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An Analysis of Economic Integration between Mainland China, Hong Kong and Macau

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Abstract

This research contributes to the literature of economic integration. Mainland China, Hong Kong and Macau are discussed together for the first time, in multiple angles, to assess the extent of their economic integration for both the pre- and post-reform periods, on both the Greater China (which covers Mainland China, Hong Kong and Macau) and regional levels. The impacts of economic integration on income convergence as well as productivity convergence for these Chinese economies, which have been neglected in other studies, are also studied. In addition, the connections, the policy implications and future prospects of these three mechanisms are also reviewed at the same time. In the analyses of economic integration, the trade intensity and trade complementarity indices, correlation matrix, the Johansen Cointegration Test and the Vector Error Correction Model (VECM) are employed. In light of the scenario of income convergence, the coefficient of variation, the Mankiw, Romer and Weil (1992)'s estimation method (MRW method) and the Augmented Dickey-Fuller (ADF) test for Unit Root are applied to examine the issues of deterministic and stochastic income convergence between Mainland China, Hong Kong and Macau. This works to investigate if the income level of Mainland China or some of its provinces can catch up with that of Hong Kong and Macau. As for the process of productivity convergence, the stochastic frontier approach is advocated to estimate the growth rate of total factor productivity (TFP) and its components for Mainland China, Hong Kong and Macau on the provincial level. Making use of the MRW method, the issue of productivity convergence is also tested to see if Mainland China can grow faster than Hong Kong and Macau with respect to total factor productivity.

The empirical results indicate a long-run cointegration relationship between the per capita real gross domestic product (RGDP) of Mainland China, Hong Kong and Macau. Incorporating the highly intensive and complementary trade relationship and the tightly correlated income levels, it is believed that a high extent of economic integration has been achieved between Mainland China, Hong Kong and Macau after 1990. From the VECM, the short-run dynamic of Hong Kong's per capita RGDP Granger causes that of

Guangdong's, while the per capita RGDP of Mainland China and Guangdong Granger causes that of Macau are also observed. In the case of income convergence, absolute β-convergence is found between Mainland China, Hong Kong and Macau in the post-reform period on both the Greater China and regional levels, and international trade has contributed to accelerate the process. Subsequently, it has brought about δ-convergence between these economies. Despite the occurrence of β- and δ-convergence, stochastic convergence is rejected in the cointegration and ADF tests which imply that the income convergence process between these economies may not come to an end to stabilize. In the discussion on productivity, it is found that the TFP growth pace of Mainland China is faster than that of Hong Kong and Macau since the 90s, and β-convergence in TFP between Mainland China, Hong Kong and Macau, in which the initially less efficient or poorer Mainland China has a higher TFP growth rate than the initially more efficient or richer Hong Kong and Macau, is also observed in the post-reform period. Last but not least, the economic reform of Mainland China is regarded as the ultimate driving force for the processes of economic integration, income and productivity convergence.

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Chapter 1: Introduction

1.1. Economic Integration

Economic integration is a broad concept in which two or more economic entities have become increasingly interdependent through a lengthy and complicated process. It is not an easy task to explain economic integration because there is no unique explanation and standard understanding on its meaning. Various specifications, such as the negative and positive integration by Tinbergern (1954), Holzman (1976)'s price equalization, or Mennis and Sauvant (1976) and Pelkmans' (1984) removal of economic boundaries and elimination of economic frontiers have been introduced in defining economic integration[1]. In general, economic integration is interpreted as the elimination of economic impediments in trade and investment, or the liberalization of factor markets, as well as the improvement in resources allocation between different economic entities. For this reason, it is necessary to consider a series of economic factors, such as the similarity in economic structure, as well as the development and intensity on trade and investment activities, so as to assess if the economies in consideration have become increasingly interrelated. After that, it is then possible to conclude whether a certain extent of economic integration has been achieved by them.

Apart from examining if economic integration has been achieved by different economies, it is essential to assess the consequences of this process. The implication of economic integration could be an increase in both potential and actual competition. Improvement in allocative efficiency within and across the participating countries, specialization according to comparative advantage and better utilization of economies of scale are regarded as the dynamic effects of integration[2]. Despite the short-run adjustment costs such as competition or liberalization led increase in bankruptcy, unemployment and temporary economic slump, the participating economies are expected to enjoy a boost in trade activities, an expansion in foreign direct investment (FDI) transactions and an increase in gross domestic products (GDP) in the long-run. Furthermore, given a high

[1] Please see Jovanovic (1992).
[2] Please see Hitiris (1998) for more details.

degree of integration which allows free mobility of production factors, it will lead to a contraction in wage gap, interest rate gap and price gap across member states which may eventually move towards factor cost equalization. Eventually, the economies in the economic bloc tend to have fully synchronized business cycles. The relatively poorer members in the group would be able to catch up with the relatively richer one with respect to income to arrive at a equalization in income over the long-run.

1.2. Economic Integration in Practices

The European Union (EU) is perhaps the only modern example of successful economic integration achieved by independent nations. Since 1958, it has taken the European countries more than four decades to remove their internal trade barriers, consolidate and approximate their external trade policies, harmonize their economic policies, liberalize their factor markets, as well as to introduce a single monetary policy and single currency. Since 1999, the European Union has arrived at the stage of economic and monetary union[3]. Such a high degree of economic integration would bring about net benefits to all the participants in the long-run. In practice, the integration process of the EU has advocated the conventional negotiation and discussion based approach to proceed step by step toward the current status of an economic and monetary union. Similar approach has also been advocated by the other international organizations, such as Association of Southeast Asian Nations (ASEAN), North American Free Trade Agreement (NAFTA) and Asia-Pacific Economic Corporation (APEC). The integration process of the EU is able to catch the world's attention because it is the only successful attempt in modern history which has pooled the world's most important countries in both political and economic sense to form an economic and monetary union. In terms of economic strength, the GDP of EU(15)[4] was recorded at the United States' Dollar (USD)10,482.74 billion in 2003. It was the 2nd largest economic entity in the world and its GDP is equivalent to 96.33% of the United States'. According to the World Bank's World Development Indicators (WDI)

[3] Please see Hitiris (1998) for more details.

[4] EU(15) refers to the 15 member states of the European Union before the enlargement in 2005.

2004, the combined trade transactions of the EU(15), consisting of both internal and external trade were the largest in the world, at USD2,901 billion and USD2,920 billion for exports and imports respectively in 2003. These turnovers were 400.69% and 224.10% of the United States (US)'s total exports and imports respectively. Due to its strong international significance and uniqueness, the integration process of the EU has become one of the most popular topics in the literature of economic integration and international economic cooperation.

The United States and Organization for Economic Co-operation and Development (OECD) are another two cases that have been frequently discussed in the literature on economic integration. For the former, apart from the free mobility of goods and capital, labours can also move without any restrictions from one state to another within the country. This pattern has been thoroughly discussed in a series of studies. The United States is the only example of a full union in the world. Economists and political scientists have even attempted to project whether the EU will follow the footsteps of the United States to form a United States of Europe! As for the OECD, the member states of this organization, which covers both the member states of the EU(15) and the United States, have built up very close economic contacts. The economic condition and income level of the member states have been getting more and more similar to each other. Consequently, this organization is regarded as an example of successful economic integration and its experience has also caught the attention of many economists.

1.3. Stages of Economic Integration

The process of economic integration would normally follow the steps as shown below:

1. Free Trade Area.
2. Custom Union.
3. Common Market.

4. Economic Union.
5. Economic and Monetary Union.
6. Political Union and
7. Full Union.

The actual progress of economic integration, however, does not necessarily follow exactly the above-mentioned stages. Taking the European Union as an example, its integration process involves the initiation, discussion, negotiation and ratification of agreements which had driven member states through the stages of custom union, economic union, economic and monetary union, without undergoing the intermediate stages of free trade area and common market. The ASEAN and APEC, on the contrary, view the achievement of a free trade area as their short to medium term objective.

1.4. The Economic Integration between Mainland China, Hong Kong and Macau

Relative to the progress achieved by the EU, the economic integration between the People's Republic of China (Mainland China) and its Special Administrative Regions(SARs, which are referred to Hong Kong and Macau after their handover in 1997 and 1999 respectively to the People's Republic of China) of Hong Kong and Macau is still very far from maturity. This process, unlike the European experience, is not initiated by negotiations and agreements but driven by the market mechanism, and could be regarded as a natural process. In fact, even before the economic reforms, trading activities had been taking place between Mainland China, Hong Kong and Macau. The SARs were once regarded as the only windows of the country to the outside world. These trade contacts then evolve together with the economic reforms and open door policies of Mainland China. Since 1978, new growth and development strategies have been formulated, international trade is promoted and preferential terms have been introduced to encourage the inflow of foreign capital. Through these new policies, Mainland China intends to resume its economic connections with the outside world, as well as to take advantage of these external transactions to improve the economic condition of the country.

1.4.1. The Economic Linkages between Mainland China and Hong Kong

In the early years of the reform period, Mainland China was subjected to many challenges, including underdeveloped infrastructure and lack of business experiences, necessary knowledge and skills. Besides, due to its three decades of isolation from the western world, investors from the world's major economies did not have sufficient information nor trust on Mainland China and they hesitated on doing business with the country. To overcome these difficulties, it is necessary for the country to find a middleman to facilitate the reform-led open door policies. Due to the similarities in cultures, the tight social, economic and even political connections, and the territory's rich experience in providing trade and financial services, the role of Hong Kong as a window of Mainland China was resumed after the economic reforms. Apart from importing foreign products through the territory, a considerable amount of Mainland China's exports have also gone through Hong Kong to their final destination in order to make use of the territory's well-established external connections and relatively advanced shipping and trade-related facilities and services. Furthermore, foreign investors have started to make use of Hong Kong as a stepping stone, to invest in Mainland China through their Hong Kong subsidiaries. Together with the investments originated from the territory, a strong flow of FDI has been injected into Mainland China from Hong Kong. It has then marked the beginning of economic integration between Mainland China and Hong Kong in the reform period.

The two decades of economic reforms have tightened the economic linkages between Mainland China and Hong Kong. Special Economic Zones (SEZs) and open cities were set up, and one of them, for example, Shenzhen, is adjacent to Hong Kong. Trade transactions were promoted and FDI was encouraged in these areas and since then, businessmen in Hong Kong were more willing to engage in cross-border transactions with Mainland China. The economic transactions between Mainland China and Hong Kong have started to boost and Hong Kong has also fully resumed its role as an entrepôt of Mainland China. At the same time, given lower costs of production and the preferential treatment offered by the Chinese government, industrial firms have began to relocate to Mainland China. In line with such development was a soar in FDI hosted in Mainland China, particularly in Guangdong and an expansion in outward-processing trade and re-export businesses between the two economies. These economic transactions have been contributing to the rapid transition, growth and living standard improvement of Mainland China, as well as the continuous growth of Hong Kong. Nowadays, Hong Kong has specialized in the provision of trade-related, banking and financial services to Mainland China. At the same time, it has continued to be a major entrepôt or window of the country. Concerning the role of Mainland China, it supplies the territory with the dairy products, consumer goods and raw materials it needs, as well as offering a favourable environment for Hong Kong people to do business in Mainland China. As reported by some Hong Kong newspapers, Hong Kong investors have employed more than 3 million workers in Guangdong. The outputs of most of these Hong Kong investments will then be exported to the United States, Japan, EU or even back to Hong Kong. Apparently, a mutually beneficial and complementary economic relationship has been formed between the two economies allowing both parties to exercise their own comparative advantages on the one hand, while simultaneously achieving economic growth and development on the other.

1.4.2. The Economic Linkages between Mainland China and Macau

As a tiny economy with less than half a million inhabitants, the Macau economy has always been overlooked by economists who are interested in the Mainland China economy. Macau is another SAR of Mainland China after Hong Kong and has also had a tight economic connection with the Mainland. Similar to Hong Kong, businessmen in Macau have taken advantage of the opportunities offered by Mainland China under the open door policies. A large number of industrial plants, in particular, textiles and garments factories, have been relocated to Mainland China for cost efficiency. Given an underdeveloped banking sector and the absence of a financial market, Macau could only provide little trade finance and banking facilities to Mainland China. Besides, with relatively backward infrastructure, re-export activities between Mainland China and

Macau are not frequent. Instead of being a major entrepôt of Mainland China or a stepping stone for foreign businessmen, Macau identifies itself as a tourism spot for leisure and vacation in the region. In fact, Macau is also the only place in the region in which casinos are legal and regulated by the government, it has successfully attracted millions of people from Mainland China and Hong Kong to utilize its gambling services every year.

In line with the sustained growth and development of the Mainland China and Hong Kong economies, the income effect has brought about an increasing number of tourists to Macau. The spending of these tourists, especially in the casinos, has brought about significant tax contributions to the Macau economy. In return, Macau residents have continuously expanded their investment in Mainland China. The proximity of its border with Mainland China has also made consumptions in the Mainland to become a regular activity for a lot of Macau citizens. Such transactions are the basic economic linkages between Mainland China and Macau.

1.5. The Role of Mainland China in the World Economy

Increasing concerns have been placed on Mainland China and the Greater China economy since the economic reforms and the growing interest on the Mainland China issue can be explained by the country's rapid and sustained growth pace, the improvement in exportability and productivity, as well as the huge amount of FDI that it has successfully attracted. In fact, the economic magnitude of Mainland China has been developing and expanding since its economic reforms, and the country has also become more and more influential in the world. If Hong Kong and Macau are considered, the combined Greater China economy would have even stronger economic strength, becoming a major economic and trading bloc in both Asia and the world.

1.5.1. Trade and Foreign Direct Investment Share

According to the United Nations[5], Mainland China's total merchandising exports and imports were USD18.1 billion and USD20.0 billion respectively in 1980, representing just 0.97% and 0.9% of the world's aggregate[6]. Considering the Greater China economy of Mainland China, Hong Kong and Macau as a whole, it shared 2.1% and 1.9% of the world's total exports and imports respectively. At the same time, the export value of the Greater China economy was 17.05% of the US's, 5.06% of the EU's and 29.6% of Japan's. On the import side, it was 16.71% of the US's, 5.04% of EU's and 30.55% of Japan's (WDI 2004). In the two decades that followed, the Greater China economy not only was able to maintain a continuous expansion in its regional trade activities, but could also manage to maintain its growth pace over that of the US, the EU and Japan. Since its economic reforms and implementation of the on-going open door policies, the Mainland China economy and the Greater China economy have gradually become an important economic entity in the world market with growing significance. In 2003, the total exports and imports of Mainland China have amounted to USD438.2 billion[7] and USD412.8 billion respectively, which were 24 and 21 times the turnovers of 1980. The corresponding international trade share rose to 23.5% and 23.73% of the total exports and imports in Asia, or 6.01% and 5.45% of the world's total exports and imports based on the WDI (2004)'s statistics. If the Greater China economy of Hong Kong, Macau and Mainland China and the involving re-exports and transshipments were considered, their total exports and imports have accounted for 9.17% and 8.57% of the world's total,[8] and was equivalent to 92.43% and 49.81% of the United States', 23.07% and 22.23% of the EU(15)'s, 141.77% and 169.46% of Japan's. Apparently, Mainland China or the Greater China economy has replaced Japan, to be the most important trader in Asia and ranked 3rd in the world. The pace of growth of the country's exports and imports transactions have also exceeded those of the US and EU(15). Consequently, Mainland China or the Greater

[5] UN's International Trade Statistics Yearbook 1998.
[6] UN's International Trade Statistics Yearbook 1998.
[7] World Banks's World Development Indicators 2004.
[8] World Trade Organization's World Trade Report 2004.

China economy's trade position in the world has been catching-up with that of the US and the EU(15).

In light of FDI, when dated back to 1982, Mainland China could only absorb around USD 0.43 billion or 1% of the world's total FDI according to the World Bank's WDI (2004). The widening and deepening of the economic reforms and the continuous economic growth have improved the attractiveness of Mainland China as the destination of FDI. In 2003, the actually utilized foreign capital has increased to USD53.51 billion which was 124 times the value of 1982, representing an average annual growth rate of 40.85% for the period. According to the WDI (2004), in 2002, Mainland China has absorbed 7.82% of the world's total FDI and this share has even exceeded the 6.28% share of the US, or the 1.44% share of Japan, although it was still much lower than the EU(15)'s 60.33% share. If the FDI received by Hong Kong was added together, the share then made up 9.35% of the world's total incoming FDI, which was equivalent to 148.84% of the US's, 649.15% of Japan's or 15.5% of the EU(15)'s aggregate. Such expansion in incoming FDI represents that Mainland China has achieved a great success in its economic reforms. Its economic potential, meanwhile, has also been recognized by the rest of the world. Upon Mainland China's accession to the World Trade Organization (WTO), it has committed to further liberalizing its internal market for trade and investment. It is then expected that the country would be able to attract more foreign investment capital in different areas of the world.

1.5.2. The Economic Strength of Mainland China

As stated in the WDI (2004), in 1960, the RGDP of Mainland China was recorded at USD62.92 billion, which was just 2.65% of the US's and 7.96% of Japan's and the economic strength of the country could hardly be compared with the other dominating economies. Although Mainland China has managed to achieve certain economic progress in the next two decades, the economic and political struggles that had happened in the period have seriously distorted the pace of growth and development of the country. In 1978, the real gross domestic product (RGDP) of Mainland China was USD 141.06

billion, which was more than double the level of 1960. Nevertheless, its income gap with the other major economies was expanded further. Its RGDP level was equivalent to just 3.04% of the US's, 2.34% of the EU(15)'s and 4.63% of Japan's based on the World Bank's WDI (2004). The enlarged income gaps, which was partially caused by the depreciated RMB, have indicated that the economic performance of Mainland China was dissatisfactory relative to that of the other economies.

Only after the introduction of the economic reforms, the economic condition and performance of Mainland China has started to experience some revolutionary changes. In line with the liberalization policies, the reforms in ownership structure, and the introduction of the open door policies, Mainland China was able to accelerate its pace of growth. From 1978 to 2003, the RGDP of Mainland China has increased from Chinese "Renminbe" (RMB) 362.41 billion to RMB3407.02 billion, implying an average annual growth rate of 9.5% a year throughout this 26-year period. Given such a high and sustained pace of growth, the output level of Mainland China is able to catch up with the other leading economies. As shown in the WDI (2004), Mainland China's RGDP was USD397.64 billion in 1990, which was 6.10% of the US's, 4.97% of EU(15)'s and 8.06% of Japan's. This catching-up process has continued and in 2001, the RGDP of Mainland China has reached USD1,119.31 billion, equivalent to 12.47% of the US's, 11.21% of the EU(15)'s and 19.61% of Japan. Measured in Purchasing Power Parity (PPP), the GDP of Mainland China was 5,111.24 billion (WDI 2004) in the year, and has reached 52.20% of the US's, 56.09% of EU(15)'s and 160.08% that of Japan's. In 2003, the nominal GDP of Mainland China has amounted to USD1,409.85 billion and was ranked 7th in the world, after the US, Japan, Germany, UK, France and Italy. When PPP was used as the unit, Mainland China's GDP has climbed up to 6,435.84 billion, which was the 3rd in the world after the US and the EU(15), or the 2nd after the US when comparison was made on the country level, equivalent to 59.20% of the US's, 63.53% of the EU(15)'s and 179.65% of Japan's.

1.6. Research Objectives

In view of the major trade partners of Mainland China, the top six trade partners in terms of the sum of total exports and imports in 2003 were Japan, the United States, Hong Kong, Korea, Taiwan and Germany. Their trade share were recorded at 15.69%, 14.85%, 10.27%, 7.43%, 6.86% and 4.94% respectively[9], with their sum accounting for 60% of Mainland China's total trade turnovers in the year. In relation to the utilization of foreign capital, according to the Statistical Yearbook of China (2004), Hong Kong has been the largest investor of Mainland China since the beginning of the economic reforms and in 2003, USD17.70 billion was injected into the country, making up 33.08% of total in the year. Japan, Korea, the United States, Taiwan and Singapore, meanwhile, took the 2nd to the 6th rank in the same year, with their share measured at 9.45%, 8.39%, 7.85%, 6.31% and 3.85% respectively. The combined share of the six largest investing countries has arrived at 68.93% of the total.

Once the major trade partners and major sources of FDI are put together, it is not difficult to find that the major trade partners of Mainland China are also its major investors, which may suggest that most foreign investments in Mainland China tend to be export-oriented, and there could be a very close linkage between trade and inward FDI transactions.

With regard to these primary trade partners and investors, the United States and Japan are not only the countries with the highest GDP in the world, but also the core trading countries and investors. It is, therefore, not surprising to find them on the top of the list. In light of Korea, it is adjacent to Mainland China and has chosen the country as a destination of its investment with an intention to explore the internal market of Mainland China, as well as to take advantage of its lower production costs. As for Hong Kong, given its tiny geographical area and relatively small population, if one do not realize its historical background, it could be hard to imagine the role of the territory in Mainland China's external economic contacts. Hong Kong had very limited economic strength and it ranked 30th in the world in terms of year 2003's nominal GDP in USD. Its GDP level was equivalent to 1.46% of the US's, 1.51% of the EU(15)'s, 3.67% of Japan's or 11.25%

[9] China Statistical Yearbook 2004.

of Mainland China's according to the WDI (2004). Nevertheless, the territory not only was the 3rd largest trade partner of Mainland China when re-exports activities were included, but also the most important source of FDI of the country. Taiwan, being another Asian Dragon with much bigger GDP and population size, however, could only obtain the 5th position in both categories. The intensive and disproportionately high trade and investment transactions between Mainland China and Hong Kong, which are brought about by the economic reforms, could be viewed as evidences of the integration process between the two economies. In the process of economic integration, Mainland China could be able to take advantage of the trade transactions and incoming FDI to improve its knowledge, technological know-how and productivity. In addition, the one-way free mobility of human flow from Hong Kong to Mainland China may also provide new business opportunities as well as new business experiences, which may further enhance the growth process of the country. On Hong Kong's side, its economic contact with Mainland China would contribute to the territory's growth and development. Eventually the integration process tends to reduce both the income and productivity gaps between these two economies. Consequently, Mainland China could be able to catch up with Hong Kong in terms of both income and productivity. Similar processes of economic integration, income and productivity convergence may also take place between Mainland China and Macau given the economic reforms and the development in trade and investment activities between these economies.

Given the growing magnitude of Mainland China or the Greater China in the world economy with respect to its GDP, trade turnovers and FDI received, as well as the extra-ordinary high trade turnovers and FDI flows between Mainland China and Hong Kong, this research is organized with an intention to explore and understand the linkages of these economies. As Macau has a historical background very similar to that of Hong Kong, despite its less significant economic strength, it will also be considered in this research. Therefore, the objective of this study is to discuss and examine whether the Mainland China, Hong Kong and Macau economies have integrated in economic sense. If economic integration is on its way, the consequences of the process will then be assessed. Emphases will be placed on the income and productivity gaps between these economies, with an intention to examine whether economic integration would bring about the impacts of income and productivity convergence between Mainland China, Hong Kong and Macau.

1.6.1. The Economic Integration between Mainland China, Hong Kong and Macau

Since the initiation of the economic reforms in Mainland China, a considerable number of studies, such as Jones, King and Klein (1992, 1993), Ash and Kueh (1993), Lin (1999), Wu (2000a), Lin and Lin (2001) and Keng (2001), have been conducted to review the development of the economic linkages between Hong Kong, Taiwan and Mainland China. However, in these studies, much of the attention was paid to either the Hong Kong or the Taiwan economy, without including Macau in the discussion. This research seeks to fill the gap in this area, aiming to give a precise answer on whether Mainland China, Hong Kong and Macau have had their economies integrated to form a Greater China economic entity over the past two decades. In practice, the extent of economic integration on the national level, between Hong Kong, Macau and Mainland China, as well as on the regional level, between Guangdong, Hong Kong and Macau will both be evaluated. In addition, it is also the objective of this research to explore the corresponding role that Mainland China, Hong Kong and Macau has played in the economic bloc, as well as to estimate the interdependent economic relationships of these economies. Although the discussion will cover both the pre- and post-reform periods, emphases will be placed on the post-reform period as most of the economic contacts has began to develop and intensify in this period. By understanding the correlation[10] or the interrelationship between the members in the Greater China economy, it would allow us to project the impacts of the following arrangements, such as Mainland China's WTO accession, Mainland China's consensus with the ASEAN on the transition towards a free trade area (FTA), the newly signed Closer Economic Partnership Arrangement (CEPA) and the

[10] Empirical studies including Shan and Sun (1998), Liu, Wang and Wei (2001) and Liu, Burridge and Sinclair (2002) have employed cointegration test, causality test and VAR model to estimate the correlation between different economic variables. The correlation between trade, FDI and economic growth in the Chinese case has been discussed by them.

Pan-Pearl River Delta Economic Cooperation (Pan-PRD), on the progress of economic integration, as well as to give further insights on the possible directions of future economic integration between Mainland China, Hong Kong and Macau.

1.6.2. Income Convergence between Mainland China, Hong Kong and Macau

After analyzing if the Mainland China, Hong Kong and Macau economies have integrated economically, the issue of convergence in national income will then be discussed to assess whether economic reforms and the resulted economic integration would bring about income convergence between Mainland China and its SARs.

In Chen and Fleisher (1996), Jian, Sachs and Warner (1996), Gundlach (1997) and Raiser (1998), Yao and Zhang (2001a, 2001b), Zhang and Yao (2001) and Zhang, Liu and Yao (2001), etc., the issue of provincial income convergence of Mainland China has been addressed. These papers, however, have only focused on the provincial or regional income disparities problem, with the 31 provinces and municipalities of Mainland China in their samples. In fact, relatively few studies have placed their emphasis on the income inequality between Mainland China and its SARs. This research intends to extend the scope of discussion to cover both Hong Kong and Macau in the analysis, aiming to evaluate the income disparity problem in the Greater China region in both static and dynamic manners. The objective is to examine if Mainland China as a whole or certain regions or provinces of the country, for example, the coastal region or Guangdong could catch up with Hong Kong and Macau in terms of per capita income after the economic reforms. The roles of trade and FDI transactions in the process of income convergence will also be addressed in the analysis. Besides, suggestions on how to reduce the income gap between Mainland China, Hong Kong and Macau will also be raised in the discussion.

1.6.3. Total Factor Productivity Convergence between Mainland China, Hong Kong and Macau

As another research objective, this study attempts to assess if economic integration would bring up the productivity level of the initially poorly-performed Mainland China economy, and thus bring about a catching-up process and eventually proceeding to productivity convergence between Mainland China, Hong Kong and Macau. Unlike Wu (2000a) which compared the partial and total productivity levels of Hong Kong, Taiwan, Guangdong and Fujian, this analysis will consider the issue of productivity convergence. Comparing with the other available studies, such as Bernard and Jones (1996), Gouyette and Perelman (1997) Carree, Klomp and Thurik (2000) which focused on the issue of productivity convergence between a group of OECD countries, this research intends to discuss not only the phenomenon of productivity convergence, but also aims at showing the possible connections between economic integration, income and productivity convergence. Given economic integration and extensively developed trade and FDI transactions, if there is evidence on productivity convergence, then the conventional beliefs of trade-led knowledge and experience transfer and the subsequent improvement in efficiency, technology and productivity could be proved in the case of Mainland China, Hong Kong and Macau. The correlations between economic integration, income convergence and productivity can also be estimated in due course.

1.7. Research Structure

The next chapter is a literature review which summarizes and discusses critically the possible advantages and problems inherited in the available studies on economic integration, income convergence and productivity convergence. Existing researches on how to define and measure economic integration, and the impacts of economic integration on the economic performance of the economies involved will be reviewed. And since income and productivity convergence are regarded as two possible outcomes of economic integration, studies concerning absolute and conditional β- and δ-convergence with respect to per capita income, partial and total factor productivity's measurement and its decomposition, and the issue of convergence in productivity level will also be discussed in this chapter. By making use as well as assessing the information in these researches, it is possible to work out a more adequate approach and formulate a more appropriate and complete methodology in addressing the issue of economic integration in the Greater China. The chapter following the literature review is the economic profiles of Mainland China, Hong Kong and Macau which summarizes the economic condition of these economies. The purpose is to make a comprehensive description on the history of development of these economies, and to deliver some background knowledge on the current economic situation of them. In the case of Mainland China, its economic performance in the pre- and post reform periods, the output and ownership structure, as well as the performance on trade and inward FDI will all be reviewed. In addition, the objectives, implementation and impacts of the economic reforms of Mainland China will also be summarized and discussed in this chapter. In light of Hong Kong and Macau, the development pattern of these economies, their composition and restructuring process, inflation and employment condition and trade development will be studied as well. Chapter four discusses the economic integration between Mainland China, Hong Kong and Macau which focuses on the economic linkages and the integration process between these Chinese economies. This chapter not only explains the analytical model, estimation method and sampling data that will be employed, but also illustrates the regression results and their implications on the economic integration of Mainland China, Hong Kong and Macau. By analyzing the evolution of cross-border economic activities, such as trade and investment, working out the correlation matrices with respect to per capita income and measuring different indices, such as the trade intensity and trade complementary indices, it is possible to draw a general picture on the integration process of these economies. To show precisely the correlation of these economies and the roles that each of them has played in the integration process, more sophisticated econometric methods, for example, the Johansen Cointegration Test and the Vector Autoregressive Error Correction Model (VECM) will be employed. Given the estimation results, the degree of integration that the three economies have achieved could be shown. Besides, the interdependent relationship of the three economies and the income causality between Mainland China, Hong Kong and Macau could also be observed in this estimation.

The issue of income convergence between Mainland China, Hong Kong and Macau will then be discussed in chapter five. Apart from conducting a descriptive analysis to review the evolution of the income ratios, the coefficient of variation on income per capita will also be measured. The resulting indices exhibit whether the income gap between these Chinese economies is enlarging or diminishing. In addition, the issue of β-convergence on income levels between Mainland China, Hong Kong and Macau will also be examined in both absolute and conditional manners in order to see if Mainland China can catch up with Hong Kong and Macau. Apart from this, an alternative approach of convergence study, stochastic convergence, will also be examined. Furthermore, this chapter aims to quantify the contributions of cross-border economic activities, such as the trade and FDI transactions, aiming to investigate if these activities could accelerate the catching-up and convergence process. Given the result on income convergence, suggestions on how to reduce the income disparity problem between Mainland China, Hong Kong and Macau will then be raised.

Chapter six attempts to test if economic integration and income convergence will bring about productivity spill-over and convergence. In particular, the hypothesis of initially poorly-performed economies tend to have higher productivity growth rate than the initially well-performed ones, resulting in productivity convergence across these economies will be examined. Applying the methodology as employed in the previous chapter, the β-convergence test with respect to productivity will be performed to measure the pace of productivity convergence between Mainland China, Hong Kong and Macau. In performing these estimations, rather than advocating the partial productivity or the "Solow residuals", the total factor productivity (TFP) will be employed as the basis of study. The rationales behind the adoption of TFP and its decomposition method will be further explained in this chapter.

Chapter seven, which is the conclusion of this research, will be organized with an attempt to summarize comprehensively the findings on economic integration, income and productivity convergence. The possible linkage between these three mechanisms, as well as the policy implications of these processes will also be discussed. Apart from this, in line with the accession of Mainland China to the WTO, the launching of CEPA, the introduction of the Pan-PRD Economic Cooperation and the consensus between Mainland China and ASEAN on the formation of a FTA, a projection will be made to describe the possible implications of these policies and arrangements to Mainland China, Hong Kong and Macau. Under these agreements, there is a strong tendency for the extent of economic integration between Mainland China, Hong Kong and Macau to deepen and widen, the two convergence processes are also likely to sustain. The details of the estimated outcomes will be thoroughly discussed in this chapter.

Chapter 2: Literature Review

2.1. Economic Integration

Economic integration is a complicated process in which two or more economic entities have become increasingly interdependent. It is not an easy task to explain economic integration as this process can be defined in various ways. In Jovanovic (1992), the author had referred to a couple of concepts which could be viewed as definitions of economic integration. In Tinbergern (1954), negative integration was regarded as the removal of discriminatory and restrictive institutions and the introduction of freedom in economic transactions. Positive integration, on the other hand, was the adjustment of existing policies and institutions endowed with coercive powers as well as the establishment of new ones. In the meantime, Pinder (1969) defined integration as the combination of parts into a whole. Balassa (1973) indicated that the dynamic concept of integration was the removal of discrimination between different states. The static concept of integration, meanwhile, suggested the absence of different forms of discrimination. From the economic contact's point of view, Maksimova (1976) argued that economic integration was the process of developing a deep and stable relationship in the division of labour between national economies. Holzman (1976) stated that economic integration was a situation in which the prices of all similar goods and factors in two regions equaled each other. This has made the two regions, in essence, a single region or market. Similarly, Mennis and Sauvant (1976) viewed integration as a process under which boundaries between nation-states have become less discontinuous, thereby leading to the formation of more comprehensive systems, and Pelkmans (1984) defined economic integration as the elimination of economic frontiers between two or more economies. Furthermore, El-Agraa (1985) understood international economic integration as the discriminatory removal of all trade impediments between the participating nations and the establishment of certain elements of coordination between them. Robson (1987) noted that economic integration focused on the efficiency in the use of resources with particular reference to the spatial aspect. Marer and Montias (1988) pointed out that economic integration has traditionally been equated with the division of labour in a geographical region. Last but not the least, Sung (1998) understood economic integration as a lowering of the barriers to business between two economies. The barriers could be institutional one, such as tariffs and the other quantitative restrictions or natural one, for example, transportation costs.[11]

Apparently, there is no unique explanation or single understanding on the meaning of economic integration. It can either be interpreted as elimination of economic impediments in trade and investment, or liberalization of factor markets, as well as improvement of resources allocation between different economic entities. The existing literature implies that an integrated study which makes use of multiple definitions and criterions is necessary. For this reason, rather that employing any of the above single definition, this research will utilize an array of factors, such as trade flows and patterns, FDI, factor allocation, correlation of business cycles, etc., in order to provide a full scale assessment on the issue of economic integration.

2.2. The Economic Linkage between Mainland China, Hong Kong and Taiwan

2.2.1. Descriptive Analysis

In consideration of their rapidly expanding and extra-ordinary high volume of trade, investment transactions and human flows, Mainland China, Hong Kong and Macau and even Taiwan could be viewed as a group of economies which have already achieved certain degree of integration. In fact, the extensive development in trade and investment interactions between Mainland China, Hong Kong and Taiwan has long been widely discussed. Descriptions such as "Triangle Economies", "Great or Greater China Economy" and "Mainland China Economic Area" have also been suggested in these studies. In an OECD working paper written by Jones, King and Klein (1992), the economies of Mainland China, Hong Kong and Taiwan were called the "Chinese Economic Area (CEA)" and the "de facto" economic integration that has been taking place between these three economies during the post-reform era was reviewed. The economic profiles of the three economies were summarized and the authors suggested that "as low cost labour on the Mainland combines with technology, management and

[11] Sung (1998), p.47.

marketing skills from Hong Kong and Taiwan, Mainland China may expect a surge in exports of..."[12]. This kind of cooperation was defined as a complementary economic relation which could be explained by the economic reform of Mainland China, the relaxed policy of Taiwan toward the Mainland and the difference in endowments and comparative advantages between the three economies. As suggested in this paper, during the process of integration, a remarkable growth was observed on trade turnovers and investment flows between the three economies while major structural adjustment has also taken place at the same time. On the international consequences of the development of CEA, the OECD paper projected that the CEA "could become a major player in world markets within one generation and require massive adjustment in the rest of the world."[13]

In another OECD discussion paper prepared by Jones, King and Klein (1993), the formation of the Chinese Economic Area and its consequences were reviewed. According to the authors, the opening of Mainland China and the rapid economic growth of its southern provinces have allowed Hong Kong to resume its role as an entrepôt of Mainland China in facilitating the country's trade and FDI activities. In the meantime, the economic ties between Mainland China and Taiwan have also been strengthened as the latter has loosened its ban on contacts with the Mainland since 1987. In addition, the flows and pattern of internal trade and investment between the three economies, in particular, Hong Kong, Taiwan and the two southern Chinese provinces - Guangdong and Fujian were discussed in this study. It was suggested that during the 1980s, the economic growth of Mainland China has become more closely correlated to the OECD, while that of Hong Kong and Taiwan tended to be more dependent on the Mainland China factor, with reducing linkage with the OECD. The difference in resources endowments and comparative advantage, the reforms and policy adjustments in Mainland China and Taiwan and the political tie of the three were regarded as the driving forces to economic integration which would then bring about a major structural transition for all these economies. It was projected that the intra-CEA trade would continue to expand, especially for the bilateral transactions between Mainland China and Hong Kong and the

[12] Jones, King and Klein (1992), p.19.
[13] Jones, King and Klein (1992), p.2.

development and reliance of the CEA on OECD's export markets would significantly affect the latter.

Ash and Kueh (1993) have evaluated the causes and impacts of the economic integration between the three economies of Hong Kong, Taiwan and Mainland China. On the disaggregate level, the economic integration between Guangdong, Fujian, Hong Kong and Taiwan has also been addressed. In the analysis, the bilateral trade intensity ratios of Hong Kong-Mainland China and Mainland China-Taiwan were measured to depict the trade linkages between these economies. According to the authors, the changing composition in shipments of goods to and from the Mainland was the result of economic integration, which was caused particularly by the FDI injected by Hong Kong and Taiwanese manufacturers and the corresponding development of outward processing activities in Guangdong and Fujian. In addition, it has indicated that Hong Kong was the largest foreign investor in Mainland China, with most of its capital being invested into Guangdong. Besides, the authors suggested that the close economic tie between the Mainland, Hong Kong and Taiwan would be the consequence of joint production and/or the cross-border division of labour and the internationalization of manufacturing production. The movement of production factors as well as of finished products within the Greater China, however, was still very limited as Hong Kong and Taiwan's FDI were still highly concentrated in just the SEZs. In general, the rapid development of trade and the expansion of foreign investment in Mainland China have enhanced economic growth in the Greater China region. The differentials in resource endowments and the variations in development levels between Mainland China, Hong Kong and Taiwan could explain how these economies would benefit from greater economic integration.

Lin (1999) is a descriptive study which was made to discuss the economic interactions between Mainland China, Hong Kong and Taiwan. The triangular flows of trade and investment activities, the industrial patterns and comparative advantages of the three Mainland China economies as well as their performance in external trade were discussed in details. Evidences have been found to support the phenomenon of integration in the triangular economies of Mainland China, Hong Kong and Taiwan and the process was believed to be driven by market forces. Guo (1999) has conducted another descriptive study to compare the economic background of Mainland China, Hong Kong, Macao and Taiwan. In addition, the direct and indirect trade, investment and exchange rate patterns of these economies were also discussed. The mutually complementary characteristics of the Greater China economies with respect to natural resources, labour force, technology and industrial structure was once again mentioned in this paper.

In Wu (2000a), the economies of Hong Kong, Taiwan and the Guangdong and Fujian provinces of the PRC were studied and compared. Similar to other studies, evidences of economic integration between the four economies were revealed and the author has attributed their rapid integration to geographical proximity, shared cultural and language background, the open door policy of Mainland China, Taiwan's lift of martial law control as well as the economic complementarities among the four regions. The study has also measured and compared the trend of partial and total factor productivity of these four economies. The result indicated that the labour productivity of the two Mainland China provinces has significantly increased since the economic reform. Nevertheless, the labour productivity of Hong Kong and Taiwan were still higher than that of Mainland China's. As for the capital productivity, that of Mainland China has been increasing since the economic reform in 1978 while that of Hong Kong and Taiwan, on the contrary, has been declining. Hence, there was a tendency for labour productivity to converge over time. In light of the total factor productivity, this factor has played an important role in the economic growth of the four regions. During the discussion period, all the four economies have achieved significant growth in TFP and Guangdong and Fujian have even surpassed Hong Kong and Taiwan in their TFP growth pace, especially for the period of 1993-1997. To sum up, this study concluded that the strong growth in investment and trade have not only sped up the integration process between the four economies, but have also acted as a driving force that has enhanced the catching-up of the two Mainland China provinces.

Another two recently published papers, Lin and Lin (2001) and Keng (2001), have focused on the issue of regionalization of the Chinese economies and the Greater China. In Lin and Lin (2001), the Greater China Economies were defined as that of Mainland

China, Hong Kong and Taiwan and the formation of these Triangle Economies was a global trend toward regionalism. The trade and investment activities of the three economies have been assessed and these linkages were regarded as evidences of economic integration. The paper has recalled that the integration of the Triangle Economies could take advantage of the resource complementation between the three economies, and the integration was basically driven by private initiatives and market forces. In contrast, in the European case, integration was driven by negotiations and agreements and could only be achieved when the business cycles of the participating economies have synchronized, with tight policy coordination and political commitments. As for the case of Mainland China, the authorities of the three economies were conservative and have been passive in arranging cross border policy co-ordinations. Nevertheless, these three governments have independently provided various measures to facilitate economic integration. In line with the economic reforms in Mainland China, the degree of integration between the three economies have been deepening and it was also found that Hong Kong and Taiwan have gradually decreased their export shares in the US and Japanese market, while that of the Mainland has been increasing. For this reason, the authors have indicated that the competition between these three economies in foreign markets for light industrial products would be massive.

Keng (2001) has projected the growth potential of Mainland China until 2020. The underlying difficulties in the growth process, for example, the shortage of land, as well as the problems arising from transportation development were also considered. It was then suggested that the relaxation of government intervention in economic activities and the respect of market mechanism has led and would be leading Mainland China to decentralize its central government authority over economic planning and control. It would consequently stimulate regional economies and eventually lead to regionalization. Mainland China has had a historical trend of economically divided regions and as shown by the authors, inter-regional economic activities between major neighboring regions were surprisingly small even during 1994. Different regions have developed their own relatively independent and autonomous industrial structures, and enjoyed their own markets of scale economy. If Mainland China's central authority keeps on maintaining the market-based institutional reform and steadily decentralizes its economic power to regional authorities, many regional economies with relatively autonomous industrial structures and markets would consequently emerge. The author suggested that there would be 10 such regional economies emerging in the Mainland. Continuous reforms, liberalization and decentralization would encourage economic regionalization of Mainland China, improve the competitiveness and growth potential of Mainland China and induce Hong Kong and Taiwan to accelerate their pace of economic integration with their motherland, in particular, with the Pearl River Delta and Fujian province. Then these four sub-regional economies would be in a much better position to jointly optimize their industrial structures, capital and labour utilization and market scale, such that they could attain their maximum economic strength to compete globally. Subsequently, these economies could also help to generate a huge production capacity to support other Chinese regions.

Similar arguments on the regionalism of the Mainland China economy was made by Tang (1998), in which the author has indicated that decentralization, as a tool to stimulate economic growth, has successfully boosted the growth pace of Mainland China. Nevertheless, local protectionism has become stronger as a consequence of the decentralized decision-making process. Neither capital nor commodities could enjoy free mobility across provinces and the Mainland China economy has become fragmented on the regional level. This finding is consistent with the assessment made by the World Bank (1994), which stated that the growth pace of inter-provincial exports and imports have fallen behind their external counterparts, and the Chinese provinces were more open to the outside world than to each other. The author then adopted a business cycle approach to estimate the degree of integration/ interdependence between those Chinese provinces. Among the different measurements in indicating economic integration, such as price convergence, capital and labour mobility and the similarity of business cycles, the last approach was advocated and the paper has estimated whether economic shocks were asymmetric across different provinces. In the application, the correlations of provincial business cycles were measured by Vector Autoregressive (VAR) model with monthly industrial output and retail price index from 1990Q2 to 1995Q4 as the explanatory variables and a 12 months' lag was adopted. Then it was shown that several eastern provinces, including Liaoning, Zhejiang, Anhui, Fujian, Jiangxi and Hunan, were consistently and strongly correlated in terms of output shocks. The author also suggested that treating Mainland China as a united economy might be misleading since Mainland China was not a well-shaped single economic entity given all the regional economic barriers that persisted in the country.

Without covering the Taiwan economy, Tuan and Ng (1995) has investigated the issues of outward investment and regional economic integration between Hong Kong and Guangdong. It indicated that the Chinese region which is closer to Hong Kong has been able to absorb more investment from the territory. Labour supply and the purchasing power of the region which was called market potential in the paper were important to cross border investment decision. Finally, it was suggested that the economic integration between Hong Kong and Guangdong, driven by outward investment and cross-border process "has resulted in a significant restructuring of the Hong Kong economy..."[14]

In Sit (1999), the economic integration between Hong Kong and Mainland China, in particular, the integration between Hong Kong and Guangdong has been discussed. The mutually complementary economic relationship between the two economies was described as a "Front-shop: Back-factory" model by the author. The result of integration was a drastic structural transformation in both places. Finally, a projection was made to assess the impacts of Mainland China's accession to the WTO on the economic cooperation between Hong Kong and Guangdong. The author believed that both of them would stand to gain and the two economies would be able to tighten further their economic integration.

Cheng and Tsang (1996) is another study that has addressed the issue of economic integration or economic link between Hong Kong and Guangdong. Similar to the other papers, this study has adopted a descriptive approach to review the development in trade and investment flows between Mainland China and Hong Kong and their structural

[14] Tuan and Ng(1995), p.400.

adjustment since the 1978 economic reform. The paper has also figured out the problems and difficulties inherited from the integration process. In light of Guangdong, the problems of low level of specialization, insufficient level of genuine technological upgrading, regional imbalance and the lack of internal coordination have been indicated. As for Hong Kong, the problems of a relative slow growth, little progress in technology improvement, inflation as well as increasing inequality have been mentioned. To conclude, the paper has suggested more coordination between Hong Kong and Guangdong to ensure mutually beneficial developments and hence to avoid duplication in efforts and undesirable convergence in industrial structure.

In light of the integration process between Mainland China and Macau, owing to the territory's small geographical area and very limited economic strength, the role or importance of Macau in the Greater China region has been overwhelmed by that of Hong Kong and Taiwan. Amongst the very few studies about the Macau economy is "Macau and Greater China" by Richard Edmonds (1993). As mentioned, the Macau economy is small but "it has had a unique role to play in its relationship with the People's Republic of China, Hong Kong, Taiwan and overseas Chinese"[15] The paper has reviewed the political, social and economic trends of the Macau economy since the 80s. The territory's infrastructure development, trade and investment linkage with Hong Kong and the Mainland China, in particular, Guangdong as well as the middleman's role that Macau played in the economic contact between Taiwan and the Mainland have also been discussed on a descriptive basis. Nevertheless, without including quantitative analysis of any kind, this study could only provide some general knowledge on the economic, social and political conditions of Macau and its economic contact with the neighborhood.

As a whole, the above papers are of similar pattern and the statistics on trade, FDI, human flows and the structural adjustment processes have been examined. Given the tight and complementary economic linkages with respect to these economic and social activities, it was suggested that a tight economic linkage had been formed between Mainland China, Hong Kong and Taiwan. This relationship has been intensifying since the beginning of the

[15] Please see Edmonds (1993).

economic reforms. In forming this linkage, the involving parties, for example, Mainland China, Hong Kong and Taiwan were able to derive mutual benefits as well. In these studies, however, the role of Macau and its economic position in the region has been ignored. In addition, the fact that the tight economic linkage between Mainland China and Hong Kong was driven by the market mechanism, and was built to capture the comparative advantages on both sides, and thus to explore a larger share of foreign market was not thoroughly discussed. The linkages of these economies with respect to income level was not carefully discussed as well. Last but not least, before the conclusion of economic integration could be drawn, more sophisticated methods, such as numerical indices or econometrical regressions, must be employed in order to improve the explanatory power of the analysis. Therefore, integration related indices and quantitative assessments will be measured and conducted in this research in addition to the above-made descriptive analyses.

2.2.2. The Trade Intensity and Trade Complementarity Index

A couple of indices have also been applied in some studies with an attempt to perform a numerical assessment on the extent of trade contacts between these two economies. In Dale (1997), for example, to quantify the trade pattern between Mainland China and Hong Kong, an intra-industry trade index in two different specifications, namely the Grubel-Lloyd intra-industry trade index and the Aquino's adjusted index have been introduced:

The Grubel-Lloyd intra-industry trade index is specified as:

$$B_j = \frac{[\sum_i (X_{ij} + M_{ij}) - \sum_i |X_{ij} - M_{ij}|]}{\sum_i (X_{ij} + M_{ij})} \qquad (2.1)$$

in which j is country j and i refers to individual industries and a large index indicates the dominant role of intra-industry transactions in trade.

The Aquino's adjusted index is measured as:

$$Q_j = \left[\left[\sum_i (X_{ij} + M_{ij}) - \sum_i \left| X_{ij*} - M_{ij*} \right| \right] / \sum_i (X_{ij} + M_{ij}) \right] \times 100 \tag{2.2}$$

where

$$X_{ij*} = \left[X_{ij} \times 0.5 \sum_i (X_{ij} + M_{ij}) \right] / \sum_i X_{ij} \tag{2.3}$$

$$M_{ij*} = \left[M_{ij} \times 0.5 \sum_i (X_{ij} + M_{ij}) \right] / \sum_i M_{ij} \tag{2.4}$$

It is an alternative measurement of intra-industry trade index and is able to resolve the problem of substantially imbalanced trade account.

Intra-industry trade is defined as the simultaneous exports and imports of goods within the same industry. When a pair of countries are concentrating on intra-industry, these countries would export and import items in the same product category. For this reason, certain kind of external shocks, for example, industry specific shocks would be common to them. The business cycles of these two economies may have a chance to comove and the economic condition of them would be closely related to each other. Inter-industry trade, on the other hand, is referred to specialization in production such that trade activities would be performed according to the competitive advantages of a country. As a result, a shock that affects one sector in a country may be neutral to another country due to specialization. The chance of having synchronized business cycles may probably reduce accordingly. The intra-industry trade index could therefore be viewed as an indicator of trade integration.

Dale (1997) has regarded the intra-industry trade index as one of the indicators in reflecting the level of economic integration between different economies. A high intra-industry trade index implies that the trade transactions between the economies in consideration would be mostly in the form of intra-industry trade in which the trade partners have been exporting and importing products in the same category. Then the pair of economies would be affected by similar disturbances and therefore might have similar business cycles.

In the case of the trade activities between Hong Kong and Guangdong, Dale (1997) has indicated that the difference in factor endowment is the driving force of intra-industry trade between them. It has also referred to the analysis made by Culem and Lundberg (1983)[16] on the prevalence of intra-industry trade in manufacturing industries between economies with distinctly different factor endowment patterns. According to Dale (1997), Culem and Lundberg (1983) indicated that "intra-industry trade between developed countries (for example, Hong Kong) and developing countries (for example, Mainland China) appears to consist of primarily an exchange of "same" types of semi-fabricated products. The resulted growth in intra-industry trade based on supply side factors differs from developed country intra-industry trade that was based on demand side factors".[17]

Furthermore, the paper has suggested that "the likelihood of intra-industry trade levels rising following economic integration depends on pre-integration market structures. Competitive rather than complementary production structures will encourage intra-industry trade relative to inter-industry trade. Similarity in income levels and the stages of industrialization will encourage intra-industry trade"[18]

Apart from the intra-industry trade index, another two indices, namely trade intensity and trade complementarity indices were also mentioned in the study.

The trade intensity index is written as:

$$Iij = (X_{ij} / X_i)/(M_j / T) \qquad (2.5)$$

where X_{ij} is country i's exports to country j, X_i is country i's total exports. M_j / T is the share of country j's imports in world imports T. T equals to world's total imports, M_w minus country j's imports, M_j. This index is used to measure the extent of trade contact

[16] Dale (1997). P.116.
[17] Dale (1997). P.116.
[18] Dale (1997). P.116.

between a pair of economies and a high value represents a tighter trade linkage between the pair of economies under consideration.

The trade complementarity index is specified as:

$$C_{ij} = \sum_{k=1}^{n}\left[(X_i^k / X_j) \times (T / T^k) \times (M_i^k / M_j)\right] \qquad (2.6)$$

It could be used to measure the extent to which country i's exports matches country j's imports more or less intensively than it matches the commodity composition of world trade.

Apart from the trade intensity and complementarity indices, there is another concept called country bias index:

$$B_{ij}^k = \left[X_{ij}^k / X_i^k\right] / \left[M_j^k / T^k\right] \qquad (2.7)$$

It examines the extent to which country i's exports have a higher or lower level of favorable access to country j's import markets than might be expected from both of these countries' shares of world trade in commodity k.

As for the application of these indices, Dale (1997) has found a substantial increase in the trade intensity index with respect to Hong Kong and Mainland China in the period of 1984 to 1991. In the meantime, there was also a growth in the complementarity index. These evidences may imply that in line with trade expansion, the trade transactions between Hong Kong and Mainland China have also become more and more complementary in nature. In addition, a high value of country bias index has been observed, which has implied low relative resistances in the trade between Hong Kong and Guangdong. The declining trend of the country bias index, on the other hand, may suggest that either Hong Kong or Guangdong has started to diversify their trade. In line with the development of new trade contacts with the rest of the world, the weight of Hong Kong-Guangdong trade has started to decline in both of these economies.

Furthermore, based on the above mentioned indices, it was suggested that outward processing activities were the driving forces behind the integration process of Hong Kong, Taiwan and the southern coastal provinces of Mainland China. The large labour cost differential between Hong Kong and the southern coastal Chinese provinces has led to a massive relocation of labour-intensive manufacturing activities from the former to the latter. In the meantime, Hong Kong was also becoming more and more service-oriented in order to match the growing demand of Mainland China on trade and shipping sector related services. Economic theories predict that competitive economic structure tends to develop intra-industry trade while a complementary structure promotes inter-industry trade. In addition, similarity in income levels and the stage of industrialization will also encourage intra-industry trade. Evidences, however, have shown that this conventional belief was not relevant. The author has observed an increase in intra-industry trade between Hong Kong and Mainland China as a consequence of economic integration, despite the fact that the economic structure of the two regions are complementary, which according to the economic theories, should have encouraged inter-industry trade rather than intra-industry trade. This pattern can perhaps be explained by Hong Kong's special status as an outward processing trader and entrepôt in which industrial products entered Mainland China through the territory for outward processing and in turn, the finished products were exported to a third party via Hong Kong.

The Grubel and Lloyd intra-industry trade index is also applied in Faustino, Silva and Carvalho (2000) in the following specification:

$$B_i = \frac{[(X_i + M_i) - |X_i - M_i|]}{(X_i + M_i)} \times 100 \qquad (2.8)$$

for all the industries of the country, the index is in the form of:

$$B = \sum_{i=1}^{n} B_i \left[\frac{(X_i + M_i)}{\sum_{i=1}^{n} (X_i + M_i)} \right] \times 100 \qquad (2.9)$$

The index is adopted to measure the development of intra-industry trade between Portugal and Spain during the implementation process of the Single Market Program in Europe. The paper then indicated a general strengthening position of intra-industry trade between Portugal and Spain in the period 1990-96. The extent of economic integration between these two countries has also deepened.

As for the trade intensity index, it can also be found in Florkemeier (2000) in the following specification:

$$I'_{ij} = \frac{x_{ij} / x_i}{\sum_{i=1}^{N} x_{ij} / (\sum_{i=1}^{N} x_i - m_i)}, \; i \neq j \text{ where} \quad (2.10)$$

x_{ij}: exports of country i to country j,

x_i: total exports of country i,

m_i: total imports of country i.

The index, which is very similar to the one stated in Dale (1997), was adopted as a measure of regional biases to international trade. As stated, the value of the index would increase when trade between the two trading partners is disproportionately high. It is larger than one if country i exports more than average to country j and *vice-versa*. If so, then the two economies may have formed a functional trading region. The author has also remarked that this index tends to relate negatively to the per capita income of the exporting countries. In addition, as a country diversifies its exports, the comparability of this index tends to decline.

Another application of the trade intensity and complementarity index was made in Piazolo (1997) to analyze the trade integration between Eastern and Western Europe. The author has expressed that the relative intensity of bilateral merchandising trade could reflect the degree of mutual dependence of the goods markets and could be used as a criterion for the identification of functional region. Then two ratios of X_{ij}/X_i and X_{ji}/X_j were introduced in which X_{ij} represents country i's exports to country j and X_i is country i's total exports and *vice-versa*. These ratios have been used to measure the intensity of bilateral trade, which reflects to a large extent the magnitude of economic integration that a pair of countries has achieved. An alternative measure of "Actual Trade Intensity Index" developed by Kojima (1964) was also suggested in the paper in the following specification:

$$I_{ij} = \frac{\frac{X_{ij}}{X_i}}{\frac{M_j}{(M_w - M_i)}} \tag{2.11}$$

However, according to the author, this specification may fail to distinguish the difference between dependency and integration. The example, according to the author, was Germany and Liechtenstein in which the index has indicated that the two economies are highly integrated. But in fact, it is Germany that determines the economic well-being of Liechtenstein while the reverse is not true.

In Piazolo (1997), the trade complementarity index is measured as:

$$C_{jk} = 1 - (\sum |m_{ik} - x_{ij}|)/2, \tag{2.12}$$

with x_{ij} as the share of good i in total exports of country j and m_{ik} as the share of good i in total imports of country k. The index is zero when goods exported by country j are not imported by country k and is one when the commodity shares in country k's imports correspond exactly to those of country j's exports, given that the existing trade barriers do not heavily distort the structure of trade between the countries.

As explained, the trade complementarity index indicates whether the two trading parties could gain from the regional arrangement and it can also demonstrate the odds of successful integration. In practice, the trade complementarity index between the Eastern European countries and the EU member states were measured. The result has shown that the value of the complementarity index was stable and comparable with the one inherited within EU member states. It implied that the Eastern European countries have achieved certain degree of integration with the EU and the trade transactions between them have also experienced a significant expansion.

In light of the numerical measurements on economic integration, Dale (1997) has employed a couple of trade related indices to assess the extent of trade integration between Mainland China and Hong Kong. This paper works to quantify the economic relationship, in particular, trade relationship between these two economies. Nevertheless, Dale (1997) has only focused on the economic contacts between Mainland China and Hong Kong. The trade contacts between Mainland China and the rest of the world, which could have been developed extensively at the same time, were not discussed. In view of Piazolo (1997)'s complementarity index, relative to Dale (1997)'s, it compares directly the trade pattern of the exporting and importing countries without considering the weight of the flow in world's total trade. This index, however, is still preferred to Dale (1997)'s due to its relative simple structure, as well as the measurement results on trade complementarity for those matured economic bloc, such as the EU(15), EU and the Eastern European countries, the US and Canada, etc. In this research, the trade intensity index applied in Dale (1997) and the trade complementarity index adopted in Piazolo (1997) will be utilized. Apart from calculating the trade intensity index between Mainland China and Hong Kong like Dale (1997), the one between Mainland China and Macau and those between Mainland China and major trading economies in the world will also be measured. It is then possible to evaluate if Mainland China has traded more intensively with its SARs than the rest of the world. As for the complementarity index, Piazolo (1997)'s specification will be employed. Then it is possible to examine the degree of economic or trade integration between these Chinese economies, as well as to compare the trade complementarity of Mainland China, Hong Kong and Macau to the western counterparts.

Trade related indices are able to exhibit, at most, the extent of trade integration between a group of economies. However, trade integration could just satisfy one of the criterions of economic integration. Therefore, the above papers may have insufficient explanatory power in proofing the presence of economic integration. Further investigations are still required to examine whether there are comoving or synchronized business cycles before the conclusion of economic integration can be drawn.

2.2.3. Quantitative Analysis on Economic Integration

The Correlation between Trade and Economic Integration

As previously discussed, extensive development in trade tends to affect the business cycles of the economies involved in a certain way. This hypothesis has been further discussed in Frankel and Rose (1996, 1998). In these papers, the trade intensity index was considered as a determinant of economic integration, and has been used as an explanatory variable to examine if an intensive trade linkage tends to tighten the business cycle correlation between different economies.

To measure the trade linkage between two economies, a trade intensity index in the following form was introduced in Frankel and Rose (1996):

$$wt_{ijt} = \frac{(X_{ijt} + M_{ijt})}{(X_{it} + X_{jt} + M_{it} + M_{jt})} \quad \text{where} \qquad (2.13)$$

X_{ijt} denotes total nominal exports from country i to country j during period t. X_{it} denotes total global exports from country i and M denotes imports. A high value of wt_{ijt} implies greater trade intensity between countries i and j.

In Frankel and Rose (1998), an alternative trade intensity index was suggested and was written as total trade normalized by total nominal GDP.

$$wy_{ijt} = \frac{(X_{ijt} + M_{ijt})}{(Y_{it} + Y_{jt})} \qquad (2.14)$$

On the correlation of business cycles across different countries, 4 indicators of real economic activity, namely real GDP, an index of real industrial production, total employment and the unemployment rate were identified in Frankel and Rose (1998). These quarterly data were de-trended by various processes, including the fourth-differences, and regressions with either a linear time trend or a quadratic time trend for the estimated residuals. Besides, the Hodrick–Prescott filter will also be advocated (by applying the HP filter to the residuals of a regression in which the indicator was regressed on a constant and quarterly dummies) in order to de-trend the data series. The bilateral correlations of these de-trended real activities, $Corr(v,s)_{i,j,t}$, which could be viewed as the correlation between country i and country j over time span t for activity concept v, were computed as business cycles correlations.

Afterwards, estimations were run based on the following function form:

$$Corr(v,s)_{ijt} = \alpha + \beta Trade(w)_{ijt} + \varepsilon_{ijt} \tag{2.15}$$

where $Corr(v,s)_{ijt}$ denotes the correlation between country i and country j over time span t for activity concept v. $Trade(w)_{ijt}$ denotes the natural logarithm of the average bilateral trade intensity between country i and country j over time span t. ε_{ijt} represents the myriad influences on bilateral activity correlations above and beyond the influences of international trade. α and β are the coefficients to be estimated. The authors have referred to the conclusion made in Eichengreen (1992), Kenen (1969) and Krugman (1993) that "as trade becomes more highly integrated, countries specialize more in production. Given this logic, increased specialization will reduce the international correlation of incomes, given sufficiently large supply shocks." [19] As indicated, a negative β could fulfill what Eichengreen (1992), Kenen (1969) and Krugman (1993) have suggested "the consequence of a closer trade tie is that countries would become more specialized in the goods in which they have comparative advantages"[20] and hence their business cycles would become more idiosyncratic. On the contrary, a positive β tends to support the authors' hypothesis that trade development could bring about synchronized business cycles.

The estimation result then suggested a strong positive relationship between the degree of bilateral trade intensity and the correlation of business cycles across different countries. Therefore, the authors' hypothesis of "trade integration tends to bring about more synchronized business cycles" has been proved.

[19] Frankel and Rose (1998). P.1012-1013.
[20] Frankel and Rose (1996), p.2.

Torres and Vela (2003) has considered the issues of trade integration and synchronization between the business cycles of Mexico and the United States. Making use of a simple linear regression and the bivariate Granger causality test, the correlation between GDP, imports and exports of the two countries have been reviewed. The study then indicated that the manufacturing sectors of the two economies have become more integrated and the business cycle of Mexico has become more synchronized with that of the United States.

Similar study was made in Shin and Wang (2004) in which the conclusion made in Frankel and Rose (1998) has been further examined and proved. Making use of the Korean data, the authors have attempted to test if the bilateral trade intensity between Korean and the other Asian economies could bring about business cycles' comovement or synchronization. By applying the same methodology as employed in Frankel and Rose (1998), business cycle correlation was regressed on the trade intensity and intra-industry trade indices. The authors have observed that intra-industry trade "is most important in explaining synchronization of the business cycle"[21].

Although the extent of business cycles correlation or synchronization has been estimated, this group of papers have just attempted to explain its linkage with trade integration. The other important economic contacts, such as FDI and human flows, were not seriously considered. Their roles in the integration process were not identified and will be covered in this research.

Business Cycle Synchronization

If a high extent of economic integrations has been achieved by different economies, it is not surprising to find interrelated business cycles, either with a direct or inverse relationship. Therefore, a workable way of assessing whether different economies have fully integrated with each other would be to examine the degree of business cycle synchronization.

[21] Shin and Wang (2004), p.226.

To examine the issue of business cycle synchronization in Europe, Artis and Zhang (1995) has attempted to detrend the seasonally adjusted figures on monthly industrial production by the phase-average-trend (PTA) estimation, the Hodrick and Prescott (HP) filter as well as the linear trending process. Then the bilateral contemporaneous correlation between the detrended business cycles of the ERM countries and those of the United States and Germany were measured for the extent of synchronization between them. The paper depicted that before the implementation of the Exchange Rate Mechanism, the business cycles in most of the EU 12 had closer correlation with the US business cycle than the German cycle[22]. This pattern, however, has reversed during the ERM period in which the business cycles of the EU member states have become more synchronized with the German cycle.

Relatively few studies have placed their emphasis on the business cycle correlation with respect to the regional economies of Mainland China. Amongst, the measurement of income correlation can be found in Yao (1996) in which the linkage of the income level in different sectors was measured by utilizing the correlation matrix. In particular, the relationship between agriculture, industry, transportation, construction and services with respect to their income level was estimated and the results have shown that the agricultural sector's income level was closely related to the service sector. Apart from the correlation matrix, the Vector Autoregressive (VAR) model and the cointegration analysis have been employed in the analysis to examine the contribution of the agricultural sector to the development of the other sectors in the country. The estimation result suggested that the agricultural sector was exogenous in the pre-reform period, but contributed to the development of the other sectors as the impulse response function has shown that a growth in the sector tended to bring above a positive impact to the others. Since the economic reforms, such exogenous pattern has disappeared and the sector has become endogenously affected by the other sectors in the country. In another application, Ling (2001) has made use of the correlation matrix to show the inter-relationship of inflation rate and growth rate across different Asian economies, including Mainland

[22] Artis and Zhang (1995), p.12.

China, Hong Kong and Taiwan, etc. The results have displayed a tighter linkage in the inflation rate than growth rate between these Asian economies.

Caporale, Pittis and Prodromidis (1999) intended to answer the question of whether Europe was an Optimum Currency Area (OCA). In the theory of OCA, the costs involved in the implementation of monetary integration are believed to be smaller if the business cycles of the participants are synchronized. For this reason, the synchronization of business cycles and long-run output linkages in the EU countries were tested in this paper - by evaluating the similarity on the degree of persistence of output shocks between different countries. The methodology employed in assessment is therefore worth mentioning.

As stated, a sufficient condition for synchronization in output movements was a similar stochastic property of output, with a comparable size of random walk (similar country specific shocks). In the case of a small random walk component, it implied that the stationary component in output accounts for most of the variance in output growth[23]. After de-trending the output series, it was possible to examine the size of the correlation coefficient between the detrended variables, as what has been done in Frankel and Rose (1996, 1998). When the random walk component was big, the pairwise cointegration properties should be examined for the similarity in output fluctuations. In this paper, for example, the output linkage between an EU member state and Germany has been estimated. Cointegration between the output level of an EU member state and Germany implied economic integration between them.

In order to know if the industrial outputs of the EU member states were stationary, their statistical properties were tested by applying the standard Dickey Fuller (DF) and Augmented Dickey Fuller (ADF) test with and without trend. Afterwards, bivariate cointegration tests on the industrial output of each EU country with that of Germany were conducted. This analysis was made to address the issue of comovement, to test whether shocks to the German output have been transmitted to the rest of the EU countries.

[23] Caporale, Pittis and Prodromidis (1999). P.178.

Furthermore, a correlation matrix for the detrended industrial production output of the EU countries has also been constructed to describe the inter-relationships of these output levels.

In the estimations on random walk, the authors have discovered a small random walk process inherited in the EU outputs. As for the bilateral correlation of business cycles, the output of Austria, Belgium, France, Italy, the Netherlands, Spain, Greece and Switzerland have their output cointegrated with that of Germany, inferring a comovement of their gross national product (GNP) in the long-run and the presence of a European business cycle.

Similar cointegration analysis have also been applied in Jorda and Burguet (1998), to estimate the long-run and short-run impacts of depreciation/devaluation on trade balance for the major European Union member states, including Germany, France, Italy and the United Kingdom (UK) over the period of 1975 to 1997. Again, the authors have recalled that most of the time series data had non-stationary residuals and cointegration analysis has been utilized to deal with this phenomenon. Similar to the other studies that has advocated the cointegration analysis, the augmented ADF test has been performed to distinguish a stochastic trended (random walk) process:

$$y_t = \beta + y_{t-1} + \varepsilon_t \tag{2.16}$$

from a deterministic trended process:

$$y_t = \alpha + \beta t + \varepsilon_t \tag{2.17}$$

The tests on stationarity reported the number of unit roots containing in the series. Afterwards, both the Johansen (1988) multivariate cointegration technique and the error correction models were applied to examine the static and dynamic correlation between trade transactions and exchange rate. For the long-run relationships between the non-stationary variables, the general VAR is in the following specification:

$$y_t = a + \sum_{i=1}^{3} \phi_i Q_{it} + \sum_{i=1}^{k} \pi_i y_{t-i} + \varepsilon_t \tag{2.18}$$ [24]

[24] Jorda and Burguet (1998). P.614

y_t and y_{t-i} indicate the logarithms of the four trade variables (trade balance for country i, TB_i, real effective exchange rate for country i, q_i, domestic income for country i, Y_i, and foreign income Y^*). a is the intercept, Q_{it} represents the deterministic seasonal dummies and ε_t is a disturbance term which is independently and identically distributed with zero mean and constant variance.

The results of the cointegration tests have revealed that the real effective exchange rate has affected the trade balance in the long-run for the four sampling EU countries. The local and foreign income levels, as reported, were important to trade balance and "play an important role in the attainment of cointegration relationship"[25]. To address the short-run correlation between exchange rate and trade balance, the Vector Autoregressive Error Correction Model (VECM) has been introduced in the following specification:

$$\Delta y_t = a + \sum_{i=1}^{3} \phi_1 Q_{it} + \sum_{i=1}^{k-1} \Gamma_i \Delta y_{t-i} + \Pi y_{t-k} + \varepsilon_t \qquad (2.19)$$

Δy_t and Δy_{t-1} are lagged variables and $\Pi$is the error correction term which measures the speed of adjustment of the variables to equilibrium. By reviewing the sign and the statistical property of the estimated coefficient, it is also possible to show the direction and the magnitude of the causal links between the involved variables. In practice, the first difference of trade balance was regressed on its own lags, the first difference of real effective exchange rate in first lag, the first difference of domestic income in the first to the forth lags and the first difference of foreign income level in first lag, etc. Estimation results have suggested the existence of a negative relationship between domestic income and trade balance in the long-run. The trade balance of UK and Italy had a positive relationship with their real effective exchange rate. The trade transactions between Germany and France, on the other hand, have not been significantly affected by the real effective exchange rate. Foreign income level, meanwhile, was a positive factor to the trade balance of these two countries.

In practice, the cointegration test is always applied with the VECM, and they serve as a popular method to estimate the long-run equilibrium relationship and short-run dynamics

[25] Jorda and Burguet (1998). P.617

of different economic factors. Thornton (1996), for example, has applied the cointegration and Granger causality tests to test the export-led growth hypothesis for Mexico and has observed a cointegrated relationship between real exports and RGDP. The export-led growth hypothesis has also been proved. Similar export-led growth hypothesis was further discussed in Jin (2002) and the provincial economies of Korea were the samples concerned. A causal export-led growth linkage was once again being worked out in this study. In Ahmad and Harnhirum (1995), Islam (1998), Siddique and Selvanathan (1998) and Ramos (2001), the cointegration test and VECM have been employed to examine the cointegrated relationship and causality between export expansion and economic growth. Their concerns embraced the ASEAN countries, selected Asian economies, Malaysia and Portugal respectively and one-way causality of export-led economic growth could be found in most of these studies, while some of them have even observed bi-directional causality.

In relation to the Chinese issue, Shan and Sun (1998) has examined the export-led growth hypothesis of the country. The ADF test was applied and it indicated that the exports and GDP statistics of Mainland China carried 1 unit root. A VAR and a Granger Causality analysis were then applied to estimate their causal link. The Granger Causality test displayed a one-way causality from exports to industrial output, the VAR has suggested a feedback impact from growth to exports. Given these findings, the study has concluded a bi-directional causality between economic growth and exports of Mainland China. Zhang and Felmingham (2001) has employed the cointegration test to explore the causal linkage between inward FDI and exports of Mainland China. A bi-directional relation was found between these two flows in the study. Liu, Burridge and Sinclair (2002) has expanded the analysis to cover economic growth, FDI and trade of Mainland China in the investigation for their causal linkage. Cointegrated relationships were then found between these factors. In the VECM, a bi-directional causality was also found between the economic growth, FDI and exports of Mainland China.

In light of the correlation of the same economic variable in different economies, Anoruo, Ramchander and Thiewes (2002) has applied the cointegration analysis to examine the linkage of inter-market interest rates between the Asian countries, as well as the influences of the United States' and Japan's interest rate on the region. In the estimation, correlation matrices were built to show the causal linkage of the interest rate levels and the multivariate cointegration analysis was also applied to examine the long-run equilibrium relationship. Moreover, a VECM was adopted in the estimation on top of the cointegration analysis with an intention to estimate the dynamic pattern of this relationship and the short-run responses of the variables. In addition, the VECM could contribute to explore the short-run causality of the variables in consideration. The estimation results have indicated cointegrated interest rates and the VECM suggested either one-way or bi-directional causality between the interest rate levels of different pair of economies. Similar cointegration test and VECM have been adopted in Cheung and Yuen (2002) to test the bilateral inflation linkage between Hong Kong, Singapore and the United States. The estimations suggested that the inflation rate of Hong Kong and Singapore cointegrated with that of the US respectively. As for the dynamic of these equilibrium relationships, as shown in the VECM, the inflation rates in the two small economies have responded to the short-run deviations and adjusted accordingly until they returned to their respectively long-run stable relationship with the US.

By applying similar cointegration test, Liang (1999) has evaluated if there was an equilibrium relationship between the long-run real exchange rate of Mainland China and Hong Kong. If there was any common trend in real exchange rate of these two economies, then they tended to fulfill one of the criteria of the Optimal Currency Area. The test results then depicted no cointegrating relationship between the real exchange rate of Mainland China and Hong Kong. By employing both the cointegration test and the VECM, Nieh and Yau (2004) has examined the interest rate relationship between Mainland China, Hong Kong and Taiwan. Empirical evidences were observed to support cointegrated interest rate level between the three economies and there was a long-run equilibrium relationship between them. As for the short-run dynamics, the VECM has indicated a one-way causality with the interest rate level of Mainland China affecting that of Hong Kong and Taiwan. In Groenewold, Tang and Wu (2004), cointegration test and VECM has been used once again to assess the linkage of share price between the Mainland, Hong

Kong and Taiwan stock market. The estimation results reported a weak predictive power of Hong Kong for the returns in the Mainland's markets. Nevertheless, the Mainland markets were still relatively isolated from both the Hong Kong and Taiwan markets.

As shown in the above papers, Frankel and Rose (1996, 1998) have estimated the de-trended business cycle correlation index against the trade intensity index with an attempt to show the correlation between these two mechanisms. A big business cycle correlation index, however, may not necessarily imply economic integration, whereas measuring the correlation coefficients could help to provide certain basic information on the linkage of the economic factors over time, and will therefore be adopted in this research. To provide evidences with sufficient explanatory power, the cointegration test and VECM would be adopted. This approach has an advantage over the correlation coefficient as it does not only show the long-run equilibrium correlation between the factors in consideration, but also their short-run dynamics and causalities. The available papers, such as Shan and Sun (1998), Zhang and Felmingham (2001) and Liu, Burridge and Sinclair (2002) have employed this method to estimate the linkages of several economic factors in an economy, such as exports, imports, FDI and economic growth. Other studies, such as Anoruo, Ramchander and Thiewes (2002) and Cheung and Yuen (2002) have adopted this approach to measure the linkage of the same economic factor in different economies, for example, inter-bank interest rate and inflation. In this research, the cointegration test and VECM will also be adopted and a more controversial factor - RGDP per capita, which is rarely found in the application of cointegration analysis, will be considered in order to examine whether equilibrium output correlations exist in the long-run between Mainland China, Hong Kong and Macau. Furthermore, the estimation is extended by employing the VECM to examine the income causality between these economies. This is one of the first times in literature to measure quantitatively the long-run equilibrium relationship and causality with respect to the output level of these Chinese economies. The result contributes to reflect the degree of economic integration that these economies have achieved, as well as their level of interdependence which have not been systematically assessed in the past.

In the cointegration test and VECM, the prerequisite is to organize a DF or an ADF test for unit root. If and only if there is a unit root in the data series, it is possible to proceed to the cointegration test. It is because cointegrated series are defined as the formation of a stationary linear combination by at least two non-stationary time series. Given cointegated series, a VECM can then be conducted for the short-run dynamics of the variables. The Johansen Cointegration Test and the VECM have been widely used in examining the long-run and short-run relationship and causality between the same data series in different economies, or between different economic indicators of the same economy.

Apart from the cointegration test and VECM, in Bayoumi and Eichengreen (1997), an alternative way was developed to test whether the business cycles of the European countries were symmetric, so as to infer their goodness of fit in joining the economic and monetary union (EMU). In the analysis, the output disturbances of the potential members were measured as the standard deviation of the difference in the rate of change of output in the two countries (the standard deviation of $\square Y_i - \square Y_j$)[26]. Thus, for countries in which business cycles were symmetric and national outputs have been moving together, the magnitude of this measurement would be small and their business cycles tended to be closely related. Furthermore, the exports structure of different countries were compared as another proxy to measure the symmetry of the shocks they have experienced. In the study, the authors have also noted that when two countries have similar revealed comparative advantage in their exports, then they would probably have more symmetric business cycles. This approach can test the output gap in between different economies and a declining output gap may imply synchronized business cycles. The output causality between a group of economies, however, are not able to be examined in this way.

In light of the issue of economic integration in the Greater China region, in Tsang and Ma (1997), the impacts of a change in the inflow of FDI and a reduction in inward FDI paid by Hong Kong on the performance of the Mainland China economy were simulated. In the model, the Mainland China economy was decomposed into 7 sectors and equation sets

[26] Bayoumi and Eichengreen (1997). P.763.

were constructed to describe the condition in each sector. Simulations were being made based on this model. In another paper, (Tsang and Ma (2000)), the authors have incorporated the International Monetary Fund (IMF)'s MULTIMOD world model to analyze the interdependence and the spillover effects among Mainland China, Hong Kong and the world economy. A Mainland China and a Hong Kong Model were firstly introduced which contained five blocs including the demand side factors of consumption, investment, trade and government sector, and the supply side factors of labour market, prices and financial sector, etc. There were altogether 77 equations in the Mainland China model and 56 equations in that of Hong Kong's. Afterwards, the IMF's MULTIMOD model framework was discussed which has covered the production flows, employment, investment, prices, interest rate, exchange rate, financial markets, trade flows, capital flows as well as government sector. The Mainland China, Hong Kong and world economies were linked up and estimations were run to explore the extent of influence of the three blocs of economies on each other. The findings showed that Hong Kong has been fully integrated into the world economy and it was sensitive to external shocks from both Mainland China and the rest of the world. On the contrary, the Mainland China economy had a tighter integration with Hong Kong than with the world economy, such as the OECD countries. An adverse shock, such as a reduction in outward processing from Hong Kong, would be more influential to the Mainland China economy than any policy change initiated by OECD countries. Although the MULTIMOD model offers a thorough analysis which covers almost all the aspects of the economies in consideration, it aims to estimate the correlation or linkages of a group of economic factors. Due to the complexity of this model, the limitation of statistics, especially for Macau, the possible specification errors in model formation and the diversified economic structure between Mainland China, Hong Kong and Macau, the more popular Johansen Cointegration Test and VECM are preferred to the MULTIMOD and will be applied in the following discussion.

Xu (2002) has attempted to answer the question of how integrated different Chinese provinces was. The paper has referred to the conclusions made by the World Bank (1994) that regional price differentials were large in Mainland China, with major structural differences across regions. In addition, inter-regional trade and investment as a proportion of total trade and investment have been declining and the mobility of labour was under restrictions as well. Consequently, Mainland China could not enjoy the advantages of efficient allocation of resources, economies of scale, diffusion of technology, increasing competition as well as efficiency improvement. This study has adopted another method to measure the degree of regional economic integration in Mainland China. Rather than measuring the correlation of the economic variables of the economies in consideration, it has placed its emphasis on the comovement of provincial business cycles. In the error components model that was applied, the sectoral real value-added growth in each province was decomposed into national effects, industrial-specific effects and province-specific effects.

$y_{(i,j,t)}=h_{(i)}+g_{(i,j)}+b_{(t)}+f_{(i,t)}+m_{(j,t)}+u_{(i,j,t)}$, *where:* (2.20)

$y_{(i,j,t)}$: the growth rate of sector i's real valued-added in province j at time t.

$h_{(i)}$: a fixed industry effect specific to industry i.

$g_{(i,j)}$: a time invariant effect specific to industry i and province j.

$b_{(t)}$: a pure time effect.

$f_{(i,t)}$: the interaction between a fixed industry and a time effect specific to industry i and to time t but common to all provinces.

$m_{(i,t)}$: the interaction between a fixed province and a time effect for each province j at each time period t.

$u_{(i,j,t)}$: an idiosyncratic disturbance to industry i in province j at time t.

The long-run comovement across provinces are captured by $h_{(i)}$ and $g_{(i,j)}$, while $b_{(t)}$, $f_{(i,t)}$ and $m_{(j,t)}$ represent common business cycle, sectoral and provincial effects. This specification is estimated using a dummy variable regression method for the panel of data of Mainland China's 29 provinces over the period of 1991-1998. The estimation suggested that coastal areas have followed most closely the national business cycle. The central region also tended to follow the common growth cycle but at various degrees. This coincidence has reflected the spillover of economic growth from the coastal to the central region. In the case of the northeast, southeast and the inland regions, their cyclical patterns were opposite to that of the common business cycle. To conclude, it was suggested that certain progress have been achieved in the process of economic integration between different Chinese provinces. This process, however, was still very far from over.

Similar decomposition has been performed by Xu and Voon (2003) to test the degree of market integration between different Chinese provinces. Integration "was defined as the comovement of price variable across provinces"[27] and an error component model was utilized to decompose sectoral price variation in each province into national effects, sector-specific effects and provinces-specific effects. As the estimation results indicated a stronger magnitude for the sector-specific effects, it implied that the Chinese provinces might have achieved a high level of integration. Taking into account the price control exercised by the central government, similar result could still be found, especially since the 90s after the central government had uplifted its control over price level.

Comparing with the cointegration test, the error component model is able to decompose sectoral output growth to evaluate the contributions of sectoral specific, province specific and time specific shocks and their interactions. The causalities of sectoral output growth, however, were not estimated in these papers. Since assessing the growth pattern and the underlying driving forces of Mainland China and its provinces are not the major objectives of this research, therefore, the error component model is not the appropriate approach to be employed. Instead, cointegration test and VECM are more suitable and will be adopted as the methodology in this research.

2.3. Consequences of Economic Integration

2.3.1. Convergence on the Income level

When different economies have fully integrated economically, the trade and investment transactions, as well as human flows between these economies should intensify. Consequently, the business cycles of these economies tend to be closely related to each other, as suggested in some of the above-mentioned literature. One approach to assess such kind of "correlation" has fallen onto the investigation of "Convergence". In

[27] Xu and Voon (2003), p.36.

O'Rourke (1999), the issues of economic integration and convergence were brought together and the author has referred to the Heckscher-Ohlin theorem to illustrate the connections between trade transactions and price equalization. Furthermore, liberalization in international trade tends to bring about commodity price convergence which will turn out producing factor price convergence. In addition, the research has reviewed the development history of a couple of economies and have indicated that migration, international capital flows, imports and exports transactions were influential to the catch up process of the Scandinavian countries, as well as that of the Irish and Italian economies towards the UK and United States. Apart from this, factor market integration was also regarded as "a crucial variable determining relative performance"[28]. As barriers on trade and factors mobility are still persist between Mainland China, Hong Kong and Macau, price differentials are still enormous between these economies, the Heckscher-Ohlin theorem of price equalization then becomes inappropriate in testing economic integration and convergence.

The concept of convergence in the above studies sheds light on the overall economic performance of a group of economies. Karras (1997) has assessed the linkage between convergence in per capita income and economic integration for ASEAN, EU and LAFTA countries. By testing if the deviation from the sample mean was stationary or not, as well as measuring the variance of the sampling per capita GDP, the paper has indicated that economic integration did not necessarily facilitate convergence in per capita income. Evidences have suggested that some economic blocs, for example, the ASEAN has not achieved convergence in per capita income as what the EU did.

By utilizing a similar approach, Ben-David (1996) has utilized the ADF test to examine if there was any unit root in the deviation from sample mean. As stationary implied convergence while non-stationary indicated divergence, the analysis was able to assess if those trade-based groups have exhibited any convergence in income level. Then the estimations have provided evidences to support income convergence among countries

[28] O'Rourke (1999), p.163.

with intensive exports or imports transaction. Such convergence conclusion, however, did not exist anymore among those randomly grouped estimation irrespective of trade volume. In a recent paper, Ben-David (2001) has further noted that liberalized trade led by formal agreements tended to intensify the process of income convergence. With reference to the evidences of European Economic Community (EEC), European Free Trade Area (EFTA) and General Agreement on Tariff and Trade (GATT)'s Kennedy Round trade negotiations, a significant decline in income gap between the original EEC countries, the US and Canada have been found. In this paper, the idea of convergence is restricted to the catching-up of income level. The speed at which the income gap is declining, however, was not measured.

Income convergence could also be viewed as one of the possible consequences when different economies have successfully integrated themselves through an extensive development in trade and capital transactions. The concept of income convergence is derived from the neo-classical growth model. The phenomenon is built based on the assumptions of diminishing returns on capital, common preferences and technology. Two concepts of convergence were prescribed in the papers of Barro and Sala-i-Martin (1990, 1991), Sala-i-Martin (1994, 1996b), Bernard and Durlauf (1996) and Raiser (1998), etc. The first one is called β-convergence and it refers to the inverse relationship between the initial income level and the rate of income growth. If a relatively poorer economy can grow faster than a relatively richer economy, then the income gap between them tends to decline and β-convergence with respect to income has taken place between them. In the β-convergence test, apart from assessing whether a higher growth rate is associated with a lower initial income level, it is also possible to estimate the speed at which the income gap is declining. The other concept of convergence is δ-convergence, and it focus on the actual gap between the income levels of the economies under consideration. If the income gap is declining, then the economies involved may have achieved δ-convergence which specifies that income disparities between different economies tend to diminish over time. Bernard and Durlauf (1996) defined convergence as countries i and j converge between dates t and t+T if the per capita output disparity at t is expected to decrease in value. In addition, convergence was viewed as equality of long-term forecasts at a fixed time.

Countries i and j converge if the long-term forecast of per capita output for both countries were equal at a fixed time, t. In regard of the relationship of these two process, the second definition could cause the first one. As for the definition of income level, it was interpreted as per capita GDP by De Long (1988), Barro and Sala-i-Martin (1990), Chen and Fleisher (1996) and Jian, Sachs and Warner (1996), but viewed as GDP per worker by Barmul (1986), Lyons (1991), Barro and Sala-i-Martin (1992), Gundlach (1997) and Raiser (1998).

Islam (1998) is a comprehensive study which has reviewed theoretically the entire literature of convergence and this process was systematically divided into convergence within or across economies, convergence in terms of growth rate or income level, β- or δ-convergence, absolute/unconditional or conditional convergence, unconditional or club convergence, income or total factor productivity (TFP) convergence and deterministic or stochastic convergence. In relation to the approaches used in carrying out convergence test, 5 approaches, namely informal cross-section, formal cross-section, panel, time series and distribution approaches have been specified in this paper. In this research, the β- and δ-convergence tests in absolute/unconditional or conditional convergence with respect to both per capita RGDP and TFP, which are seldomly discussed together, will be applied to empirically discuss the situation in the Greater China. The idea of stochastic convergence defined as both cointegrated income levels and stationary income ratio will also be discussed. It is then possible to show the conventional linkages between economic integration, income convergence and productivity convergence which have not been thoroughly investigated in the literature of economic integration.

2.3.2. β-convergence

A number of studies have attempted to estimate β-convergence across a group of different countries, as well as across different regions of a single country. These analyses can further be sub-divided into absolute/unconditional and conditional evaluation. In the assessment of the former, initial income level is the only factor of concern and the catching-up process will take place if the initially poorer economies have higher growth pace than the initially richer one. Application of this approach can be found in Baumol (1986), De Long (1988) and Barro and Sala-i-Martin (1992). As for the latter, income convergence and the catching-up process can only be initiated given the presence of additional factors, such as investment to GDP ratio, population growth, openness ratios, FDI to GDP ratio, etc. In conditional β-convergence, the above-mentioned growth related factors determine the steady state income level of an economy and if an economy is far from its steady state income level, then it tends to have a higher speed of economic growth. However, in the process of conditional β-convergence, the initially poorer economies will have the tendency of just moving towards its steady state income level rather than to the income level of the richer economy. Chen and Fleisher (1996), Jian, Sachs and Warner (1996) and Raiser (1998) are some of those which have adopted this analytical approach.

On the estimation of absolute/unconditional β-convergence, Baumol (1986) has estimated the growth rate of per capita GDP against its initial level and has drawn a conclusion favoring the unconditional cross-country income convergence in 16 OECD countries. This study, however, has not received wide consensus because according to De Long (1988), "Baumol's regression uses an *ex post* sample of countries that are now rich and have successfully developed"[29], that is, the estimation sample was biased since the sampling economies came from the same income group, for example, OECD members. By adjusting the sampling economies, the unconditional cross-country test has failed to show any evidence to support convergence. Barro and Sala-i-Martin (1990) have expressed that absolute/unconditional income convergence with respect to both personal income and Gross State Product did appear in the United States from 1880 to 1988. The dispersion of Personal income has also declined in the period which could be viewed as an evidence of δ-convergence. In light of Europe, both β- and δ-convergence were observed in Europe between 74 regions of 7 European countries for the period of 1950 to 1985, at a rate of approximately 2% per year. The analysis has also discovered that the rate of β-convergence could vary over time, depending on technology, preferences, labour mobility and capital mobility. In Barro and Sala-i-Martin (1992), apart from addressing

[29] De Long (1988), p.1138.

the convergence issue of the United States, β-convergence was documented for a sample of 98 countries, conditional to the initial enrolment rates and public spending to GDP ratio. In both cases, there were evidences to support income convergence at a rate of approximately 2% a year.

An empirical study attempting to explain the discipline of economic growth was performed in Barro (1991). The paper concentrated on a couple of growth related variables. Factors such as initial period real per capita GDP, real domestic, private or public investment to GDP ratios, total fertility rate, mortality rate, population growth, secondary- and primary-school enrolment rate, student-teacher ratio, adult literacy rate, number of revolution and number of assassinations per million population per year as well as dummy variables have been considered in a series of estimations to explain the income growth of 98 different economies. Later on, in Mankiw, Romer and Weil (1992), the role of secondary- and primary-school enrolment rate were systematically discussed. The authors have introduced an augmented Solow growth model (MRW model), which has taken human-capital accumulation into consideration, has attempted to explain the difference in international income level.

$$Ln\left[\frac{Y(t)}{L(t)}\right] = LnA(0) + gt - \frac{\alpha+\beta}{1-\alpha-\beta}Ln(n+g+\delta) + \frac{\alpha}{1-\alpha-\beta}Ln(s_k) + \frac{\beta}{1-\alpha-\beta}Ln(s_h) \quad (2.21)$$
[30]

where $\frac{Y(t)}{L(t)}$ is the income per capita, n and g are the growth rates of labour and technology, δ is depreciation, s_k and s_h are the accumulation in capital and human-capital. α and β are the capital and human-capital share of output and their sum is assumed to be less than 1.

This model predicted that the relatively poorer economies might not necessarily converge their income to the level of the relatively richer ones, but have their income level approached to their respective steady states, which were determined by their endowments, including physical and human capital and labour forces. In application, this augmented

[30] Mankiw, Romer and Weil (1992), p.417.

model was adopted to address the issue of convergence on a group of countries, including the non-oil producing and OECD countries. Comparing with the typical Solow model without human-capital, human-capital was found to be strongly significant in explaining the growth pace of an economy. The augmented model has also depicted higher estimated coefficient on physical capital and population growth. Afterwards, the human-capital augmented model was advocated to examine the Solow model's predictions of income convergence. As indicated by the authors, the Solow model does not predict convergence. Instead, it states that the income per capita of a country tends to converge to its own steady-state value and different countries can still have very different level of income. Incorporating the steady state income level y^*, the speed of convergence was defined as:

$$\frac{dLn(y(t))}{dt} = \lambda\left[Ln(y^*) - Ln(y(t))\right], \tag{2.22}$$

where $\lambda=(n+g+\delta)(1-\alpha-\beta)$ and it implied:

$Ln(y(t)) = (1-e^{-\lambda t})Ln(y^*) + e^{-\lambda t}Ln(y(0))$, then the growth function could be written as:

$$Ln(y(t)) - Ln(y(0)) = (1-e^{-\lambda t})\frac{\alpha}{1-\alpha-\beta}Ln(s_k) + (1-e^{-\lambda t})\frac{\beta}{1-\alpha-\beta}Ln(s_h)$$ [31]

$$-(1-e^{-\lambda t})\frac{\alpha+\beta}{1-\alpha-\beta}Ln(n+g+\delta) - (1-e^{-\lambda t})Ln(y(0)) \tag{2.23}$$

where $y(0)$ is income per effective worker in the initial period.

The augmented model predicted that the income level of countries with similar technologies, investment rate and population growth tended to converge, at a rate slower than the one prevailed in the typical Solow model. The investment, population growth rate and human-capital investment rates have improved the goodness of fit of the estimations and lowered the estimated coefficient of the initial income level. Without the additional control variables, however, the income levels of the sampling economies have failed to converge, except for the OECD members.

[31] Mankiw, Romer and Weil (1992), p.423.

This MRW model was further discussed and expanded in Fuente (1995). In the analysis, the author has incorporated technical progress fuelled by research and development (R&D) investment together with technological diffusion across countries into the MRW model. The intention was to examine whether the capital-poor countries could grow faster than the richer ones if technology displayed diminishing returns to reproducible factors and reduced the returns on investment. In the estimation, technological progress was assumed at 2% and the initial technological gap with the leader was measured as the initial position of the sampling economies relative to the US with respect to the average of i) the fraction of the population holding a university degree, ii) the number of scientists and engineers employed in R&D activities as a fraction of the labour force, and iii) the average per worker at the beginning of the sampling period. These two factors were inserted into the estimation together with the typical investment ratio on physical capital, human capital and population growth rate to assess if there was any evidence of convergence for the OECD economies. The estimation results have shown that conditional convergence and technological diffusion, which was the initial technological gap, have played a crucial role in the process. Accordingly to the author, it is because "technological backwardness provides the opportunity for rapid growth through the adoption of more advance technologies developed elsewhere"[32].

Islam (1995) has extended the model suggested in Mankiw, Romer and Weil (1992), MRW, together with the dynamic Panel data approach to conduct an analysis on a group of different countries, including OECD and non-oil exporting countries for the period of 1960 to 1985. The specification of the dynamic panel data model is different from the MRW model by a time-invariant individual country-effect term. According to the author, "controlling for the unobservable individual country effects will create a cleaner canvas for the relationship among the measurable and included economic variable to emerge"[33]. Both single cross-section, pooled and Least Square with Dummy Variables (LSDV) estimations were conducted and when these results were compared, the panel data

[32] Fuente (1995), p.33.
[33] Islam (1995), p.1137.

approach indicated a higher rate of conditional convergence but a smaller elasticity of output with respect to capital.

Instead of formulating regressions to examine the issue of income convergence, Bernard and Durlauf (1995) has employed an alternative approach, to apply the cointegration techniques to test for convergence. In this study, stochastic convergence in income was defined as cointegrated output levels with cointegrating vector [1, -1] and "the long-term forecast of output for all countries are equal at a fixed time t"[34]. If the long-term forecast of outputs are just proportional at a fixed time t, for example, with cointegrating vector [1, -α], then there is a common trend in outputs and economies respond to the same long-run driving process. Such definition is completely different from the previous understanding of catching-up process and absolute β-convergence. To investigate, the time-series properties of the output series would be examined. In the assessment process, the ADF tests were firstly applied to test for unit root. Given a unit root, the cointegration tests were performed on both the multivariate and pairwise basis for the existence of cointegrating vectors. Applying the RGDP per capita of 15 industrialized countries into the empirical investigation, the tests revealed little evidences of stochastic convergence since the output series were not cointegrated. However, evidences were found indicating cointegration and convergence across OECD economies. The results also showed that there were a number of common long-run factors which could affect the output growth of these OECD economies.

In the case of Mainland China, Lardy (1980) was one of the earliest studies to review the condition of income distribution in Mainland China and has suggested that "the degree of inter-regional income inequality in Mainland China substantially exceeds the inequality found in several countries that are treated in the economic development literature as classic cases of north-south dualism"[35]. Lyons (1991) has reviewed the overall development of the country, and the issue of inter-provincial income disparities for the period of 1952 to 1987. In the analysis, the author has made use of the statistics of net

[34] Bernard and Durlauf (1995). P.99.
[35] Dernberger ed. (1980), p.162

material product (NMP) and provincial private consumption to access how income was distributed in the country. Both absolute dispersion in NMP and consumption specified as standard deviation or coefficient of variation or actual per capita NMP and consumption of different provinces or regions have been considered. The results have revealed considerable disparity in the pre-reform period, especially in the 50's. However, since the economic reforms, the argument of widening income gaps across provinces could be rejected. This finding is consistent with those in Tsui (1993) in which the authors attempted to further divide the regional inequalities of Mainland China into intra-, inter-provincial and rural-urban dispersion by decomposing the measure of generalized entropy (GE). The study has concluded that the pre-reform regional disparities, particularly the rural-urban one, were rather serious and were attributed to the "urban-biased industrialization strategy and restrictive inter-regional migration policies"[36]. On the belief of post-Mao reform-led regional inequalities, the rural-urban inequalities in Mainland China have worsened since the early 90s. In a later analysis, Tsui (1996) had made use of the provincial GDP statistics of Mainland China to address the issue of inter-provincial inequality in Mainland China once again. Making use of the measures of Gini coefficient, coefficient of variation (CV) and GE, the absolute dispersion on income level was estimated. Similar to the previous conclusion, inequality across different provinces declined in the first half of the 80s, but deteriorated again since the second half of the 80s. Such inequality, accordingly to the author, was induced by the reforms of the industrial sector. Similar decomposition technique was employed by Kanbur and Zhang (1999) to estimate the relative contribution of rural-urban and inland-coastal inequality to overall regional inequality in Mainland China for the period of 1983 to 1995. In the analysis, the GE was applied to measure inequality and the result indicated that rural-urban disparities could explain most of the inequality issue of Mainland China, while the inland-coastal disparities was increasing rapidly.

Chen and Fleisher (1996) was a study with emphasis on the post-reform income dispersion of Mainland China. The authors have focused on the post-Mao era and in the regression analysis, both unconditional and conditional estimations were made to

[36] Tsui (1993), p.623.

examine the provincial income disparities. The MRW human-capital augmented Solow model was adopted as the specification, and the conditional estimations were found to have yielded a more impressive rate of convergence than the unconditional counterpart. There were evidences of income convergence in the coastal and non-coastal provinces, but a substantial income gap still persisted between the coastal and central areas of Mainland China. In the estimation, the FDI to GDP ratio was found to be strongly significant and has contributed to accelerate the pace of conditional convergence. Similar conclusion was also drawn by Jian, Sachs and Warner (1996) and a "strong and statistically significant negative association"[37] between growth and initial income was found over the post-reform years. In practice, it has employed the unconditional convergence test to estimate the growth of per capita RGDP against its initial level of Mainland China for the period of 1952 to 1993, with initial agricultural GDP sector and a coastal dummy as the conditional factors. Evidences have been found to support convergence from 1952 to 1965 and divergence from 1965 to 1978. A strong evidence of convergence was identified during the reform period due to the rural reforms. Since the late 80s, however, the authors have observed an enlargement in the income gap between coastal and non-coastal regions. It was found that intra-regional disparities have declined during the reform period but the cross-group income gaps have experienced very little improvement. In another study, Gundlach (1997) has suggested an inter-provincial income convergence rate of 2.2% in Mainland China. In contrast to this empirical finding, such predicted rate of convergence was computed based on an open economy, human-capital augmented conditional neo-classical growth model. The empirical estimations have also indicated that "convergence of output per worker across Chinese provinces has been supported by high inter-provincial physical capital mobility"[38]. Although the predicted rate was not significantly different from the empirical estimation, this rate was expected to decline. As explained, the economic reforms have encouraged fiscal decentralization, and might thus hinder the inter-provincial capital mobility. This fear has also been raised by Raiser (1998) in which a declined pace of income convergence on the inter-regional/inter-provincial since 1985 was noted. This finding was

[37] Jian, Sachs and Warner (1996), p.5.
[38] Gundlach (1997), p.425.

attributed to the shift of rural to industrial reforms, as well as the system of fiscal transfers in post-reform period. The former transition allowed the relatively richer coastal provinces to benefit disproportionately and thus slowing down the convergence process. The latter system, which has provided fiscal aids to the relatively richer inner provinces, has become serious obstacles to the income convergence among the inner provinces.

Apart from applying the cross-sectional analysis, the panel unit root test has also been employed in Yao, Newbery and Pedroni (2000) in testing the evidence of income convergence of Mainland China on the provincial level. In this paper, the ADF approach similar to Karras (1997) and Ben-David (1996, 2001) was followed to test if the deviation from the sample mean with respect to the RGDP per capita of a Chinese province has inherited any unit root. In the pre-reform period of 1952 to 1977, the unit root null hypothesis was rejected and it implied that the Chinese provinces have achieved income convergence. In the post-reform period, however, unit root was found in the deviation from the sample mean and it served as an evidence of regional income divergence for the period of 1978 to 1997. In addition, the authors have remarked that "Mainland China's regional income has embarked on a divergence course and formed a divergence club since 1978"[39]. The panel unit root test offers a new estimation method to examine the issue of income convergence. This research, however, will only employ the conventional approaches of cross-sectional, panel data and unit root tests in order to compare the estimation results of the new sample to the existing one. Then it is possible to examine whether an extension of the existing convergence tests to consider Hong Kong and Macau and the formation of the Greater China would bring about any new findings on income convergence.

Yao and Zhang (2001a) has surveyed the income inequality issue of Mainland China and the concept of "Club Divergence", which described the income divergence problem between the geo-economic regions of the East, Central and the West, was introduced. A regression model was formulated to address the provincial growth differences of the country in the post-reform era. Investment to GDP ratio, population growth, technological

[39] Yao, Newbery and Pedroni (2000), p.13.

progress, depreciation, export to GDP ratio and two dummies for the distance between the East to Central and Central to the West were considered as the explanatory variables. In the estimation, the hypothesis of "Club Divergence" has been proved given the negative and significant estimated coefficients for the two distance dummies. It implied that the further away from the growth center in the East, the slower would be the rate of economic growth. Besides, a unit root test similar to the above mentioned has also been performed in the study and the result has suggested "Club Divergence" and the East and the West of Mainland China "belong to two different clubs"[40]. Yao and Zhang (2001b) has employed the panel data approach to examine the convergence issue of Mainland China across different provinces and different regions. It has adopted the MRW human-capital augmented Solow growth model as the specification and has introduced trade to GDP ratio and length of highways, railways and waterways as additional explanatory factors. The estimation results suggested δ-divergence and absolute β-divergence for the period of 1978 to 1995. However, the estimations also indicated conditional β-convergence after controlling for population growth, depreciation, physical and human capital investment, trade and transportation. It was found that the three geographical regions of Mainland China, namely the coastal, central and western regions, might have converged into "three distinctive geo-economic clubs of economic growth, within each economic club, there was a tendency of convergence, but between the clubs, there was a tendency of divergence"[41]. These two studies have altogether reconfirmed the conclusion made by Yao, Newbery and Pedroni (2000) in which the convergence force was at work in the pre-reform Mainland China. Zhang and Yao (2001) and Zhang, Liu and Yao (2001) have addressed the issue of income inequality of Mainland China again. The former placed its focus on the variation between inequality in per capita consumption and inequality in per capita RGDP. It has advocated the GE, which is an alternative of the CV, to measure the extent of inequality with respect to both RGDP and consumption per capita for the coastal, central and western regions of Mainland China. The findings have shown a widening inter-regional inequality between the three geographical area of Mainland China, with respect to both GDP and consumption measures. This result is consistent with the one

[40] Yao and Zhang (2001a), p.480.
[41] Yao and Zhang (2001b), p.182.

suggested in Yao and Zhang (2001a). In addition, inequality problem measured by per capita RGDP was more serious than that measured by per capita consumption.

Zhang, Liu and Yao (2001) has utilized the ADF test and it showed that the eastern and western provinces of Mainland China have achieved stochastic convergence since the per capita income statistics of these two regions were stationary. However, as suggested by both the intercept and slope of the income statistics, the relatively richer eastern provinces had become even richer while the relative poorer western provinces had become even poorer. The central region, on the contrary, was affected by both the eastern and western regions and had no clear tendency of income convergence. The introduction of a structural break to the ADF test did not help to rewrite the estimation results, and the findings indicated that the income levels in the eastern and western regions of Mainland China were converging to their own steady states respectively, and "Mainland China's provinces were re-forming into different income clubs"[42]. To estimate whether "Club Convergence" exists in the case of the Greater China, similar ADF test will also be conducted in this research, to asses whether some of the geographical regions of Mainland China can catch-up with the SARs faster than the others.

Yang (2002) viewed the growing inland-coastal disparity as one of the causes of high inequality in Mainland China apart from the rural-urban gap. The author has elaborated that the urban-biased policies were responsible for the upswing in rural-urban gap. In light of the inland-coastal gap, preferential policies were introduced at the very beginning of the reform favoring the coastal regions, consequently "throughout the 1980s and early 1990s, the coastal provinces have attracted disproportionately high shares of foreign capital and trade and have become the cradle of rural enterprises, which have been the driving force behind Mainland China's income growth"[43]. It has brought about an income divergence between the inland and the coastal regions.

Given the substantial variations between different geographical regions of Mainland

[42] Zhang, Liu and Yao (2001), p.256.
[43] Yang (2002), p.333.

China, the Chinese provinces will be divided into the coastal, central and western regions and the concept of "Club Divergence" will also be reviewed in this research. The three income clubs of Mainland China have been extended to cover both Hong Kong and Macau and the conventional β- and δ-convergence and ADF tests are the methodologies to govern the estimations. The intention is to show whether the insertion of Hong Kong and Macau in the discussion could bring about a different result to the convergence issue of the country. Since the CV for all the income clubs will be measured to examine for δ-convergence, the GE, which is an alternative measurement, will not be considered in the analysis.

2.3.3. Trade and Foreign Direct Investment in the process of Income Convergence

As for the correlation between trade and convergence, Sachs and Warner (1995) has figured out that the relatively poorer open economies tended to have a higher growth rate than the other relatively richer but closed counterparts. Ben-David (1996) has found a positive correlation between trade volume and the speed of per capita income convergence in a group of rich countries over the period of 1960-1989. Slaughter (1997) has suggested three forces which could help to prove the hypothesis of trade stimulates income convergence. The first one was the Factor Price Equalization theorem, the second channel was that international trade would mediate international flows of technology. These two forces could help to reduce the income gaps between trading partners. Last but not least, it was expected that trading on capital goods could directly affect a country's per capita income, thus favoring income convergence across regions. Adams and Shachmurove (1997) has indicated that income growth would lead to transitions in trade composition from primary sector-based to secondary or capital-intensive dominated exports. The industrial sector of an economy could probably enjoy such benefits disproportionately, resulting in an increase in the overall income disparities of a country, after a contraction in dispersions in the earlier stage of growth. Continuous liberalization of both internal and external trade in Mainland China, on the other hand, might help to level off inter-regional dispersions, thus promoting income convergence. Zhang (2001) has investigated the role of trade and FDI in cross-country convergence. The study attempted to assess the linkage between regional integration and economic convergence by considering intra-regional trade and FDI in the analysis on income convergence. On top of the conventional specification in unconditional convergence, the exports to GDP and FDI to GDP ratios were introduced into the regression. Based on the sample of Asian economies, the estimations indicated a statistically significant exports and FDI ratios in some of the sub-groups, for example the Asian Newly Industrialized Economies (NIEs) and Japan, and suggested that these two ratios tended to accelerate the convergence process since given these two ratios, the size of β had increased from 1.1% to 2.89% per year.

In light of Mainland China, Chen and Fleisher (1996) viewed the ratio of FDI to GDP as one of the factors in explaining the growth performance of Mainland China. This ratio was found to be statistically significant and has contributed to the growth of the country. A simulation has been produced in Yang and Huang (1997) which suggested that trade liberalization in Mainland China could probably correct both rural-urban and intra-rural income inequalities. In addition, it suggested that comprehensive modification on the tariff rate would lead to large welfare improvement in the country, to significantly reduce the rural-urban income dispersion and improve, likewise, the welfare of the urban inhabitants. In Yao and Zhang (2001a, 2001b), the exports to GDP and trade to GDP ratios were considered as explanatory variables to the rate of growth respectively. In these studies, a positive and statistically significant estimated coefficient was found for both export and trade ratios which implied that exports or trade have contributed to the economic growth of Mainland China. Demurger (2001) has regarded FDI to GDP ratio as one of the growth determinants for Mainland China. In addition, share of agricultural and collective sector, transportation, population density, number of telephones, distance to town, village accessible by telephone, and factors related to the infrastructure development were considered in the estimation as the author intended to assess the role of infrastructure investment in the growth process. Then the results showed that openness, geographical location and infrastructure endowment did play a significant role in accounting for the growth performance of a province. The FDI to GDP ratio was also strongly significant and directly related to the pace of growth of the Chinese provinces.

Fu (2004) has attempted to explain the coastal-inland inequality problem of Mainland China by relating the issue to the structure of exports and FDI. The spillover and migration effects of exports and FDI were investigated and as reported, the coastal region was able to derive significant benefits from exports and incoming FDI, as a result it was able to achieve higher growth rate. The economic growth, nevertheless, did not spillover to the relatively poorer inland region and therefore, export and FDI tended to intensify inequality. Besides, the development in the coastal region has encouraged migration from the inland to the coastal regions which has led to an enlargement in income gap. Overall speaking, "exports and FDI have played an important role in increasing regional disparities in Mainland China"[44].

In order to show the influences or contributions of trade and FDI to the process of income convergence between Mainland China, Hong Kong and Macau, the trade to GDP ratio (openness ratio) which covers both exports and imports, and the ratio of incoming actually used foreign capital to GDP (FDI ratio) will be considered in this research. Trade and FDI are two closely correlated economic activities, and as shown in Zhang and Felmingham (2001) and Liu, Burridge and Sinclair (2002), there are bi-directional causalities between exports/trade and inward FDI. For this reason, unlike the previous studies, either the openness or the FDI ratio will be considered in the growth estimation to investigate the issue of income convergence to avoid the problem of multicollinearity.

2.3.4. δ-convergence

Three indices which have been used to measure δ-convergence, including the Standard Deviation by Lyons (1991), Barro and Sala-i-Martin (1991) and Jian, Sachs and Warner (1996), and the population weighted and unweighted Coefficient of Variation (or variation coefficient, CV) which had been widely used in a series of studies, such as Lyons (1991), Tsui (1996), Chen and Fleisher (1996), Raiser (1998), Zheng, Xu and Tang (2000), Xu and Zou (2000), Wu (2002) and Chang (2002), and most of these papers

[44] Fu (2004), p.162.

intended to discuss the income disparity issue of Mainland China. As suggested in Lyons (1991), CV could be used to measure the relative inter-regional income dispersion while the standard deviation of regional GDP per capita could show the absolute dispersion of a region. A continuous decline in the measured CV or standard deviation can be viewed as an improvement in income inequality and the involved countries may then achieve δ-convergence. Comparing δ-convergence with β-convergence, the latter is able to capture more research interest because and according to Sala-i-Martin (1994), "it is interesting to know whether poor countries are predicted to grow faster than rich ones. If we knew ... would not ever care about current income disparities."[45]. Besides, β-convergence is also the necessary condition for δ-convergence as the relatively poorer economies should first achieve a higher income growth before it can reduce the income gap with the relatively richer one.

In view of δ-convergence with respect to Mainland China, Lyons (1991) has adopted both the weighted and unweighted (by population) CVs with different composition to estimate the inequality problem of Mainland China with respect to net material product per capita. An upsurge was found between 1957 and 1960, afterwards, the CV has returned to the 1957 level in 1962. The index then increased again from 1967 to another peak in 1977, and is followed by a declining trend in the early years of the post-reform period. Tsui (1996) showed that the CV of Mainland China on the provincial level has been declining since 1978 until 1984 from 0.445 to 0.416, then started to increase again to 0.422 in 1989. It implied that the economic reform has led to improvements in income inequality in the early 80s. In line with the urban reforms, the inequality problem has worsened again. Although Jian, Sachs and Warner (1996) has employed standard deviation instead of CV to measure the extent of income inequality, similar result was found and the income inequality problem has shown a significant improvement since the beginning of the reforms until 1990. Afterwards, the income gap across provinces has widened.

In Chen and Fleisher (1996), the CV on the provincial level was found to be increasing as a whole in the pre-reform period, with a downward drift only after 1980. However, there

[45] Sala-i-Martin (1994), p.745.

was a tendency for the CV to increase after 1990 and as explained by the authors, the increase was attributed to the widening gap between the coastal and non-coastal provinces in the period. The income inequality problem on both the provincial and regional levels were considered in Raiser (1998) and the variation coefficients on the provincial level with respect to GDP per capita have presented a declining trend over the period of 1978 to 1992, from 0.98 to 0.56. Afterwards, the Chinese provinces were divided into coastal and interior regions and a contraction was found in the coastal region, from 0.78 in 1978 to 0.35 in 1992. For the interior, its CV has declined from 0.38 in 1978 to 0.28 in 1987, then increased again to 0.35 in 1992. Zheng, Xu and Tang (2000) has measured the CV on the provincial level from 1952 to 1995 and a clear declining trend was found, particularly in the post-reform period from 0.9728 in 1978 to 0.6216 in 1990. However, the CV has started to increase to 0.6407 in 1991. Similar conclusion can also be found in Chang (2002) which suggested year 1990 to be the turning point and the size of CV or the income gap across different Chinese provinces has started to enlarge after this year. The CV was recorded at 0.601 in 1990 and has climbed up to 0.759 in 2001. Wu (2002) did not only calculate the CV across different Chinese provinces, but has also attempted to calculate the CV on the regional basis. The results displayed that the CV for the whole country has started to increase since the 90s, after one decade of contraction. When the regional CVs were reviewed, the income gap in both the coastal (without cities) and central regions of the country have been declining continuously. That of the western region, however, has shown no clear tendency of δ-convergence nor divergence.

To measure the actual income gap between Mainland China, Hong Kong and Macau, the conventional δ-convergence test, which is made based on studying the evolution of CV, and conducted in Chen and Fleisher (1996), Gundlach (1997), Raiser (1998) and Yao and Zhang (2001a, 2001b), etc. will be performed. It is then possible to compare the analytical results with the previous studies to assess whether the formation of the Greater China economies with Hong Kong and Macau can rewrite the previous conclusion on the issue of income convergence.

2.4. Productivity Convergence

Conventionally speaking, economic integration tends to reinforce interactions between countries, through regional trade and investment flows. The extensive development in these cross-border activities would probably lead to knowledge spillover, which would then bring about a positive impact on the productivity of the initially poorly-performed economy. Consequently, there would be a catching-up and convergence in productivity.

In light of the linkage between economic integration and productivity adjustment, Giannetti (2002) has indicated that cross-border interactions would intensify international knowledge spillovers, then "may significantly alter the dynamics of convergence across countries and, within countries, across regions".[46] It appears that stronger knowledge spillovers would bring about convergence across regions such that the economies involved would shift their production completely to high-technology goods. Besides, knowledge spillovers would also bring about convergence across countries since the high-technology sector would have an increasing share in total output. The disparity problem in those countries specializing in traditional sectors, on the contrary, would tend to amplify since the traditional sector could not benefit from knowledge spillover. The conclusion drawn was that the intensity of international knowledge spillovers would be crucial in determining convergence across countries.

The consequences of economic integration on productivity were further discussed in Wu (2000a) in which the author suggested that rapid growth in trade and investment flows among economies has led to an increasingly integrated sub-regional economic bloc, for example, the one in the Southern Mainland China Region between Hong Kong, Taiwan, Guangdong and Fujian province. Then the author has attempted to identify the influence of economic integration on productivity performance, as well as to find out whether regional integration would lead to convergence in growth and efficiency. The author has observed that Guangdong and Fujian have been catching-up rapidly with Hong Kong and Taiwan in terms of their growth and productivity, while the continuous inflow of investment could explain much of these improvements. Investment growth was also

[46] Giannetti (2002). P.540.

regarded as an important stimulus for the growth in total factor productivity and a driving force of the income convergence process in these economies.

In the discussion, three levels of analysis, namely partial productivity of labour, capital productivity and total factor productivity have been measured and compared for the four economies. Labour productivity was calculated as per employment GDP of the economy in PPP unit. Capital productivity was measured by dividing GDP by total capital stock. The total capital stock, meanwhile, was measured as the sum of the last period's capital stocks and investment minus depreciation, and the beginning period's capital stock was assumed to be five times the year's GDP.

2.4.1. Productivity Measurement

Total Factor Productivity (TFP) is different from the labour and capital productivity which is understood as GDP per unit of labour or capital. It is the portion of output that cannot be explained by labour and capital inputs. In Miller and Upadhyay (2000), TFP was measured as the constant term of the Cobb-Douglas production function in log form, with or without human-capital in the specification. The production functions displayed either increasing, constant or decreasing returns to scale so that the sum of capital, labour and human-capital share can be greater than, equal to or less than one respectively. Besides, time-specific dummy variables with a value from 1 to 6 were inserted to capture the time-specific effects which may happen in the six time-blocs under discussion.

Afterwards, the correlation between total factor productivity and the other economic factors was addressed and it is observed that the ratio of export to GDP has contributed to TFP growth over time. It might imply that economic integration and the induced expansion in trade transactions tends to accelerate the pace of productivity growth. In addition, it was also found that an undervalued currency could help a country to boost its TFP and a lower inflation rate would be helpful in maintaining a higher TFP.

The Cobb-Douglas production function approach was also found in Martin and Mitra (2001) to estimate TFP on the industrial level. The issue of productivity convergence in the agricultural and manufacturing sectors across countries was assessed as well. For the production function, it was specified as:

$$\ln Y_t = \ln A_0 + rt + \alpha \ln L_t + \beta \ln K_t \quad (2.24)$$[47]

"r" is the TFP growth rate and A_0 is the initial TFP level. Y_t, L_t and K_t represent output, employed labour and employed capital respectively, "ln A_0" and "r" can vary across countries. However, the labour share, α, and capital share, β, in the production function should be regarded as constant across countries.

In light of the convergence phenomenon, the United States was regarded as the reference country and the study has attempted to measure the technology gap between the United States and the other countries. The productivity of a country converged with that of the US's if the productivity gap between this country and the US was stationary. Then the study has depicted a strong evidence of high rates of technical progress in both the agricultural and manufacturing sectors. Convergence in TFP and the growth rate of TFP was also observed, particularly in the agricultural sector.

As an application of the production function estimation of TFP, Wang and Kalirajan (2002) has divided the Chinese economy into agricultural and non-agricultural sectors and the productivity improvement of each of these sectors were estimated respectively. Regional dummies were introduced to address the growth and productivity differentials across provinces in various periods. The time period dummies, on the other hand, were inserted to capture the impact of policy adjustments on economic performance. The estimations performed in the study illustrated a positive TFP growth in both the agricultural and rural-industrial sectors in Mainland China over the period of 1980 to 1992. The TFP growth in the rural-industrial sector was found to be higher than that of the agricultural sector. Lastly, the negative and significant time period dummy suggested that

[47] Martin and Mitra (2001), p.407.

the anti-market policy adopted from 1989 to 1992 has brought about negative impacts on the economic growth of Mainland China.

Two different approaches, namely the regression analysis and growth accounting approaches were suggested in Dowling and Summers (1998) as ways to measure TFP. In the case of regression analysis, the study has referred to World Bank (1993) in which TFP was interpreted as the average output growth unexplained by capital growth, labour growth and human capital growth. This paper then adopted the regression methodology in Young (1995) in which TFP was defined as the output per worker which was not attributed to the per worker capital. As for the growth accounting approach, the elasticity of output with respect to labour and capital were pre-determined, and TFP growth was measured based on a decomposition process. This approach required assumptions on the production structure of the economy, such as fixed weights on the contributions of factor inputs and sufficient competition in the economy such that factor earnings could equal factor productivity[48].

The paper then summarized that the estimated TFP was sensitive to the process of technological transfer, the level of economic growth and the external trade condition. It was also found that TFP was higher in periods of rapid economic growth and relative to developed economies, TFP would be more important in explaining the economic growth of developing Asian economies.

Similar discussion in relation to TFP could be found in Felipe (1997), in which the theoretical background and applications of TFP were discussed. Again, two approaches of TFP estimation, namely, the growth accounting and econometric estimation of production function have been reviewed. The TFP measured by the growth accounting approach was called the "Solow residual" which was interpreted as the growth of output that could not be explained by the growth of labour and capital inputs. The objective of this technique was "to determine how much economic growth is due to accumulation of labour and capital inputs and how much can be attributed to technical progress, or how much growth

[48] Dowling and Summers (1998), p.173.

can be explained by movements along a production function, for example, caused by a change in labour and capital, and how much should be attributed to advances in technological and organizational competence such as a shift in the production function."[49]

As an alternative way of the measurement, Wu (1995, 2000a) have employed a stochastic frontier approach to estimate TFP growth rates. In Wu (2000a), the production function was written as:

$$\log Y_i(t) = \alpha + \beta_1 t + \beta_2 t^2/2 + (\gamma_1 + \gamma_2 t)\log L_i(t) + (\eta_1 + \eta_2 t)\log K_i(t) + e_i(t) \text{ and}$$
$$e_i(t) = v_i(t) + u_i(t) \qquad (2.25)$$

α, β, γ and η were the parameters to be estimated. Those $Y_i(t)$, $L_i(t)$ and $K_i(t)$ represented GDP, labour and capital of the i[th] economy at time t. $e_i(t)$ was the error term combining a random term, $v_i(t)$, as well as a term associated with technical inefficiency, $u_i(t)$.

In the stochastic frontier approach, a maximum output which is determined by the best practice or technological frontier is defined. It has an advantage over the "Solow's residual", which was applied in the above-mentioned papers, since decomposition of TFP growth into changes in technical efficiency and technological progress is allowed. As described, total factor productivity growth is the output growth that is not attributed to input growth. Therefore, output growth can be decomposed into three components, namely input growth, technological progress and changes in technical efficiency. Technical efficiency, meanwhile, is defined as the ratio of actual output to potential output.

Wu (1995, 2000a) then suggested to firstly conduct a growth regression to address the correlation between output growth and the growth of all factor inputs. The estimation residuals were the sum of technological progress and technical efficiency. Afterwards, the residuals were regressed on a time trend and its square plus a constant and the fitted values were regarded as technical efficiency. Then Wu (1995) has attempted to examine and

[49] Felipe (1997), p.7.

decompose the TFP growth of the Chinese industries, namely the state industry, rural industry and agriculture on the provincial level. A Cobb-Douglas production function was used as the specification for estimation. Apart from the usual explanatory variables such as number of labour or labour hours and capital stocks, parameters including fixed assets, working capital, machinery, fertilizer and land were also inserted into the estimation. The pooled analysis with fixed effects then indicated that "technological progress dominates technical efficiency changes as the main source of total factor productivity growth in all of the three sectors of the economy. This means that the production frontier has shifted upward while the gap between standard practice and best practice remains."[50] The research has also exposed that the technical efficiency level of all the Chinese industries ranges from 50% to 60% for the period of 1985 to 1991, which implied that there is still a big room for further improvement.

Wu (2000a) has compared the labour and capital productivity as well as the total factor productivity of Hong Kong, Taiwan, Guangdong and Fujian for the period of 1978 to 1997. The objective of this research was to estimate the impact of economic integration on productivity performance, and to test if regional convergence can bring about convergence in growth and efficiency. The regression model was developed from the usual Cobb-Douglas production function, with time trend and its square being introduced as additional factors. The pooled estimation with fixed effect indicated that "the TFP in Guangdong and Fujian has grown much faster than in Hong Kong and Taiwan since the late 80s…, Guangdong and Fujian have exploited the advantage of being backward and forged ahead of their advanced counterparts in terms of productivity improvement."[51] In terms of TE, "Hong Kong and Taiwan performed much better in the late 1970s and early 1980s than in the late 1980s and the 1990s. In contrast, Guangdong and Fujian performed much better in the 1990s than in the 1980s."[52] As for the convergence of TFP, according to the author, capital-labour ratio should be viewed as the most critical factor in explaining TFP convergence. In light of Guangdong and Fujian, the two provinces have

[50] Wu (1995), p.215.
[51] Wu (2000a), p.50.
[52] Wu (2000a), p.51.

experienced rapid capital accumulation since the economic reforms, thus allowing them to achieve stronger TFP growth to catch up with Hong Kong and Taiwan.

The stochastic frontier approach was also found in Mahadevan (2002b) to measure the TFP growth in the manufacturing sector of Australia, using the two-digit industry level data, empirical evidences were found to show that TFP growth has contributed the most to the output growth of the country in between the late 60's and the early 70's. Technological progress, meanwhile, has also shown a positive and increasing trend. In Mahadevan and Kalirajan (2000) and Mahadevan (2002a), Singapore's manufacturing and services sectors' TFP growth rate have been estimated and decomposed respectively by using the stochastic frontier approach. A weak performance in TFP growth was suggested in both of these papers and it was attributed to the slow technological progress as well as the deteriorated technical efficiency of the country.

Although the stochastic frontier approach allows the advocators to decompose TFP into technological progress and technical efficiency, this approach faces the constraint that the estimated technological progress is only a sample average. To improve, the employment of a translog production function was suggested and have been followed by Tsao (1985), Lau and Brada (1990), Gumbau-Albert (2000), Wu (2000b, 2003), Kim and Han (2001) and Tong and Chan (2003), etc. In these papers, the per capita income growth was regressed on the stock of capital and labour, their square and their products with time trend. Besides, time trend and its square and the product of capital and labour stocks were considered as explanatory variables in the regression. The advantage, according to Gumbau-Albert (2000), was that it permitted the estimation of different growth rates of technological progress for each sampling region. Based on the stochastic frontier approach with a translog production function, this paper intended to study the technical efficiency of Spanish regional economy. Similar methodology has been adopted in Kim and Han (2001) to measure and decompose the TFP growth of South Korean's manufacturing industries. It was found that the growth in TFP was led by technological progress. Making use of similar technique, Tsao (1985) has analyzed the linkage between economic growth and productivity growth of Singapore. The study then indicated that the

TFP growth of Singapore's major manufacturing industries was low, despite the rapid economic growth enjoyed by the country.

In relation to Mainland China, the country's TFP on both the provincial and industrial levels has been measured in many studies. In Wu (2000b), the TFP growth of Mainland China on the provincial level in the post-reform period was estimated and decomposed. The sources of productivity growth, the contribution of productivity improvement to economic growth as well as the convergence and catch up issue with respect to productivity have all been addressed in this study. The research results suggested that the economic growth of Mainland China in the 80s was attributed to efficiency improvement and input growth. Since the 90s, technological progress has become the most important factor in explaining economic growth. Furthermore, convergence in technical efficiency on the regional level has been taking place since the early 80s and it can be viewed as one of the contribution of the economic reforms. Wu (2003) has also applied the frontier approach and the translog production function to estimate and decompose the TFP growth of Mainland China. The contribution of productivity growth to economic growth was estimated as well. The study then indicated that TFP growth has accounted for less than 20% of the economic growth of Mainland China. From 1982 to 1997, TFP growth could just explain 13.5% of the economic growth of the country. In addition, the technical efficiency of Mainland China has also encountered considerable fluctuations in the same period.

On the industrial level, Lau and Brada (1990) has utilized the translog production function and the stochastic frontier approach to estimate the technical efficiency and technological progress of Mainland China for the period of 1953 to 1985. The analysis displayed a positive technological progress of 2% to 3% in Chinese state owned enterprises. Besides, considerable variations were found on the technical efficiency of these enterprises which has led to a mixed performance on TFP growth. In another paper, Tong and Chan (2003) have placed their emphasis on the provincial township and village enterprises (TVEs) of Mainland China with an attempt to measure their efficiency and productivity level for the period of 1988 to 1993. The estimation results showed that the TE of Mainland China's

TVEs has been declining in the sampling period. Besides, great regional imbalance was also observed on the TE of these TVEs. According to the study, the TE of the enterprises located in the eastern region is about 20% and 30% higher than those located in the central and western regions.

So far, a couple of studies on productivity have been reviewed and it could be found that the "Solow residual" and the stochastic frontier approach are both mainstream methods in estimating the TFP of an economy. The stochastic frontier approach, as stated in some of these papers, is equipped with an in-born advantage and can be decomposed easily to the sum of two critical elements - change in technical efficiency and technological progress. For this reason, this approach has been increasingly adopted to measure the TFP level of different economies, and will be employed in this research to estimate the TFP of the Chinese provinces and municipalities, Hong Kong and Macau. When the stochastic frontier approach is applied together with the translog production function, then time and sample specific technical efficiency, technological progress and total factor productivity can be estimated. Although this estimation method is rather popular, this research moves one step forward to group Mainland China, Hong Kong and Macau together for the first time to measure their TE, TP and TFP growth, and more importantly to examine if there is any tendency of productivity convergence between these Chinese economies.

2.4.2. The Contribution of Productivity Improvement to Economic Growth

As a survey on empirical studies, Felipe (1997) has quoted a series of researches conducted by Alwyn Young (1992, 1994a, 1994b, 1995) as examples to illustrate the application of TFP estimations. The growth accounting methodology has been adopted by Young (1992) and a zero TFP growth was found between 1971 and 1990 in the case of Singapore. This indicated that factor accumulation was the main source of growth while productivity growth has played an insignificant role in the process. Hong Kong, meanwhile, could enjoy substantial growth in TFP which could explain around 35% of its output growth during the period. This conclusion was further confirmed by two other studies of Young (1994b, 1995).

In Young (1992, 1995), the growth of total factor productivity for the East Asian NICs (Young 1995), including that of Hong Kong and Singapore (Young 1992) were discussed. These two papers have challenged the common belief of extra-ordinary high productivity growth in the NICs and have indicated that the productivity growth in the non-agricultural sector was 0.2% in Singapore, 2.3% in Hong Kong, 1.7% in South Korea and 2.1% in Taiwan.[53]

In light of Mainland China, in Fleisher and Chen (1997), a test on the productivity differentials between coastal and non-coastal provinces of Mainland China has been conducted with an attempt to explain the income gap between them. In the analysis, a standard production function estimation was adopted and the log differing RGDP per capita of the Chinese provinces and municipalities (excluding Jilin, Guangxi, Hainan, Qinghai and Tibet) for the period of 1978 to 1993 was regressed on the investment to output ratio, the growth rate of employment and the lagged value of real GDP. The estimated residuals were viewed as provincial productivity shocks, in which the total factor productivity was derived from. The paper then decomposed TFP and the growth of TFP and the result indicated that geographical position is important to the size of TFP. Human capital was another factor that has contributed to TFP. In addition, the lagged value of TFP has carried the strongest magnitude with a high level of statistical significance in explaining the size of TFP.

The role of productivity in the process of economic growth and convergence has been discussed in Drysdale and Huang (1997). The study has revealed that TFP growth was important to the rapid economic growth of the East Asian economies apart from the significant contributions brought about by inputs growth. The authors suggested that 80% of the above-average income growth in Japan, Hong Kong, Korea, Taiwan, Thailand and Indonesia was caused by TFP advances. Nevertheless, the situation of Mainland China and Malaysia were very different as TFP growth had a smaller magnitude in the growth process of these two economies.

[53] Young (1995), p.672, table XIII.

In Young (2000), the productivity growth of Mainland China was reviewed and the issue of statistical bias was suggested, resulting in a discount on the growth performance of this emerging economy. In the discussion, the author has made some systematic adjustments on the data series of Mainland China, such as the statistics on output, labour input, human capital, physical capital, factor income shares as well as inflation rate. Given the adjusted data series, the total factor productivity in the non-agricultural sector of Mainland China in the reform period of 1978 to 1998 was re-estimated. Taking into account the facts of a more realistic price index, the rising labour participation rate, the improvement in educational attainment, the overall growth of output per capita has contracted from 7.8% to 2.6%. The total factor productivity has, in the meantime, dropped to 1.4% per annum from the original 3% level.

In Chen and Demurger (2002), the authors have made use of the Cobb-Douglas production function to estimate the productivity of 23 manufacturing sectors in Mainland China between 1988 to 1994. It intended to find out the link between FDI and the differential in productivity and the results have shown "significant differences in TFP growth between manufacturing sectors dominated by FDI and those dominated by domestic investment in the consumer goods industry"[54]. It implied that FDI contributed to improve productivity and accelerate economic growth. Nevertheless, no major TFP growth disparities could be found in those sectors that were intensively funded by domestic investment. Conclusively, in this research FDI was regarded as a force that could reinforce greater regional disparities, particularly in those sectors that were relatively more open.

In general, the above papers indicated that the major cause of economic growth for Mainland China was factor accumulation rather than TFP growth, although a satisfactory growth performance could be found for the latter. Since the main intention of this research is to examine the possibility of productivity convergence between Mainland China, Hong Kong and Macau following the achievement on economic integration and income

[54] Chen and Demurger (2002), p.1.

convergence. The contributions of TFP improvement to economic growth will not be evaluated in the following discussion.

2.4.3. Convergence in Productivity

As mentioned in Islam (1998), one branch of convergence study has placed its emphasis on total factor productivity to investigate the phenomenon of productivity catch up and convergence. Gouyette and Perelman (1997) is one of the example in this area of study which has applied the concept of δ- and β-convergence to examine whether the productivity level of the OECD countries have converged. In practice, the TFP growth was decomposed into technical efficiency and technological progress by both the frontier and Divisia index approaches. In the cross-sectional estimation, the TFP growth was regressed on the beginning period's technical efficiency level and the capital intensity ratio (which was measured as the capital stock to GDP ratio). The coefficient of variation with respect to the productivity level of these countries was also measured. The results indicated both δ- and β-convergence in the productivity level of the service sectors in the OECD countries, but not in the manufacturing sector. This implied that in the service sector, the initial efficiency or productivity levels and the TFP growth rate were inversely related. The productivity gap between the service sector of the sampling countries has also declined. Similar application can also be found in Bernard and Jones (1996) which regressed TFP growth on its initial value to examine the issue of productivity convergence of 14 OECD economies during 1970 to 1987 on a sectoral basis. The estimation results had exhibited productivity convergence in the service sector, but not in the manufacturing sector. In Carree, Klomp and Thurik (2000), δ- and β- convergence of average labour productivity across manufacturing industries in 18 OECD countries over the period of 1972 to 1992 was examined. Similar analysis was also done in Miller and Upadhyay (2002) to regress the growth of TFP on its initial level on both the cross-sectional and pooled basis to examine for productivity convergence. In the meantime, income convergence was also tested. The estimation results then suggested absolute income convergence between those high income countries, but the convergence process has never happened between all the 83 sampling countries, nor between the 22 low-income and 38 middle-income sub-samples. Absolute convergence of TFP, on the other hand, was found in the entire sample as well as all the sub-samples. These findings indicated convergence in technology rather than per capita GDP. Making use of the standard deviation, the absolute gap of both per capita RGDP and productivity were measured. The results suggested δ-divergence in per capita RGDP across all the countries, the low-income and middle-income sub-sample. In the case of the high-income sub-sample, standard deviation first declined and then increased again throughout the sampling period. In relation to productivity convergence, the productivity gap has declined between all the countries and the countries in the high-income sub-sample. Such declining trend, however, was less obvious in both the low- and middle-income sub-samples.

Similar to the studies on income convergence, the test of unit root has also been adopted to examine if there is convergence. Freeman and Yerger (2001) has adopted the ADF test to examine if the difference between the manufacturing sector's productivity of an individual country and the sample average was stationary for eight OECD countries in the period of 1958 to 1998. The finding of unit root implied no convergence, indicating that shocks to the productivity level of a country were permanent. If the series was stationary, it suggested that the shocks to productivity were temporary and convergence occurred either on an absolute or a relative basis. Then the estimations revealed no convergence when all the sampling countries and the entire sampling period were considered. When the sub-periods were focused, a strong evidence of β-convergence on manufacturing sector's productivity was found in the pooled sample for the period of 1971 to 1998.

The ADF test was applied again in Martin and Mitra (2001) to test empirically whether the level of productivity of a group of developed and developing countries have converged. Rather than using the sample average, the US was chosen as the reference country and its productivity level was compared with those of the others. The difference in productivity level was called technological gap and if this series was stationary, then the economy has converged its productivity to the US's level. The authors have employed the Solow's residual as the method in estimating the productivity level. The unit root test then displayed productivity convergence in the agricultural sector. Such pattern, however, did not appear in the manufacturing sector. In addition, the technological gap was regressed on a country dummy and a time trend. As for the agricultural sector, the estimated coefficient of the time trend was found to be negative and statistically significant, and it implied convergence between different countries. On the contrary, a positive and statistically significant coefficient time trend was found for the manufacturing sector and it indicated divergence.

The objectives of this research is to examine if Mainland China, Hong Kong and Macau have integrated economically, and to estimate the possible impacts of economic integration on income and productivity. Productivity convergence, which is believed to be one of the possible results of economic integration and a branch of convergence study as stated in Islam (1998), will subsequently be an issue to be addressed. This research then aims to show the conventional linkages of these mechanisms, to cover Mainland China, Hong Kong and Macau for the first time in literature, to discuss the issue of productivity convergence and measure the actual efficiency and productivity gap between these Chinese economies at the same time. In the estimation process, the conventional methods of β- and δ-convergence tests, which were frequently used to estimate income convergence, but have been rarely employed to conduct productivity convergence tests, will be applied. The specifications of the estimation equations in this research, however, are slightly different from the above-mentioned counterparts so as to study the correlation between initial income level and productivity growth. Then it is able to examine if there is any catching-up process on productivity, to allow the initially less efficient or poorer Chinese provinces to grow faster than the initially more efficient or richer Hong Kong and Macau economies on top of economic integration and income convergence.

2.5. Chapter Summary

In the literature of economic integration, there exists a rich collection of papers which were organized to discuss in a descriptive manner the evolutions and consequences of trade and FDI development, and to measure the intensity and complementarity of trade between the member states of some famous international organization, such as the OECD and EU (15). In the meantime, King and Klein (1992, 1993), Ash and Kueh (1993), Cheng and Tsang (1996), Dale (1997), Tang (1998), Sit (1999), Lin and Lin (2001), Keng (2001), etc. have placed their emphases on the issues of trade and economic integration between Mainland China, Taiwan and Hong Kong. Apart from the descriptive analyses, there are also studies, such as Frankel and Rose (1996, 1998) and Torres and Vela (2003), which have made used of the correlation matrix and simple causality test to measure the linkages of economic activities between different countries, in order to prove if there is any evidence of business cycle synchronization, as well as to assess the correlation between business cycles and trade intensity.

Despite employing the correlation matrix, there is another branch of studies which has utilized the VAR, cointegration test and VECM to estimate whether the income levels of different economies are comoving. In Yao (1996) and Caporale, Pittis and Prodromidis (1999), for example, the cointegration test were applied. The relationship of incomes between different sectors of Mainland China and that between different EU member states were estimated respectively in these papers. These two papers, however, have not introduced the VECM to estimate the short-run dynamics of income relationships and causalities of the income level, although the cointegration test and VECM have been widely employed to assess the relationship of trade, FDI and growth.

Comparing with the existing studies, a new sample, which covers Mainland China, Hong Kong and Macau, is formed in this research to explore the issue of economic integration and its impacts on the politically unified Chinese economies. In addition to the conventional descriptive analyses, the correlation matrix and the cointegration test which have been adopted in the available papers, the VECM, which have been applied in Shan and Sun (1998), Zhang and Felmingham (2001, Liu, Burridge and Sinclair (2002), etc. to examine the correlation and causality between trade/export, FDI and growth of Mainland China, will be employed to estimate the correlation and causality between the per capita RGDP of Mainland China, Hong Kong and Macau for their long-run equilibrium relationship and short-run dynamics and adjustments.

In view of the scenario of income convergence, the β- and δ-convergence tests are popular methods in testing for the presence of a catching-up process and estimating the actual income gap between different economies. They have been adopted in Chen and Fleisher (1996), Jian, Sachs and Warner (1996), Gundlach (1997), Raiser (1998), Yao and Zhang (2001a, 2001b), etc. to assess the issue of income convergence of China. Relative to the GE and the decomposition of Gini coefficient, the β- and δ-convergence tests do not only indicate the degree of inequality, but also the speed of income convergence and the contributions of different factors, such as investment, trade and FDI to the convergence process. For this reason, they will be employed in this research to examine the convergence issue between Mainland China, Hong Kong and Macau, which is discussed for the first time in literature.

Apart from the β- and δ-convergence test, the issue of stochastic convergence will also be studied in this research. In addition to the ADF test which have been used in Karras (1997), Ben-David (1996, 2001), Yao, Newbery and Pedroni (2000), Zhang, Liu and Yao (2001), etc., a more restrictive classification of stochastic income convergence which was introduced in Bernard and Durlauf (1995, 1996) and has not been widely applied will also be employed.

As for the issue of productivity convergence, before it can be tested, the productivity level of Mainland China, Hong Kong and Macau have to be measured. Rather than applying the growth accounting approach or the concept of partial productivity, such as labour and capital productivity, the idea of TFP will be measured and investigated in the research. According to the World Bank (1993), TFP refers to the portion of output growth that cannot be explained by labour and capital expansion. To estimate the TFP, the stochastic frontier approach will be employed since the TFP growth obtained from this method can be decomposed into changes in TE and TP. It is then possible to have an in-depth understanding on the causes of productivity growth and the stochastic frontier approach is therefore preferred to the other alternatives. As stated in the available literature, both the Cobb-Douglas and translog production functions can be used as the specification to estimate TFP. The former has been adopted in Dowling and Summers (1998), Miller and Upadhyay (2000), Wu (2000a), Wang and Kalirajan (2002), etc., while the latter could be found in Tsao (1985), Lau and Brada (1990), Gumbau-Albert (2000), Wu (200b, 2003), etc.. However, to estimate the technological progress of an economy in a specific year, the translog production function has to be employed since Cobb-Douglas production function could only work out the average technological progress. Then the translog production function will be adopted with the stochastic frontier approach to estimate the TE, TP and TFP growth of Mainland China, Hong Kong and Macau altogether for the first time.

As mentioned in Islam (1998), productivity convergence is a branch of convergence studies but only a limited number of papers have attempted to discuss this issue. Amongst, Bernard and Jones (1996), Gouyette and Perelman (1997), Freeman and Yerger (2001) and Miller and Upadhyay (2002) have made use of the methods, such as β- and δ-convergence and ADF tests, which have been frequently employed in income convergence tests, to examine whether there was productivity catching-up and convergence between the OECD members, while little efforts was devoted to study the situation of Mainland China or Greater China. This research then intends to fill in this gap, to employ these conventional methods to examine the issue of productivity convergence between Mainland China, Hong Kong and Macau. Apart from investigating whether the initially less efficient Chinese economies can have stronger productivity improvement than the initially more efficient ones, the specification has been modified to assess if the initially poorer Chinese economies can achieve productivity convergence with the initially richer ones.

Chapter 3: The Economic Profiles of Mainland China, Hong Kong and Macau

3.1. Mainland China

3.1.1 The Economic Condition before the Economic Reforms

Economic Background

Since its establishment in 1949, one of the major difficulties faced by the People's Republic of Mainland China is how to produce enough food and other daily necessities to satisfy the needs of its millions of inhabitants. To overcome this challenge, central planning was the approach adopted by the communist authorities in solving the economic hardships as well as directing the economic development of the country. Under this system, market mechanism was replaced by the planning unit which directly or indirectly controlled all the means of production in every aspect. All the production decisions were centralized and after determining the production quotas, inputs were assigned and outputs were collected and distributed by the authorities. Apart from this, price and wage levels were also determined by the authorities. This was the basic structure of Mainland China's economic system in the pre-reform era.

Economic Performance

As shown in Table 3.1, the overall economic performance of the People's Republic of Mainland China was impressive even in the pre-reform period. Mainland China's RGDP has increased from RMB288.72 billion in 1953 to RMB1,054.55 billion in 1977, implying an average growth rate of 6.48% per annum.

Table 3.1: Basic Statistics of Mainland China in the Pre-reform Period, RMB 100 million at 1995 price

Year	RGDP	RGDP per capita in RMB	Pop 10,000	Gross fixed capital format -ion	GDP share, %	Total export	Total import	Trade to GDP ratio
1953	2887.17	491.05	58796	403.99	13.99	121.93	161.53	9.82
1957	3883.40	600.65	64653	679.96	17.51	198.17	181.81	9.78
1963	3864.42	558.67	69172	674.62	17.46	156.67	111.86	6.95
1967	5583.60	731.14	76368	1019.41	18.26	185.18	168.17	6.33
1973	8956.83	1004.01	89211	2187.44	24.42	384.82	341.04	8.10
1977	10545.5	1110.36	94974	3000.72	28.45	460.10	437.38	8.51
			Average growth rate, %					
1953/77	*6.48*	*4.32*	*2.03*	*13.43*		*7.52*	*7.11*	
1953/57	*9.34*	*6.81*	*2.38*	*20.43*		*15.07*	*7.11*	
1958/62	*-0.62*	*-1.53*	*0.82*	*6.31*		*-3.76*	*-7.50*	
1963/67	*10.10*	*7.35*	*2.56*	*15.67*		*5.60*	*11.24*	
1968/72	*8.60*	*5.76*	*2.68*	*16.62*		*8.60*	*5.50*	
1973/77	*4.98*	*3.19*	*1.73*	*8.14*		*12.11*	*19.18*	

Source: Comprehensive Statistical Data and Materials on 50 Years of New China.
Total exports and imports are deflated by GDP deflator.

Although Mainland China could attain a certain extent of economic achievement, the expanding population has significantly reduced the quantity of outputs one could enjoy and discounted the pace of living standard improvement of the country. In the pre-reform period, population had grown from 574.8 million in 1952 to 949.7 million in 1978, representing an expansion of 65.22% or an average growth rate of 2% a year. Consequently, the increased outputs had to be shared by a larger group of people and the per capita RGDP could only increase at a speed of 4.32% per annum, from RMB434.49 in 1952 to RMB1,110.36 in 1977, which was 2.17% below the RGDP growth rate in the period.

Generally speaking, the economic performance of Mainland China in the pre-reform period was very far from stable. The fluctuations in real growth rate was remarkably high, and the highest RGDP growth rate was recorded at 19.4% in 1970, while a negative growth rate of 27.3% could be found in 1961. Furthermore, with reference to the growth statistics of Mainland China, a recovery period of double-digit growth could be found from time to time after an economic disaster. Such volatile performance is attributed to various political decisions, social and economic campaigns and the associated policies pursued by the central government.

In light of investment spending, as stated in column 5 of Table 3.1, gross fixed capital formation in real terms amounted to RMB29.68 billion in 1952, equivalent to 13.99% of the RGDP. Similar to the RGDP and RGDP per capita, the series has experienced huge fluctuations which were attributed to the social and economic campaigns and political struggles that arose in Mainland China. In 1977, the gross fixed capital formation rose to RMB3,000 billion, which was the highest in the pre-reform period. The average growth rate of investment was recorded at 13.51% for the entire pre-reform period.

As for the investment to GDP ratio, it was rather high in the pre-reform period, reflecting the government's recognition of the contribution of investment in the process of economic development. This ratio was just 13.99% in 1952 and has been increasing thereafter. Despite the occurrence of various economic and social shocks, the government has consistently sacrificed consumption to reserve more resources for investment purpose. Since 1965, fixed capital investment has climbed up to more than 20% of the GDP, and it has arrived to 28.45% in 1977. Attributed to the emphasis on investment, the average investment to GDP ratio was rather high in Mainland China, keeping an average of 22.24% for the entire pre-reform period.

Given this impressive growth in fixed capital investment and the relatively high and increasing investment to GDP ratios, it is not surprising to find a satisfactory RGDP growth rate in the pre-reform period. Nevertheless, if the growth rate of RGDP and investment are carefully compared, the efficiency level of the Mainland China economy would probably be questioned.

In relation to the external linkages of Mainland China, the country did not actively expose itself to international trade in the pre-reform era. In 1952, total exports and imports at 1995 price amounted to just RMB9.97 billion and RMB13.79 billion respectively, accounting for 3.99% and 5.52% of GDP. At the same time, imports made up of only 13.55% of total retail sales of consumer goods, playing an insignificant role in the economy. With respect to the belief of self-sufficiency, imports was considered as a means of supplement to local inadequacy while the exportation of domestic products allowed the country to gain enough foreign exchange to finance its imports. Despite their insignificant share, both export and import flows have experienced a stable expansion in the pre-reform period, except for those problematic years. In the 70s, following the modernization program, total exports and imports have experienced a more rapid expansion, from RMB22.58 billion and RMB17.27 billion in 1971, to RMB46.01 billion and RMB43.74 billion in 1977. The GDP share of these trade transactions have expanded simultaneously from 2.82% and 2.16% to 4.36% and 4.15% respectively. As a whole, an average real growth rate of 7.52% and 7.11% were recorded for total exports and imports in the pre-reform period.

Table 3.2: Output and Employment Structure of Mainland China in the Pre-reform Period, %

Year	Primary sector		Industrial sector			Tertiary sector	
	GDP share	Employ-ment share	GDP share	Employ-ment share	Light/ heavy ratio*	GDP share	Employ-ment share
1953	45.87	83.07	23.36	8.03	1.68	30.76	8.90
1957	40.26	81.23	29.68	9.01	1.22	30.06	9.76
1963	40.34	82.45	33.05	7.65	0.81	26.61	9.89
1967	40.28	81.67	34.00	8.64	1.13	25.72	9.70
1973	33.35	78.73	43.11	12.26	0.77	23.54	9.01
1977	29.42	74.51	47.13	14.81	0.78	23.45	10.68
			Average growth rate, %				
1953-77	*2.21*		*12.78*			*5.65*	
1953-57	*3.86*		*20.32*			*10.04*	
1958-62	*-5.20*		*6.28*			*0.60*	
1963-67	*8.60*		*14.48*			*6.88*	
1968-72	*1.58*		*15.54*			*6.36*	
1973-77	*2.22*		*7.26*			*4.38*	

Source: Comprehensive Statistical Data and Materials on 50 Years of New China.
The real output by industry are deflated by the corresponding GDP deflators.
*The ratio of gross industrial output value between light and heavy industries

In the case of the output structure of the economy, Mainland China has been an agricultural-based country for thousands of years and the dominating position of the sector could still be found in the 50s. In 1953, for example, the GDP share of the primary sector was 45.87%, while that of the industrial and tertiary sectors were 23.36% and 30.76% respectively. Despite its initial weight in the economy, the development of the primary sector was hindered by the asymmetric policies which favoured the industrial sector. As the government had placed its emphasis on the industrial sector, while the primary sector was regarded as the mean to support the industrial development, the output growth of the sector was volatile. The subsequent GDP share of the primary sector, despite the expansion in its output, has declined to 29.42% in 1977. The GDP share of the industrial and tertiary sectors, in the meantime, have grown to 47.13% and 23.45% respectively. The industrial sector was also the one with the highest growth rate at 12.78% throughout the pre-reform period.

In the industrialization process of Mainland China, the resources allocated to light and heavy industry were rather imbalance. A policy skew was observed favouring the heavy industry production, thus pressing the light to heavy industry output ratio from 2.78 in 1949, to 1.68 in 1953 and a record low of 0.5 in 1960. Until the end of the pre-reform period, heavy industry was still emphasized by the central government, and it had generated 56.03% of the total industrial output of Mainland China in 1977. At the same time, the light to heavy industry output ratio had declined to 0.78 in 1977.

To shed some light on the employment condition of Mainland China, in 1953, 83.07% of the employment was engaged in the primary sector, the rest 8.03% and 8.90% worked in the industrial and tertiary sectors. Since a disproportional larger number of workers were assigned to the industrial sector to cope with the industrialization policies of the government, the employment share of the primary sector had been declining steadily. The primary sector, being affected by the industrialization policies, had been employing less and less labour and its employment share had declined to 74.51% in 1977. Concerning the industrial sector, its employment share had increased to 14.81% in 1977. As for the tertiary sector, its employment share was relatively stable and stayed at 10.68% in 1977.

3.1.2. The Economic Reforms of Mainland China

The Economic Reform

One of the most influential policies in modern Chinese history should have been the economic reform which was introduced by Deng Xiaopeng after he took over the power and became the leader of Mainland China in 1978. This decision does not only directly affect 13 billion of Chinese or one fourth of the world's population, but has also brought about significant and long-lasting impacts to the economic and political systems of different countries in the world. The economic and political impacts of Mainland China's reform have spilled over and affected the US, EU, Japan, the Soviet Union and all the major developed and developing economies of the world.

The Rural Reform of Mainland China

The rural reform of Mainland China began in 1978 and the household responsibility system was the key component of this movement. This system established clear and precise responsibilities and viewed the peasant household as a production as well as a management unit. The income level of farmers was no longer determined by the Commune's egalitarian distribution system, but rather on their productivity and efficiency. Rural markets were reopened to allow farmers to sell their surplus at the market price. Along with the launching of the responsibility system, the state procurement price has also been reformed and increased for both the quota and above-quota prices to offer additional incentives to the peasants. Later on, the right of the farmers on using the assigned pieces of land was extended and ownership became transferable. Farmers were also encouraged to develop some sideline economic activities, for example, retail, transport and service enterprises under the name of township and village enterprises.

The Reform of the State-owned Enterprises (SOEs)

The urban or SOEs reform initiated in 1978. In the process, enterprises were allowed to retain a portion of total profits at a rate which was determined by the Ministry of Finance and the local Finance Bureaux. Extra outputs were allowed to be produced when the firms have fulfilled their production quotas. In addition, enterprises were required to pay for their fixed assets while working capital was to be financed by bank loans rather than by grants. The other elements included increasing autonomy on the use of the retained profits, on production planning, on output sales, on experimentation with new products and capital investment[55]. In relation to the determination of price, the state has withdrawn part of the controls on price and enterprises could freely fix the prices of their outputs based on the costs of production and the demand-supply conditions in the market. In addition, the SOEs were permitted to retain a portion of their profits for research and development, welfare, bonus and reserves and the percentage allowed has been increasing annually.

The Dual-track Price and the Contract Responsibility Systems

These systems were two of the major new policies introduced in the second stage of urban reform which began in 1984. The Dual-track Price System combined the planning and the market approach. Enterprises could obtain their inputs from the state at a lower price under fixed quota, or purchase from the free market at a higher price with no quota limit. On top of the quotas, enterprises were also allowed to sell their above-quota outputs to, as well as to purchase additional inputs from the market at a higher market price.

The Contract Responsibility Systems was launched in 1987 and its essential content was a contract negotiated between the enterprises and the state's supervisory agencies with detailed description on "profit remittance, investment and technical innovation targets and the tying of wage bills to total profits"[56]. The Contract Responsibility System carried different formats and one of those was the Contract Management Responsibility System in which different profit sharing schemes were introduced between the contractors and the state, such as a fixed amount of direct and indirect taxes to the state irrespective of profits or losses, or to remit profits to the state based on a fixed amount plus an annual percentage increase, or a profit quota to be delivered plus a specified sharing ratio for above-quota profits. In return, contract grants the corresponding individual the right to control and run the enterprise.

[55] Chow (2002), p.49.

[56] Please see Fan Q. and Peter N. edited (1994).

The Open Door Policy

The open door policy was another core arrangement in the economic reforms of Mainland China. Starting from 1980, a number of Special Economic Zones (SEZ) namely Shenzhen, Zhuhai, Shantau and Xiamen were established in the two coastal provinces, Guangdong and Fujian. The SEZ is a region where special and more attractive economic policies and economic management systems operate. It attracts and utilizes foreign funds as their main means of economic development. Policies which promote foreign trade and inward FDI could also be found in these regions. In the SEZ, the existence of various ownership structures is permitted and foreign-funded enterprises are given priority as well. Apart from the SEZs, open cities were also set up in the coastal area of Mainland China to encourage foreign trade and attract foreign investment.

The Economic Performance in the Post-Reform Period

The economic reforms have decentralized the decision making process of Mainland China. Peasants and managers were granted more autonomy in determining what to produce and how to produce, the result was an improvement in allocative efficiency as more appropriate and accurate decisions could be made. The reopening of the private market has introduced the concept of competition to Mainland China and the importance of efficiency was also highlighted by the economic reforms. The liberalization on price and wage controls have improved the fairness of the rewarding system and improved the working incentives in both the rural and urban areas. In addition, the introduction of the responsibility system has assured the interest of the contractors and thus encouraged them to devote increasing efforts in production.

Furthermore, given the open door policies and the preferential arrangements, Mainland China was able to attract huge amount of foreign investment and has also been increasingly involved in foreign trading transactions. These economic activities not only have provided the country with the required capital, foreign exchange and demand, but have also brought about valuable technology, knowledge and experience, all of these have contributed to accelerate the growth and development pace of Mainland China.

As shown in Table 3.3, the RGDP of Mainland China has increased from RMB1,177.93 billion in 1978 by 8.6 times to RMB10,122.65 billion in 2002. It implies an average growth rate of 9.5% per annum in the post-reform period, which was 3 percentage points higher than the average growth rate in the pre-reform period. This progress indicates that the reform policies have accelerated the growth pace of Mainland China. In some sub-periods, for example, in the periods of 1983 to 1987 and 1993 to 1997, the RGDP growth rate has once arrived at a two-digit level of 12% and 11% respectively. Similar to the RGDP, the per capita RGDP of Mainland China was able to grow at a higher pace, at 8.19% per annum in the post-reform period. This progress was 3.87 percentage points ahead of that in the pre-reform period. The per capita RGDP of Mainland China has increased by 6.44 times from RMB1,223.71 in 1978 to RMB7,880.43 in 2002. As for the population size, attributed to the population control policies, the average population growth rate of Mainland China in the post-reform period has declined to 1.22%, which was much lower than the 2.03% level in the pre-reform period. Such contraction in population growth rate should have helped to accelerate the growth pace of per capita RGDP.

The economic growth of Mainland China, however, has also brought about a new challenge to the country. The removal of price and wage controls and the formation of a free market have led to a sharp increase in both price and wage levels, and has also worsened the inflation problem of the country. In the post-reform period, an average inflation rate of 6.29% per annum was recorded. This rate was significantly higher than the 0.78% average rate in the pre-reform period. In certain years, such as 1987 to 1988 and 1994 to 1995, double-digit inflation rates were recorded and corresponding government measures have been introduced to cool down the overheat economy. Consequently, the inflation problem in Mainland China was under control and the average inflation rate has thus reduced from 13.4% in the period of 1993 to 1997, to a deflation rate of 0.38% in the period of 1998 to 2002.

Table 3.3: RGDP and Population Statistics of Mainland China in the Post-reform Period, RMB 100 million at 1995 price

Year	RGDP	*growth, %*	RGDP per capita in RMB	*growth, %*	Population 10,000	*growth, %*	Inflation rate, %
1978	11779.32	*11.70*	1223.71	*10.21*	96259	*1.35*	0.7
1982	15681.65	*9.10*	1542.65	*7.40*	101654	*1.58*	*1.9*
1987	27609.89	*11.60*	2526.07	*9.77*	109300	*1.67*	*7.3*
1992	41409.19	*14.20*	3534.08	*12.89*	117171	*1.16*	6.4
1997	69732.09	*8.80*	5640.57	*7.71*	123626	*1.01*	2.8
1998	75171.20	*7.80*	6022.85	*6.78*	124810	*0.96*	-0.8
1999	80508.35	*7.10*	6400.42	*6.27*	125786	*0.78*	-1.4
2000	86949.02	*8.00*	6860.26	*7.18*	126743	*0.76*	0.4
2001	93296.30	*7.30*	7310.08	*6.56*	127627	*0.70*	0.7
2002	101226.50	*8.50*	7880.43	*7.80*	128453	*0.65*	-0.8
			Average output growth, %				
1978-02		*9.51*		*8.19*		*1.22*	6.29
1978-82		*8.28*		*6.82*		*1.37*	2.92
1983-87		*12.00*		*10.39*		*1.46*	5.56
1988-92		*8.52*		*7.02*		*1.40*	9.94
1993-97		*11.00*		*9.81*		*1.08*	13.40
1998-02		*7.74*		*6.92*		*0.77*	-0.38

Source: Statistical Yearbook of China, various issues.

In order to explain the rapid RGDP growth of Mainland China, the figures of gross fixed capital formation, its growth rate and GDP share were summarized in Table 3.4. In 2002, the gross fixed capital formation summed to RMB40,492.58 billion at 1995 price, accounted for 38.85% of the year's GDP. It also implied a growth of 14.73% from 2001. The average real growth rate of gross fixed capital formation was 11.4% for the entire post-reform period, which was 2 percentage points lower than the average of the pre-reform period. The average GDP share of gross fixed capital formation, on the contrary, has increased from 22.24% in pre-reform period to 31.74% in the post-reform period. The increase in investment ratio indicates that more resources have been pulled out from GDP for investment purpose, and it can partially explain the rapid economic growth that Mainland China has experienced in the post-reform period.

Table 3.4: Investment and Trade Statistics of Mainland China in the Post-reform Period, RMB 100 million at 1995 price

Year	Gross fixed capital form-ation	*growth %*	GDP share, %	Total export	*growth %*	Total import	*growth %*	Trade to GDP ratio
1978	3490	*16.32*	29.63	545	*18.40*	609	39.26	9.85
1982	4423	*19.40*	28.20	1226	*12.78*	1059	-2.59	14.05
1987	8637	*14.96*	31.28	3393	*29.30*	3726	2.54	26.17
1992	12929	*29.76*	31.22	7269	*13.24*	6907	21.16	35.26
1997	23556	*6.92*	33.78	14198	*19.57*	11056	1.33	36.01
1998	26511	*12.55*	35.27	14607	*2.88*	11155	0.89	33.99
1999	28916	*9.07*	35.92	15853	*8.53*	13475	20.80	36.16
2000	31705	*9.65*	36.46	20053	*26.50*	18114	34.42	43.96
2001	35293	*11.32*	37.83	21115	*5.29*	19327	6.70	42.79
2002	40493	*14.73*	40.00	26031	*23.28*	23599	22.11	47.62
			Average output growth, %					
1978/02		*11.40*			*18.43*		*18.60*	
1978/82		*8.50*			*21.82*		*20.13*	
1983/87		*14.35*			*22.95*		*31.49*	
1988/92		*9.41*			*17.34*		*13.50*	
1993/97		*13.28*			*16.72*		*10.90*	
1998/02		*11.46*			*13.30*		*16.98*	

Source: Statistical Yearbook of China, various issues.
Total exports and imports are deflated by GDP deflator.

In view of the external trade of Mainland China, the open door policies were designed to promote trade and investment transactions and they have brought about satisfactory economic performance. Total export and import value, for example, has increased by 47.78 and 38.74 times from RMB54.48 billion and RMB60.91 billion in 1978 to RMB2,603.14 billion and RMB2,359.94 billion in 2002 respectively. It implied an average growth rate of about 18% for both series in the post-reform period. This pace of expansion was much better than the 7% exports and imports growth in the pre-reform period when Mainland China was still a relatively closed economy. In light of the composition of exports, in 2002, manufactured goods made up over 91% of the total exports in which 43% of them were machineries and transport equipments. Machineries, electric equipments and accessories, recorders, video recorders and accessories have accounted for over 35% of the total exports, while textile materials and products had an export share of about 18% at the same time. For imports, in 2002, manufactured goods accounted for 83% of the total imports in which over 55% of them were machineries and transport equipments. Same as exports, machineries, electric equipments and accessories, recorders, video recorders and accessories was the largest importing category and made up over 42% of total imports. The second largest category was base metals and related products which had an import share of 8.9% in 2002.

In view of the trade balance, Mainland China has been running a trade surplus since the 90s, with an exception in 1993. In 1998, the country has maintained its highest trade surplus that has never been achieved before, at RMB345.18 billion, or 4.55% of its GDP. In 2002, a trade surplus of RMB243.20 billion was recorded and it accounted for 2.33% of Mainland China's GDP.

As for its trade partners, in 2002, Mainland China exported 21.48% of its total to the United States, 17.96% to Hong Kong, 14.88% to Japan, 4.77% to Korea, 3.49% to Germany and 2.8% to the Netherlands. At the same time, Mainland China has purchased 18.11% of its total imports from Japan, 12.89% from Taiwan, 9.68% from Korea, 9.23% from the United States, 5.56% from Germany and 3.63% from Hong Kong. Given these figures, it is not hard to tell that the United States was the most important market for Mainland China's exports, while Japan was the most important source of imports for Mainland China.

In the post-reform period, Mainland China has been actively and aggressively participating in external transactions and consequently, its trade to GDP ratio has been increasing continuously from less than 10% in 1978 to 47.62% in 2002. Such a growing trend indicated that Mainland China has evolved itself from a relatively closed economy in the pre-reform period to an open economy in the post-reform period.

In light of another flow of external transactions - FDI, under the open door policies, incoming FDI was welcomed and encouraged by the government and various preferential policies were introduced to improve the attractiveness of Mainland China towards foreign investors. Given these policies, the country has successfully attracted huge amount of foreign capital from abroad. According to Table 3.5, in 2002, a sum of USD55 billion FDI was received and the total amount of FDI that Mainland China has ever obtained accumulated to USD476.26 billion since 1979. Despite the sluggish progress in the past few years, the incoming actually used FDI has been growing at an average rate of almost 30% a year. This pace of growth does not only exceed the growth rate of RGDP and gross fixed capital formation, but is also higher than those of total exports and imports. Simultaneously, the significance of FDI, stated as the FDI to GDP ratio, has been increasing from less than 1% in the 80s, to its peak of 6.26% in 1994. Although the ratio has dropped to less than 5% in 2002, its importance and contributions to Mainland China's growth and development should never be ignored.

Table 3.5: Actually Used Foreign Direct and Other Investment of Mainland China, USD 100 million

Year	FDI received	*growth, % (from previous year)*	GDP ratio, %
1979-82	17.67		
1983	9.16		0.30
1987	26.47	*17.96*	0.82
1993	277.71	*145.96*	4.62
1997	523.87	*24.33*	5.83
1998	475.57	*-9.22*	5.03
1999	424.47	*-10.75*	4.28
2000	493.56	*16.28*	4.57
2001	496.72	*0.64*	4.22
2002	550.11	*10.75*	4.35
Average			
1983-02		*29.28*	2.95
1983-87		*31.36*	0.60
1988-92		*41.58*	1.25
1993-97		*43.07*	5.45
1998-02		*1.54*	4.49

Sources: Statistical Yearbook of China, various issues.

Since the beginning of the economic reform, Hong Kong has been the largest foreign investor of Mainland China. In 2002, the territory has injected USD19.17 billion or 34.85% of the total actually used FDI to Mainland China. Following it were the United States, Taiwan, Japan, Korea and Singapore, and they have respectively contributed 10.10%, 8.03%, 7.92%, 4.96% and 4.25% of the total incoming FDI to Mainland China in 2002.

Looking at the performance of the three production sectors in the post-reform period, the rural reforms have improved the performance of the primary industry. The real output has expanded from RMB331.01 billion in 1978 to RMB1,556.91 billion in 2002. It implied an average real growth rate of 6.79% per annum in the post-reform period. In relation to the GDP share of the sector, in line with the industrialization process, its GDP share has fallen from 28.10% in 1978 to 15.32% in 2002.

As for the industrial sector, it has been growing at an average rate of 9.89% per annum in the post-reform period. Its real output has increased from RMB567.24 billion in 1978 by 9 folds to RMB5,117.82 billion in 2002, which made up 50% of the country's total output for the same year. In the past two decades, the output share of the sector was rather stable and has been moving within the levels of 40% to 50%; its fluctuations were also the lowest among the three sectors.

Regarding the pattern of industrial production, the economic reforms and the market mechanism have pushed the economy toward the production of light industrial goods, so as to exercise the comparative advantage of the country. As shown in column 6 of Table 3.6, the light to heavy industry output ratio has increased from 0.76 in 1978 to over 0.9 in the 90s. It suggests that the market mechanism has directed the country to produce more light industrial products as compared with the situation in the pre-reform period. Since 1998, a new classification was applied and only the statistics of state-owned and non-state-owned above designated size industrial enterprises were reported. Making use of these new data sets, the output ratio has reduced to 0.75 in 1998 and more importantly, a declining trend was inherited in this ratio and its value has dropped by more than 0.1

percentage point in 5 years. In view of the gap in between 1997 and 1998, it may be interpreted as state-owned and non-state-owned above designated size industrial enterprises were more likely to engage in the production of heavy industrial products due to their rich capital endowment and the consideration of scale economies. On the other hand, the small industrial firms, whose figures were not reflected in these statistics, had more incentives to produce the relatively labour-intensive and capital-saving light industrial products.

Table 3.6: Output and Employment Structure of Mainland China in the Post-reform Period

Year	Primary sector		Secondary sector			Tertiary sector	
	GDP share	Employment share	GDP share	Employment share	Light/ heavy ratio*	GDP share	Employment share
1978	28.10	70.53	48.16	17.30	0.76	23.74	12.18
1982	33.27	68.13	45.01	18.43	1.01	21.72	13.45
1987	26.79	59.99	43.90	22.22	0.93	29.31	17.80
1992	21.77	58.50	43.92	21.70	0.87	34.31	19.80
1997	19.09	49.90	49.99	23.70	0.96	30.93	26.40
1998	18.57	49.80	49.29	23.50	*0.75*	32.13	26.70
1999	17.63	50.10	49.42	23.00	*0.72*	32.95	26.90
2000	16.35	50.00	50.22	22.50	*0.66*	33.42	27.50
2001	15.84	50.00	50.10	22.30	*0.65*	34.07	27.70
2002	15.32	50.00	50.37	21.40	*0.64*	34.30	28.60
			Average output growth, %				
1978/02	*6.79*		*9.89*			*11.36*	
1978/82	*11.09*		*7.36*			*6.75*	
1983/87	*7.31*		*11.43*			*19.18*	
1988/92	*4.15*		*8.68*			*12.06*	
1993/97	*8.21*		*13.98*			*8.72*	
1998/02	*3.21*		*7.99*			*10.08*	

Source: Statistical Yearbook of China, various issues.

*The ratio of gross industrial output value between light and heavy industries, measured by the statistics from "Comprehensive Statistical Data and Materials on 50 Years of New China." For the ratio from 1998 to 2002, it is measured as the ratio of gross output value of light to heavy industrial enterprises in all state-owned and non-state-owned above designated size industrial enterprises.

When the employment shares of the three sectors of Mainland China are considered, in the last 3 columns of Table 3.6, it is shown that primary sector was still the largest sector of Mainland China in terms of total employment in 2002. Tertiary sector has replaced the industrial sector to be the sector with the second largest employment in Mainland China since 1994. The industrial sector, though it had the largest GDP contribution, employed the least personnel in the country. In the post-reform period, the total number of employed persons in Mainland China has increased at 2.58% a year from 401.52 million in 1978 to 737.4 million in 2002. Consequently, the total number of employment in all the three sectors have experienced a growth. When the paces of growth are compared, the total employment in the primary sector has increased from 283.18 million in 1978 by just 30.20% to 368.70 billion in 2002. In contrast, the total employment in the industrial sector has expanded from 69.45 million in 1978 by 2.27 times to 157.8 million in 2002. The highest growth rate could be found in the tertiary sector in which total employment has enlarged from just 48.90 million in 1978 by 4.31 times to 210.9 million in 2002. In line with this rapid expansion, the tertiary sector has also become the second largest sector in Mainland China in terms of employment. Its employment share has grown from 12.18% in 1978 to 28.6% in 2002. The industrial sector, on the other hand, has become the sector with the smallest number of labours, even its employment share has increased from 17.3% in 1978 to 21.4% in 2002. As for the primary sector, despite its dominant position in the labour market, the sector's employment share has been declining from over 70% in 1978 to just 50% in 2002.

In the case of the ownership structure of the industrial firms of Mainland China, in the post-reform period, ownerships other than State-Owned and Collective-Owned are allowed and promoted. Many of the existing SOEs have also transformed themselves into share-holding enterprises. Given these adjustments, it is expected that there will be revolutionary changes in the ownership structure of Mainland China's industrial units. As shown in column 3 of Table 3.7, the output share of the SOEs, which indicates the economic magnitude of this form of ownership, has been declining steadily from over 77% in 1978 to around 50% in the early 90s. In 1999, the output share of the SOEs has fallen to 26.14%. In fact, statistics suggests that the number of SOEs in Mainland China in the post-reform period was rather stable. However, in line with the growth in the number of collective-owned, individual-owned, foreign-owned, or oversea-Chinese-owned enterprises, SOEs have been losing their importance and economic status. In light of the collective-owned enterprises, an expansion was found in both the number of firms and total output value and as a result, its output share has climbed up from 22.37% in 1978 to 32.78% in 1999.

Table 3.7: Gross Industrial Output of Mainland China and the Shares of Different Ownerships, RMB100 million

Year	Gross industrial output	Share of SOE, %	Share of collectively owned, %	Share of individual owned, %	Share of other ownership, %*
1978	4237	77.63	22.37	0.00	0.00
1982	5811	73.94	24.65	0.73	0.67
1987	13813	58.55	33.93	5.54	1.98
1992	34599	51.52	35.07	5.80	7.61
1997	113733	29.81	35.92	16.89	17.39
1998	119048	26.47	36.01	16.04	21.47
1999	126111	26.14	32.78	16.85	24.22
Average					
1978-99		55.11	31.52	6.41	6.96
1978-82		76.07	23.31	0.27	0.35
1983-87		65.20	30.80	2.73	1.28
1988-92		54.36	34.68	6.17	4.79
1993-97		36.35	36.15	12.43	15.06
1998-99		26.31	34.40	16.45	22.85

Source: Statistical Yearbook of China 2000. Starting from 1998, a new classification was launched and the gross output value of the state-owned and non-state-owned above designated size industrial enterprises were measured. Other ownership is referred to "Industry of Other Types of Ownership" which includes Share-holding Corporations, Enterprises Funded by Foreigners or Entrepreneurs from Hong Kong, Macau and Taiwan.

As stated in Table 3.8, the output share of SOEs have been contracting from 56.56% in 1993 to 40.78% in 2002 and it indicates that in the post-reform period, SOEs could no longer dominate the industrial sector of the country. In light of the output share of the collective-owned enterprises, it has reduced from 30.44% in 1993 to just 8.68% in 2002. Meanwhile, the share-holding enterprises, which can be regarded as a form of collective-owned ownership, have gained an increasing output share and its output contribution has increased from 3.74% in 1993 by 3.4 times to 12.75% in 2002.

Table 3.8: Share of Gross Output Value of all State-Owned and Non-Stated-Owned above Designated Size Industrial Enterprises, %

Year	State-owned	Collective-owned	Share holding	Foreign funded	Entrepreneurs from HK, Macau & Taiwan
1993	56.56	30.44	3.74	4.74	4.51
1997	41.98	29.99	7.20	11.96	8.86
1998	49.63	19.46	6.40	12.49	12.25
1999	48.92	17.07	7.22	13.70	12.37
2000	47.34	13.90	11.78	15.05	12.34
2001	44.43	10.53	13.30	16.11	12.41
2002	40.78	8.68	12.75	16.96	12.34

Sources: Statistical Yearbook of China, 1993 to 2003.
For the figures from 1993 to 1997, they are measured as the share of the gross output value of industrial enterprises at township and above level.

Apart from the share-holding enterprises, the output share of foreign-funded and Hong Kong, Macau and Taiwan owned enterprises have also experienced rapid expansion, from 4.74% and 4.51% in 1993 to 16.96% and 12.34% in 2002 respectively. It indicates that the open door policies of Mainland China have been successful and are capable of attracting the establishment of productive, efficient and fast-growing foreign enterprises. The economic influence and significance of these enterprises has been growing since the mid 90s.

3.2. Hong Kong

3.2.1. Economic Background

As stated in Cheng (1979), the Hong Kong economy was dominated by transshipment businesses in the aftermath of World War II. In the late 40s and early 50s, Hong Kong has benefited from the Korean War during which huge amount of consumer products as well as military materials were shipped to Mainland China through Hong Kong and the role of the territory as an important entrepôt in Southern Mainland China was built up at the moment[57]. In 1951, the United Nations had imposed a trade embargo on Mainland China and the entrepôt status of Hong Kong was seriously affected thereafter, despite the fact that strategic materials were still smuggled from the territory to Mainland China. The trade embargo, together with a shift of Mainland China's trade towards the Soviet Union, did not only create a panic to the trade-related sector, but had also brought about a depression to the territory.

The changes in international circumstances had forced Hong Kong's economy to restructure itself from being an entrepôt concentrating on transshipments, to an export-oriented industrialized economy. The manufacturing sector of Hong Kong started to develop in the mid-50s with foreign countries being its core markets. Textiles and garments production had also become the leading industry in the sector. In line with such industrialization process was a continuous growth in domestic exports[58]. By the end of the 50s, the output of industrial products increased at a rate of around 20% per annum and their share in total exports had exceeded that of re-exports.

Along with industrialization process, export boom and economic growth was a rapid development in the construction sector. Then the land and property prices had started to increase and speculative activities were commonly found. Eventually, the speculative bubble in the property market burst and the banking sector was also exposed to a crisis as some banks had found themselves running short of liquidity and gradually resulted in bankruptcy. Following the banking crisis was a depression in investment and a fall in property price. The Cultural Revolution which took place in Mainland China had posed an adverse impact on the social stability of Hong Kong. A series of riots broke out in Hong Kong in 1967 and had further dampened the performance of the economy. Then, the real GDP growth of Hong Kong had shrunk to its lowest level in the 60s.

[57] According to Cheng (1979), the estimated total re-export from Hong Kong to Mainland China amounted to HKD3,296 million in 1950, and had expanded to HKD3,883 million in 1951.
[58] In 1950, when Hong Kong was still concentrated in transshipment business, total domestic exports was just HKD420 million, equivalent to 12.74% of re-exports' turnover. As the territory began to develop export-oriented manufacturing industries, the value of domestic exports had been rising and it summed to HKD1,000 million or 65.19% of re-exports' turnover in 1955.

Shortly after Hong Kong's revival from the bank crises and social unrest, the economy was affected by the oil crisis. The deteriorated business environment had resulted in crashes in the world's major stock exchanges and Hong Kong was no exception. The weak international demand coupled with poor domestic consumption incentives had led to a slowdown in economic growth and an increase in unemployment, and between 1974 and 1975, Hong Kong had achieved almost no economic growth.

In the 80s, the development of the Hong Kong economy has entered a new page. The economic reforms of Mainland China which took place since 1978 did not only offer new opportunities to Hong Kong, but have also accelerated the restructuring process of the territory. As the labour-intensive manufacturing sector has started to relocate northward to take advantage of Mainland China's relatively lower costs of production, the manufacturing sector has lost its dominant role in the economy shortly after the reforms. The trade, construction, banking and finance sector, on the other hand, has been expanding rapidly to become the new growth engine of the economy. The handover issue and the June 4th incident have once posed certain adverse impacts on the Hong Kong economy. Nevertheless, the territory has successfully overcome such political uncertainty to regain its economic momentum and sustain its transformation.

By the early 90s, Hong Kong has already completed its transformation from an industrial-based to a service-based economy. The territory has been specializing in the provision of business, trade, banking and financial services to facilitate the economic transition and development of Mainland China. It was also the most important source of foreign capital and the largest entrepôt of Mainland China. A complementary economic relationship was formed between Mainland China and Hong Kong, with the former being responsible for the production process. The latter, meanwhile, had full engagement in venture capital, production design; quality control; sales services as well as all the other accommodating processes.

In conjunction with the rapid economic growth and development of Mainland China was an improvement in the performance of the Hong Kong economy. Despite the fading out of the manufacturing sector, the trade services, banking and finance and construction industries have experienced remarkable growth since the early 90s. The well being of the economy was not very much affected by the international financial turmoil in 1992 and 1995, nor the political struggles between Mainland China and the UK regarding the future political system of Hong Kong. However, in 1997, Hong Kong could no longer stay away from adverse external shocks of the Asian Financial Crisis.

After the crisis, the performance of Hong Kong's economy has started to worsen. The depreciation in exchange rate has significantly improved the international competitiveness of the East Asian economies and this has brought about unfavourable impacts to the export performance of both Mainland China and Hong Kong. The sluggish export performance together with the stock market crash and high interest rate has discounted the growth pace of the Hong Kong economy. After a decade's appreciation, adjustment has eventually taken place in the territory's property market. The pace of adjustment was accelerated by the government's announcement on increasing public housing supply which resulted in the burst of the speculation bubble, a contraction in property price and a depression in the stock market. Following the property market slump, the Hong Kong economy has entered another round of recession. Since the real estate sector and the financial sector have been dominating the economy, the dissatisfactory performance of these sectors and their linkage effects have discounted the prosperity of the economy.

3.2.2. Economic Performance

In view of the overall performance of the Hong Kong economy, as shown in Table 3.9, it has been growing continuously in the past four decades and contraction could only be found after 1999. The RGDP at 1995 price has expanded from Hong Kong Dollar (HKD) 92.26 billion in 1962 by 11.13 times to HKD1,026.80 billion in 2002. This growth progress represented an average growth rate of 6.27% per annum.

Table 3.9: RGDP and Population Statistics of Hong Kong, HKD billion at 1995 price

Year	RGDP	*growth, %*	RGDP per capita in HKD	*growth, %*	Population 10,000	*growth, %*
1963	97.69	*3.45*	28555.04	*-0.06*	342.10	*3.51*
1967	112.88	*6.12*	30322.50	*3.48*	372.27	*2.55*
1973	181.26	*14.38*	42733.32	*11.19*	424.17	*2.87*
1977	240.96	*3.74*	52569.77	*2.25*	458.36	*1.45*
1983	446.10	*4.58*	83460.17	*3.00*	534.51	*1.53*
1987	582.86	*8.92*	104446.62	*7.83*	558.05	*1.01*
1993	999.66	*8.48*	169405.27	*6.63*	590.10	*1.73*
1997	1226.51	*5.71*	189005.02	*4.83*	648.93	*0.84*
1998	1228.68	*0.18*	187765.71	*-0.66*	654.37	*0.84*
1999	1157.05	*-5.83*	175137.11	*-6.73*	660.65	*0.96*
2000	1085.41	*-6.19*	162852.03	*-7.01*	666.50	*0.89*
2001	1064.79	*-1.90*	158334.93	*-2.77*	672.49	*0.90*
2002	1026.80	*-3.57*	151288.97	*-4.45*	678.70	*0.92*
		Average growth rate, %				
1963-02		*6.27*		*4.36*		*1.82*
1963-67		*3.65*		*1.21*		*2.41*
1968-72		*7.04*		*4.87*		*2.07*
1973-77		*8.82*		*6.52*		*2.14*
1978-82		*12.16*		*9.07*		*2.82*
1983-87		*6.47*		*5.24*		*1.17*
1988-92		*9.61*		*8.76*		*0.78*
1993-97		*5.90*		*3.56*		*2.28*
1998-02		*-3.46*		*-4.32*		*0.90*

Source: Hong Kong Census and Statistics Department.

As for the RGDP per capita, as expected, it had a similar growth pattern as RGDP and was able to increase from HKD29,127 in 1961 by 5.19 times to HKD151,288.97 in 2002, with an average growth rate of 4.37% per annum.

In relation to the population size, historically, Hong Kong was the destination for immigrants of Mainland China and the continuous inflow of immigrants have brought about rapid population growth to the territory. In 1961, for example, there was 3.17 million inhabitants in the territory and it has reached 6.79 million in 2002, implying an average growth rate of 1.82% per annum. As an increasing number of immigrants were allowed to settle in Hong Kong since the beginning of Mainland China's economic reforms, a growth rate of 2.82% which was the highest among all the sub-periods was therefore recorded in the period of 1978 to 1982. Furthermore, in conjunction with the handover of Hong Kong, the economic growth and development of Mainland China, the growing convenience in cross border travel and the economic recession in Hong Kong, fewer people from the Mainland were interested in migrating to Hong Kong. Incorporating with the low birth rate of the territory, the pace of population growth has been declining since 1997 to around 0.9% a year.

Concerning the investment condition of Hong Kong, as shown in Table 3.10, the gross fixed capital formation at 1995 price was HKD23.67 billion in 1961, accounting for 25.65% of the year's GDP. The amount of investment has been growing in the following decades and reached HKD346.89 billion in 2002, which was 14.66 times the value of 1961's, equivalent to 33.78% of GDP. When the growth rate of this investment flow was reviewed, an average rate of 6.72% per annum was found for the entire discussion period. In view of the investment to GDP ratio, it had experienced large fluctuations in the past decades, ranging from over 40% in the early 60s to less than 30% in the early 80s and 90s. For the entire discussion period, an average investment rate of 33.13% was measured and it was the highest in the Greater China economies under research.

In relation to the external transactions performed by Hong Kong, trade flows have been critical to the growth and development of the territory and in the past decades, both exports and imports have been expanding rapidly. Total exports of goods which include domestic exports and re-exports, for example, have arrived at HKD1,823.43 billion in 2002 in which over 90% of this flow were re-exports. This amount was 95.47 times the level of 1961, implying an average annual growth rate of 11.95% throughout the whole discussion period. As for the exports of services, it has increased from HKD32.5 billion in 1961, which was 1.7 times the value of goods' exports, to HKD421.06 billion or 23% of total goods' exports in 2002. These figures indicated that services exports, which mainly came from the provision of tourism services, was developing at a lower speed than domestic exports or re-export transactions, at an average rate of 6.61% a year between 1963 and 2002. This progress was much slower than the two-digit growth pace that was achieved by goods' exports.

Table 3.10: Investment and Trade Statistics of Hong Kong, HKD billion at 1995 price.

Year	Gross fixed capital formation	GDP Share, %	Total export of goods	Total export of services	Total import of goods	Total import of services	Trade to GDP ratio, %
1963	43.10	44.12	24.31	34.97	36.70	7.15	105.58
1967	38.50	34.11	43.42	41.33	51.39	9.30	128.83
1973	62.88	34.69	83.36	63.94	97.27	17.34	144.49
1977	90.08	37.38	107.67	78.42	122.96	23.42	137.97
1983	140.24	31.44	222.29	114.80	247.75	50.94	142.52
1987	174.50	29.94	441.10	174.15	453.30	82.05	197.40
1993	258.93	25.90	1087.10	242.67	1148.85	145.50	262.50
1997	411.88	33.58	1495.21	294.25	1673.72	176.07	296.72
1998	381.86	31.08	1430.96	292.83	1552.60	178.75	281.21
1999	318.27	27.51	1483.06	312.26	1552.60	171.42	304.17
2000	353.25	32.54	1736.60	353.24	1835.22	178.75	378.09
2001	362.43	34.04	1679.29	375.14	1800.35	182.33	379.15
2002	346.89	33.78	1823.43	421.06	1943.50	182.86	425.68
Average	*growth, %*			*growth, %*			
1963-02	*6.72*	33.13	*11.95*	*6.61*	*10.90*	*8.82*	196.90
1963-67	*5.61*	43.86	*14.07*	*4.05*	*8.16*	*7.08*	117.64
1968-72	*8.41*	32.22	*11.03*	*8.63*	*11.44*	*11.11*	150.43
1973-77	*10.33*	32.65	*8.78*	*5.01*	*7.44*	*8.48*	132.03
1978-82	*11.29*	37.79	*12.69*	*6.86*	*13.40*	*14.46*	144.97
1983-87	*2.98*	29.47	*18.36*	*9.94*	*15.10*	*12.60*	162.37
1988-92	*7.45*	27.49	*16.93*	*5.40*	*17.76*	*10.97*	228.66
1993-97	*10.59*	29.80	*9.39*	*5.49*	*10.52*	*5.05*	285.44
1998-02	*-2.93*	31.79	*4.34*	*7.54*	*3.40*	*0.80*	353.66

Source: Hong Kong Census and Statistics Department.

On the import side, total import of goods has increased from HKD29.36 billion in 1961 by 66.20 times to HKD1,943.50 billion in 2002. The average growth rate of this series was measured at 10.90% a year between 1963 and 2002. In general, the development trend of goods' imports was consistent with that of goods' exports due to the fact that materials were imported and processed before they were exported to another country. Another reason was that products were imported and afterwards, shipped northwards to Mainland China. In view of services' imports, it has been expanding from HKD6.08 billion in 1961 to HKD182.86 billion in 2002. Though the series has attained an average annual growth rate of 8.82%, its value has dropped from 20.71% to just 9.41% of good's imports.

Obviously, the magnitude of services imports has been completely overtaken by goods' imports.

As stated in the last column of Table 3.10, the amount of total trade turnovers, which consist of both trade in goods and services was larger than the GDP of Hong Kong since 1962 and the ratio has been increasing from over 100% in the 60s to 200% in the late 80s. In 1988, the trade to GDP ratio has already exceeded 200% and in the decade that followed, the ratio have been inflating rapidly, arriving at 300% in 1999 and it was even over 400% in 2002. In addition, re-exports transactions have accounted for almost 45% of Hong Kong's total trade in the same year. This extra-ordinary high ratio has once again exhibited Hong Kong's role as an important entrepôt of Mainland China.

When the balance of trade was studied, it could be found that Hong Kong has never run a surplus in products' trade and the total amount of importing products have been exceeding that of exporting products for the past four decades. The accumulated deficit in products' trade was HKD1,755.40 billion for the period of 1961 to 2002. In contrast, when services' trade was taken into account, an overall trade surplus could be found in almost all the years since the 60s, except for the period of 1994 to 1997. It suggested that services' exports were essential in balancing the deficit of products' trade. From 1961 to 2002, the total trade surplus has already accumulated to HKD1,426.03 billion.

On the major trading products and trading partners of the territory, in 2002, miscellaneous manufactured articles were the most important domestic exports of the territory, accounting for 63.85% of the total. Machinery and transport equipment, meanwhile, was the second largest exporting item of Hong Kong, with a share of 18.76% in the year. In light of imports, machinery and transport equipment was the largest kind of imports, and over 46% of the total importing commodities were under this category. Another 25% of imports were defined as miscellaneous manufacturing articles. Amongst all the foreign markets, the United States was still the largest one, accounting for 32% of Hong Kong's domestic exports in the year. Mainland China, at the same time, got the second place with 31.6% of the territory's domestic exports being sold to the country. Apart from these two countries, the UK, Taiwan and Germany were also important trade partners and markets of Hong Kong, with export shares of 5.80%, 3.35% and 3.26% respectively in 2002. As for imports, Mainland China, Japan, Taiwan, the US and Korea were the most important suppliers of Hong Kong's imports. The shares of these economies were 44.28%, 11.27%, 7.16%, 5.65% and 4.69% respectively in 2002.

Regarding the economic structure of Hong Kong, as shown in Table 3.11, it has fully transformed from an industrial-based economy in the 60s and 70s to a service-based economy since the mid 90s. In the past two decades, the performance of the industrial sector was sluggish. Between 1983 and 2002, an average annual growth rate of only 0.85% was recorded.

Table 3.11: Output and Employment Structure of Hong Kong, %

Year	Secondary sector		Tertiary sector			Inflation rate, %	Unemployment rate, %*
	GDP share	Employment share	GDP share	Employment share	Services' exports to GDP ratio		
1983	31.70	39.27	67.70	60.73	25.73	10.0	4.50
1987	29.30	35.78	70.30	64.22	29.88	5.7	1.70
1993	18.50	20.72	81.30	79.28	24.28	8.8	2.00
1997	14.70	12.61	85.20	87.39	23.99	5.8	2.20
1998	14.90	11.29	85.00	88.71	23.83	2.8	4.70
1999	14.60	10.54	85.30	89.46	26.99	-4.0	6.20
2000	14.20	9.98	85.70	90.02	32.54	-3.8	4.90
2001	13.40	9.25	86.50	90.75	35.23	-1.6	5.10
2002	12.74	8.50	87.16	91.50	41.01	-3.0	7.30
			Average output growth, %				
1983/02	*0.85*		*6.40*				
1983/87	*6.04*		*6.80*				
1988/92	*2.59*		*12.13*				
1993/97	*-1.36*		*7.59*				
1998/02	*-6.13*		*-3.02*				

Source: Hong Kong Census and Statistics Department.
*The annual average unemployment rate without seasonally adjusted.

In contrast, the tertiary sector of Hong Kong has been developing rapidly and its real output value has increased from HKD237.05 billion in 1980 by 3.78 times to HKD895 billion in 2002. It represented an average annual growth rate of 6.4% a year in the period of 1983 to 2002. Between 1987 and 1994 during which the territory was restructuring its economy from industrial to service based, the tertiary sector has once attained a 10% annual growth rate for almost eight successive years. The GDP share of the sector, meanwhile, has also expanded from 70.30% in 1987 to 83.40% in 1994. In 2002, the GDP share of the sector stood at 87.16% which was 20 percentage points higher than the level of 1961. There is no doubt that the Hong Kong economy is dominated by the tertiary sector.

To assess the contribution of the tourism sector to the economy, the ratio of services' exports to GDP was measured and reported in Table 3.11. This ratio, which was over 30% in the late 60s has arrived at 42.52% in 1970. Afterwards, the ratio has been declining to less than 30% in 1980. It indicated that services' exports have been losing its economic significance in line with the industrialization of the economy. Between the early 80s and late 90s, the ratio was rather stable and moved within a narrow range of 23% to 30%. After the handover, it became more convenient for tourists from Mainland to visit Hong Kong and this increasing number of incoming tourists has brought about a recovery to the tourism sector of Hong Kong. The services' exports ratio, meanwhile, started to increase since 1998 and has reached 41.01% in 2002.

As shown in Table 3.11, the average inflation rate in the period of 1982 to 2002 was 5.77% per annum, which could be regarded as a relatively high level. In fact, the inflation rate of Hong Kong in the past two decades was not only high, but also volatile. It stood at 10.9% in 1982 and dropped to just 3.5% in 1985, but increased again to 10.3% in 1989. In the 90s, the inflation rate of the territory stayed at around 9% until 1995, then started to fall and has eventually became negative in 1999 when there was a recession in the economy.

Turning to the employment condition of Hong Kong, the total number of employed persons was 2.41 million in 1982 and it has reached 3.23 million in 2002, and an average growth rate of 1.5% per annum was found in the period. On the distribution of employment, in the early 80s, around 40% of the employed labour force was working for the secondary sector. By the end of the discussion period, only 8.5% of the total employment was left in the secondary sector and the tertiary sector has utilized 91.50% of the total employment of Hong Kong.

The annual average unemployment rate of Hong Kong was reported in the last column of Table 3.11. As the figures indicated, unemployment was not a serious issue in the early 80s. In 1987, the unemployment rate was just 1.7% and it was very close to the natural rate level. Since the mid 90s, however, the economic environment of Hong Kong has started to deteriorate and it has led to a continuous increase in unemployment rate. In 1997, the unemployment rate of Hong Kong was still staying at a low level of 2.2%, but in one year's time, the unemployment rate has doubled to 4.7%. The post-Asian Financial Crisis recession has worsened the unemployment problem of the territory and the unemployment rate has also reached its highest level for the past two decades, at 7.3% in 2002.

3.3. Macau

3.3.1. Economic Background

Macau is a small city of size 27 square kilometers located at the river mouth of the Pearl River, Mainland China. Since the arrival of the Portuguese 400 years ago, this small village has started to become open to international trade and investment. However, its status as a window of Mainland China has been completely replaced by its neighbour - Hong Kong when the city became a colony of the United Kingdom 150 years ago. From then on, Macau has changed its role from an entrepôt conducting trade-related businesses, to an economy that produced handicrafts, such as matches and fire crackers, and also one that provided gambling services in a small scale. In the early 70s, taking advantages of the status as a developing economy, Macau could enjoy preferential treatments in quotas distribution under the Multi-Fiber Agreement (MFA). It has then attracted a number of Hong Kong investors who suffered from quota restrictions to establish their textiles and garments factories in Macau. Since then, the textiles and garments productions of Macau have been expanding continuously and so was the export value of the territory. Apart from these, toys and shoes were also important outputs and exports of Macau in the early 80s.

Since the mid 80s, local producers were attracted by the favourable treatments and the lower production costs that were offered on the Mainland side. Northward relocation began and the manufacturing sector has been losing its economic magnitude in the territory. The construction and real estate industries, on the other hand, were expanding at a relatively high speed to become the growth engine of the economy. Stimulated by speculators from Hong Kong and Mainland China, the construction and real estate industries have reached its peak in the early 90s. The number of construction sites, finished apartments and property price have all reached their historical high and a bubble was formed in the sector in the early 90s. Nevertheless, this bubble has exploded shortly after the launching of macroeconomic control in Mainland China in 1994. The burst of the speculative bubble has also brought about an excess supply problem in the property market.

In light of the gambling industry of Macau, casinos have been operating legally in Macau since the beginning of the 19th century. The sector has experienced a stable and continuous development in the decades that followed and was one of the major sources of income for the Macau government. In addition, the sector was also one of the biggest sectors in Macau in terms of total employment and it had employed around 10% of the total labour force. In the 80s, the major source of customers of the local casinos were tourists from Hong Kong, Japan, the United States and Europe, while Hong Kong was the most important market among these places. In the 90s, the demand from Japan and Hong Kong has become sluggish and it has dampened the development pace of the gambling sector. Apart from these, the macroeconomic measures of Mainland China and the burst of the speculative bubble in the property market has further weakened the growth and development progress of the sector. Between 1997 and 1998, the performance of the sector has reached its trough. Affected by the Asian Financial crisis and stock market crashes in the surrounding area, the number of tourists' arrival has declined and it has adversely affected the business of casinos.

The handover, which took place in Macau in 1999, did not only end the colonial history of the territory, but have also marked a new page for the growth and development of the Macau economy. Shortly after the handover, the new SAR government has started to reform the outdated Portuguese administrative system and it has also decided to liberalize and introduce competition to the monopolized telecommunications and gambling sectors. In 2000 and 2001, the telecommunications and gambling industries were both opened by the government and the number of franchises in these two industries has been increased to three. In addition, a migration program was introduced to attract investors to invest in Macau in order to obtain the right of residence. Following these measures, there was an increase in incoming foreign investment and the economy has started to recover from the long-lived recession. In line with the continuous growth of Mainland China, there was increased number of tourists visiting Macau's casinos and they have contributed to the recovery of the gambling sector.

3.3.2. Economic Performance

Table 3.12: RGDP and Population Statistics of Macau, USD million at 1995 price.

Year	RGDP	*growth, %*	RGDP per capita in USD	*growth, %*	Population 10,000	*growth, %*
1982	2911.94		11434.09		25.47	
1987	4268.40	*14.29*	13910.64	*10.28*	30.68	*3.64*
1992	6129.11	*13.30*	16525.71	*7.42*	37.09	*5.47*
1997	6894.28	*-0.28*	16456.17	*-1.11*	41.89	*0.84*
1998	6579.15	*-4.57*	15433.23	*-6.22*	42.63	*1.75*
1999	6379.43	*-3.04*	14848.59	*-3.79*	42.96	*0.78*
2000	6674.40	*4.62*	15467.69	*4.17*	43.15	*0.44*
2001	6821.64	*2.21*	15621.37	*0.99*	43.67	*1.20*
2002	7472.20	*9.54*	16919.33	*8.31*	44.16	*1.13*
Average						
1983-02		*4.94*		*2.06*		*2.80*
1983-87		*8.04*		*4.06*		*3.81*
1988-92		*7.55*		*3.55*		*3.87*
1993-97		*2.41*		*-0.08*		*2.47*
1998-02		*1.75*		*0.69*		*1.06*

Source: Statistical Yearbook of Macau, various issues

Concerning the economic performance of Macau, as shown in Table 3.12, the territory's RGDP has increased from USD2,911.94 million in 1982 by 2.57 times to USD7,472.20 million in 2002. It implied an average growth rate of 4.94% per annum. When the per capita RGDP was considered, it has increased from USD11,434.09 in 1982 to USD16,919.33 in 2002, and an average growth rate of 2% per year was observed in the period. The population size of Macau, meanwhile, has increased from 0.25 million in 1982 to 0.44 million in 2002 in which a considerable portion of the increase could be explained by the new immigrants from Mainland China.

In light of the gross fixed capital formation of Macau, according to Table 3.13, it was USD686.80 million at 1995 price in 1982, accounting for 18.49% of RGDP. As a consequence of economic expansion, this investment flow has been increasing in the later years to USD2,054.41 million in 1994. The GDP share of investment has also arrived at over 30% at the same time. Then investment started to decline, the gross fixed capital formation of Macau was USD821.69 million in 2002, which was very close to the level in the mid 80s, accounting for just 11% the year's GDP. In light of the growth rate, the average for the period of 1983 to 2002 was 2.11% per annum.

When the trade flows of Macau were considered, the last column of Table 3.13 has revealed the importance of external transactions to the Macau economy. As indicated, the trade to GDP ratio of Macau was always higher than 100%, which suggested that total trade turnovers exceeded the GDP of the economy. On the export side, since 1991, services' exports have replaced merchandizing exports as the dominant export flow of the economy. The value of services' exports has increased from USD1,716.05 million in 1982 to USD4,901.87 million in 2002, representing an average growth of 5.86% per annum throughout the period. In contrast, the development of merchandising exports was sluggish, and a growth rate of just 0.86% was measured for the same period. In 2002, the total merchandising exports of Macau was USD2,604.77 million or 53% the value of services' exports.

On the import side, the value of merchandising imports purchased by Macau was rather stable in the 80s and has been increasing from USD2,827.63 million in 1982 to USD3,175.17 million in 1989. Due to the economic recession, importing value then began to fall to less than USD3,000 million a year since 1993. In 1998, total import of goods has dropped to USD2,430.96 million. Following the handover and the recovery, more and more foreign products were imported by the territory and as a result, the value of merchandising imports has revived to USD3,483.47 million. In light of the growth rate, between 1982 and 2002, total merchandising imports has increased at 1.26% a year on the average. As for services' imports, in 1982, the territory has purchased USD383.99 million worth of services, equivalent to 12% of total imports of the economy. In the following two decades, the amount of services that the economy imported has increased significantly, reaching USD1,118.24 million in 2002, which was 2.9 times the value of 1992, accounting for 24% of total imports. Between 1983 and 2002, services' imports have been increasing at an average rate of 5.76% per annum.

In view of the trade balance, Macau has been running deficits in merchandising trade with the exception in 1987. The accumulated deficits for the period of 1982 to 2002 have arrived at USD9,297.77 million. Nevertheless, the territory was able to run a surplus in services' exports and the amount of surplus was so large that it not only could payoff the services' imports, but also the deficit in merchandising trade. As a whole, total trade surplus could be maintained by the economy and the amount has also increased from USD833.85 million or 7.29% of the GDP in 1982 to USD2,904.93 million or 17.17% of the GDP in 2002.

Table 3.13: Investment and Trade Statistics of Macau, USD million at 1995 price.

Year	Gross fixed capital formation	GDP share, %	Total export of goods	Total export of services	Total import of goods	Total import of services	Trade to GDP ratio, %
1982	686.80	18.49	2329.43	1716.05	2827.63	383.99	195.42
1987	811.12	19.03	3004.66	1563.79	2944.68	401.98	185.69
1992	1954.50	31.79	2190.65	2758.96	3009.30	459.92	136.93
1997	1506.92	21.79	2118.87	3120.49	2489.61	620.10	120.75
1998	1318.85	20.00	2170.71	2883.88	2430.96	642.41	123.25
1999	1227.32	19.22	2289.52	2820.49	2647.64	756.97	133.37
2000	875.49	13.16	2725.05	3520.32	3020.99	888.14	152.68
2001	795.55	11.71	2516.15	4123.43	3199.90	976.30	159.25
2002	821.69	11.00	2604.77	4901.87	3483.47	1118.24	162.03
			Average growth rate, %				
1983/02	*2.11*	21.07	*0.86*	*5.86*	*1.26*	*5.76*	155.42
1983/87	*4.01*	18.68	*5.50*	*-1.41*	*1.07*	*1.19*	190.62
1988/92	*19.77*	24.14	*-6.04*	*12.06*	*0.52*	*2.79*	163.07
1993/97	*-4.55*	26.46	*-0.58*	*2.57*	*-3.64*	*6.40*	121.86
1998/02	*-10.79*	15.02	*4.56*	*10.21*	*7.09*	*12.64*	146.12

Source: Statistical Yearbook of Macau, various issues.
Export of goods are the sum of domestic exports, re-exports and temporary exports. Trade to GDP ratio is the sum of total goods' and services' exports and imports divided by GDP.

As for the trade components, on the export side, miscellaneous manufacturing articles, in particular, textiles and garments were the most important exporting products of Macau. In 2002, this category has amounted to over 76% of the total merchandising exports. In light of imports, manufactured goods were the largest importing item of Macau, summing to 35% of the total merchandising imports. The second largest import item was miscellaneous manufacturing articles, accounting for around 20% of the total in 2002.

Regarding the trade partners of Macau, in 2002, 48.35% of the total merchandising exports was sold to the United States, while 23.23% of them were exported to the EU, 15.58% to Mainland China and 5.81% to Hong Kong. On the import side, 41.71% of the total merchandising imports came from Mainland China, 14.55% from Hong Kong, 11.78% from the EU, 6.75% from Japan, 6.68% from Taiwan and 4.96% from Korea.

Considering the output structure of Macau, as indicated in Table 3.14, the secondary sector which includes manufacturing, electricity, gas and water supply and construction industries, has been losing its importance since the late 80s. The sector's real output value has reduced from USD1,323.03 million in 1989 to USD943.81 million in 2002. Simultaneously, the GDP share of the sector has also declined from 27.5% in 1989 to 12.63% in 2002. Throughout this period, the secondary sector has been contracting at an average rate of 2.45% a year. In contrast, the tertiary sector, which was made up of industries, such as wholesale, retail and repair, hotels, restaurants and similar, transportation, storage and communications, financial intermediation, real estate and business activities, public administration and other public affairs, education, health and social welfare, other community, social and personal services, households with employed persons and extra-organizations and bodies, has been developing at a much higher speed. Its output level has increased from USD3,487.99 million in 1989 to USD6,528.95 million in 2002, representing an average growth rate of 5.11%. The GDP share of the sector has also increased from 72.5% to 87.4% at the same time. Amongst, the GDP share of the gambling industry was 33.34% in 2002.

To further illustrate the importance of the tourism industry to the Macau economy, the ratio of services' exports to GDP was measured and stated in column 6 of Table 3.14. Services' exports were the sum of non-residents' expenditure in the domestic market, postal and telecommunications services, industrial and non-industrial services. Among these four entries, non-residents' spending has occupied a dominating share and has accounted for 91.72%, 91.94% and 92.11% of the total services' exports for the period from 2000 to 2002 respectively. The services' exports to GDP ratio, for this reason, is able to reflect the importance and contribution of the tourism industry to Macau. In fact, this ratio has been increasing from 15% in 1982 to 29% in 2002. It indicated that the tourism industry has become one of the most important industries of Macau and tourists' spending has made up almost one third of the economy's total output.

Table 3.14: Output and Employment Structure of Macau, %

Year	Secondary sector		Tertiary sector			Inflation rate, %	Unemployment rate, %**
	GDP share	Employment share	GDP share	Employment share	Services' exports to GDP ratio		
1982	n.a.	n.a.	n.a.	n.a.	15.01	1.94	n.a.
1987	n.a.	n.a.	n.a.	n.a.	11.24	9.47	n.a.
1992	20.50	38.30	79.5	61.23	16.69	7.71	2.20
1997	15.30	28.80	84.7	71.20	18.96	3.49	3.20
1998	15.90	31.70	84.1	68.00	18.69	2.28	4.60
1999	16.30	30.60	83.6	69.28	18.99	-3.20	6.30
2000	15.10	28.16	84.9	71.71	22.76	-1.61	6.80
2001	13.32	30.57	86.7	69.08	26.40	-1.99	6.40
2002	12.63	28.46	87.4	71.54	28.97	-2.64	6.30
			Average output growth, %				
1989/02	*-2.45*		*5.11*				
1989/92	*-1.36*		*11.95*				
1993/97	*-3.40*		*3.73*				
1998/02	*-2.14*		*2.38*				

Source: Statistical Yearbook of Macau, various issues.
*Inflation rate is the rate of change of consumer price index relative to the figure in the previous year.
**The annual average unemployment rate.

When the inflation rate was reviewed, the figures indicated that Macau has experienced rigorous price fluctuations. Despite a moderate average inflation rate of 4.22% over the period of 1982 to 2002, inflation rate has once approached to 10% in the early 90s. Following the economic slump and recession, inflation problem was replaced by deflation since the late 90s and stayed at 2.64% in 2002.

As indicated reported in the last column of Table 3.14, the unemployment rate of Macau was still high but it has already achieved certain improvements. In line with the recession, the rate of unemployment has increased from the lowest level of 2.1% in 1993 to its peak of 6.8% in 2000. The employment condition has started to improve during the recovery process and by the end of the discussion period, the unemployment rate has reduced to 6.30%.

In light of the total employment, it has increased from 0.17 million in 1992 to 0.20 million in 2002 in which 23,460 or 10.96% of them was imported labour. The distribution of the labour force was uneven and has been changing over the discussion period. In 1989, for example, over 46% of the labour force was employed by the secondary sector. In line with the economic restructuring and transition, the employment share of the sector has dropped to only 28.46% in 2002. The absolute number of employment in the secondary sector has reduced from 64,804 in 1992 to 57,091 in 2002. Simultaneously, there was a growth in both the employment number and share in the tertiary sector. The total number of employment of the sector has increased from 0.10 million in 1992 to 0.14 million in 2002, its employment share has also increased from 51.87% in 1989 to 71.54% in 2002. The gambling industry alone has employed 13,755 of labour or 6.86% of the total employment in 2002.

3.4. Chapter Summary

The economic profiles, such as the economic histories and reform processes of Mainland China, Hong Kong and Macau have been reviewed in this chapter. There is a general consensus that the economic reforms of Mainland China has brought about revolutionary changes to all the Greater China economies. Statistics have revealed impressive economic progress for all these economies, especially in the post-reform period of early 80s until the mid 90s. During this period, major structural adjustments have taken place and Mainland China has experienced a transition from an agricultural-oriented to an industrial-oriented economy with respect to its output structure. Hong Kong and Macau, in the meantime, have transformed from industrial-based to service-based economies and the tertiary sector has occupied a dominant share in both of these economies. Since the mid 90s, the economic performance of these Chinese economies has started to diversify. Economic slump and recession have taken place in both Hong Kong and Macau with a significant increase in unemployment. In contrast, Mainland China could still maintain its high pace of economic growth until the end of the discussion period.

The importance of investment is widely recognized by the Chinese economies and for this reason, the investment rate is rather high for both Mainland China and Hong Kong. As Macau was suffering from a recession, its investment ratio is the lowest among the three economies. In light of trade and FDI flows, historically they were the growth engines which have driven the growth and development of the SARs. However, these transactions were negligible in Mainland China in the pre-reform period. Since the early 80s, trade and FDI activities have been expanding rapidly in Mainland China with a double digit average growth rate throughout the whole discussion period. In fact, a big portion of these trade and FDI transactions were conducted with Hong Kong and the territory was also one of the most important trade partners and the largest source of foreign capital for the country. The details of these economic contacts, in particular, the trade and investment flows between Mainland, Hong Kong and Macau will be discussed further in the next chapter.

Chapter 4: The Economic Integration between Mainland China, Hong Kong and Macau

In the last chapter, the general economic condition of Mainland China, Hong Kong and Macau have been discussed. The economic contacts, for example, trade, FDI and human flows, between these economies, however, have not been considered. In fact, these economic transactions have been employed in a series of researches, for example, Jones, King and Klein (1992, 1993), Ash and Kueh (1993), Tuan and Ng (1995), Cheng and Tsang (1996), Lin (1999), Guo (1999), Wu (2000a), Lin and Lin (2001) and Keng (2001) in assessing if economic integration has taken place between Mainland China, Hong Kong and Taiwan. Making use of these economic flows, this chapter attempts to investigate the development pattern of the external linkages of Mainland China, with emphasis on its bilateral economic activities with Hong Kong and Macau. The growth rate and GDP share of these bilateral trade and FDI flows will firstly be measured, with an intention to examine if the trade and FDI transactions between Mainland China, Hong Kong and Macau have been expanding with growing economic magnitude overtime. Afterwards, quantitative analyses similar to those in Thornton (1996), Jorda and Burguet (1998), Shan and Sun (1998) and Jin (2002) will be conducted. The econometric methods of Johansen Cointegration Test and Vector Error Correction Model (VECM) will be applied to estimate the economic correlation and interdependence between Mainland China, Hong Kong and Macau in both the short-run and long-run. The income causality of these economies will also be tested. The objective is to search for any possible evidence of economic integration between these economies. On the disaggregate level, the economic contacts between Guangdong, Hong Kong and Macau will also be reviewed and discussed.

4.1. The Trade Tie

As one of the most important type of economic contacts, trade transactions allow the participating economies to exercise their comparative advantages, improve their economies of scale and subsequently, there will be price reduction and improvement in the availability of products. In principle, free trade tends to bring about mutual benefits to all the participating economies. If a pair or a group of countries trade extensively among each other, then these countries may become interdependent with their economic factors correlating with each other. Taking the European Union as an example, it is broadly agreed that the member states of this community have achieved a high degree of economic integration. In view of the intensity of trade among the EU member states, over 60% of the EU's trade is in the form of internal trade, it implies that EU member states are more willing to trade with each other rather than with a non-member state. It may suggest that high intensity of trade is a necessary condition for economic integration. To examine whether Mainland China, Hong Kong and Macau have a high intensity of trade has also become the first job when trying to assess the degree of economic integration of these economies.

4.1.1. Mainland China's Trade with Hong Kong and Macau

Tables 4.1 to 4.2 have summarized the development of trade activities between Mainland China, Hong Kong and Macau in the post-reform period. In Table 4.1, it can be found that the total exports and imports of Mainland China have been expanding since the economic reforms. However, the country's imports from both Hong Kong and Macau have been declining since the 90s, despite the expansion of its exports to the two SARs. As for the pace of growth, as shown in the lower part of Table 4.1, the trade transactions between Mainland China, Hong Kong and Macau have experienced a two-digit growth rate of 14% and 38%, for exports and imports respectively in the pre-reform period of 1953 to 1980. In the same period, Mainland China's total exports and imports were growing at the same rate of 13%. It indicates that in the pre-reform period, Mainland China's external trade has concentrated on Hong Kong and Macau, and the SARs were also the major source of imports for the country. In the aftermath of the economic reforms, along with the liberalization policies, the trade transactions between Mainland China, Hong Kong and Macau have mushroomed. In the early reform period of 1982 to 1990, an impressive two-digit growth rate of 20% and 33% were recorded for Mainland China's exports to and imports from Hong Kong. This pace of expansion is even faster than the growth rate of Mainland China's total exports and imports which was only 12.5% and 12.3% respectively in the period. Given these figures, there is a tendency for Mainland China to trade more with Hong Kong than with the other trade partners. Since the 90s, this situation has started to turn around and the pace of trade expansion between Mainland China and Hong Kong has started to slow down. From 1991 to 2002, an average growth of just 9.4% was recorded on the export side, while the development of importing activities was sluggish. In the meantime, Mainland China's total exports and imports were growing at 15.2% and 15.8% respectively. This major adjustment in trade progress is probably attributed to the economic restructuring of Hong Kong and the re-location of Hong Kong's export-oriented factories to Mainland China, thus reducing Hong Kong's merchandising exports to Mainland China. Besides, the success of Mainland China's products in exploring and diversifying their markets as well as the modification of the statistical classification in Mainland China may have contributed to Mainland China's export expansion. It also helps to illustrate the decline of Hong Kong's exports to Mainland China and the simultaneous growth of re-export activities between the two. As for the trade activities between Mainland China and Macau, a pattern similar to that of Mainland China-Hong Kong trade can be observed in the post-reform period.

Table 4.1: Trade between Mainland China, Hong Kong and Macau, USD million

Year	Mainland China's exports to HK	Mainland China's imports from HK	Mainland China's exports to Macau	Mainland China's imports from Macau	Mainland China's total exports	Mainland China's total imports
1981	5276.24	1242.01	288.86	9.06	22010	22020
1985	7204.33	4796.95	249.36	53.68	27350	42250
1991	32137.19	17463.04	526.34	171.53	71840	63790
1995	35983.43	8590.71	793.40	128.58	148780	132080
1996	32905.54	7827.70	572.71	120.88	151050	138830
1997	43782.86	6990.26	641.95	122.85	182790	142370
1998	38753.21	6658.42	747.48	122.96	183760	140170
1999	36862.75	6891.88	637.51	96.95	194930	165700
2000	44518.29	9429.01	709.86	94.99	249200	225090
2001	46541.24	9422.50	742.36	119.12	266100	243550
2002	58463.15	10726.24	876.12	142.27	325600	295170
			Average growth rate, %			
1953-1980*	*14.08*	*38.16*	*n.a.*	*n.a.*	*13.07*	*13.30*
1982-1990	*20.43*	*33.17*	*7.57*	*41.10*	*12.52*	*12.28*
1991-2002	*9.43*	*0.17*	*5.81*	*-0.28*	*15.24*	*15.83*
1981-2002	*14.14*	*14.31*	*6.56*	*17.45*	*14.08*	*14.30*

Sources: Statistical Yearbook of China, various issues.
* Hong Kong and Macau as a whole

To assess the magnitude of trade between Mainland China and the SARs, the share of Hong Kong and Macau's trade in Mainland China's trade record are measured and reported in Table 4.2. In the pre-reform period, Hong Kong and Macau were already important trade partners of Mainland China, especially on the export side and from 1950 to 1980, around 20% of Mainland China's exports were conducted with Hong Kong and Macau, while only 3% of Mainland China's imports came from these two economies. The economic reforms and open door policies have accelerated the development of this regional trade flow.

Table 4.2: Trade Share of Hong Kong and Macau in Mainland China's Trade Record, %

Year	X to HK	M from HK	X to HK[a]	M from HK[b]	X through HK[c]	M through HK[d]	X to Macau	M from Macau
1981	23.97	5.64	23.99	2.38	10.43	6.54	1.31	0.04
1985	26.34	11.35	27.68	4.59	16.26	13.90	0.91	0.13
1991	44.73	27.38	52.50	10.98	56.50	30.93	0.73	0.27
1995	24.19	6.50	46.85	6.22	55.26	37.57	0.53	0.10
1996	21.78	5.64	48.86	5.74	58.54	38.93	0.38	0.09
1997	23.95	4.91	42.98	5.80	51.11	40.33	0.35	0.09
1998	21.09	4.75	40.81	5.16	48.58	37.46	0.41	0.09
1999	18.91	4.16	40.12	3.92	47.55	31.03	0.33	0.06
2000	17.86	4.19	36.82	3.09	43.74	27.88	0.28	0.04
2001	17.49	3.87	32.86	2.61	38.95	26.14	0.28	0.05
2002	17.96	3.63	28.24	1.80	34.02	24.84	0.27	0.05
			Average trade share, %					
1950-80*	20.48	3.04	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1981-90	31.47	14.47	34.22	6.30	24.41	15.01	1.05	0.17
1991-02	25.24	9.06	44.24	5.83	51.73	33.28	0.44	0.11
1981-02	28.07	11.52	39.69	6.04	39.31	24.97	0.72	0.13

Sources: Statistical Yearbook of China and Hong Kong's Monthly Digest of Statistics, various issues.
X: exports, M: imports
* Hong Kong and Macau as a whole.

a. It is measured as the ratio of Hong Kong's imports from Mainland China in Hong Kong's record to the total exports of Mainland China.
b. It is measured as the ratio of Hong Kong's domestic exports to Mainland China to the total imports of Mainland China.
c. It is measured as the ratio of Hong Kong's re-exports of Mainland China's products to the total exports of Mainland China.
d. It is measured as the ratio of Hong Kong's re-exports to Mainland China to total imports of Mainland China.

As shown in columns 2 and 3, Mainland China has been trading extensively with Hong Kong since 1981 and the corresponding flows have accounted for up to 44.7% of the total exports and 27.4% of the total imports of Mainland China in 1991. However, these figures may cover the transactions of exports, re-exports and transshipments. Notwithstanding such expansion, a one-shot decline in both export and import shares was found in 1993 and the export share has dropped from 44.16% to 24.19%, while the import share has contracted from 25.48% to 10.07%. This volatility may be caused by the change in trade classification in which re-exports were distinguished from definite exports and imports. After the adjustment, a declining trend is found on the trade between Mainland China and

Hong Kong. Despite the continuous expansion in Mainland China's total exports and imports, the export and import shares of Hong Kong have reduced to 18% and 3.6% respectively in 2002. From 1991 to 2002, Mainland China's exports to and imports from Hong Kong has accounted for 25% and 9% of the country's total exports and imports on the average, which is 6 and 5 percentage points less than the corresponding average share in the early reform period.

For comparison purpose, another measurement of trade share is computed in columns 4 and 5 of Table 4.2. In the calculation, the share of Mainland China's exports to Hong Kong is defined as Hong Kong's imports from Mainland China to Mainland China's total exports, while the share of Mainland China's imports from Hong Kong is specified as Hong Kong's domestic exports to Mainland China over Mainland China's total imports. Due to the differences in surveying method and definition, these two trade share figures are remarkably different from the previous measurement. Nevertheless, a peak can still be found in the early 90s, for example, export share has arrived at its peak of 56.6% in 1993 while import share has reached its peak of 11.42% in 1990. Thereafter, a declining trend is recorded for both series and this pattern matches with what is described previously. Historically, Hong Kong is one of the most important trade partners of Mainland China, however, the situation has begun to change in the 90s. Although Mainland China-Hong Kong trade is still expanding in the 90s, its weight has been declining in the 90s regardless of the measurement method used. It seems that since the beginning of the 90s, Mainland China has already switched its focus from Hong Kong to the world market and Hong Kong has also changed its role - from previously being a trade partner to become an enterpôt of Mainland China.

The percentage of Mainland China's exports and imports that are transshipped in Hong Kong are shown in columns 6 and 7 of Table 4.2. On the export side, it is calculated as Hong Kong's re-exports of goods by main origin - Mainland China, divided by the total exports of Mainland China. On the import side, it is the ratio of Hong Kong's re-exports of goods by main destination - Mainland China, to Mainland China's total imports. Similar to the other trade ratios, these two indices carried an increasing trend in the 80s, reaching their peaks in the early and mid 90s and then contracting continuously in the recent years. It could be interpreted that ever since the 90s, fewer portion of Mainland China's exports and imports have passed through Hong Kong during their transportation process. It may be attributed to the rapid development of infrastructure and port facilities of Mainland China so that the country can export or import her products directly by herself. Besides, the development and improvement in trade-related services in Mainland China as well as the high operating costs in Hong Kong may have also motivated businessmen in Mainland China to handle trade transactions directly in the Mainland. Despite the declining weight in the recent years, the re-export transactions between Mainland China and Hong Kong were still very active in the 90s and over 50% of exports and 30% of imports of Mainland China have gone through Hong Kong. These figures are still significantly higher than the 24% and 15% in the early reform period.

As for the trade between Mainland China and Macau, due to the limited economic strength of Macau, it is not surprising to find that the transactions between Mainland China and Macau are insignificant for both exports and imports. In line with the economic reforms and development of Mainland China, Macau is able to expand its trade with the mainland. However, similar to Mainland China-Hong Kong trade, the share of Macau in Mainland China's total trade has been declining since the early 90s.

4.1.2. Hong Kong's Trade with Mainland China

The value and growth rate of Hong Kong's bilateral trade with Mainland China together with its percentage share in Hong Kong's trade record are summarized in Table 4.3. Except for the domestic exports to Mainland China, the value of inward and outward re-exports and imports from Mainland China have experienced a continuous growth throughout the reform period. If the reform period is divided into two stages, an impressive growth rate ranging from 22% to 36.2% could be found in various trade related flows, such as domestic exports, inward re-exports to Mainland China, outward re-exports of Mainland China's products and imports from Mainland China in the period of 1981 to 1990. Hong Kong's various trade flows with Mainland China then expand at a decreasing rate of 10.1% to 15.6% from 1991 onwards and a negative growth rate of 0.7% is recorded in the domestic exports flow. The trade activities between Mainland China and Hong Kong are expanding since the economic reforms. However, the pace of growth in the 90s is much slower when compared with the achievements in the early reform period.

On the weight of Mainland China's trade, as indicated in Table 4.3, the major trade transaction between Mainland China and Hong Kong are the re-exporting activities. Hong Kong has also exported its domestic products to Mainland China, but the weight is rather small and after arriving at the peak of 7.72% in 1988, the share of domestic exports to Mainland China in overall trade has been declining to a record low level of 2.65% in 2002. On the contrary, re-exporting activities has been developing rapidly throughout the economic reforms. In 1981, inward and outward re-exporting activities have accounted for 6.58% and 8.54% respectively of Hong Kong's total exports. These two ratios have climbed up to 36.65% and 54.58% respectively in 2002. It implies that Hong Kong has been concentrating on the re-exporting activities related to Mainland China. Since the economic reforms, Hong Kong has specialized in the trade-related businesses, serving as a major entrepôt of Mainland China to conduct incoming and outgoing re-exporting activities as well as to provide a series of trade-related services for the Mainland.

Apart from the domestic exports, re-exports and imports transactions, an important series that cannot be neglected would be the outward-processing trade activities in Mainland China. As reported by the statistical department of Hong Kong, in 1989, 76% of domestic exports, 43.6% of re-exports to Mainland China and 58.1% of imports from Mainland China were related to outward-processing in Mainland China. The proportion of outward-processing trade has changed to 70% for domestic exports, 43% for re-exports to Mainland China, 82% of re-exports of Mainland China's products to other places and 74% of Hong Kong's imports from the Mainland in 2002. These figures depicted that a dominant portion of the trade transactions between Mainland China and Hong Kong are related to outward-processing activities in which raw materials or semi-finished products are shipped to Mainland China for industrial processing in order to reduce the costs of production. After completing certain steps of production, the goods would be transported back to Hong Kong for the final stage of production or simply for export purpose. As a result, all the Mainland China-related trade transactions of Hong Kong, including domestic exports, inward and outward re-exports to Mainland China and imports are somewhat related to outward-processing activities. The domestic exports sold to Mainland China, for example, are probably not 100% made in Hong Kong but certain production steps of them are performed in Mainland China. As for the imports that the territory purchases from Mainland China, they may be shipped back to the Mainland for further processing. As for the re-exports activities, products are transshipped through Hong Kong to the foreign economies or Mainland China not only because of Hong Kong's status as an entrepôt or regional financial center, perhaps some of the firms in Mainland China are funded by Hong Kong capital and for this reason, finished products are transshipped through the territory. The outward-processing activities in the Mainland and the capital injected by Hong Kong investors in Mainland China are therefore closely related.

Table 4.3: Hong Kong's Trade with Mainland China in Hong Kong's Trade Record, USD million

Year	Domestic X to China	share of total X* %	Re-exports to China	share of total X %	Re-exports of China's products	share of total X %	M from China	share of total M %
1981	523	2.39	1439	6.58	2296	8.54	5279	21.33
1985	1950	6.46	5908	19.57	4445	12.69	7569	25.48
1991	7002	7.10	19732	20.02	40629	37.57	37755	37.66
1995	8211	4.73	49618	28.57	82221	46.65	69700	36.18
1996	7972	4.41	54043	29.88	88424	47.35	73796	37.15
1997	8252	4.39	57349	30.49	93465	48.90	78601	37.67
1998	7234	4.16	52563	30.23	89190	49.69	74918	40.63
1999	6497	3.74	51442	29.59	92800	51.29	78292	43.62
2000	6952	3.44	62750	31.08	109052	53.38	91783	43.12
2001	6352	3.35	63663	33.53	103637	54.02	87433	43.49
2002	5304	2.65	73317	36.65	110765	54.58	91933	44.28
			Average growth rate, %					
1981/90	*35.6*		*36.2*		*34.9*		*22.0*	
1991/02	*-0.7*		*15.6*		*11.8*		*10.1*	
1981/02	*15.8*		*24.9*		*22.3*		*15.5*	

Sources: Hong Kong Monthly Digest of Statistics, various issues.
* Total exports are the sum of domestic exports and re-exports and China refers to Mainland China.

On the import side, Mainland China has been Hong Kong's major supplier of products of various kinds. In line with the country's economic development, the improvement in production skill, output quality and product availability, as well as the economic growth of Hong Kong, Mainland China has been expanding its exports to Hong Kong, and has become the most important trade partner of the territory. As expressed in the last column of Table 4.3, about 21% of Hong Kong's imports came from Mainland China in 1981. This figure has been growing continuously to 44.3% in 2002.

4.1.3. Macau's Trade with Mainland China and Hong Kong

Table 4.4: Macau's Trade by Country in Macau's Trade Record, USD million

Year	X to China	share of total X %*	X to HK	share of total X %	M from China	share of total M %	M from HK	share of total M %
1981	25.57	3.70	152.17	22.02	231.65	32.61	257.74	36.28
1985	59.88	6.67	163.25	18.19	164.25	21.27	339.38	43.94
1991	140.38	8.43	217.88	13.08	399.00	21.52	645.75	34.83
1995	195.98	9.82	200.00	10.02	444.04	21.76	589.71	28.89
1996	158.97	7.97	211.29	10.59	479.05	23.97	580.55	29.04
1997	139.40	6.49	164.99	7.68	594.86	28.56	523.96	25.15
1998	144.81	6.77	162.83	7.62	637.30	32.65	462.70	23.70
1999	202.38	9.20	149.56	6.80	727.03	35.64	368.59	18.07
2000	259.03	10.21	165.63	6.53	925.16	41.05	343.46	15.24
2001	268.37	11.67	146.70	6.38	1016.81	42.59	331.26	13.88
2002	367.12	15.58	136.99	5.81	1055.67	41.71	368.12	14.55
			Average growth rate, %					
1981/90	*277.5*		*23.7*		*14.5*		*13.4*	
1991/02	*17.2*		*-3.5*		*12.7*		*-4.3*	
1981/02	*135.5*		*8.8*		*13.5*		*3.8*	

Sources: Statistical Yearbook of Macau, various issues.
* Total exports include domestic exports and re-exports and China refers to Mainland China.

When Macau's exports to Mainland China are considered, about 94% of the transactions were re-exports activities for the period of 1996 to 2002. As indicated in Table 4.4, the development of Macau's exports to Mainland China is not stable and has experienced enormous fluctuations in the past two decades. Following a two-digit escalation in the early reform years, the export flow has shrunk in the mid 90s. This flow, however, has regained its momentum since 1998. As a whole, Macau's exports to Mainland China could still achieve a positive growth in the reform period, but the pace of expansion in the period of 1991 to 2002 is slower than that in the earlier period. As for Macau's exports to Hong Kong, as shown in column 5 of Table 4.4, this flow was also volatile but a positive growth could be attained in the early reform period. After a period of stagnancy in the early 90s, it has started to plummet in the late 90s with a diminishing trend until the recent years. In light of the composition of the export flows, re-exports activities have accounted for most of the exports transactions. Its weight was 62% in 1996 and has soared to 81% in 2002, that is, in 2002, 80% of Macau's exports to Hong Kong were re-exports.

On the import side, Table 4.4 suggests that the role of Hong Kong as a major supplier of Macau's imports has been replaced by Mainland China since 1997. From 1981 to 1990, Macau's imports from Mainland China and Hong Kong have been growing at a similar rate of 14.5% and 13.4% respectively. From 1991 onwards, a negative growth rate is found in the imports from Hong Kong. Meanwhile, imports from Mainland China have been expanding continuously at a two-digit rate. This development should be largely attributed to the economic restructuring of Hong Kong and the economic take-off of Mainland China. Consequently, Mainland China has become the major source of imports for the Macau economy.

The exports and imports share of Mainland China and Hong Kong in Macau's trade account are also stated in Table 4.4. As indicated in the data series, exports to Mainland China has had an increasing share throughout the reform period, but it has just accounted for 15.6% of Macau's total exports in 2002. At the same time, exports to Hong Kong have been shrinking and the implied share has diminished from 22% in 1981 to 5.8% in 2002. These two shares suggest that neither Mainland China nor Hong Kong is the major market for Macau's exports. Nevertheless, Macau has become more and more dependent on imports from Mainland China, with the import share escalating from 32.61% in 1981 to 41.7% in 2002. Simultaneously, fewer products have been imported from Hong Kong and thus, the import share of Hong Kong has contracted from 36.28% in 1981 to 14.6% in 2002. As a result, Mainland China has replaced Hong Kong in the late 90s to be the largest supplier of imports for Macau.

4.1.4. Guangdong's Trade with Hong Kong and Macau

The statistics discussed above have revealed that Mainland China has been trading extensively with Hong Kong and Macau even before the economic reforms. However, as a big country with 30 provinces and 1300 million inhabitants, it is not surprising for

Mainland China-Hong Kong and Mainland China-Macau trade to concentrate on one or several provinces. It is, therefore, necessary to study the spatial pattern of the trade transactions between these economies. As an adjacent province to the Special Administrative Regions, it is natural for Guangdong to have a closer trade relationship with Hong Kong and Macau than the other provinces of the country. As indicated in Table 4.5, Guangdong's exports to Hong Kong have been experiencing a stable growth in the 90s, but its imports from Hong Kong have been shrinking simultaneously. As for the trade share, as shown in Table 4.6, an average 40% of Guangdong's exports were conducted with Hong Kong in the period of 1989 to 2002 and this share is much higher than the corresponding share of Mainland China. In the 90s, Guangdong has diversified its market and consequently, the importance of Hong Kong as a major market of Guangdong's product has been declining. Nevertheless, Hong Kong is still the biggest market for Guangdong's exports. In 2002, 36% of Guangdong's exports were sold to Hong Kong, another 20% and 7% were sold to the United States and Japan respectively. On the import side, Guangdong has been importing a variety of products from Hong Kong since the economic reforms but most of these imports were re-exports that were produced in other countries. After the introduction of a new trade classification in 1993, Guangdong's imports from Hong Kong has dropped dramatically from USD 27,225 million in 1992 to USD14,513 million in 1993, with the import share reducing from 56% to 16% in one year and it has marked the beginning of a contraction trend. In the years that followed, Guangdong has imported less and less from Hong Kong with the import share plummeting further to 5% in 2002. In comparison, 19.35%, 16.92% and 6.52% of the province's imports came from Taiwan, Japan and the US respectively in the same year. As for Macau, its trade order with Guangdong is very similar to that of Hong Kong. The territory's imports from Guangdong have been soaring over time. On the other hand, Macau can no longer export as much to Guangdong as before. In line with the rapid expansion of international trade, the weight of Macau in Guangdong's trade account has been declining since the 90s. In 2002, exports to Macau could only make up 0.63% of Guangdong's total exports, which was once 1.2% in 1992. On the import side, the share of Macau has reduced, from 0.47% in 1992 to 0.13% in 2002.

Although the weight of Hong Kong and Macau in Guangdong's trade has been declining since the early 90s, Guangdong is still the province that has the closest trade relationship with the two SARs. As shown in Table 4.7, Guangdong has facilitated 29% of Mainland China's exports and 28% of imports to Hong Kong in 1989. These two figures have boosted to 73% and 49% respectively in 2002. That is, over half of the trade between Mainland China and Hong Kong is conducted by Guangdong. In light of Macau, its trade with Mainland China has concentrated more on Guangdong. In 1989, 32% and 38% of the Mainland China's exports to and import from Macau were done by Guangdong. These two figures have climbed up to 85% and 96% respectively in 2002. Over years, both Hong Kong and Macau have taken advantages of their geographical adjacency to concentrate trade with Guangdong, and hence the province has become the place in Mainland China that trades the most with the SARs.

Table 4.5: Trade between Guangdong (GD), Hong Kong and Macau, USD million

Year	GD's exports to HK	GD's imports from HK	GD's exports to Macau	GD's imports from Macau	GD's total exports	GD's total imports
1987					10140	10897
1991	<u>11369</u>	<u>6230</u>	<u>224</u>	<u>64</u>	27073	25448
1995	21567	5937	688	118	56592	47380
1996	21772	5192	485	117	59346	50614
1997	29185	4619	555	117	74564	55556
1998	26503	4159	631	94	75618	54180
1999	26370	4056	521	83	77705	62663
2000	31530	5250	575	85	91919	78187
2001	33683	5093	614	104	95421	81066
2002	42386	5229	742	136	118458	102634

Sources: Guangdong Statistical Yearbook, various issues.
Underlined statistics are "external trade statistics", while the others are Custom Statistics.

Table 4.6: Trade Share Hong Kong and Macau in Guangdong's Trade Record, %

Year	The share of GD's exports to		The share of GD's imports from		GD's trade as a % of Mainland China's total	
	HK	Macau	HK	Macau	Exports	Imports
1987					25.71	25.22
1991	41.99	0.83	24.48	0.25	37.68	39.89
1995	38.11	1.22	12.53	0.25	38.04	35.87
1996	36.69	0.82	10.26	0.23	39.28	36.46
1997	39.14	0.74	8.31	0.21	40.79	39.07
1998	35.05	0.83	7.68	0.17	41.15	38.62
1999	33.94	0.67	6.47	0.13	39.86	37.80
2000	34.30	0.63	6.71	0.11	36.89	34.73
2001	35.30	0.64	6.28	0.13	35.85	33.28
2002	35.78	0.63	5.09	0.13	36.38	34.77
Average	40.26	0.86	15.69	0.23	37.17	35.69

Sources: Guangdong Statistical Yearbook, various issues.

Table 4.7: Trade Share of Guangdong- Hong Kong/Macau's Trade in Mainland China's Trade Record, %

Year	GD's exports to HK	GD's imports from HK	GD's exports to Macau	GD's imports from Macau
	as a % of Mainland China's exports or imports with Hong Kong		as a % of Mainland China's exports or imports with Macau	
1991	35.38	35.68	42.53	37.25
1995	59.94	69.11	86.71	92.00
1996	66.17	66.33	84.75	96.77
1997	66.66	66.08	86.46	95.24
1998	68.39	62.46	84.42	76.45
1999	71.54	58.85	81.72	85.61
2000	70.82	55.68	81.00	89.48
2001	72.36	54.05	82.59	87.31
2002	72.50	48.75	84.69	95.59
Average	60.33	58.10	72.71	77.99

Sources: Guangdong Statistical Yearbook, various issues.

4.1.5. Trade Intensity Ratio

The analysis on the bilateral trade flows between Mainland China, Hong Kong and Macau shows that Mainland China has already become the largest supplier of imports for both Hong Kong and Macau. Besides, since the 90s, Hong Kong has also changed its role from a major market for Mainland China's products to an important entrepôt of the country and a considerable amount of Mainland China's exports and imports have gone through Hong Kong before reaching their final destinations. In addition, trade involving outward-processing activities between Mainland China and Hong Kong have been developing since the economic reforms. However, given these evidences, it is only possible to confirm the presence of a close trade relationship between Mainland China, Hong Kong and Macau. In the meantime, Mainland China has probably built up similar intensive trade relation with the other trade partners. To examine whether Mainland China tends to trade more with Hong Kong and Macau than the other economies, the trade intensity index, I_{ij}, is introduced to evaluate how close the trade relation is between them. The trade intensity index is a measurement to capture the degree of trade integration between different economies. The value of the index increases when trade between the two trading partners is disproportionately high. It is larger than one if country i exports more than average to country j and *vice-versa*. Generally speaking, a big intensity index and an increasing trend could be interpreted as evidence of a close and expanding trade linkage, which could probably be regarded as an evidence of economic integration as well. In Flörkemeier (2000), it was shown that the trade intensity index tended to relate negatively to per capita incomes of exporting countries. Furthermore, as a country diversifies its exports, the comparability of this index tends to decline. This index has been adopted in Frankel and Rose (1996), Dale (1997), Piazolo (1997) and Flörkemeier (2000) to measure the intensity of trade between two countries. In Dale (1997), the index is specified as:

$$I_{ij} = (X_{ij} / X_i)/(M_j / T) \text{, in which} \tag{4.1}$$

X_{ij} is country i's exports to country j, X_i is country i's total exports. M_j/T is the share of country j's imports in world imports. T is the world's total imports, M_w, minus country j's imports, M_j. If there is no regional bias, then the export share of a country should match the country's share in world imports and the index will be 1. If it is bigger than 1, then country i has exported more than average to country j. Generally speaking, a high index suggests high trade intensity for the pair. Apart from this, the ratios of X_{ij}/X_i and X_{ji}/X_j, in which X_{ij} represents country i's exports to country j and X_i is country i's total exports, were introduced in Piazolo (1997) and have been employed to measure the intensity of bilateral trade.

In this research, the specification employed in Dale (1997) will be adopted as it is one of the most popular measurements in available literature. Besides, by advocating this specification, it is possible to compare the intensity indices measured here with those available in Dale (1997). The bilateral trade intensity indices inherited in Mainland China-Hong Kong and Mainland China-Macau trade will then be calculated. The trend of these indices will also be analyzed and compared with the bilateral trade intensity indices of Mainland China-USA, Mainland China-Japan, Mainland China-Germany, etc. in order to find out if the trade linkage between Mainland China and its SARs is closer than that with the rest of the world. In the case of the bilateral trade transactions between Mainland China and Hong Kong, a considerable percentage of Mainland China's exports to Hong Kong are classified as re-exporting activities by Hong Kong's statistics. In our calculation, exports and re-exports will not be distinguished but their sum will enter the measurement for the reason that re-export activities are also evidences of economic integration. For this reason, the analysis here will group outward re-exporting activities and domestic exports together as total exports so as to reflect the intensity of economic contacts between Mainland China and Hong Kong.

Table 4.8: Trade Intensity Index of Mainland China with its Major Trade Partners

Year	Hong Kong	Hong Kong[a]	Macau	USA	Japan	Germany	UK	Italy	France
1981	17.95	8.00	36.60	0.43	2.79	0.42	0.34	0.24	0.20
1982	17.36	8.96	30.55	0.50	2.87	0.39	0.25	0.22	0.19
1983	19.08	9.53	30.01	0.44	2.70	0.42	0.46	0.23	0.17
1984	16.55	12.85	29.73	0.42	2.71	0.36	0.23	0.26	0.16
1985	16.04	11.56	22.61	0.38	3.08	0.30	0.22	0.23	0.14
1986	18.26	10.25	24.49	0.39	2.40	0.33	0.73	0.24	0.16
1987	16.74	13.15	23.98	0.37	2.50	0.31	0.20	0.26	0.16
1988	15.19	13.64	20.56	0.37	2.37	0.32	0.19	0.31	0.16
1989	16.17	13.18	18.62	0.44	2.19	0.32	0.18	0.26	0.15
1990	17.38	16.07	18.69	0.48	2.02	0.29	0.15	0.25	0.15
1991	15.16	15.15	14.41	0.53	2.03	0.27	0.16	0.24	0.15
1992	13.02	13.98	12.39	0.61	2.16	0.25	0.18	0.25	0.14
1993	6.23	11.50	10.92	0.98	2.54	0.44	0.37	0.35	0.25
1994	6.68	11.90	11.31	0.93	2.61	0.41	0.36	0.32	0.21
1995	6.10	12.63	13.53	0.94	2.74	0.38	0.35	0.33	0.22
1996	5.68	13.13	10.38	1.00	2.99	0.42	0.38	0.31	0.23
1997	6.09	13.49	9.53	0.94	2.73	0.41	0.36	0.32	0.25
1998	6.09	13.32	11.65	1.01	3.05	0.43	0.42	0.34	0.28
1999	5.88	11.33	9.31	0.96	2.93	0.45	0.43	0.38	0.28
2000	5.29	9.72	8.32	0.88	2.72	0.45	0.47	0.41	0.30
2001	5.34	9.22	7.43	0.89	2.90	0.44	0.48	0.39	0.28
2002	5.50	8.35	7.00	0.96	2.75	0.43	0.46	0.38	0.25

Author's own calculation based on Dale (1997)'s specification.
Mainland China's statistics come from the Statistical Yearbook of China, various issues. World trade figures are extracted from IMF's International Financial Statistics online. Mainland China is country i and the trade partners of Mainland China are countries js in the calculation.
a. Hong Kong is country i and Mainland China is country j with re-exports to Mainland China included in the calculation

As shown in Table 4.8, the pattern of the trade intensity indices of Mainland China with its major trade partners is consistent with those stated in Dale (1997)[59] and Mainland China does trade more intensively with Hong Kong and Macau given the high value of the indices. Japan has also had a close trade relationship with Mainland China and the United States ranks the fourth. All of these economies have an index that is either bigger or very close to 1 in 2002. For the European countries, all their trade intensity indices are less than 1. This is the evidence suggesting that their trade relationships with Mainland China are looser than the other countries in our sample, and Mainland China exports less than

[59] Dale (1997), p.126.

average to the European countries. Although the Mainland China-Hong Kong and Mainland China-Macau indices are still the biggest two in the sample, since the economic reforms, these two indices have been declining continuously from 17.95 or 8 and 36.6 for Hong Kong and Macau in 1981, to 5.5 or 8.35 and 7 in 2002. Such development pattern may reveal a tendency of declining trade intensity between Mainland China, Hong Kong and Macau. That is, the bilateral trade volume between Mainland China, Hong Kong and Macau are still growing. However, Mainland China's trade with the other countries, for example, the United States, UK and Italy, have been expanding at a much faster speed. As a result, the indices of Hong Kong and Macau have shrunk, while the indices for the US, UK and Italy have been boosting at the same time. It implies that the SARs may have been losing their roles as the windows of Mainland China since the country has been trading directly with the rest of the world in line with the economic reforms. In 2002, the trade intensity index for the US was more than double of 1981's. A significant growth can also be found in the case of UK and Italy in the past two decades.

4.1.6. Trade Complementarity Index

The complementarity index measures the degree that country i's exports matches the imports of country j. This concept has been advocated in Dale (1997) and Piazolo (1997) in assessing the trade pattern of Mainland China and Portugal. In Piazolo (1997), the index is specified as:

$$C_{jk} = 1 - \left(\sum \left| m_{ik} - x_{ij} \right|\right) / 2 \qquad (4.2)$$

where x_{ij} is the share of good i in total exports of country j, and m_{ik} is the share of good i in total imports of country k. The index is zero when goods exported by country j are not imported by country k. It is 1 when the commodity shares in country k's imports correspond exactly to those of country j's exports. A high complementarity index represents a complementary trade relation between the two countries. As explained in Piazolo (1997), the index indicates whether the two trading parties could gain from the regional arrangement. In addition, it also demonstrates the odds of successful integration, since successful trade agreement tends to reshape the trade pattern of the countries involved as they are allowed to better exchange their products with comparative advantages.

The trade complementarity index is measured to assess if the Mainland China-Hong Kong and Mainland China-Macau trade are conducted on a complementary basis in which these economies can exchange their comparative advantages during the process. Conventional beliefs suggest that due to the inherited differences in the relative capital and labour endowments, the trade activities that take place between Mainland China and Hong Kong, or Mainland China and Macau tend to be complementary, rather than competitive. The measurement of the complementarity index then attempts to prove if there is any evidence of such. Besides, according to Piazolo (1997), countries involved in a trade agreement would have a higher trade complementarity index, for example, of over 0.5. Meanwhile, successful trade agreement would lead to trade and economic integration.

In practice, the bilateral trade complementarity index of Mainland China-Hong Kong and Mainland China-Macau will be measured. The measured trade complementarity index can be regarded as an evidence showing numerically whether the trade between Mainland China, Hong Kong and Macau are complementary, such that these economies can exchange their comparative advantages. In addition, by assessing the evolution of the index, it is possible to review the evolution of their trade pattern. Given a highly complementary trade relationship, it is more likely to prove that the Mainland China, Hong Kong and Macau economies have fully integrated into a single economic entity. Furthermore, a comparative study can also be conducted. If the size of the complementarity indices for Mainland China-Hong Kong or Mainland China-Macau trade are compatible with those inherited in successful trade blocs or fully integrated economies, then it may imply that the degree of trade integration or economic integration between Mainland China, Hong Kong and Macau is no looser than the other well integrated economies.

Table 4.9: Trade Complementarity Index of Mainland China-Hong Kong and Mainland China-Macau's Trade

Year	Mainland China-Hong Kong[a]	Mainland China-Macau[a]	Mainland China-Hong Kong[b]	Mainland China-Macau[b]
1983	0.71	0.64	0.46	0.30
1984	0.68	0.62	0.48	0.31
1985	0.55	0.57	0.48	0.29
1986	0.60	0.55	0.48	0.25
1987	0.62	0.59	0.49	0.17
1988	0.64	0.60	0.51	0.22
1989	0.67	0.60	0.51	0.22
1990	0.67	0.60	0.52	0.21
1991	0.69	0.63	0.53	0.25
1992	0.77	0.67	0.56	0.28
1993	0.77	0.65	0.56	0.29
1994	0.78	0.67	0.56	0.27
1995	0.82	0.71	0.56	0.27
1996	0.83	0.65	0.56	0.25
1997	0.83	0.64	0.56	0.22
1998	0.85	0.59	0.55	0.23
1999	0.89	0.62	0.55	0.25
2000	0.89	0.62	0.55	0.26
2001	0.91	0.64	0.55	0.27
2002	0.91	0.68	0.54	0.30

Author's own calculation based on Piazolo (1997)'s specification.

a. Mainland China is the exporting economy (country j) and Hong Kong or Macau is the importing economy (country k). Statistics on trade by commodities on SITC rev3 one-digit level are extracted from the Asian Development Banks' online database. Macau's statistics are extracted from the Statistical Yearbook of Macau, various issues.
b. Mainland China is the importing economy (country k) and Hong Kong or Macau is the exporting economy (country j).

As exhibited in Table 4.9, there is an upsurge in the complementarity indices and in line with this pattern, trade between Mainland China and Hong Kong for both imports and exports has become increasingly complementary in nature. In addition, Mainland China's exports have been matching Hong Kong's imports more intensively over time and it may be a signal of a better exchange in comparative advantages between the two economies.

Similar increasing pattern can also be found in Dale (1997)'s calculation[60] in which the index has been increasing from 0.63 in 1983 to 1.19 in 1990 and 1.28 in 1994.

Apart from the complementary pattern, the value of the index is also comparable to the corresponding indices associated with those fully integrated economies. In 1997, the trade complementarity indices between the founding members of the EEC, between Canada-USA and between CEECs exports and EU imports were 0.53, 0.64 and 0.71[61] respectively. The index between Mainland China and Hong Kong, meanwhile, was 0.83 (or 0.56 when an alternative measurement is used). Since the index does not only exceed 0.5, but also has a value higher than that of the EU's and the US's, it can be viewed that the degree of trade integration between Mainland China and Hong Kong is not looser than any other famous trade blocs in the world.

In contrast, given the smaller size of the index, the trade relationship between Mainland China and Macau is less complementary in nature than the one between Mainland China and Hong Kong. Nevertheless, the Mainland China-Macau index, which was 0.64/0.22 in 1997, is still comparable to the indices associated with any other successful trade blocs in the world. However, unlike that of Hong Kong, the Mainland China-Macau index does not carry a distinct increasing pattern over time. It implies that the trade pattern between Mainland China and Macau was rather stable in the past two decades.

To conclude, the analysis on trade intensity and complementarity indices of Mainland China-Hong Kong and Mainland China-Macau exhibits an intensive trade relation between these economies, as well as a matching of Mainland China's exports with both Hong Kong's and Macau's imports. It shows that Mainland China is more tightly connected with Hong Kong and Macau than the other trade partners with respect to trade contact. As the trade linkages, especially for the one between Mainland China and Hong

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60 In Dale (1997), the trade complementarity index is specified as: $C_{ij} = \sum_{k=1}^{n}\left[(X_i^k / X_j)\times(T/T^k)\times(M_i^k / M_j)\right]$ in which X_i^k is country i's exports of product k, M represents imports and T is the world's total imports.

61 Piazolo (1997), p.279.

Kong, have become increasingly complementary, these economies may be able to better utilize their comparative advantages during the process of trade. Finally, the presence of an intensive trade contact and a complementary trade linkage, as suggested by Dale (1997) and Piazolo (1997), implies a high degree of trade integration between these economies.

4.2. Foreign Direct Investment

Apart from international trade, cross border direct investment is another important economic contact between different countries. FDI is considered as a significant economic factor because it is able to reshape the economic structure of both the capital outgoing and incoming countries, as well as to derive mutual benefits for both of these economies. Apart from the acceleration of structural adjustment, it is also possible for FDI to generate additional trade and bring about further economic integration between the capital outgoing and incoming countries. To study the FDI flows, therefore, has become a necessary procedure in the process of analyzing the degree of economic integration between different countries.

4.2.1. Foreign Direct Investment in Mainland China

The inward actually used foreign direct and other investments to Mainland China by different countries are presented in Table 4.10. Since the economic reforms in 1978, Mainland China has been receiving a stable stream of investment from a couple of countries among which Hong Kong is the biggest investor. In 2002, a sum of USD19.17 billion has been invested by Hong Kong, which makes up 35% of the total inward actually used foreign capital of Mainland China in the year. From 1985 to 2002, a sum of USD211.76 billion's foreign direct and other investments has entered Mainland China from Hong Kong, which has made up of 44.5% of the USD476.26 billion total FDI that Mainland China has received ever since 1979. The second largest foreign investor of Mainland China in 2002 was the United States, but it has only injected USD5.56 billion which accounted for 29% of Hong Kong's or 10% of Mainland China's total FDI in 2002. In the meantime, the total inward FDI made by the United Stated has amounted to USD40.23 billion, which was equivalent to 19% of Hong Kong's or 8% of Mainland

China's total by 2002. The third to the sixth largest investors in Mainland China were Japan, Taiwan, Singapore and Korea respectively in 2002. For the European countries such as Germany, France and the UK, the amount of FDI that they have contributed to Mainland China is less significant when compared to the other investors.

Table 4.10: Mainland China's Actually Used Foreign Direct and Other Investment by Country, USD 100 million

Year	Hong Kong[a]	Macau	USA	Taiwan	Japan	Singapore	Korea	Total[b]
1979-82								17.67
1985	9.56	n.a.	3.57	n.a.	3.15	0.10	n.a.	19.56
1991	25.79	0.83	3.31	4.72	6.10	0.58	n.a.	46.66
1995	201.85	4.40	30.84	31.65	32.12	18.61	10.47	378.06
1996	208.52	6.06	34.44	34.82	36.92	22.47	15.04	421.35
1997	215.51	4.03	34.61	33.42	43.90	26.07	22.28	523.87
1998	194.00	4.39	41.74	30.51	34.44	34.04	18.04	475.57
1999	174.02	3.38	42.23	27.59	30.64	26.43	12.80	424.47
2000	167.29	3.82	43.85	25.37	30.61	21.73	15.00	493.56
2001	179.35	3.54	45.42	33.72	45.09	21.45	21.55	496.72
2002	191.70	5.02	55.56	44.15	43.56	23.39	27.29	550.11
Sum	2117.59	48.47	402.26	344.04	369.06	214.89	154.76	4762.61
			Average growth rate, %					
1986-90	19.26	n.a.	8.51	n.a.	21.01	56.21	n.a.	14.87
1991-02	29.91	31.43[c]	36.24	39.71	22.84	54.06	48.29[d]	32.44
1986-02	26.78	n.a.	28.08	n.a.	22.30	54.69	n.a.	27.27

Sources: Statistical Yearbook of China, various issues.

a. The statistics from 1985 to 1990 are the sum of Hong Kong and Macau's FDI and Foreign Other Investment.
b. Total Actually Used Foreign Direct and Other Investment of Mainland China.
c. The average growth rate of 1992 to 2002.
d. The average growth rate of 1993 to 2002.

Although Hong Kong is still the largest investor of Mainland China, the amount of FDI from Hong Kong has been expanding at a pace that is slower than the other countries. As indicated in the lower part of Table 4.10, from 1986 to 1990, FDI from Hong Kong was expanding at an average rate of 19.3% a year, and this pace has accelerated further to almost 30% since the 90s. Such speed of expansion, however, was still significantly slower than that of Singapore, Korea, Taiwan and even the United States in which their FDI to Mainland China was growing at an annual rate of 54.06%, 48.29%, 39.71% and 36.24% respectively from 1991 to 2002. The result is a drop of Hong Kong's share in

Mainland China's FDI stock. In Table 4.11, it can be observed that the FDI share of Hong Kong has risen from 48.86% in 1985 to 68.34% in 1987. Then it has started to decline from over 60% in the late 80s to less than 60% in the early 90s. In 1996, the FDI share of Hong Kong has diminished to 49% and has contracted further to 34.85% in 2002, which was only half of the share in 1987. In fact, not only Hong Kong, but also the United States and Japan have encountered the phenomenon of declining share in FDI in Mainland China. In the case of the US, its FDI share has fallen to 10.1% in 2002 from its peak of 18.26 in 1985 and that of Japan's has also dropped from 16.11% in 1985 to 7.92% in 2002. Simultaneously, FDI from Singapore and Korea has experienced a rapid growth since the 90s. For Singapore, its FDI share has boosted from 0.52% in 1985 to 4.25% in 2002 and in light of Korea, the share has climbed up from 1.07% in 1992 to 4.96% in 2002. Such development pattern indicates that Mainland China has had a success in attracting FDI from countries other than those traditional investors, such as the United States and Japan. Another possibility is that international investors do not want to make use of Hong Kong, but rather invest directly in Mainland China for efficiency consideration. Consequently, the FDI share of some countries in Mainland China has increased at the expense of a drop in Hong Kong's FDI share.

Table 4.11: Composition of Mainland China's Actually Used Foreign Direct and Other Investment by Country, %

Year	Hong Kong[a]	Macau	USA	Taiwan	Japan	Singapore	Korea	Sum[b]
1985	48.86	n.a.	18.26	n.a.	16.11	0.52	n.a.	83.75
1991	55.27	1.77	7.09	10.11	13.06	1.25	n.a.	88.56
1995	53.39	1.16	8.16	8.37	8.50	4.92	2.77	87.27
1996	49.49	1.44	8.17	8.26	8.76	5.33	3.57	85.03
1997	41.14	0.77	6.61	6.38	8.38	4.98	4.25	72.50
1998	40.79	0.92	8.78	6.42	7.24	7.16	3.79	75.10
1999	41.00	0.80	9.95	6.50	7.22	6.23	3.02	74.70
2000	33.90	0.77	8.88	5.14	6.20	4.40	3.04	62.34
2001	36.11	0.71	9.14	6.79	9.08	4.32	4.34	70.49
2002	34.85	0.91	10.10	8.03	7.92	4.25	4.96	71.02

Sources: Statistical Yearbook of China, various issues.

a. The statistics from 1985 to 1990 are the sum of Hong Kong's and Macau's.

b. The sum of columns 2 to 8.

To shed lights on the magnitude of the foreign direct and other investment paid by Hong Kong and Macau, Table 4.12 indicates that the inward FDI from Hong Kong had growing importance on the Mainland China economy. The ratio of inward FDI from Hong Kong to Mainland China's GDP has been surging from 0.31% in 1985 to 3.75% in 1994. But afterwards this ratio has started to decline to 1.6% in 2002. As for the ratio of Hong Kong's outward FDI in Mainland China to Hong Kong's GDP, it has been increasing in the 80s with 3 exceptional years of 1989 to 1991, it then regained momentum in the early 90s. However, after arriving at its peak of 15% in 1994, this ratio has started to shrink to 11.87% in 2002. Nevertheless, comparing with the situation in the 80s, Hong Kong's outward FDI in Mainland China has not only become more important for the territory, but it has also brought about a significant contribution to the Mainland China economy.

Table 4.12: The GDP share of Mainland China's Actually Used Foreign Direct and Other Investment by Country, %

Year	Mainland China's FDI[a] to its GDP	HK's FDI[b] to Mainland China's GDP	HK's FDI[b] to HK's GDP	Macau's FDI to Mainland China's GDP	Macau's FDI to Macau's GDP
1985	0.64	0.31	2.73		
1991	1.15	0.66	2.97	0.02	2.18
1995	5.40	2.95	14.36	0.06	6.33
1996	5.16	2.63	13.43	0.07	8.73
1997	5.83	2.44	12.50	0.04	5.75
1998	5.03	2.10	11.82	0.05	6.75
1999	4.28	1.79	10.89	0.03	5.51
2000	4.57	1.58	10.13	0.04	6.17
2001	4.22	1.56	11.02	0.03	5.70
2002	4.35	1.55	11.87	0.04	7.42

Sources: Statistical Yearbook of China, various issues.
a. Mainland China's total inflow of actually used foreign direct and other investment.
b. The statistics from 1985 to 1990 are the sum of Hong Kong's and Macau's.

In relation to Macau's outward FDI in Mainland China, its development is rather stable without any sharp fluctuations since the 90s. As shown in the last two columns of Table 4.12, the ratio of inward FDI from Macau to Mainland China's GDP has been growing in the early 90s, then started to drop after 1993 and has been moving around narrowly from 0.03% to 0.05% since 1997. Similar development pattern is followed by the ratio of

Macau's outward FDI in Mainland China to Macau's GDP and after standing at over 10% in 1993, the ratio has started to decline and has been moving within a narrow range of 5% to 7%.

4.2.2. Foreign Direct Investment in Hong Kong and Macau

As for the direct investment that Hong Kong and Macau have received from Mainland China, according to the limited statistics provided by the Hong Kong government in its press release, by the end of 1995, Hong Kong has hosted 6% more inward direct investment relative to the year before, amounting to USD62.47 billion at market value in the non-manufacturing sectors. The UK was the most important source of foreign capital for Hong Kong and it has invested USD18.35 billion, accounting for 29% of the total in the year. The 2nd to the 4th positions was held by Mainland China, Japan and the United States, with their investment accounting for 21%, 14% and 12% of the total. After the handover together with an adjustment in the estimation method, the composition of Hong Kong's incoming foreign capital has shown a major adjustment and according to the latest press release published by the Hong Kong government, the tax heavens, namely the British Virgin Island and Bermuda were the two largest sources of foreign capital for the territory. Among the USD379.54 billion at market value FDI that Hong Kong has received in 2003, 31.6% and 8.6% of the capital came from the above-mentioned tax heavens respectively and Mainland China ranked the third, with a contribution of 26% to the total FDI. The Netherlands and the United States ranked the 4th and 5th position and their investment have accounted for 8.7% and 6.3% of the total. It is noticeable that the direct investment from the British Virgin Islands (BVI) or Bermuda may be the result of re-channeling in which enterprises from Hong Kong or the other countries set up non-operating companies in these offshore financial centers and re-direct their investment back to Hong Kong in order to enjoy tax advances. Direct investments from BVI or Bermuda, therefore, may cover funds from local businessmen or capital from Mainland China.

In view of Macau, the stock of inward direct investment has increased by 10.06% from 2002 to USD3.58 billion in 2003 and an inflow of USD0.4 billion was recorded in the same year. On the composition of this stock of foreign capital, 72% of it came from Hong Kong, 12.4% came from Mainland China and 9.6% came from Portugal. Hong Kong was therefore the most important source of inward foreign capital of Macau. In light of the flow of foreign capital, Hong Kong has invested the most, with a share of 54% of the total in 2003. Mainland China was the 2nd largest with a share of 16.5% in the year and the 3rd position was held by Portugal with a share of 6.5%.

To sum up, the inward FDI statistics of Hong Kong and Macau suggest that their capital transactions with Mainland China are not developing in just a single direction. Mainland China has benefited from the direct investment made by or through Hong Kong and Macau. Simultaneously the country is also an important investor for both of the SARs. The capital transactions between these economies are rather tight and also ever expanding, especially after the handover.

4.2.3. Foreign Direct Investment in Guangdong

Since Guangdong is adjacent to Hong Kong and Macau, it is believed that similar to trade transactions, the province should be able to absorb a considerable portion of Hong Kong's and Macau's outward FDI. As indicated in Table 4.13, Guangdong has been receiving inward FDI from different regions and countries since the economic reforms and amongst all, Hong Kong was the one that has invested the most in 2002. The accumulated amount of inward FDI from Hong Kong has summed up to USD84.8 billion since 1985, which has accounted for 68% of the USD124.9 billion accumulated FDI that Guangdong has ever received. The second place was occupied by Taiwan and it has invested a sum of USD4.77 billion from 1988 to 2002. The third and the fourth position have gone to Japan and Singapore respectively. As for the composition of FDI by countries, in 2002, over 50% of the inward FDI in Guangdong came from Hong Kong, followed by the 6% from the US, the 4.9% from Taiwan and the 4% from Japan. It reconfirms Hong Kong's leading position in Guangdong with respect to its outward FDI in the province.

Table 4.13: Value and Composition of Guangdong's Actually Used Foreign Direct Investment by Country, %

Year	Total USD100 million	Share, %						
1979	0.31	HK*	Macau	Tai-wan	Japan	Sing-apore	Korea	USA
1980	1.23							
1985	5.15	87.37						
1991	18.23	74.42	5.05	6.01	4.35	0.39	0.07	5.39
1995	101.80	78.31	2.47	3.53	4.14	2.22	0.23	3.30
1996	116.24	72.15	2.97	4.08	4.72	3.57	0.76	2.31
1997	117.11	72.00	2.08	3.88	3.88	3.15	0.22	2.92
1998	120.20	67.63	1.95	2.92	3.25	2.16	0.48	2.38
1999	122.03	60.14	1.64	3.85	4.36	2.66	1.48	2.48
2000	122.37	60.87	2.14	4.07	2.52	4.01	1.12	5.47
2001	129.72	54.63	1.25	3.78	5.17	3.56	0.62	4.30
2002	131.11	53.23	2.09	4.85	4.02	2.58	0.46	6.14

Sources: Guangdong Statistical Yearbook, various issues.
* The share in the period of 1985 to 1989 are the sum of Hong Kong's and Macau's.

Nevertheless, when the evolution of the FDI share is taken into account, it can be found that the share of Hong Kong's outward FDI in Guangdong has been declining from over 80% in the 80s, to 70% in the mid 90s and gradually to around 50% in the late 90s. Simultaneously, the shares of Japan, Singapore and the United States have experienced a stable expansion over years. It implies that Guangdong is able to attract FDI from other places besides Hong Kong, or may be that foreign investors no longer consider Hong Kong as the gateway to or stepping stone of Mainland China and choose to organize their projects in Guangdong directly. Notwithstanding the declining trend, Hong Kong is still the most important source of FDI for Guangdong.

In light of Macau, its outward FDI in Guangdong has been increasing in the early 90s, but has started to decline since 1997. In 2002, the territory has invested USD0.27 billion in Guangdong, and its total FDI has accumulated to USD2.76 billion, accounting for 2.2% of Guangdong's accumulated FDI. On the share of Macau's outward FDI in Guangdong, it has once arrived at a share of 5% in 1991, then began to fall to around 3% in 1994 and has been staying at around 2% since 1997.

Table 4.14: Inward Actually used FDI in Guangdong as a percentage of Mainland China's total by Country, %

Year	Investment in Guangdong as a % of total FDI made in Mainland China							GD's share*
	HK	Macau	Tai-wan	Japan	Sing-apore	Korea	USA	
1983								26.77
1985								26.34
1991	52.60		23.22	13.01	12.16		29.73	39.07
1995	39.50	57.17	11.36	13.11	12.14	2.22	10.89	26.93
1996	40.22	56.99	13.62	14.86	18.47	5.88	7.79	27.59
1997	39.13	60.50	13.58	10.35	14.14	1.16	9.87	22.35
1998	41.90	53.30	11.51	11.33	7.64	3.20	6.85	25.28
1999	42.17	59.41	17.01	17.37	12.27	14.15	7.17	28.75
2000	44.52	68.35	19.61	10.08	22.61	9.11	15.27	24.79
2001	39.51	45.92	14.54	14.88	21.51	3.75	12.27	26.12
2002	36.41	54.60	14.40	12.10	14.43	2.23	14.49	23.83
Average	40.40	56.06	15.67	10.62	15.31	4.51	12.65	28.37

Sources: Guangdong Statistical Yearbook, various issues.
* Guangdong's inward FDI as a percentage of Mainland China's total.

As for the share of Guangdong's inward FDI in Mainland China, according to the last column of Table 4.14, the province has received more than one fourth of Mainland China's total FDI since the economic reforms. The FDI share of Guangdong has once arrived to 39% in 1991, but has been reducing in the recent years to 24% in 2002. In columns 2 and 3, it shows that most of the outward FDI from Hong Kong and Macau to Mainland China were made to Guangdong. The percentage share is rather stable over the years with an average share of 40% and 56% for Hong Kong and Macau respectively. These two shares are also significantly higher than the other countries. It can be interpreted as apart from trade, there is a tight linkage between Guangdong, Hong Kong and Macau with respect to FDI, and most of the outward FDI from the SARs to Mainland China are utilized in Guangdong. While investors from Hong Kong and Macau have placed their emphasis on Guangdong, investors from the other countries, for example, Korea, Singapore and Taiwan, have started to diversify their investment to other provinces of Mainland China. As a result, it can be found that the FDI share of these countries in Guangdong have started to fall since the late 90s. It has led to a contraction of the FDI share of Guangdong in Mainland China.

Table 4.15: The GDP share of Guangdong's Actually Used FDI by Country, %

Year	GD's FDI[a] to GD's GDP	HK's FDI[b] to GD's GDP	HK's FDI[b] to HK's GDP	Macau's FDI[c] to GD's GDP	Macau's FDI[c] to Macau's GDP
1981	1.02				
1985	2.62	2.29	1.29		
1991	5.12	3.81	1.56	0.26	2.43
1995	14.83	11.61	5.67	0.37	3.62
1996	14.82	10.70	5.40	0.44	4.98
1997	13.27	9.55	4.89	0.28	3.48
1998	12.57	8.50	4.95	0.24	3.60
1999	11.93	7.18	4.59	0.20	3.27
2000	10.48	6.38	4.51	0.22	4.22
2001	10.08	5.51	4.35	0.13	2.62
2002	9.22	4.91	4.32	0.19	4.05
Average	6.96	6.48	3.48	0.28	3.44

Sources: Guangdong Statistical Yearbook, various issues.
a. Guangdong's total inward FDI.
b. Hong Kong's outward FDI in Guangdong.
c. Macau's outward FDI in Guangdong.

To further illustrate the magnitude of the FDI flows to Guangdong, Hong Kong and Macau, various FDI to GDP ratios are measured and summarized in Table 4.15. In the second column, the ratio of Guangdong's total inward FDI to its GDP is presented and it carried an increasing trend since 1979 with its value increasing from 0.23% in 1979 to 3.15% in 1989 and 17.93% in 1994. Afterwards, the ratio has been falling continuously to around 9% in 2002. The ratio of inward FDI from Hong Kong to Guangdong's GDP is shown in column 3. Following the growth of inward FDI from Hong Kong, the ratio has been increasing from 2.29% in 1985 to its peak of 14.82% in 1994, and then began to drop to 4.91% in 2002. That is, Hong Kong's outward FDI in Guangdong is equivalent to around 5% of Guangdong's GDP. In relation to Hong Kong, it has just invested about 1.6% of its GDP to Guangdong in the 80s and the outward FDI to GDP ratio has been escalating since then to its peak of 5.88% in 1994. Then the ratio has started to diminish after the mid 90s and Hong Kong's has invested around 4% of its GDP in Guangdong in

2002. As for Macau, the ratios of Macau's outward FDI in Guangdong to the province's GDP and Macau's outward FDI in Guangdong to Macau's GDP carried an increasing trend before 1996 and since then, these ratios have been declining. This development pattern is very similar to that of Hong Kong's.

Given the reducing GDP share, it seems that the significance of cross-border FDI has been diminishing since the mid 90s, for Guangdong, Hong Kong and Macau from a static point of view. Nevertheless, the FDI to GDP ratio can only be viewed as a relative measurement on the size of FDI. This ratio, meanwhile, fails to reflect neither the productivity of FDI nor the contribution of FDI to the pace of economic growth and development. Therefore, it is inappropriate to conclude that FDI has lost its importance in Guangdong, Hong Kong and Macau.

4.2.4. FDI Intensity Index

In Zhang (2003), the FDI intensity index (FDIII), which was developed from the trade intensity index, was introduced to assess the bilateral relation between the capital outgoing and incoming economies on FDI. The index was defined as the ratio of the share of country i's outgoing FDI in country j's total incoming FDI, to the share of country i's total outgoing FDI in the world's total outgoing FDI. Similar to the trade intensity index, if the FDIII exceeds one, then country i invests intensively in country j. In Lee (2001), a different definition on FDIII could be found and the index was measured by adjusting for the host country's share in total world FDI. The other FDI related indices include the Inward FDI Performance Index, the Outward FDI Performance Index and the Inward FDI Potential Index as introduced by the United Nations Conference on Trade and Development (UNCTAD). The first two indices are measured as the ratio between the inward or outward FDI share of country i in the world's corresponding FDI flow and the share of country i in the world's GDP. For the last index, it is estimated based on a couple of factors, such as GDP per capita, rate of GDP growth, export share in GDP, etc., which could influence the attractiveness of the country in acquiring inward FDI. These UNCTAD indices contribute to exhibit the strength of a country in attracting or organizing inward and outward FDI, but could not reflect the extent of FDI development between a pair of countries.

In light of the FDIII measured in Zhang (2003) and Lee (2001), it depicts the bilateral intensity of FDI transactions and is able to show whether country i has made a disproportionately large amount of investment in country j relative to country i's investment in the rest of the world. Nevertheless, the FDIII will not be considered in this research due to the fact that the trade intensity index, which carries a similar structure as Zhang (2003)'s FDIII, has already been discussed and analyzed in the previous section. The trade intensity index has indicated a tight trade linkage between Mainland China, Hong Kong and Macau. In the meantime, Zhang and Felmingham (2001) and Liu, Burridge and Sinclair (2002) have identified cointegrating relationship between trade and inward FDI of Mainland China. Then an intensive trade relationship may probably imply an intensive FDI relationship and the FDIII will not be considered separately. Furthermore, as the per capita RGDP of Mainland China, Hong Kong and Macau will be discussed directly in examining the issues of comovement and economic integration, the FDIII, which can only reflect indirectly the extent of integration, will not be measured and discussed.

4.3. Human Flows

In addition to those tangible transactions of merchandizing trade and FDI, human mobility has also played a non-negligible role in the process of economic integration. It implies not only an increase in services' trade, but could also help to accelerate the exchange and transfer of knowledge and experiences, which could have contributed to the growth and transition of the economies involved.

4.3.1. Human Flows between Mainland China, Hong Kong and Macau

Table 4.16: Mainland China's Total Number of Visitors' Arrival, 10,000

Year	Mainland China's total	of which from HK, Macau & Taiwan	*% share*	Guang-dong	of which from HK & Macau	*% share*	Guangdong's share of Mainland China's total %*
1981	777	705	*90.81*				
1985	1783	1637	*91.80*				
1991	3335	3051	*91.47*	2750	2592	*94.24*	82.45
1995	4639	4038	*87.06*	3615	3364	*93.06*	77.93
1996	5113	4423	*86.51*	4003	3698	*92.38*	78.29
1997	5759	5006	*86.93*	4545	4214	*92.71*	78.93
1998	6348	5625	*88.61*	5157	4816	*93.39*	81.24
1999	7280	6426	*88.27*	5923	5521	*93.21*	81.37
2000	8344	7321	*87.73*	6729	6254	*92.94*	80.64
2001	8901	7779	*87.39*	7256	6745	*92.95*	81.52
2002	9791	8447	*86.27*	8033	7471	*93.01*	82.04

Sources: Statistical Yearbook of China, Guangdong's Statistical Yearbook, various issues
* Guangdong's total number of visitors as a share of Mainland China's total

Table 4.17: Hong Kong and Macau's Total Number of Visitors' Arrival, 10,000

Year	Hong Kong	Of which visitors from Mainland China	% share	Macau *	Of which visitors from HK	% share	Of which visitors from Mainland China	% share
1985				418	344.26	*82.32*	0.63	*0.15*
1991	680	88	*12.88*	749	616.14	*82.28*	1.52	*0.20*
1995	1020	224	*21.99*	775	561.75	*72.46*	54.32	*7.01*
1996	1170	231	*19.75*	815	520.56	*63.86*	60.42	*7.41*
1997	1041	230	*22.07*	700	470.25	*67.17*	52.98	*7.57*
1998	957	260	*27.13*	695	472.18	*67.95*	81.68	*11.76*
1999	1133	321	*28.30*	744	422.98	*56.82*	164.52	*22.10*
2000	1306	379	*28.99*	916	495.46	*54.08*	227.47	*24.83*
2001	1373	445	*32.41*	1028	519.61	*50.55*	300.57	*29.24*
2002	1657	683	*41.20*	1153	510.14	*44.24*	424.04	*36.77*

Sources: Hong Kong Monthly Digest of Statistics, Macau's Statistical Yearbook, various issues.
* The figures from 1984 to 1990 are visitors' arrival by sea.

Table 4.18: Hong Kong Residents Departures by Destination, 10,000

Year	All destinations	Mainland China	% share	Macau	% share
1981	862.65	453.75	*52.60*	301.59	*34.96*
1985	1581.30	1096.07	*69.31*	371.64	*23.50*
1991	2631.86	1905.68	*72.41*	520.82	*19.79*
1995	3444.27	2643.97	*76.76*	498.04	*14.46*
1996	3713.96	2879.21	*77.52*	490.24	*13.20*
1997	4160.51	3367.76	*80.95*	416.96	*10.02*
1998	4759.43	3914.05	*82.24*	425.71	*8.94*
1999	5314.37	4517.52	*85.01*	379.38	*7.14*
2000	5890.11	5008.31	*85.03*	420.69	*7.14*
2001	6109.59	5200.29	*85.12*	429.36	*7.03*
2002	6454.01	5564.84	*86.22*	418.24	*6.48*

Source: Hong Kong Monthly Digest of Statistics, various issues.

As reported in Tables 4.16, 4.17 and 4.18, the human flows between Mainland China, Hong Kong and Macau are enormous, as well as ever expanding since the economic reforms. In the case of Mainland China, in 2002, over 8.4 million or 85% of its visitors came from Hong Kong, Macau and Taiwan. Without taking Taiwan into account, visitors from the SARs have still made up over 80% of the country's total. This flow, meanwhile, has got no tendency to contract as well. Between 1979 and 1990, an average growth rate of over 30% was recorded for the total number of visitors from Hong Kong, Macau and Taiwan. A double-digit growth rate of 10.53% was also observed in the period of 1991 to 2002. These two rates are very close to Mainland China's total visitors' growth rate, at 29.44% and 11.26% in these two periods. Amongst all the Chinese provinces, Guangdong, which is adjacent to the SARs, is the most popular destination for visitors. In 2002, the province has welcomed over 7.5 million of Hong Kong and Macau visitors, which has accounted for over 90% of the province's total number of visitors or 76% of the country's total visitors. From 1989 to 2002, the number of visitors from Hong Kong and Macau were expanding at 9.6% a year. As shown in the last column of Table 4.16, Guangdong is an important window of the country and every year, the province has entertained over 80% of the country's total number of visitors. The total number of visitors arriving Guangdong were growing at 9.82% a year in the period of 1989 to 2002.

In light of Hong Kong and Macau, as indicated in Table 4.17, since the economic reforms, these SARs have entertained an increasing number of visitors from Mainland China. In 1987, there were less than 0.5 million and 5000 visitors from Mainland China arriving the two territories respectively. The economic reforms and improved living standard of Mainland China, the liberalization policies imposed by Mainland China's authorities together with the economic integration have brought about a growing number of tourists from the Mainland to the SARs. From 1988 to 2002, the total number of visitors arriving Hong Kong were growing at 8.93% a year, of which those from Mainland China were expanding at a 2 digit rate of 20.32% a year. As for Macau, total number of visitors and visitors from Mainland China were increasing at 5.18% and 93.65% respectively in the period of 1985 to 2002. Visitors from Hong Kong, on the contrary, could only manage to increase at 1.65% a year. In 2002, there were over 6.8 million and 4.2 million visitors from Mainland China arriving Hong Kong and Macau, representing 41.2% and 36.77% of the total arrivals of these two SARs respectively. Mainland China has also replaced Japan and the United States or Hong Kong to be the most important market of the tourist industry for both Hong Kong and Macau.

Since the mid 90s, Mainland China has been the most important market of the tourist sector for both Hong Kong and Macau. The country, at the same time, is also the most popular destination for Hong Kong residents. As stated in Table 4.18, in the early reform years, only half of the Hong Kong residents have chosen Mainland China to be their visiting destination. In line with the economic reforms and the open door policies, a growing number of Mainland China residents have migrated to Hong Kong (at a rate of 150 persons per day). Meanwhile, more and more Hong Kong residents, including those new immigrants, have chosen Mainland China to be their destination when they travel. From 1982 to 1990, this flow was growing at 12.77% a year which was ahead of the growth rate of traveling residents by 2.37 percentage point. Although the growth rate has slowed down to 9.48% in the period of 1991 to 2002, it was still higher than the 7.93% growth rate of traveling residents. In 2002, the total number of times for Hong Kong residents visiting Mainland China was recorded at 55 million, which was more than double the figures of 1992. In addition, this figure suggests that each Hong Kong resident has visited Mainland China for more than 8 times in a year on the average. In relation to the human flow between Hong Kong and Macau, as shown in column 5, after a decade of rapid expansion, the development of this flow has started to stagnate, then decline at a rate of 1.88% since 1991 in contrast to the growth rate of 5.54% for the period of 1982 to 1990. In the recent few years, there are approximately 4 million Hong Kong residents visiting Macau each year.

4.4. Parametric Analysis on the Economic Integration between Mainland China, Hong Kong and Macau

4.4.1. Correlation of RGDP per capita

Apart from directly utilizing the trade intensity and trade complementarity indices, there exists an alternative and indirect method which makes use of business cycles to estimate the degree of economic integration between different economies. Frankel and Rose (1996) suggested that trade integration tends to tighten the correlation of business cycles. Correlated or synchronized business cycle, meanwhile, is viewed as an evidence of integrated economies. Therefore, by examining whether the business cycles of a couple of economies are comoving or synchronized, given they have built up intensive trade and investment connections, it is then possible to show if these group of economies have integrated economically. For this reason, business cycles correlation could be regarded as an indirect indicator of measuring whether economic integration has been achieved by a group of economies.

To measure the interrelationship or connection between different variables, the correlation matrix is a conventional and direct way of showing how close one factor is related to another. Even the correlation matrix does not offer to distinguish cause and effect, it is still being widely applied to express the connection between different factors in one economy, or the linkage of the same factor in different economies. Yao (1996) has utilized the correlation matrix to measure the linkage of income level in different sectors of Mainland China. Correlation matrices were also estimated in Ling (2001) to show the interrelationship of inflation rate and growth rate across different Asian economies. This technique has also been used in Anoruo, Ramchander and Thiewes (2002) and Xu (2002). The former analyzed the interconnection of short-term interest rate across a series of countries, while the later estimated the correlation of business cycle for different Chinese provinces.

In practice, the correlation matrix can be applied to measure the conventional connection of income levels between different economies. If the income level of an economy has a tight linkage with that of another, then these two economies may have correlated or even synchronized business cycles. Highly correlated per capita income or business cycles may turn out implying the achievement of economic integration at a certain extent.

To examine the correlation of business cycles between Mainland China and the SARs, correlation matrices will be established to estimate the relationship of the logged RGDP per capita between Mainland China, its geographical regions, Guangdong, Hong Kong and Macau. In estimating the correlation matrix, the entire sampling period of 1961 to 2002 will also be divided into the sub-periods of 1961 to 1978 and 1979 to 2002. The shortening of the sampling period may result in a reduction in the significance of the estimation results. Subject to the fact that the economic development of Mainland China has gone through a major transition in 1978 from a planned to a market-oriented economy, it is still necessary to break down the sampling period to pre- and post-reform periods to examine the differences in the development of economic linkages before and after the economic reforms.

If the correlation coefficient between Mainland China and Hong Kong has experienced a rapid growth, it implies that these two economies have had a closer economic correlation, particularly in the aspect of per capita income, and the income level of one tends to be closely related to that of another. Subsequently, these two economies tend to comove.

Table 4.19: Correlation of logged RGDP per capita in USD by Regions

Panel A:

1961-1978	Mainland China	Coast	Central	West	Hong Kong
Mainland China	1.0000				
Coast	0.9929	1.0000			
Central	0.9916	0.9771	1.0000		
West	0.9619	0.9571	0.9553	1.0000	
Hong Kong	0.8991	0.9401	0.8577	0.8657	1.0000
1979-2002					
Mainland China	1.0000				
Coast	0.9986	1.0000			
Central	0.9973	0.9985	1.0000		
West	0.9988	0.9952	0.9950	1.0000	
Hong Kong	0.9263	0.9141	0.9004	0.9293	1.0000

Panel B:

1961-1978	Mainland China	Coast	Guangdong	Hong Kong
Mainland China	1.0000			
Coast	0.9929	1.0000		
Guangdong	0.9531	0.9490	1.0000	
Hong Kong	0.8991	0.9401	0.8863	1.0000
1979-2002				
Mainland China	1.0000			
Coast	0.9986	1.0000		
Guangdong	0.9976	0.9967	1.0000	
Hong Kong	0.9263	0.9141	0.9412	1.0000

Panel C:

1982-2002	Mainland China	Coast	Guangdong	Hong Kong	Macau
Mainland China	1.0000				
Coast	0.9992	1.0000			
Guangdong	0.9966	0.9949	1.0000		
Hong Kong	0.8712	0.8618	0.9057	1.0000	
Macau	0.7924	0.7791	0.8344	0.9707	1.0000

Author's calculation based on the RGDP per capita in USD at 1995 price and exchange rate of the economies in consideration. RGDP per capita come from the Statistical Yearbook of China, the Statistical Yearbook of Macau and the Hong Kong Monthly Digest of Statistics in various issues.

As depicted in the panels of Table 4.19, given a correlation coefficient of over 0.95, there is a high degree of income correlation between all these Chinese regions in both the pre-and post-reform periods. This evidence suggests that the per capita RGDP of these Chinese geographical regions are probably comoving, especially in the post-reform period. In Panel A, the figures have exhibited a closer bilateral correlation between the coastal and central regions and the national average in the pre-reform period. Then the economic reforms have allowed the western region of Mainland China to develop in line with the other regions, and also with the national average. As stated in Panel A, the income correlations between the western region and the whole country or the other regions have experienced a jump after the economic reforms, when certain preferential policies were granted to the region. In addition, the reforms and open door policies have also tightened the income correlation between Mainland China and Hong Kong, and the coefficient has increased from 0.8991 in the pre-reform period to 0.9263 in the post-reform period. On the disaggregate level, due to the reform-led increased economic contacts, the income correlation between Hong Kong and the Chinese regions have also become closer since 1979.

When Guangdong is taken into consideration, as shown in Panel B, relative to the other coefficients, the province's income correlation with Hong Kong was almost the lowest in the pre-reform period. It is attributed to the biased policies that had hindered the development of trade and other external economic contacts of this province. As a result, the economic performance of Guangdong was sluggish and its income correlation with Hong Kong was loose. The economic reforms have stimulated the trade and capital flows between Guangdong and Hong Kong, and have reshaped their economic relationship to bring about a significant growth to the correlation coefficient from 0.8863 in the pre-reform period to 0.9412 in the post-reform period. In the meantime, taking advantage of its geographical position, Guangdong has become the economy with the closest income correlation with Hong Kong. The increasingly correlated Guangdong and Hong Kong economies has brought about a growth in the income correlation between the national average and Hong Kong, from 0.8991 in the pre-reform period to 0.9263 in the post-reform period. In contrast, the correlation between Hong Kong and the coastal region was weakened from 0.9401 to 0.9141 after the reforms since the economic activities between Mainland China and Hong Kong have been concentrated in Guangdong.

As displayed in Panel C, in the post-reform period, Hong Kong and Macau are found to have a closer income correlation with Guangdong than with the coastal region or the national average. It can be well explained by the adjacent position of the province as well as the similar cultural background of these economies. Besides, it appears that Guangdong's per capita RGDP has a stronger correlation with that of Hong Kong than that of Macau due to the huge inward investment and trade flows made by the former. In light of Macau, despite its intimate correlation with Mainland China, the costal region and Guangdong, the territory is found to have the tightest income correlation with Hong Kong. It is because both Hong Kong and Macau have been operating under a capitalist economic system for over a hundred years. The economic policies applied in these two economies are also quite similar with no external tariffs, no trade barriers and low tax rate. In addition, Macau has been traditionally utilizing Hong Kong's port and financial system to facilitate its trade related and banking business and for this reason, the territory has a closer income correlation with Hong Kong than with Mainland China.

4.4.2. Cointegration Analysis and Vector Error Correction Model

The conventional study on correlation matrix has displayed an intimate economic correlation between Mainland China, Hong Kong and Macau in the post-reform period. To further discuss the issue of economic integration, additional investigation will be performed to examine whether there is an equilibrium relationship on the GDP of Mainland China, Hong Kong and Macau. A cointegration analysis, for this reason, will be organized to identify the number of cointegrating or long-run equilibrium relationships between the output levels of Mainland China, Hong Kong and Macau. Given cointegrated relationships, these economies tend to achieve certain degree of economic integration with their business cycles comoving in the long-run. Besides, according to Zhang, Liu and Yao (2001), if the per capita income level of two or more economies cointegrate, then they were defined as stochastic convergence by Campbell and Mankiw (1989) and Bernard and Durlauf (1995). For this reason, the cointegration test on the per capita RGDP of Mainland China, Hong Kong and Macau does not only offer evidence on the degree of economic integration, but also serves as a proof of stochastic income convergence between them.

Methodology

Cointegration can be interpreted as two or more series being linked to form an equilibrium relationship spanning the long-run. Even if the series themselves contain stochastic trends, they will nevertheless move closely together over time and the differences between them will be stable. If two or more non-stationary data series are integrated, then there is at least one linear combination of these data series in which their sum is stationary.

To test if two data series are cointegrated, the first and compulsory step would be to test for the presence of unit root. Following Siddique and Selvanathan (1998), Thornton (1996, 1997), Islam (1998), Ahmad and Harnhirum (1995), Zhang and Felmingham (2001) and Liu Wang and Wei (2001), a unit root test will be firstly conducted to examine the stationarity of the series. If and only if the data series are non-stationary, it is then possible for them to form a stable long-run relation.

The Engle and Granger (1987)[62] procedure is an alternative and a direct way implemented to test for cointegrated relation. In this procedure, the error term should firstly be estimated by regressing the variables in discussion. Afterwards, the error term in first difference will be regressed on its own lags to examine whether it becomes stationary or not. This process, however, suffers from defects such as its inability in figuring out the number of cointegrating vectors when two or more variables are considered. Besides, if any mistakes are made in the first step, then there will be a problem with the error term and it would eventually cause a misleading conclusion. To overcome these problems, an alternative of Johansen and Juselius (1990) procedure, which places its emphasis on the characteristic roots and the rank of the estimated coefficients in matrix presentation, will be performed in this research.

[62] Please see Pindyckl and Rubinfeld (1998) for more information.

The Johansen and Juselius (1990) is developed based on the Dickey-fuller test in multivariate format of high-order autoregressive process:

$$x_t = A_1 x_{t-1} + A_2 x_{t-2} + \ldots + A_p x_{t-p} + \varepsilon_t \text{ [63]} \tag{4.3}$$

where x_t is the (n x 1) vector $(x_{1t}, x_{2t}, \ldots, x_{nt})$, ε_t is an independently and identically distributed n-dimensional vector with zero mean and variance matrix.

The equation can be re-written into:

$$\Delta x_t = (A_1 - I)x_{t-1} + A_2 x_{t-2} + A_3 x_{t-3} + \ldots + A_p x_{t-p} + \varepsilon_t \ , \tag{4.4}$$

if $(A_1 - I)x_{t-2}$ is added and subtracted, then the above would change to:

$$\Delta x_t = (A_1 - I)\Delta x_{t-1} + (A_2 + A_1 - I)x_{t-2} + A_3 x_{t-3} + \ldots + A_p x_{t-p} + \varepsilon_t \tag{4.5}$$

if the process continues, then:

$$\Delta x_t = \sum_{i=1}^{p-1} \pi_i \Delta x_{t-i} + \pi x_{t-p} + \varepsilon_t \ , \tag{4.6}$$

where:

$$\pi = -\left[I - \sum_{i=1}^{p} A_i \right] \tag{4.7}$$

$$\pi_i = -\left[I - \sum_{j=1}^{i} A_j \right] \tag{4.8}$$

To test whether the rank of the estimated matrix π is zero or with no cointegrating vectors, two test statistics have been introduced:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} \ln(1 - \hat{\lambda}_i) \tag{4.9}$$

$$\lambda_{\max}(r, r+1) = -T \ln(1 - \hat{\lambda}_{r+1}) \tag{4.10}$$

where $\hat{\lambda}_i$ is the estimated values of the characteristic roots obtained from the estimated π matrix.

T is the number of usable observations.

[63] Enders (1995), p.389.

λ_{trace} is used to test the null hypothesis of r=0, a zero rank with no cointegrated relationship, against the H_1 of r=1, 2 or 3... with at least one cointegrated relationship. To test a specific number of cointegrated relationship, $\lambda_{\max}$ is used to test H_0 : r=0 against H_1 of r=1 or r=2. In the examination, it is possible that the two test statistics would bring about conflicting conclusions. $\lambda_{\max}$, however, is the one that carries a more unambiguous null hypothesis.

In the Johansen and Juselius (1990) procedure, emphasis is placed on the rank of the matrix π, which is the number of non-zero characteristic roots. The rank of the matrix represents the number of independent cointegrated vectors. If the variables are not cointegrated, then the rank of the matrix will be zero. This procedure will be employed in this research to estimate if the RGDP per capita of Mainland China, Hong Kong and Macau are cointegrated on both the bivariate and multivariate bases and the number of cointegrating vectors/relations inherited in these data processes. If the RGDP per capita of the three economies are cointegrated, it implies the presence of one or more independent linear relationships formulated by the per capita income of these three economies. In addition, the cointegrated vectors can also be viewed as if the time path of these outputs are linked in the long-run. The business cycles of these economies therefore comove, Mainland China, Hong Kong and Macau have also integrated economically.

In practice, the cointegration test has been widely utilized to identify the long-run relationships between non-stationary time series. In Anoruo, Ramchander and Thiewes (2002), the cointegration analysis was used to examine the linkage of interest rates between the Asian countries and the United States. By applying similar technique, Nieh and Yau (2004) has examined the interest rate relationship between Mainland China, Hong Kong and Taiwan. The cointegration test was also adopted in Cheung and Yuen (2002) to test the bilateral inflation linkage between Hong Kong, Singapore and the United States. In the other researches, such as Ahmad and Harnhirun (1995), Thornton

(1996), Jin (2002), Zhang and Felmingham (2001) and Liu, Burridge and Sinclair (2002), the cointegration test was performed to identify the correlation between export and growth, FDI and growth, and/or FDI and exports in different countries, including Mainland China.

4.4.3. Unit Root Test

As mentioned above, in order to fulfill the pre-condition of the cointegration test, the sampling time series should be non-stationary. If the linear combination of these non-stationary series turns out to be stationary, then these variables are regarded as cointegrated. For this reason, the first step in performing a cointegration test is to estimate if the sampling series carry a unit root. The test results will then determine whether the cointegration analysis can be processed further.

The Dicky-Fuller (DF) test is a popular way of testing for the presence of a unit root. Given a data generation series in the form of:

$$y_t = \rho_a y_{t-1} + u_t \qquad (4.11)$$

The DF test has a unit root null hypothesis of $H_0 : \rho_a = 1$ against the alternative of $H_1 : \rho_a < 1$

The specification can be rewritten into:

$$\Delta y_t = (\rho_a - 1) y_{t-1} + u_t \rightarrow \Delta y_t = \gamma y_{t-1} + u_t \qquad (4.12)$$

A drift and a linear time trend could also be inserted into the specification in order to test for their existence.

$$\Delta y_t = a_o + \gamma y_{t-1} + u_t \qquad (4.13)$$

$$\Delta y_t = a_0 + \gamma y_{t-1} + a_2 t + u_t \qquad (4.14)$$ [64]

A set of critical values are given by the DF distribution in testing the hypothesis of having a unit root.

[64] Enders (1995), p.221.

Extending the DF test to consider a higher order equation, for example:

$$y_t = a_0 + a_1 y_{t-1} + a_2 y_{t-2} + a_3 y_{t-3} + \ldots + a_{p-2} y_{t-p+2} + a_{p-1} y_{t-p+1} + a_p y_{t-p} + \varepsilon_t \quad (4.15)$$

[65]

it is possible to re-write the specification into:

$$\Delta y_t = a_0 + \gamma y_{t-1} + \sum_{i=2}^{p} \beta_i \Delta y_{t-i+1} + \varepsilon_t \ ,$$

$$\text{where } \gamma = -\left(1 - \sum_{i=1}^{p} a_i\right), \beta_i = \sum_{j=i}^{n} a_j \quad (4.16)$$

A drift and a linear time trend can also be inserted into the above augmented Dickey-Fuller (ADF) test. The ADF is different from the simple DF test in that an unknown number of lagged dependent variables in their first difference are presented to capture the auto-correlated omitted variables that would otherwise have entered into the error term. The ADF test will be applied here to test if the sampling series are stationary. The null hypothesis of the ADF test is the presence of one unit root in the data series and it is specified as:

$$\Delta y_t = a_0 + a_1 t + \gamma y_{t-1} + \sum_{i=2}^{p} \beta_i \Delta y_{t-i+1} + \varepsilon_t \quad (4.17)$$

in which y_i is the per capita RGDP of the sampling economies, a_0 is a drift, t is the time trend and γ is the coefficient to be tested, where $\gamma = 0$ is the null hypothesis in the analysis. For the number of lags, p, it is selected by downward search with an initial lag of 15. The lag length is reduced by 1 each time until the lagged variable is significant with no serial-correlation in the estimation.

[65] Enders (1995), p.225.

Table 4.20: Unit Root Test Results on RGDP per capita

ADF test	Level			First Differences		
Country/ Region	intercept/ trend	No. of Lags	Test Statistics	intercept/ trend	No. of Lags	Test Statistics
Pre-Reform Period of 1961-1977						
Mainland China	intercept	1	-0.95	intercept	1	-3.53**
Coastal Region	intercept	1	-1.24	intercept	1	-4.41***
Guangdong	none	1	1.62	none	1	-2.12**
Hong Kong	none	4	0.87	none	4	-1.90*
Entire Sampling Period of 1961-2002						
Mainland China	intercept	1	0.84	intercept	4	-3.09**
Coastal Region	intercept	2	2.43	intercept	2	-3.73***
Guangdong	intercept	1	1.30	intercept	1	-2.97**
Hong Kong	intercept	3	-1.89	intercept	1	-1.97
Macau[a]	none	1	0.98	none	1	-1.98**
PP test	Level			First Differences		
Hong Kong	intercept	3	-0.82	none	13	-1.97**

*, **, and *** Significance at the 10%, 5% and 1% level.
The estimated series are the RGDP per capita in 1995 price converted to USD by using 1995 USD exchange rate.
a: For Macau, the sampling period is from 1982 to 2002.

As summarized in Table 4.20, the ADF test results show that null hypothesis of having a unit root cannot be rejected in the analyses in level in both the pre-reform and the whole sampling periods. It implies that the RGDP per capita of Mainland China, its coastal region, Guangdong, Hong Kong and Macau, all of these series are non-stationary. After taking the 1st difference, the null hypothesis of having a unit root is rejected at either 5% level or 1% level for all the series, except for Hong Kong. It can be interpreted as the RGDP per capita of Mainland China, its coastal region, Guangdong and Macau are all non-stationary in I(1) process. These series could not return to their respective means after a shock and would become stationary only after taking the 1st difference. As for Hong Kong, the ADF test statistics can only reject the unit root hypothesis at 10% level in the pre-reform period. In the entire sampling period, however, the ADF test has failed to reject the unit root hypothesis even in 1st difference. The RGDP per capita of Hong Kong has probably carried more than 1 unit root. To prove, the Phillips Perron test is performed as an alternative analysis and it expresses that the RGDP per capita of Hong Kong is also an I(1) process with one unit root when the entire sampling period is considered.

4.4.4. Cointegration Test

The ADF test results have confirmed the presence of a unit root in the per capita RGDP of Mainland China, its coastal region, Guangdong, Hong Kong and Macau in both the pre-reform and the entire sampling periods. The next step is to apply the Johansen's Cointegration Test to estimate if the linear combination of these non-stationary variables becomes stationary. Then the per capita income levels of these economies tend to move together in the long-run with a stable relationship and these income variables are also regarded as cointegrated.

Table 4.21: Cointegration Test Results

1961-77	Hong Kong-Guangdong			Hong Kong-Mainland China		
H(0)	Max. Eigenvalue test	Trace test	Lags	Max. Eigenvalue test	Trace test	Lags
r=0	12.22	12.50	1	14.14	14.22	1
r=1	0.28	0.28		0.083	0.083	
1978-90	Hong Kong-Guangdong			Hong Kong-Mainland China		
H(0)	Max. Eigenvalue test	Trace test	Lags	Max. Eigenvalue test	Trace test	Lags
r=0	11.04	11.35	1	10.27	11.53	1
r=1	0.31	0.31		1.26	1.26	
1991-02	Hong Kong-Guangdong			Hong Kong-Mainland China		
H(0)	Max. Eigenvalue test	Trace test	Lags	Max. Eigenvalue test	Trace test	Lags
r=0	30.29	33.93**	1	15.05	17.41**	1
r=1	3.64	3.64		2.36	2.36	
1982-02	Macau-Guangdong			Macau-Mainland China		
H(0)	Max. Eigenvalue test	Trace test	Lags	Max. Eigenvalue test	Trace test	Lags
r=0	14.43	22.04*	3	24.17	28.95**	3
r=1	7.61	7.61		4.78	4.78	

*, ** Significance at the 5% and 1% level.

Apart from breaking down the entire sampling period to pre- and post-reform periods, the post-reform period will be further divided into two sub-periods, namely 1978 to 1990 and

1991 to 2002. During the process of Mainland China's economic reforms, the more crucial full scale enterprises, price and exchange rate system reforms were launched only after the 90s, which could further accelerate the economic growth and transition on the Mainland side. If there is no economic integration throughout the whole post-reform period, the sub-period of 1991 to 2002 then shows whether the integration process could take place between Mainland China, Hong Kong and Macau when the reforms intensified.

Table 4.21 has summarized the estimation results of the Johansen procedure. Despite the intensive economic contacts between Mainland China, Guangdong, Hong Kong and Macau, the diversified economic background and endowments of these economies should be a major obstacle to the formation of an equilibrium economic relationship between them[66]. For this reason, emphasis is placed on the bivariate analysis and cointegration tests are performed. The lag length which is able to minimize the Akaike Information Criterion (AIC) and Schwartz Bayesian Criterion (SBC) will be adopted in the estimations. Similar technique can be found in Maysami and Koh (2000), Nieh and Lee (2001), Cheung and Yuen (2002), Anoruo, Ramchander and Thiewes (2002) and Ekanayake, Vogel and Veeramacheneni (2003). In light of the pre-reform period of 1961 to 1977, the null hypothesis of a zero rank cannot be rejected and the Johansen Cointegration Test indicates that there is no cointegrating relationship between Mainland China and Hong Kong, nor Guangdong and Hong Kong. It suggests that the degree of economic integration between these economies were rather low before the economic reforms of Mainland China. Before the economic reforms, the economic contacts between Mainland China and the SARs were underdeveloped and the country was practically closed during the period in which it was governed by a centrally planned economic system. For this reason, it should be hard for Mainland China to cointegrate with the capitalist Hong Kong and Macau economies in the pre-reform period.

[66] Two multivariate Johansen Cointegration Tests with Mainland China, Hong Kong, Macau and Guangdong, Hong Kong, Macau respectively as the sampling series have been conducted. The SBC suggests a 1 period lag length but the null hypothesis of no cointegrating vector cannot be rejected at 5% significance level in both estimations. This result indicates the absence of a cointegrating relationship or long-run linkage between Mainland China/Guangdong, Hong Kong and Macau for the period of 1961 to 2002.

When the post-reform era is focused, in the first sub-period of 1978 to 1990, as suggested by the trace statistics, the null hypothesis of a zero rank cannot be rejected in both the Hong Kong-Mainland China and Hong Kong-Guangdong analyses. It implies that in the early reform period, there is still no equilibrium relationship between the per capita RGDP of Mainland China, Guangdong and Hong Kong. The economic reforms which were initiated in 1978 have not yet led to any significant degree of economic integration to these economies since it takes time for the involving economies to transform and develop their economic contacts. In view of the period of 1991 to 2002[67], the null hypothesis of a zero rank is rejected at 1% level significance for both the Hong Kong-Mainland China and Hong Kong-Guangdong analyses. The alternative hypothesis of at least one cointegrating relationship, meanwhile, cannot be rejected. It indicates that the per capita RGDP of Mainland China, Guangdong and Hong Kong can form a bivariate, linear and stationary combination. This result depicts that the economic reforms, which have been taking place for over 1 decade, have eventually tightened the economic contacts between Mainland China, Guangdong and Hong Kong, bringing about cointegrated income levels and correlated business cycles to these economies. In relation to the Macau-Mainland China and Macau-Guangdong analyses, cointegration tests are conducted to review the discipline for the period of 1982 to 2002 and the estimation results display cointegrated per capita RGDP in both groupings. It implies that similar to Hong Kong, the per capita RGDP of Mainland China, Guangdong and Macau tend to move together with synchronized long-term movements due to the developing economic contacts between these economies. In general, the Johansen procedure indicates that Hong Kong has formed a long-run bilateral income linkage with Mainland China and Guangdong respectively after a decade of economic reforms where the economies on both sides have fully adopted to the new economic environment. Similar bilateral equilibrium relationships can also be found between Macau, Mainland China and Guangdong. These long-run linkages can be viewed as evidences of economic integration.

[67] The finding on cointegration is so strong that it has led to cointegrated per capita RGDP between Mainland China/Guangdong and Hong Kong for the entire sampling period of 1961 to 2002. The per capita income of Hong Kong is found to have a long-run equilibrium relationship with that of both Mainland China and Guangdong in this period, with a positive and statistically significant correlation.

Table 4.22: Cointegrating Relationship after Normalization with respect to Hong Kong and Macau

Period	Economies	Cointegrating Relationship
1991-02*	HK-Guangdong	LnRGDPHK = 9.47 + 0.097 x LnRGDPGD (0.40) (0.054)
1991-02	HK-Mainland China	LnRGDPHK = 1.26 x LnRGDPChina (0.18)
1982-02	Macau-Guangdong	LnRGDPMac = 8.34 + 0.178 x LnRGDPGD (0.29) (0.045)
1982-02	Macau-Mainland China	LnRGDPMac = 7.52 + 0.322 x LnRGDPChina (0.16) (0.025)

Standard Error in parenthesis.
* The result of cointegrated per capita income level in the period of 1991 to 2002 is so strong that it has led to cointegrated per capita income for the entire sampling period of 1961 to 2002.

The normalized bivariate cointegrating relationships are presented in Table 4.22. As reported, almost all the cointegrating vectors are statistically significant as suggested by the standard error with explicable positive signs. It exhibits a positive correlation between the per capita RGDP of Mainland China and Guangdong and that of Hong Kong and Macau. Besides, except for the one in the Hong Kong-Mainland China pair which has no intercept term as suggested in the model selection process, all the estimated cointegrating vectors are less than one. It expresses that given a unit change in the income levels of Mainland China or Guangdong, there will be a less than proportional change in Hong Kong's or Macau's per capita RGDP in the long-run. Being two open and tiny economies, Hong Kong and Macau are subject to the influences of Mainland China, as well as the other major economies, such as the United States, EU, Japan, etc. For this reason, the economic performance or income level of Mainland China or Guangdong cannot dominate that of Hong Kong and Macau, but only affect the SARs with discounted impacts. In relation to the magnitude of the cointegrating vectors, those associated with Mainland China have carried a bigger value than the provincial counterparts. It may be interpreted that relative to the magnitude of Guangdong, the income level of Mainland China is more important for both Hong Kong and Macau. It is because the cointegrating vectors of Mainland China reflect the influences of Guangdong, as well as those of the other provinces of the whole country.

4.4.5. The Vector Error Correction Model (VECM)

Vector Autoregressive (VAR) model is a popular method in forecasting systems of interrelated time series variables. A simple bivariate system is in the form of:

$$y_t = b_{10} - b_{12}z_t + \gamma_{11}y_{t-1} + \gamma_{12}z_{t-1} + \varepsilon_{yt}$$ [68] (4.18)

$$z_t = b_{20} - b_{21}y_t + \gamma_{12}y_{t-1} + \gamma_{22}z_{t-1} + \varepsilon_{zt}$$ (4.19)

where y_t and z_t are stationary and ε_{yt} and ε_{zt} are white noise disturbances with standard deviations of δ_y and δ_z respectively.

This structural VAR allows y_t and z_t to affect each other. The estimated coefficient b_{12} is the effect of one unit change in z_t on y_t. In testing the interdependence of the variables, the structural VAR could show the impact of current and lagged variables of y_t on z_t, as well as the feedback impact of z_t on y_t. As for the residual terms, they have an indirect impact on both y_t and z_t.

The bivariate system of VAR can be rewritten into a VAR in the standard form of:

$$y_t = a_{10} + a_{11}y_{t-1} + a_{12}z_{t-1} + e_{1t}$$ [69] (4.20)

$$z_t = a_{20} + a_{21}y_{t-1} + a_{22}z_{t-1} + e_{2t}$$ (4.21)

VAR model is a popular method in testing the inter-relationship between a couple of economic factors and it contributes to the analysis of economic integration. Nevertheless, an unrestricted VAR does not impose cointegration on its variables, that is, the VAR model can only show the short-run dynamic and correlations of the sampling factors, without taking the long-run development linkage into consideration. For this reason, the VECM is introduced to incorporate the concept of cointegration in a vector autoregressive model.

[68] Enders (1995), p.294
[69] Please see Enders (1995), p.295 for the transformation process.

The VECM is derived from the structural VAR, with cointegration as the prerequisite. If there exists one cointegrating equation among the data series, then one error correction term in levels will be inserted on the right hand side in each of the VAR equations. The first difference will be applied to all the other integrated variables. In estimating the stable and long-run relationship between non-stationary variables with the presence of cointegrated equations, a Vector Error Correction Model (VECM) should be introduced. Given a vector z_t of n potentially endogenous variables, it is possible to specify the following data generation process and model z_t as an unrestricted vector autoregressive, VAR, involving up to k-lags of z_t[70]

$$z_t = A_1 z_{t-1} + \ldots + A_k z_{t-k} + u_t \tag{4.22}$$

where $u_t \sim IN(0, \Sigma), z_t$ is (n x 1) and each of A_i is an (n x n) matrix of parameters.

The equation can be reformulated into a VECM as:

$$\Delta z_t = \Gamma_t \Delta z_{t-1} + \ldots + \Gamma_{k-1} \Delta z_{t-k+1} + \Pi z_{t-k} + u_t \tag{4.23}$$

where $\Gamma_i = -(I - A_1 - \ldots - A_i)$, (i=1,...,k-1), and $\Pi = -(I - A_1 - \ldots - A_k)$.

The estimates of Γ_i and Π reflect the short-run and long-run adjustments to changes in z_t. $\Pi = \alpha\beta'$, where α represents the speed of adjustment to disequilibrium and β is a matrix of long-run coefficients such that $\beta' z_{t-k}$ in the VECM represents up to (n-1) cointegrating relationships in the multivariate model and it ensures that z_t converges to the long-run steady state solution.

Given a cointegrating equation:

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[70] Harris (1995), p.77.

$$y_{2,t} = \beta y_{1,t}, \tag{4.24}$$

the VECM can be written as:

$$\Delta y_{1,t} = \gamma_1 (y_{2,t-1} - \beta y_{1,t-1}) + \varepsilon_{1,t} \tag{4.25}$$

$$\Delta y_{2,t} = \gamma_2 (y_{2,t-1} - \beta y_{1,t-1}) + \varepsilon_{2,t} \tag{4.26}$$

If the cointegrating equation has an intercept, such as:

$$y_{2,t} = \mu + \beta y_{1,t} \tag{4.27}$$

then VECM equations can also carry a trend, in the form of:

$$\Delta y_{1,t} = \delta_1 + \gamma_1 (y_{2,t-1} - \mu - \beta y_{1,t-1}) + \varepsilon_{1,t} \tag{4.28}$$

$$\Delta y_{2,t} = \delta_2 + \gamma_2 (y_{2,t-1} - \mu - \beta y_{1,t-1}) + \varepsilon_{2,t} \tag{4.29}$$

where γ_1 and γ_2 are the speed of adjustment parameters. A big value means the response of y to last period's deviation from long-run equilibrium is great. The VECM allows short-run deviations but restricts the long-run order of the endogenous variables to converge to their equilibrium cointegrating relationships. It is noted that one of the two adjustment parameters must be non-zero or there is no cointegrating relationship between the two y variables. In addition, γ_1 and γ_2 can be used in testing the causation between y_1 and y_2. If both of them are significant, then causality is deemed to be bi-directional. If only one of them is significant, then a single direction of causation applies.[71]

Apart from the above bivariate specification, the VECM can also be written as:

$$\Delta y_t = c + \sum_{i=1}^{p} \delta_i \Delta y_{t-i} + \alpha ECT + \varepsilon_t \tag{4.30}$$

where ECT is the error correction term given by $\beta' Y_{t-p-1}$, β is the cointegrating vector. Y_{t-p-1} are the endogenous variables, c is a constant vector. δ_i are the short-run response of a

[71] Zhang and Felmingham (2001), p.88.

variable given a change of another and α measures the speed of adjustment towards the long-run cointegrating relationship given the short-run deviation.

The VECM should be applied with caution since the Granger Representation Theorem[72] states that for any set of I(1) variables, error correction and cointegration are equivalent representations. The VECM will be used to estimate the speed of adjustment, for example, γ_1 and γ_2 in the above specification, which is also the coefficient of the error correction term.

Since per capita RGDP is the major focus of this research, the corresponding VECM can be specified as:

$$\Delta RGDP_t^{HK} = \alpha_{10} + \sum_{s=1}^{i} \alpha_{11}(s)\Delta RGDP_{t-s}^{HK} + \sum_{s=1}^{i} \alpha_{12}(s)\Delta RGDP_{t-s}^{Macau} + \sum_{s=1}^{i} \alpha_{13}(s)\Delta RGDP_{t-s}^{China} +$$

$$\gamma_1 \varepsilon_{1t-1} + e_{1t} \qquad (4.31)$$

$$\Delta RGDP_t^{Macau} = \alpha_{20} + \sum_{s=1}^{i} \alpha_{21}(s)\Delta RGDP_{t-s}^{HK} + \sum_{s=1}^{i} \alpha_{22}(s)\Delta RGDP_{t-s}^{Macau} + \sum_{s=1}^{i} \alpha_{23}(s)\Delta RGDP_{t-s}^{China} +$$

$$\gamma_2 \varepsilon_{2t-1} + e_{2t} \qquad (4.32)$$

$$\Delta RGDP_t^{China} = \alpha_{30} + \sum_{s=1}^{i} \alpha_{31}(s)\Delta RGDP_{t-s}^{HK} + \sum_{s=1}^{i} \alpha_{32}(s)\Delta RGDP_{t-s}^{Macau} + \sum_{s=1}^{i} \alpha_{33}(s)\Delta RGDP_{t-s}^{China} +$$

$$\gamma_3 \varepsilon_{3t-1} + e_{3t} \qquad (4.33)$$

If the RGDP per capita of Mainland China, Hong Kong and Macau are cointegrated, then the unrestricted VAR model can no longer be applied and the VECM will be a substitute in showing the inter-relationship of the variables. The estimated residuals of the VAR in first lag, namely ε_{1t-1}, ε_{2t-1} and ε_{3t-1} will become the error correction terms in the VECM. Both the right and the left hand sides of the VECM equation are stationary. γ_1, γ_2 and γ_3 are the speeds of adjustment. γ_1 suggests the response of the RGDP growth of Hong

[72] Enders (1995), p.371.

Kong given a one-unit deviation from its long-run equilibrium RGDP growth in period t-1. An adjustment is made in period t to eliminate the discrepancy from its long-run RGDP growth in period t-1, it is also the pace for the RGDP growth of Hong Kong to return to the long-run steady state.

As stated in Table 4.21, the per capita RGDP of Mainland China, Hong Kong and Macau are cointegrated, then these economies may have achieved a high degree of economic integration such that they have long-run interrelated income levels. Given the cointegrating relationships, it is possible to extend the analysis by making use of the Vector Error Correlation Model, VECM, to estimate the short-run dynamics of their economic relationship. The objective is to figure out the evolution of the long term equilibrium relationship, as well as to estimate the interrelationship of the variables in consideration.

In practice, due to the rejection of cointegrated relationship between Mainland China, Hong Kong and Macau with respect to per capita RGDP, the above defined multivariate VECM will not be performed. Instead, a bivariate alternative will be estimated and the results are reported in Table 4.23. In light of the Hong Kong-Guangdong pair, the error correction term in the estimation on Guangdong's income is significant[73]. It indicates that the per capita RGDP of Guangdong will respond to short-run deviations, and attempts to converge to the equilibrium relationship that it will have formed with Hong Kong in the long-run. Perhaps the inward investments and demand from Hong Kong are essential to Guangdong's economic transformation and growth, then the province responds and its income level adjusts toward the equilibrium level. The estimations also find that the per capita incomes of both Hong Kong and Guangdong can be explained by their respective lags, while the per capita income of Hong Kong can help to explain that of Guangdong, but independent of the influences from the other economies. In other words, Hong Kong's

[73] The negative sign that the error correction term carries is consistent with the findings in the other studies, including Islam (1998), Zhang and Felmingham (2001), Ramos (2001), Cheung and Yuen (2002), Ekanayake, Vogel and Veeramacheneni (2003). However, there are also estimations in which error correction term in positive sign is found, such as Thornton (1997), Moosa and Choe (1998), Chakraborty and Basu (2002) and Anoruo, Ramchander and Thiewes (2002). In general, emphasis is placed on the statistical significance of the error correction term rather than on its sign since short-run disturbances could happen on both sides.

per capita RGDP contributes to explain the per capita RGDP of Guangdong, but not the other way round. A one-way causality of Hong Kong's per capita RGDP causing that of Guangdong's is shown in the estimations. It may be interpreted as Hong Kong's inward investment and demand are controversial to the province, and have contributed to Guangdong's economic growth. On the contrary, the importance of Guangdong's income level is relatively lower and could not affect the Hong Kong economy at all. In light of the Hong Kong-Mainland China pair, the estimation results reveal that an adjustment will only take place on the Mainland side subject to short-run deviations due to the significance of the error correction term. The per capita RGDP of Hong Kong, on the contrary, does not have any tendency to adjust subject to such deviations. As it is Mainland China that is transformed from a planned to a market-oriented economy, it is naturally the one that performs most of the adjustments. In the estimations, the income levels of both Hong Kong and Mainland China are found to be affected only by their respective lags, with neither one-way nor two-way causality between the income levels of these two economies. It depicts that the economic growth or income level of a huge economy, such as Mainland China, cannot be explained solely by a tiny economy like Hong Kong. Meanwhile, Hong Kong is an open economy and Mainland China is just one of the many factors that could affect the territory's economic performance. Consequently, no two-way nor one-way causality was found in the analyses.

Table 4.23: Estimates of VECM on RGDP per capita

Panel A	Dependent Variables			
1991-2002	HongKong-Guangdong		HongKong-Mainland China	
	$\Delta RGDPHK_t$	$\Delta RGDPGD_t$	$\Delta RGDPHK_t$	$\Delta RGDPChina_t$
$\Delta RGDPHK_{t-1}$	0.935 (4.37)	0.390 (5.66)	0.797 (3.88)	0.0482 (0.62)
$\Delta RGDPGD_{t-1}$	-0.238 (-1.43)	0.486 (9.04)		
$\Delta RGDPChina_{t-1}$			-0.232 (-0.60)	0.327 (2.24)
ECT	-0.123 (-1.37)	-0.293 (-10.14)	0.00748 (0.45)	0.029 (4.57)
Adjusted R^2	0.65	0.95	0.59	0.60
Panel B	Dependent Variables			
1982-2002	Macau-Guangdong		Macau-Mainland China	
	$\Delta RGDPMac_t$	$\Delta RGDPGD_t$	$\Delta RGDPMac_t$	$\Delta RGDPChina_t$
$\Delta RGDPMac_{t-1}$	0.371 (1.69)	-0.250 (-0.84)	0.823 (4.60)	-0.164 (-0.81)
$\Delta RGDPMac_{t-2}$	0.612 (2.14)	0.121 (0.31)	1.390 (4.94)	-0.147 (-0.46)
$\Delta RGDPMac_{t-3}$	0.583 (2.16)	0.395 (1.08)	1.380 (4.85)	0.202 (0.627)
$\Delta RGDPGD_{t-1}$	0.670 (2.63)	1.167 (3.38)		
$\Delta RGDPGD_{t-2}$	-0.199 (-0.63)	-0.401 (-0.93)		
$\Delta RGDPGD_{t-3}$	0.175 (0.79)	0.207 (0.68)		
$\Delta RGDPChina_{t-1}$			1.822 (5.50)	1.032 (2.75)
$\Delta RGDPChina_{t-2}$			-0.837 (-2.42)	-0.462 (-1.18)
$\Delta RGDPChina_{t-2}$			0.122 (0.54)	0.291 (1.13)
ECT	-0.716 (-3.59)	-0.0639 (-0.24)	-1.048 (-5.64)	0.0777 (0.37)
Adjusted R^2	0.44	0.16	0.71	0.15

t-statistics in parenthesis and all the variables are in natural logarithm.

Panel B has summarized the estimation results for the Macau-Guangdong and Macau-Mainland China pair. In the case of the former, the error correction term indicates that subject to any short-run deviations, the per capita RGDP of Macau tends to adjust toward its long-run linkage with Guangdong. The per capita RGDP of Guangdong, on the other hand, does not respond to such deviations. This pattern can be explained by the tiny economic capacity of Macau which is rather sensitive to external shocks, including that from Guangdong, and Macau tends to adjust itself after experiencing such shocks. In the estimation of Macau's per capita RGDP, apart from the expected influences from the territory's lagged income levels, a change in Guangdong's income in the last period could bring about an impact on Macau's current income level. With a relatively large estimated coefficient and a positive sign, the estimation result indicates that the change in Guangdong's income in the last period is more critical in determining Macau's current income level than the territory's own lagged income. It shows that due to the tight economic linkages between the territory and Guangdong and the endogeneous economic pattern of Macau, the economic performance of the province is quite influential to the territory. Conversely, Guangdong's income level could be explained only by its own lagged income, but not the income level of Macau and a one-way causality of Guangdong's income growth causing Macau's income growth is found in the estimations.

As for the Macau-Mainland China pair, the estimation result is not distinct from that of the Macau-Guangdong pair. As indicated by the error correction term, due to its dependent economic pattern and limited economic capacity, the per capita income of Macau could not affect the income level of Mainland China, but it tends to adjust itself in response to any short-run deviations toward the long-run equilibrium relationship with Mainland China. In addition, in the estimation of Macau's per capita RGDP, the statistically significant lagged income levels reveal that the territory's current income growth tends to be positively affected by its own growth rate in the past three years. The income adjustment in Mainland China, meanwhile, tends to affect the income growth of Macau in a mixed way. An income growth in Mainland China in the last period tends to stimulate the income growth of Macau. The 2nd lag of Mainland China's income growth, however, tends to bring about an adverse impact to the current income growth of Macau. This finding may reveal that Mainland China is able to stimulate the income growth of Macau, and a higher growth rate on the Mainland side helps to bring about income growth to the territory. Nevertheless, Mainland China is also a competitor of Macau in the areas of international trade, tourist industry and inward FDI. This competitive pattern is then reflected in the 2nd lag of Mainland China's income growth. Given a higher income growth on the Mainland side, the country may be able to export more, attract more tourists or even absorb more inward FDI and thus adversely affecting the corresponding performance of Macau, and may lead to a drop on the income level of the territory. Consequently, it discounts the overall contribution of Mainland China's income growth on Macau economy, although the China factor could still contribute to Macau's income growth. As a whole, the territory's lagged income growth rates are the most influential factors in the estimation. In light of the estimation on the per capita income of Mainland China, the income growth of the country in the last period is found to be the only statistically significant variable. A change in the income level of the tiny Macau economy is insignificant in speeding up the income growth of Mainland China. This implies a one-way causality of a change in the per capita income of Mainland China causing a change in that of Macau.

4.5. The Consequences of Economic Integration

One of the possible consequences of economic integration is income convergence. In Bernard and Durlauf (1995), convergence in income was defined as the long-term forecast of income for all countries to equal at a fixed time, with cointegrating vector [1, -1]. If the cointegrating vector was [1, -α][74], then there exists a common trend in income between different economies. Based on this definition and given the results of the cointegration tests as presented in Tables 4.21 and 4.22, the income levels of Mainland China/Guangdong, Hong Kong and Macau should have failed to achieve stochastic convergence on a bivariate basis. Instead, there could be a common trend to link up the income levels of these economies. In fact, equalization in output levels is perhaps too restrictive and consequently, only a very limited number of economies can fulfill this criterion. Rather than advocating Bernard and Durlauf (1995)'s definition on stochastic convergence, the conventional β- and δ-convergence analysis, which is an alternative of stochastic convergence as stated in Islam (1998) will be employed in the next chapter.

[74] Bernard and Durlauf (1995), p.100.

Both the β- and δ-convergence tests will be conducted to examine whether Mainland China is able to catch up with Hong Kong and Macau in the post-reform period, to reduce its income disparities with the SARs. The details of this analysis will be thoroughly discussed in the next chapter.

4.6. Chapter Summary

4.6.1. The Findings from the Descriptive Analysis

The trade and FDI statistics discussed above suggest the presence of some close and dynamic economic contacts between Mainland China, Hong Kong and Macau, even though the three economies are still far from the stage of a single market and economic union. Prior to the economic reforms, the SARs, especially Hong Kong, have been viewed by the Chinese government as the window of the country since a considerable portion of the country's trade transactions were trans-shipped through the territory. The role of Hong Kong as a stepping stone toward the Mainland was further strengthened in the reform period. Following the open door and liberalization policies which were launched in 1979, trade and FDI flows between Mainland China and Hong Kong have started to mushroom. A double-digit growth was recorded in almost all the economic transactions between the two economies, including Hong Kong's domestic exports to Mainland China, its inward and outward re-exports, imports from Mainland China, as well as the territory's outward FDI in Mainland China and its inward direct investment received from the Mainland. In addition, Hong Kong's trade involving outward-processing activities in Mainland China have been developing since the economic reforms, and have intensified in line with the growth of trade and FDI in Mainland China. With respect to the extensive and solid development in trade and FDI and all the other economic transactions, Hong Kong could be regarded as one of the most important economic partners of Mainland China. The boosting of these cross-border transactions has also accelerated the evolution and transition of these economies.

In light of Mainland China, external trade and inward FDI have brought about significant improvements to the country's technological know-how, management and production experiences, productivity, production capacity, capital availability, etc. They have also contributed to enlarge the country's potential market in the rest of the world as well as to stimulate its pace of growth and development. In the 90s, Mainland China has successfully diversified its external markets and was able to attract inward FDI from the rest of the world since then. Consequently, its trade and FDI flows with Hong Kong and Macau were growing at a decreasing pace. The corresponding trade intensity indices have also declined, while those between Mainland China and the other trade partners, for example, the United States and Japan have been increasing. In the meantime, as indicated by the increasing trade complementarity indices, the trade relationship between Mainland China and Hong Kong has become more and more complementary. It implies that both Mainland China and Hong Kong have restructured their economies and are able to exchange their comparative advantages through trade transactions.

In relation to Hong Kong, the reforms and open door policies have offered valuable opportunities for the territory to explore and develop their Mainland China market, resulting in an acceleration of economic transformation from an industrial-based to a service-based economy. In fact, the territory's outward FDI in Mainland China has been increasing at a much higher speed in the 90s when the pace of economic reforms has been accelerated. It turns out reinforcing both regional and external trade with Mainland China as most of Hong Kong's outward FDI in Mainland China are export-oriented. It has also brought about an expansion in trade involving outward-processing activities. As a result, the role of Hong Kong as an entrepôt of Mainland China is further strengthened in this period. The territory is not only able to facilitate a bigger portion of Mainland China's external trade, for both exports and imports, but has also specialized itself in the handling of trans-shipments related businesses and services for Mainland China. Furthermore, it is also the biggest investor in Mainland China and in return, has received the largest share of its direct investment from the Mainland. This new form of cross-border economic cooperation has also become one of the major growth engines of Hong Kong.

As for Macau, owing to its endowment constraints, the territory could not play any significant role in Mainland China's external trade and only a limited amount of FDI can be injected by the territory to the Mainland. In contrast, due to the geographical and political reasons, Mainland China is the 2nd largest investor of the territory and the flow of inward investment from Mainland China has been increasing. The country is the most important supplier of imports for the territory with the most intensive trade connection with the territory.

In view of the human flows between these Chinese economies, the expansion in trade and FDI transactions should have contributed to the development in human mobility. As the economic contacts intensified, there would be more human flows to accommodate. In addition, the new investments in Mainland China should have attracted an increasing flow of visitors from either the SARs or the outside world to go to Mainland China. In return, the economic growth of Mainland China and the associated income effects would simultaneously encourage people from Mainland China to visit the SARs. These events have altogether accelerated the expansion of human flows in the region and Mainland China has also become the most important market for the tourist sector in both Hong Kong and Macau. Visitors from the SARs, similarly, were also the biggest group of foreign customers for Mainland China since the middle 90s.

According to Liu, Wang and Wei (2001), "if there are substantial differences in factor endowments, the capital-abundant country tends to export headquarters services into the labour-abundant country in exchange for …. Thus, FDI generates complementary trade flows from the labour-intensive country. In addition, parent firms may export intermediate inputs to their subsidies if vertical integration is involved."[75] Given this belief, the highly intensive and increasingly complementary trade pattern between Mainland China and Hong Kong, as identified previously, can be viewed as the consequences of the inward FDI flows from Hong Kong, which will turn out leading to a decline in the share of definite exports and imports, but a rapid expansion in re-exporting transactions between the two economies.

[75] Liu, Wang and Wei (2001), p.192.

All in all, there is no doubt viewing the Hong Kong economy as one of the most important economic partners of Mainland China. The economic development on both sides has been intimately tightened by various economic connections between them, resulting in a complementary economic relationship. Without further investigation and the support of numerical evidences, however, it is still not convincing to conclude that a high degree of economic integration has been achieved by Mainland China, Hong Kong and Macau. For this reason, parametric analyses will be conducted in the coming sections in order to test econometrically the hypothesis of economic integration between these economies.

4.6.2. The Findings from the Parametric Analysis

The correlation matrices indicate that the per capita RGDP of Mainland China, Hong Kong and Macau are tightly connected, and their correlation has also intensified after the economic reforms. On the regional level, it is found that the income correlations between Guangdong, Hong Kong and Macau have become more intimate than their respective national counterpart in the post-reform period since most of the economic contacts are made between the province and the SARs. These findings imply comoving or synchronized business cycles between these economies. In the Johansen Cointegration Test, the per capita RGDP of Mainland China/Guangdong, Hong Kong and Macau are found to cointegrate with one another on a bivariate basis in the second half of the reform period. Cointegrated income levels, however, could not be found in either the pre-reform period or the early reform period. This result suggests that it takes time for the reform policies to implement and also for the involving economies to transform and build up tighter linkages. In line with the implementation and deepening of the economic reforms, a long-run equilibrium relationship between Mainland China/Guangdong, Hong Kong and Macau with respect to per capita RGDP has been developing and eventually comes into existence since the 90s. This evidence marks a high degree of economic integration between these Chinese economies since the 90s and a long-run stable economic relationship has been established between each pair of them. Apart from the presence of the cointegrating relationships, in the bivariate VECM, one-way causality is observed and the per capita income of Hong Kong can help to explain the per capita income of

Guangdong, but not the other way round. It proves that the enormous investment and trade transactions made by Hong Kong in Guangdong have contributed to the province's growth and development. In contrast, a change in the income level of Hong Kong is unable to affect Mainland China's income given the enormous size and strength of the country. As Hong Kong is an open economy with substantial economic contacts with the rest of the world, the income level of Mainland China alone has failed to explained the territory's income level. Due to its dependent economic pattern and very limited production capacity, the per capita income of Macau, meanwhile, has a strong tendency to be affected by the income levels of Mainland China and Guangdong. The income level of a tiny economy, like Macau, with endowment constraints is more likely to depend or rely more on its economic partners, such as Guangdong or Mainland China.

Chapter 5: Income Convergence between Mainland China, Hong Kong and Macau

Economic integration between Mainland China, Hong Kong and Macau is found in the previous chapter, and the per capita income levels of these economies have cointegrated with a long-run equilibrium relationship. The estimated value of the cointegrated vectors, however, have failed to satisfy the criteria as stated in Bernard and Durlauf (1995) and stochastic convergence is rejected. Nevertheless, as explained in Karras (1997) and Ben-David (1996, 2001), economic integration which was driven by intensive development in trade transactions could narrow the income gap of the trading parties and bring about income convergence. Subsequently, it is expected that if stochastic convergence and long-run equalization in per capita income is not the outcome of economic integration, this process would still bring about a catching-up process and declined income gap. In order to prove this speculation, income convergence test will be performed to see whether the income disparity problem between Mainland China, Hong Kong and Macau has improved after their economic integration.

5.1. Diversification in Economic Performance

Since the establishment of the People's Republic in 1949, Mainland China has been advocating a socialist central planning system to guide the economy under which almost all economic decisions were centralized and manipulated by the authorities. They included the basic questions of how to produce, what to produce and for whom to produce. On the contrary, Hong Kong and Macau have been adopting a significantly different system with market mechanism as the driving force of the economy. This approach is not only more liberal, but is also one that has more respect on individual preferences and decisions. The deviations in economic ideologies, the great difference in endowments, such as geographical area, physical and human capital and technological know-how, reinforced by the occurrence of natural disasters as well as the social and political struggles in the Mainland, all of these have made the economic performance, extent of development and income level of Mainland China distinctively different from those of Hong Kong and Macau. After the introduction of the economic reforms in 1978, however, revolutionary changes have started to take place in Mainland China and the country has started to reform its economic structure to transit from the old centrally planned to the new market oriented economic system. The economic transition and the liberalization policies have contributed to reduce the ideological differences between the Mainland China, Hong Kong and Macau economies and market mechanism has eventually become the underlying driving forces of all these economies. This process has also tightened the economic and social contacts between Mainland China, Hong Kong and Macau, bringing about a higher growth rate and new progress and prospect to almost all the parties. In light of the difference in income between these three economies, although the gap is still enormous, there is a clear tendency for such gap to narrow in line with the continuous reforms and transition of Mainland China. This chapter then intends to estimate quantitatively whether the declining trend in income gap has developed into a process of income convergence.

In relation to the per capita income gap within Mainland China, a series of studies have been organized to discuss the evolution of income distribution in Mainland China during the Pre- and Post-reform period. Amongst them, Tsui (1996), Yao (1999), Yao and Zhang (2001a) and Gustafsson and Shi (2002) have decomposed the Gini coefficient of Mainland China in order to explain the causes of income inequality in Mainland China, and have found that rural-urban inequality and spatial inequality are the causes of such inequality. Another group of articles, including Jian, Sachs and Warner (1996), Gundlach (1997), Raiser (1998), Demurger (2001), Zhang (2001) and Yao and Zhang (2001b) have employed the conventional approach and the concepts of β- and δ-convergence to address the spatial pattern of Mainland China's economic growth and the income disparity issue of the country.

Though there are a rich collection of articles to discuss the regional disparities and growth differential problem of Mainland China at multiple angles, almost all of them have placed their emphasis on Mainland China. For some reasons, the issues of income disparities and convergence between Mainland China, Hong Kong and Macau, have been overlooked. In line with the success of Mainland China's economic reforms and its rapid economic and income growth, there would be a higher possibility or increased likeliness for the country to catch up with Hong Kong and Macau in various aspects, including the income level. Given this conventional belief, in the following discussion, not only Mainland China, but also Hong Kong and Macau will be focused to investigate the situations on growth differential and income disparities, with an intention to assess if the income levels of these economies are converging.

5.2. Disparities on the National Level

Table 5.1: RGDP Average Growth Rate* in Comparison , %

Period	Mainland China	Hong Kong	Macau
1953-1962	4.36	n.a.	n.a.
1963-1972	9.35	5.35	n.a.
1973-1982	6.63	10.49	n.a.
1983-1992	10.26	8.04	7.80
1993-2002	9.37	1.28	2.08
1953-1977	6.48	6.24[1]	n.a.
1978-2002	9.51	6.16	4.94[2]
Standard Deviation			
1963-1972	9.09	2.75	n.a.
1973-1982	3.79	4.47	n.a.
1983-1992	3.90	2.67	4.13
1993-2002	2.20	5.39	4.22

Sources: Statistical Yearbook of China, Hong Kong Monthly Digest of Statistics and Statistical Yearbook of Macau, various issues.
*RGDP average growth rate is the average of the annual RGDP (1995 price) growth rates in local currency unit.
Hong Kong's statistics are available from 1962 onward and Macau's are available since 1983.
1. The average RGDP growth rate of Hong Kong from 1962 to 1977. The average RGDP growth rate of Mainland China for the same period is 7.05%.
2. The average RGDP growth rate of Macau from 1983 to 2002.

Tables 5.1 and 5.2 compare the RGDP growth and RGDP per capita of Mainland China, Hong Kong and Macau. In Table 5.1, it indicates that the RGDP growth rate of Mainland China, except for the period of 1973-1982, is higher than that of Hong Kong in all the 10-year periods. Even in the pre-reform period, Mainland China was able to achieve an average rate of growth of 6.48% from 1953 to 1977, and a rate of 7.05% was recorded from 1962 to 1977 which was higher than Hong Kong's 6.24% growth rate and this is attributed to the growth policies implemented by the planning committee. After the launching of the economic reforms, the open door and liberalization policies, the economic performance of Mainland China has experienced significant improvement. Between 1978 and 2002, the average RGDP growth rate of Mainland China has increased to 9.51% a year which exceeded that of Hong Kong's by 3.35 percentage point. Similarly, the growth performance of Mainland China is preferred to that of Macau's. During 1983 to 1992, the average RGDP growth rate of Mainland China was 10.26% or 2.46% higher than that of Macau's. In the next decade of 1993 to 2002, when the economic reforms of Mainland China has come to its new stage, the growth spread has further enlarged to 7.29% although the growth rate of Mainland China has experienced a slight drop to 9.37%. These results expressed that when compared with Hong Kong and Macau, Mainland China could take advantage of its backwardness, to grow at a higher speed than the former two and this growth pattern could be regarded as a catching-up process.

As indicated by the standard deviation, the growth progress of Mainland China has undergone huge variations in the post-reform period. Since the country was struggling with various kinds of political unrests, economic turbulences and natural disasters, Mainland China had encountered difficulty in achieving an income level similar to that of Hong Kong and Macau. In addition, China had also witnessed enormous fluctuations in economic performance, especially after the Great Leap Forward in the Cultural Revolution period of 1963 to 1972. The country's output level then started to stabilize with much less fluctuations, especially after the implementation of the economic reforms to transform Mainland China from a centrally-planned to a market-oriented economy. In light of Hong Kong, the standard deviation has revealed an increasing variation on the RGDP growth and it is partially attributed to the territory's structural adjustments. In the case of Macau, the standard deviation stabilizes at around 4 and it implies that the growth pace of Macau has a moderate variation.

Table 5.2: Per Capita RGDP in Comparison on the National Level

Year	Mainland China		Hong Kong		Macau		Income Ratio		
	USD* (1)	PPP** (2)	USD* (3)	PPP** (4)	USD* (5)	PPP** (6)	(3)/(1)	(5)/(1)	(4)/(2)
1955	62	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1960	91	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1965	87	n.a.	3723	n.a.	n.a.	n.a.	42.88	n.a.	n.a.
1970	106	n.a.	4319	n.a.	n.a.	n.a.	40.73	n.a.	n.a.
1975	127	552	6029	7238	n.a.	n.a.	47.51	n.a.	13.11
1980	163	708	8790	11068	n.a.	n.a.	53.93	n.a.	15.64
1985	253	1096	12017	13443	12082	12546	47.51	47.77	12.26
1990	342	1482	17177	18274	15580	15812	50.23	45.56	12.33
1995	568	2509	22416	21617	16962	19200	39.43	29.84	8.62
1996	617	2716	23004	21966	16642	18889	37.31	26.99	8.09
1997	664	2916	24130	22724	16456	18657	36.33	24.78	7.79
1998	709	3131	23927	21099	15433	17553	33.74	21.76	6.74
1999	754	3311	22348	21494	14849	16822	29.65	19.70	6.49
2000	808	3547	20734	23735	15468	17559	25.67	19.15	6.69
2001	861	3796	20197	23278	15621	17823	23.46	18.15	6.13
2002	928	4054	19522	23833	16919	n.a.	21.04	18.23	5.88

Sources: Statistical Yearbook of China, Hong Kong Monthly Digest of Statistics and Statistical Yearbook of Macau, various issues.
*RGDP per capita at 1995 constant price in local currency unit converging to USD using 1995 exchange rate against USD.
**RGDP per capita in PPP international dollar at 1995 constant price extracted from World Bank's World Development Indicators 2004.

In view of the disparities in per capita RGDP, as shown in Table 5.2, the RGDP per capita of Mainland China was only USD87 in 1965, while that of Hong Kong has already arrived at USD3,723 or 43 times of Mainland China's. This huge gap can be explained by a number of factors - the differences in political structure, economic systems and ideologies, external policies, technologies and other endowments are undoubtedly some of the reasons. The gap in per capita GDP between Hong Kong and Mainland China did not show any decline until the introduction of economic reforms in Mainland China. In 1980, the income ratio has climbed up to 54, which means that the per capita RGDP of Hong Kong which was USD8,790 was 54 times that of Mainland China's! This situation has started to turn around after the economic reforms when the Chinese authorities have started to relax all the controls and restrictions over economic activities, and to adopt an economic system which is more similar to that of Hong Kong. Along with the deepening of the economic reforms in the 90s, the per capita RGDP of Mainland China has been increasing at a remarkable speed. As a consequence of population control and impressive economic growth, the per capita RGDP of Mainland China has increased to USD808 in 2000 from USD163 in 1980. Simultaneously, the income ratio between Mainland China and Hong Kong has almost reduced by half to 26. As Hong Kong has run into a recession shortly after its handover in 1997, the per capita RGDP has fallen from USD24,130 in 1997 to USD19,522 in 2002. At the same time, the per capita RGDP of Mainland China has climbed to USD928, thus causing the income ratio to decline further to 21. The continuous contraction in the income ratio represents reduced income disparity between the two economies, suggesting that Mainland China is able to catch up with Hong Kong with respect to the per capita RGDP. In relation to the income ratio between Mainland China and Macau, it shares similar declining pattern with the Hong Kong counterpart. A clear negative trend is shown in Table 5.2 and in the past two decades, the ratio has contracted by 62.5% from 48 in 1985 to 18 in 2002.

When the real purchasing power of the income level in these economies are considered, a completely different picture can be drawn. As stated in the last column of Table 5.2, the income gap between Mainland China and Hong Kong has declined significantly after taking into account the purchasing power of RMB and HKD. The per capita RGDP of Mainland China in 1975 has increased from 127 in USD to 552 at PPP international dollar and the corresponding income ratio with Hong Kong has dropped from 48 to 13 when PPP has replaced USD as the measurement unit. The income ratio in PPP has also expressed a declining trend, especially after the economic reform of Mainland China. Since 1994, the income ratio between Hong Kong and Mainland China has fallen to a one-digit level. In 2002, the per capita RGDP of Mainland China was 4054 international dollar which was 4.37 time the value in USD. The income ratio with Hong Kong, meanwhile, has declined to just 5.88 which implied that the per capita RGDP of Hong Kong in PPP was just 5.88 times that of Mainland China.

5.3. Disparities on the Regional Level

In relation to the inequality issue on the regional level, Jian, Sachs and Warner (1996), Tsui (1996) and Gundlach (1997) have placed their focus on the 29 provinces and municipalities to address the inter-provincial inequality problem of Mainland China. Yao and Zhang (2001a, 2001b) has grouped the Chinese provinces and municipalities into three geographical regions namely Coastal, Central and Western regions while Gustafsson and Shi (2002) and Wu (2002) have divided the Chinese provinces into coastal and interior regions to investigate the income distribution problem of Mainland China on the regional level. The discussions here attempt to divide Mainland China into three geographical regions, namely the Coastal, Central and Western regions, then to assess their income differential problems with Hong Kong and Macau.

As summarized in Table 5.3, the income gap between the three regions of Mainland China was minor in 1955, with a ratio of 1.34:1.36:1 between the coastal, central and western regions. Due to the manipulation conducted by the planning committee, their income gap has then experienced a slight increase in the following two and a half decades. In 1980, the per capita RGDP of the coastal region (where the capital city and the municipalities are located) was USD186.58. This was 79% higher than that of the western region and 39% higher than the central region, with an income ratio of 1.79:1.29:1 being recorded. Since the economic reforms, better growth prospects were found in the whole country, especially for some provinces in the coastal region. Despite the advantages from its geographical location and endowments, the coastal region is also able to derive disproportionately better benefits from the biased policies, such as the establishment of the Special Economic Zones (SEZs) and Open Coastal Cities, as well as other incentive policies of attracting foreign investments. At the same time, the industrialization policies towards the Central and Western region were removed. All of these have allowed the coastal region to grow much faster than the other regions of the country. Consequently, the income ratio between the three regions has enlarged to 1.88: 1.16:1 in 1991. In the second decade of economic reforms, the spatial or regional dispersion problem has worsened further and by 2002, income ratio has enlarged to 2.78:1.46:1. The development of the income ratio since the 90s indicates a large and increasing gap in per capita RGDP between these Chinese regions, especially for the gap between the coastal and western regions. Obviously, the western region has been lagged behind by the coastal and central regions. This finding is consistent with the conclusion of Yao and Zhang (2001a, 2001b) that "the Chinese regions may have converged into three distinctive geo-economic clubs of economic growth. Within each economic club, there was a tendency of convergence, but between the clubs, there was a tendency of divergence."[76]

Table 5.3: Per Capita RGDP in Comparison on the Regional Level in USD*

Year	Coastal (1)	Central (2)	Western (3)	Hong Kong (4)	Income Ratio		
					Coastal (4)/(1)	Central (4)/(2)	Western (4)/(3)
1955	65	65	48	n.a.	n.a.	n.a.	n.a.
1960	99	94	69	n.a.	n.a.	n.a.	n.a.
1965	83	80	63	3723	45.10	46.29	58.71
1970	103	92	66	4319	41.79	46.73	65.48
1975	132	103	77	6029	45.75	58.58	77.94
1980	187	135	104	8790	47.11	65.34	84.21
1985	298	211	166	12017	40.37	56.82	72.58
1990	414	270	228	17177	41.51	63.64	75.22
1995	827	444	338	22416	27.10	50.52	66.24
1996	917	497	365	23004	25.10	46.31	62.99
1997	1012	547	395	24130	23.84	44.10	61.15
1998	1108	592	423	23927	21.59	40.40	56.61
1999	1198	633	451	22348	18.65	35.30	49.58
2000	1288	686	482	20734	16.10	30.24	43.05
2001	1407	744	517	20197	14.35	27.16	39.06
2002	1555	813	559	19522	12.55	24.02	34.95

Sources: Statistical Yearbook of China and Hong Kong Monthly Digest of Statistics, various issues.
*RGDP per capita in 1995 constant price in local currency unit converging to USD using 1995 exchange rate against USD.
Coastal: Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong and Guangxi. Hainan is excluded due to incomplete data.
Central: Shanxi, Inner Mongolia, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, Hunan.
Western: Guizhou, Yunnan, Shaanxi, Gansu, Qinghai, Ningxia and Xingjiang. Sichuan and Tibet are excluded due to incomplete data.

When the bilateral income ratios between the three Chinese regions and Hong Kong are focused, their size were rather close to each other in 1965 at 45, 46 and 59 for the coastal, central and western regions. This similarity, however, did not last for long given the imbalance development experienced by these Chinese regions. Consequently, there was

[76] Yao and Zhang (2001b), p.182.

an increasing spread in the income ratio, recorded at 47, 65 and 84 respectively in 1980. The implication of such is a deterioration in income dispersion between the coastal, central and western regions. Their corresponding income gaps with Hong Kong, meanwhile, have also enlarged.

The situation has started to reverse since the economic reforms as all the Chinese regions are able to grow faster than before. The result of reforms-led rapid economic growth is an increase in per capita RGDP which enables all the regions to catch up with Hong Kong. This has led to a reduction in income ratio, to 40.37, 56.82 and 72.58 in 1985 respectively. As the reforms and economic growth sustained, the income disparity problem between the Chinese regions and Hong Kong has improved further. In 1996, the income ratios stayed at 25.1, 46.31 and 62.99. Until 2002, the income ratios of the coastal and central regions have contracted by another 50%, while that of the western region has dropped almost by half to the ratios of 12.55, 24.02 and 34.95, respectively.

In light of the income inequality problem between Mainland China and Hong Kong on the city level. In 1961, the per capita income ratio between Beijing, Tianjin, Shanghai and Guangdong was 2.02:2.08:2.99:1. Shanghai's income was 3 times that of Guangdong, while the income level of Beijing and Tianjin's were double that of Guangdong. In 1975, the ratio has increased to 2.67:2.55:3.98:1 and it implies an increase in income dispersion within the coastal region of Mainland China in the pre-reform period. Such disparity may be attributed to biased policies favouring the municipalities. Following the implementation of economic reforms and open door policies, there was a rapid increase in the income level of Guangdong, thus reducing its gap with the other economies and a ratio of 2.41:2.25:3.69:1 was recorded in 1985. In line with the economic reforms, the income level of Guangdong expands rapidly and reduces its income gap with the other coastal economies. In 1995, the ratio has dropped to 1.41:1.21:2.24:1. This smaller ratio represents a significant improvement in income inequality comparing with the level in 1985 and the pre-reform period. In 2002, the income ratio of these economies was recorded as 1.32:1.34:2.17:1, indicating a further reduction in income dispersion between the four major economies in the coastal region of Mainland China. Such contraction in income gap within the coastal region in the post-reform period is consistent with the conclusion in Yao and Zhang (2001a) as previously mentioned.

Table 5.4: Income Ratio with Hong Kong in Comparison on the City Level

Year	Beijing	Tianjin	Shanghai	Guangdong	Coastal
1961	27.10	26.51	18.40	55.07	55.60
1965	26.62	22.18	16.19	38.30	45.10
1970	15.94	18.14	12.15	42.45	41.79
1975	18.44	19.31	12.35	49.18	45.75
1980	19.26	21.04	12.81	53.70	47.11
1985	18.42	19.79	12.03	44.45	40.37
1990	19.83	23.60	13.77	37.58	41.51
1995	15.71	18.25	9.89	22.16	27.10
1996	14.93	16.45	9.00	20.87	25.10
1997	14.68	15.42	8.39	20.13	23.84
1998	13.33	14.07	7.56	18.38	21.59
1999	11.61	12.66	7.23	16.01	18.65
2000	10.48	11.06	6.74	14.22	16.10
2001	9.35	9.65	5.86	12.76	14.35
2002	8.43	8.32	5.14	11.15	12.55

Sources: Statistical Yearbook of China, various issues.
Income ratio is computed by dividing the per capita RGDP of Hong Kong in USD price against different municipalities and provinces of Mainland China.

In relation to the pace of income growth of these cities, Guangdong can derive disproportionately high benefits from the reforms and open door policies and is the economy that grows at the highest speed, especially in the post-reform period. Its income level in 2002 is 26 times the level of 1961. Between 1978 to 2002, the per capita RGDP of Guangdong has increased from USD133.56 to USD1,751.07, representing an average annual growth rate of 10.93% for the entire post-reform period. In the recent decade of 1993 to 2002, the income level of Guangdong has been increasing at 10.76% per year. As for the municipalities, their income levels in 2002 were 17.09 times, 16.81 times and 18.88 times that in 1961 for Beijing, Tianjin and Shanghai respectively. Their average annual growth rate with respect to per capita RGDP are 7.87%, 8.68% and 8.25% respectively in the post-reform period. In the past decade, meanwhile, their average growth rates were recorded at 8.38%, 10.75% and 9.70% respectively. These figures suggest that the income levels of the municipalities were growing at a similar pace in the post-reform period. On the other hand, Guangdong, as one of the major beneficiaries of the economic reforms and open door policies, is able to achieve a more rapid growth rate, and thus catches up with the other initially richer municipalities.

In view of the income gap between Hong Kong and these Chinese coastal economies, the income ratios of Beijing, Tianjin, Shanghai, Guangdong and the entire coastal region are shown in Table 5.4. On the evolution of the income ratios, they have been declining for the past 40 years, and a stable declining trend could only be found after 1991. For Beijing, Tianjin and Shanghai, for example, their income ratios with Hong Kong has declined from two-digit to one-digit level in the past four decades, reducing from 27.1, 26.51 and 18.4 in 1961, to 19.26, 21.04 and 12.81 in 1980 and 8.43, 8.32 and 5.14 in 2002, respectively. In comparison, Guangdong's income ratio with Hong Kong is higher than the municipalities in both the pre- and post-reform periods. However, the ratio has been declining more rapidly especially in the post-reform period, from 55.07 to 53.70 and 37.58 for 1961, 1980 and 1990 respectively. The ratio has further contracted to just 11.15 in 2002 and this value is also very close to the coastal average. It can be observed that the growth pattern of Guangdong is quite similar to that of the entire coastal region, which showed a relatively large income gap with Hong Kong in the pre-reform years but has narrowed remarkably in the post-reform period.

5.4. Income Convergence between Mainland China, Hong Kong and Macau

5.4.1. δ-convergence: The Coefficient of Variation

The issue of σ-convergence is studied to estimate the static disparities in per capita income levels. If the income gap between these economies is declining, then it can be viewed as an evidence of δ-convergence in which the actual income gap between the economies in consideration has reduced. The coefficient of variation (CV) which is the ratio of standard deviation to the mean is a common measurement of income inequality.

$$CV = \frac{\sqrt{\frac{\sum (y_i - \bar{y})^2}{n}}}{\bar{y}} \tag{5.1}$$

where y_i is the net material product per worker in region i and $\bar{y}$ is the mean value.

The index indicates the relative dispersion of per capita income between the parties in discussion and a high value implies a more serious income inequality problem, and *vice versa*. The CV does not only quantify the income inequality problem but also measures the development of income gap between different economies. Given a contraction in CV, one can say that the economies in consideration have experienced δ-convergence with reduced difference in their income levels. The coefficient of variation has been widely used in a number of recent studies, such as Lyons (1991), Tsui (1996), Chen and Fleisher (1996), Raiser (1998), Zheng, Xu and Tang (2000), Xu and Zou (2000) and Chang (2002). Making use of the net material product, national income or per capita GDP in nominal or real value, the coefficient of variation are computed in these articles to assess the income inequality problems of Mainland China from different angles, covering both the pre- and post-reform periods.

In order to address the income disparity and its dynamics between Mainland China, Hong Kong and Macau over the pre- and post-reform eras, the CV with respect to these economies will be measured. If the CV is declining continuously, then there is an evidence of δ-convergence, and an improvement in income inequality problem is therefore implied. In practice, the Chinese provinces and the SARs will firstly be divided into different groups, for example, all the Chinese provinces with and without the SARs, the coastal, central and western regions with the SARs, and the corresponding CV will be calculated respectively. The intention is to compare whether the income disparity problem in one group, such as that of western provinces and SARs, is more serious than that of the others. In addition, it is able to show the influences of Hong Kong and Macau to the income distribution of the Greater China.

Table 5.5: Coefficient of Variation by Groups

Year	Greater China*	Coastal region + SARs*	Central region + SARs*	Western region + SARs*	Chinese provinces
1961	3.2982	2.5745	2.5227	2.3237	0.5205
1965	3.0606	2.4690	2.4213	2.2713	0.4670
1970	2.9877	2.3527	2.4342	2.3005	0.6315
1975	3.1594	2.4066	2.5344	2.3435	0.6968
1978	3.2147	2.4553	2.5390	2.5906	0.7156
1979	3.2899	2.4944	2.5544	2.6190	0.7093
1980	3.3508	2.5214	2.5822	2.6302	0.7138
1981	3.4025	2.5507	2.5925	2.6448	0.6960
1982*	2.9917	2.0782	1.9640	1.9867	0.6718
1983	2.9607	2.0664	1.9546	1.9810	0.6668
1984	2.8961	2.0325	1.9397	1.9673	0.6570
1985	2.8231	1.9962	1.9241	1.9504	0.6475
1986	2.8106	1.9884	1.9216	1.9495	0.6378
1987	2.8175	1.9892	1.9236	1.9542	0.6255
1988	2.7962	1.9761	1.9207	1.9497	0.6246
1989	2.8297	1.9940	1.9303	1.9564	0.6197
1990	2.8507	2.0043	1.9366	1.9611	0.6195
1991	2.8313	1.9911	1.9420	1.9657	0.6210
1992	2.7914	1.9613	1.9376	1.9656	0.6248
1993	2.7272	1.9210	1.9308	1.9644	0.6393
1994	2.6588	1.8795	1.9206	1.9618	0.6400
1995	2.5653	1.8233	1.8991	1.9476	0.6581
1996	2.4900	1.7821	1.8826	1.9421	0.6685
1997	2.4380	1.7535	1.8765	1.9430	0.6816
1998	2.3421	1.6978	1.8592	1.9342	0.6904
1999	2.2218	1.6262	1.8167	1.8998	0.6551
2000	2.1097	1.5575	1.7606	1.8530	0.6227
2001	2.0060	1.4881	1.7235	1.8230	0.6370
2002	1.9172	1.4260	1.6840	1.7906	0.6409

Sources: RGDP per capita statistics obtain from Statistical Yearbook of China, Hong Kong Monthly Digest of Statistics and Statistical Yearbook of Macau. CV is calculated according to equation 5.1.

As official survey started in 1982, Macau is covered in the measurement only after 1982. The relatively lower per capita RGDP of Macau (relative to Hong Kong) has then brought about a drop in CV's in 1982.

All the income levels are measured as RGDP per capita in 1995 constant price in local currency unit converging to USD using 1995 exchange rate against USD.

Greater China: It covers the 27 provinces of Mainland China, three municipalities of Beijing, Tianjin and Shanghai; 2SARs of Hong Kong and Macau.

Chinese provinces: Only the 27 provinces and 3 municipalities of Mainland China are considered.

Coastal region + SARs: It covers 9 coastal provinces and 3 municipalities as defined before; Hong Kong and Macau. The statistics of Hainan province are discussed only after 1978.

Central region + SARs: It covers 9 Chinese provinces as defined previously; Hong Kong and Macau.

Western region + SARs: It covers the 7 inner provinces as defined before; Hong Kong and Macau. Sichuan and Tibet are discussed only after 1978 due to the availability of statistics.

As for the pattern of income distribution between Mainland China, Hong Kong and Macau, the CV dominated by the Chinese provinces, municipalities, Hong Kong and Macau are calculated and summarized in column 2 of Table 5.5. As shown, the CV was rather stable in the pre-reform years moving at around 3. Then it has started to decline in the post-reform period from 3.21 in 1978 to 1.92 in 2002. This evolution suggests δ-convergence in per capita income in the Greater China economies between the Chinese provinces, Hong Kong and Macau, and implies a contraction in the income gap between these economies. This result also matches the conclusion in the previous section that the income dispersion between the Chinese regions and Hong Kong has been declining since the beginning of the post-reform period.

The CVs between Hong Kong, Macau and each of the three geographical regions of Mainland China have also been measured and summarized in columns 3, 4 and 5 of Table 5.5. Similar to the Greater China CV, in the pre-reform period all the regional CVs were stable with similar values ranging from 2.3 to 2.5. It reflects the presence of a large income gap between the centrally planned Chinese regions and the market-oriented Hong Kong and Macau economies. In 1978, the CVs for the coastal, central and western regions were at similar level and stayed at 2.4553, 2.5390 and 2.5906 respectively. The economic reforms allowed the Chinese provinces to grow faster than Hong Kong and Macau and the indices then started to decline to 2.0043, 1.9366 and 1.9611 respectively in 1990, and have arrived at 1.4260, 1.6840 and 1.7906 in 2002. Given the declining trend of the CV, there is δ-convergence on income level between each of the Chinese regions, Hong Kong and Macau in the post-reform period. The difference between the three regional CVs shows that the income gap between the coastal provinces, Hong Kong and Macau is smaller than the central and western provinces' counterparts. It is because the coastal provinces have derived more benefits from the reforms and therefore can grow faster than the other provinces in the country.

On the size of the CV, among all the indices in Table 5.5, the Greater China one, which is measured to quantify the income disparity problem between Mainland China, Hong Kong and Macau as a whole, is the highest. This indicates the presence of a considerable income gap between the Chinese provinces, Hong Kong and Macau. This problem, however, has been easing since the economic reforms and the CV has been reducing from over 3 in 1978 to less than 2 in 2002.. Relative to the Greater China CV, the regional CV is smaller by 0.49, 0.23 and 0.13 unit in 2002 for the coastal, central and western regions. Perhaps the provinces within each of these regions have similar backgrounds, endowments and income levels, face similar policies and may have even formed a geo-economic club with each other. As a result, the income inequality problem within each of these regions is relatively small. Even if Hong Kong and Macau are grouped into these regions, the income disparity problem of these regions is still less serious than that inherited in the Greater China.

In view of the inequality problem within Mainland China, as shown in the last column of Table 5.5, due to the various political and economic movements introduced by the government, the income levels of the Chinese provinces were far from stable in the pre-reform period and the CVs have been fluctuating as a result. After the economic reforms, the CV has started to drop from 0.7156 in 1978 to 0.6195 in 1990, but has increased once again to 0.6904 in 1998. An improvement in income inequality was observed in 1999 and 2000 with CV reducing to 0.6551 and 0.6227. But the income gap has widened again in the following years to 0.6409 in 2002. This pattern can probably be explained by the initially poorer coastal province, such as Guangdong, which can achieve higher growth rate in the early reform period to catch up with the other provincial economies of Mainland China. The continuous growth and development of Guangdong, however, does not only allow the province to catch up with, but also out-performs those initially richer provinces. Thus the income gap between the Chinese provinces reduces at the beginning, then starts to expand again after the 90s. This finding is consistent with the previous studies that the economic reforms of Mainland China have brought about δ-convergence at the beginning, and the income gap between different provinces has also been narrowed. Nevertheless, the inequality problem has worsened in the later period and the income dispersion problem within Mainland China on the provincial level has deteriorated. Due to the instability of the indices, there is no clear tendency on actual income disparities on the provincial level in both the pre- and post-reform periods. The relatively smaller value of the provincial CV indicates that the income inequality problem within Mainland China is less serious than that associated between Mainland China and the SARs. It further implies that the income disparity problem displayed in the Greater China CV is not caused by the income gap between different Chinese provinces and municipalities, but is attributed to the income gap between Mainland China, Hong Kong and Macau.

5.4.2. β-convergence

The studies on the variation coefficients with respect to per capita RGDP have displayed δ-convergence in income levels between Mainland China, Hong Kong and Macau on both regional and national levels, especially after the implementation of the economic reforms and the open door policies. Given the evidence of δ-convergence and reduced income dispersion, the next step is to measure the speed at which the income gap is declining, or to estimate β-convergence.

The test of β-convergence on income levels examines if the initially poorer economies can achieve a higher growth rate than the initially richer economies. In other words, this is to examine if a higher speed of income growth is associated with a lower initial income level, and convergence is a process in which the poorer economies catch up with the richer one. In light of the analysis on β-convergence, it can be further divided into absolute and conditional convergence. In the former case, initial income level is the only factor of concern and the catching-up process will take place if the initially poorer economies have higher growth pace than the initially richer one. As for the latter, income convergence and the catching-up process can only be initiated given the presence of additional control factors, such as investment to GDP ratio, population growth, openness ratios, FDI to GDP ratio, etc. In conditional β-convergence, the above-mentioned growth related factors determine the steady state income level of an economy and if an economy is far from its steady state income level, then it tends to have a higher speed of economic growth until it arrives at its steady state. However, in the process of conditional β-convergence, the initially poorer economies will have a tendency to move just towards its steady state income level.

To examine for absolute β-convergence, the simple regression that was suggested in Baumol (1986) and applied in Chen and Fleisher (1996), Jian, Sachs and Warner (1996), Gundlach (1997), Raiser (1998), Zhang (2001) and Yao and Zhang (2001b) will be adopted in this research, to regress the growth rate of RGDP per capita against the beginning period's level of RGDP per capita on both the cross-sectional and pooled basis. The regression function is specified as:

$$LnY_{it} - LnY_{i0} = A + \beta LnY_{i0} + \varepsilon_{it} \quad (5.2)$$

[77]

and $\beta = -(1 - e^{-\lambda t})$

where λ is the pace of income convergence, Y_{it} and Y_{i0} are the ending and beginning periods' RGDP per capita respectively. The estimation will be performed on a provincial basis which covers all the Chinese provinces and municipalities (except for Chongqing), Hong Kong and Macau. A statistically significant and negative β suggests income convergence. It implies that an initially poorer economy, such as the remote provinces of Mainland China, can take advantages of its backwardness to achieve a higher growth rate so as to catch up with the initially richer economies, for example, Hong Kong and Macau. On the contrary, a positive β shows income divergence since an economy with higher initial income tends to grow faster; then the initially richer economies will become even richer, while the initially poorer economies will become even poorer in the group.

Conditional β-convergence is the next issue to be addressed in this research. If absolute β-convergence is observed, then conditional β-convergence is also implied. However, it is also possible to conduct the conditional convergence analysis and the estimation result shows if the additional factors, such as investment, population growth, openness and FDI ratios contribute to accelerate the pace of income convergence. Incorporating the investment ratio, the effective population growth rate and the rate of human capital investment, the estimation equation can be written as:

[77] Raiser (1998), p.3.

$$Ln(y(t)) - Ln(y(0)) = (1-e^{-\lambda t})\frac{\alpha}{1-\alpha-\beta}Ln(s_k) + (1-e^{-\lambda t})\frac{\beta}{1-\alpha-\beta}Ln(s_h)$$ [78]

$$-(1-e^{-\lambda t})\frac{\alpha+\beta}{1-\alpha-\beta}Ln(n+g+\delta) - (1-e^{-\lambda t})Ln(y(0))$$

(5.3)

which was developed from:

$$Ln(y(t)) - Ln(y(0)) = (1-e^{-\lambda t})Ln(y^*) - (1-e^{-\lambda t})Ln(y(0)) \qquad (5.4)$$

and the steady state level of income per effective work, y^*, was defined as:

$$\frac{dLn(y(t))}{dt} = \lambda[Ln(y^*) - Ln(y(t))], \text{ where } \lambda = (n+g+\delta)(1-\alpha-\beta)$$

(5.5)

y(t) is income per effective worker and *y(0)* is the figure in the initial period, n is the labour growth, σ is the depreciation rate and g is the technological progress. α is the capital share in income and β is the labour share. s_k and s_h are the investment in physical capital and human capital respectively, λ is the rate of convergence. According to Mankiw, Romer and Weil (1992), this augmented Solow growth model specifies that the growth of income is a function of the determinants of the ultimate steady state and the initial level of income[79].

This model argues that the income per worker in an economy will converge to the economy's own steady-state level, which is determined by its own endowments, such as physical and human capital accumulation, population growth and depreciation, etc. The income levels between different economies, however, may not necessarily approach to a similar level over time. Specifications similar to the above-mentioned could also be found in Gundlach (1997), Raiser (1998)[80], Zhang (2001) and Yao and Zhang (2001a, 2001b).

[78] Mankiw, Romer and Weil (1992), p.423.
[79] Mankiw, Romer and Weil (1992), p.423.
[80] In Raiser (1998), the ratio of non-state enterprises output to industrial production and light industry output to industrial production have been inserted into the estimation of conditional convergence to show

In assessing the growth pattern of Mainland China, Yao and Zhang (2001b) has incorporated some additional factors, such as the international trade to GDP ratio, the equivalent length of highways and regional dummies in his estimation[81].

This research will apply similar specification to examine for conditional β-convergence between Mainland China, Hong Kong and Macau. Regressions will be run on both cross-sectional and pooled basis to estimate the pace of unconditional or conditional β-convergence, that is the speed at which different economies return to their respective steady state output level. The estimations also aim at addressing the growth discipline of these economies, as well as the contributions of different factors, such as investment ratio, population growth, openness ratio, FDI ratio and the development of the secondary sector, to the growth pace and speed of income convergence of these economies. The function form of the estimation equation is specified as:

$$LnY_{ti} - LnY_{0i} = Cons\tan t + (1 - e^{-\lambda t})LnY_{0i} + \gamma_1 Ln(s)_i + \gamma_2 Ln(n + g + \delta)_i + \gamma_3 Ln(\sec)_i + \gamma_4 Ln(open)_i + \gamma_5 Ln(FDI)_i + \varepsilon_i \qquad (5.6)$$

This specification is developed from the Solow growth model with a Cobb-Douglas production as the basis. In addition to the initial per capita RGDP level Y_{0i}, growth related factors such as the investment ratio s_i (measured as the gross fixed capital formation to GDP level in real terms), the population growth rate n, the rate of technological progress g, the depreciation rate δ, the output level of the secondary sector to total GDP sec_i, the openness ratio $open_i$, and the FDI to GDP ratio FDI_i (which will only be used in the estimations without Hong Kong and Macau) are included in the specification. λ is the speed of conditional convergence to be estimated and Y_{ti} is the RGDP per capita at time t.

The above-mentioned β-convergence test will be employed to examine whether and at what speed the per capita income level of Mainland China and its SARs are approaching to each other after controlling their growth potential, or if the initially poorer Chinese

how the Open Door Policy, the market liberalization and the structural change have contributed to the growth and income convergence of Mainland China.

[81] Yao and Zhang (2001b), p.180.

economies are able to grow at a higher speed than the initially richer SARs. To address the issue of absolute β-convergence between Mainland China, Hong Kong and Macau, a simple estimation will be formulated to regress the growth rate of per capita RGDP on the beginning year's per capita RGDP. The intention is to assess if the growth rate of these economies is negatively related to its initial income level. Given a negative and statistically significant estimated coefficient for the initial income level, it is possible to conclude that the initially poorer economy is able to have a higher growth rate which enables it to catch up with the initially richer economy, and β-convergence is taking place in an absolute manner. Apart from running regression to estimate the entire sampling period of 1952 to 2002 (1961 to 2002 for the grouping with Hong Kong), the sampling period will also be divided into several sub-periods, for example, 1952 to 1977, 1978 to 1990 and 1991 to 2002. The shortening of the sampling period may result in a reduction in the significance of the estimation results. Subject to the fact that the economic development of Mainland China has gone through a major transition in 1978 from a planned to a market-oriented economy, it is still necessary to break down the sampling period to pre- and post-reform periods to examine whether the catching-up process could happen in these two periods. Furthermore, during the process of Mainland China's economic reforms, the more crucial full scale enterprises, price and exchange rate system reforms were launched only after the 90s. The sub-period of 1991 to 2002 then shows whether the catching-up process in this period could be faster than the previous one after the associated adjustments have taken place in the economy.

Absolute Income Convergence

In the estimations, the Chinese provinces will be divided into three regions namely the coastal, central and western regions. The issue of income convergence between the provinces in each of these regions, and each Chinese region with Hong Kong and Macau will be examined respectively. In this way, it is possible to check firstly if there is income convergence within each of these regions. In addition, comparison can be made to assess if, for example, the coastal region can catch up with the SARs at a higher speed than the other regions.

As reported in the first half of Table 5.6, without considering Hong Kong and Macau, no absolute β-convergence can be found in all the sub-periods. All the estimated coefficients of the initial income level are statistically insignificant in both the pre- and post- reform periods. It implies that the initially poorer Chinese provinces do not have higher growth rate than the initially richer provinces and thus fail to initiate any catching-up process. The initially poorer provinces are likely to be those agricultural-oriented with less endowments and they probably could not benefit from the government's industrialization policies. As a result, it would be hard for the initially poorer provinces to achieve a high growth rate to catch up with those initially richer economies. The negative adjusted R square shown in columns 2, 3, 4, and 5 suggests a negative model sum of squares (MSS), which means that the total sum of squares (TSS) is less than the residual sum of squares (RSS). If the RSS is greater than TSS, it implies that the estimation provided by the explanatory variable is even worse than the mean of the dependent variable. The estimation equation is simply unacceptable and fails to provide any explanation to the dependent variable. In other words, the initial income level is almost unrelated to the income growth rate and there would be no catching-up process. Given the absence of a catching-up process or β-convergence, it is then impossible for the Chinese provinces to narrow the income gap associated with them to achieve δ-convergence. This finding is rather similar to those offered by Chen and Fleisher (1996) and Jian, Sachs and Warner (1996) in which the former did not show any absolute β-convergence in both the pre- and post-reform periods, while the latter suggested a mixed result with no clear tendency of absolute β-convergence in both the pre- and post-reform periods.

Table 5.6: Basic Convergence Regressions in Cross Sectional Analysis: Chinese Provinces Only

Time period	1952-1977	1978-2002	1978-1990	1991-2002	1952-2002
Constant	0.679 (1.07)	2.485 (4.13)	1.349 (4.53)	0.656 (1.61)	2.891 (3.60)
Ln Y_{0i}	0.0392 (0.247)	-0.106 (-0.86)	-0.0989 (-1.64)	0.0648 (0.93)	0.00771 (0.038)
Implied λ	*-0.0016*	*0.0047*	*0.0087*	*-0.0057*	*-0.00015*
Adjusted R^2	-0.037	-0.0088	0.055	-0.0044	-0.040
with coastal dummy					
Constant	0.947 (1.64)	3.511 (7.23)	1.697 (5.77)	1.596 (3.87)	3.498 (8.13)
Ln Y_{0i}	-0.0589 (-0.401)	-0.356 (-3.48)	-0.184 (-2.96)	-0.115 (-1.56)	-0.215 (-1.97)
Coastal Dummy	0.304 (2.66)	0.508 (5.03)	0.172 (2.81)	0.273 (3.85)	0.690 (8.13)
Implied λ	*0.0024*	*0.018*	*0.017*	*0.011*	*0.0048*
Adjusted R^2	0.17	0.46	0.24	0.33	0.71

Estimated equation: $LnY_{ti} - LnY_{0i} = Constant + (1 - e^{-\lambda t})LnY_{0i} + \varepsilon_i$,
t statistics in parenthesis.

A coastal dummy is then introduced in the analysis to capture the impact of the biased policies favouring the coastal region. The adjusted R square then becomes positive and it indicates improved significance comparing with the upper panel. Income convergence is observed for the sub-periods of 1978 to 2002, 1978 to 1990 as well as the entire sampling period of 1952 to 2002. It shows that the economic reforms and the resulting higher growth pace have brought about absolute β-convergence, particularly to the coastal region of Mainland China. As stated before, Guangdong, which is an initially poorer province in the coastal region can receive disproportionately higher benefit from the reforms to grow faster than the initially richer municipalities in the region and bring about convergence to the entire coastal region in the post-reform period. The pace of convergence in the period of 1978 to 1990 is strong and has dominated the estimation result of the entire post-reform period of 1978 to 2002, as well as the whole discussion period of 1952 to 2002. It is possible that some of the initially poorer economies, such as Guangdong, in the coastal region have experienced a rapid growth pace in the early reform years which has not only allowed them to catch up with the other initially richer economies in the region, but had also surpassed them in the second decade of the reform period. Consequently, a non-convergence pattern is found from 1991 to 2002. Furthermore, the coastal dummies in all the estimations are strongly significant, it shows that the coastal region has its own income growth pattern which is different from the other regions of the country. This specific growth discipline could very much be explained by the open door policies and the preferential treatment which were firstly introduced by the central authorities in the coastal region with an intention to promote trade and attract incoming foreign investment.

Table 5.7: Basic Convergence Regressions in Cross Sectional Analysis: Chinese Provinces together with Hong Kong and Macau

Time period	1961-1977	1978-2002	1978-1990	1991-2002	1961-2002
Constant	0.734 (2.86)	2.922 (8.36)	0.991 (5.59)	2.112 (9.30)	3.775 (9.30)
Ln Y_{0i}	-0.0262 (-0.45)	-0.196 (-2.856)	-0.0249 (-0.72)	-0.187 (-5.08)	-0.254 (-2.78)
Implied λ	*0.0017*	*0.0091*	*0.0021*	*0.019*	*0.0071*
Adjusted R^2	-0.030	0.19	-0.016	0.44	0.20
with coastal dummy					
Constant	0.832 (3.67)	3.365 (12.62)	1.104 (6.21)	2.499 (14.09)	4.024 (16.44)
Ln Y_{0i}	-0.0766 (-1.43)	-0.325 (-5.87)	-0.0580 (-1.57)	-0.276 (-8.91)	-0.381 (-6.61)
Coastal Dummy	0.280 (2.98)	0.496 (5.24)	0.127 (2.01)	0.357 (5.44)	0.703 (6.94)
Implied λ	*0.0050*	*0.016*	*0.0050*	*0.029*	*0.012*
Adjusted R^2	0.21	0.58	0.08	0.72	0.72

Estimated equation: $LnY_{ti} - LnY_{0i} = Cons\tan t + (1-e^{-\lambda t})LnY_{0i} + \varepsilon_i$

t statistics in parenthesis.

The data set covers the statistics of Hong Kong and Macau. The estimations above begin from 1961 since Hong Kong's statistics are only available from this year onward.

Afterwards, the Chinese provinces, Hong Kong and Macau are pooled together and the basic cross-sectional regressions are re-estimated. As shown in Table 5.7, there is no evidence of income convergence in the pre-reform period due to the enormous distinctions in almost all of the aspects among these economies. Similar to Table 5.6, the adjusted R square in columns 2 and 4 are negative and it implies poor significance for the corresponding estimations. This result is consistent with the findings of the study on CV in Table 5.5. As for the post-reform period, from 1978 to 2002, absolute income convergence is shown between the Chinese provinces, Hong Kong and Macau. This process is believed to be attributed to the rapid catching-up process in the sub-period of 1991 to 2002 after the full scale reforms and transition of Mainland China to a market-oriented economy. As shown in column 5 of Table 5.7, the income convergence process in the period of 1991 to 2002 is so strong that it has dominated the other estimations. For this reason, our assessments have shown absolute β-convergence in the post-reform period of 1978 to 2002, as well as in the entire sampling period of 1961 to 2002, despite the evidence of no income convergence in both the pre- and early reform periods. To sum up, it could be viewed that it takes time for the reform policies to implement to reshape and stimulate the Chinese provincial economies. Therefore, the convergence process among Mainland China, Hong Kong and Macau began only after 1990. In the process of income convergence, the relatively poorer Chinese provincial economies are able to grow at a higher rate than the relatively richer Hong Kong and Macau economies. The rapid economic growth on Mainland side, meanwhile, could be closely connected to its economic reforms, and the subsequent adjustments in the ownership structure, the liberalization of the centralized control, the re-establishment of a market system, the reforms of the procurement and pricing system as well as Mainland China's re-integration with the outside world.

Then a coastal dummy is inserted into the cross-sectional estimation with Hong Kong and Macau. This dummy variable does not reverse any of the estimation results but contributes to improve the explanatory power of the initial income, as well as to increase the size of its estimated coefficient. The strongly significant coastal dummies in all the sub-period estimations suggest that the growth pattern in the coastal region of Mainland China is different from the other regions. In general, it could be viewed that the coastal region is able to catch up with Hong Kong and Macau at a higher speed than the other regions due to its geographical location and the preferential policies introduced by the government. The speed of convergence was 2.9% a year in the period of 1991 to 2002 which was 1 percentage point faster than the convergence pace of the whole country.

Table 5.8: Basic Convergence Regressions in Panel Data Analysis: Chinese Provinces Only

Time period	1953-1977	1978-2002	1978-1992	1993-2002	1953-2002
Constant	0.681 (3.29)	0.243 (3.74)	0.403 (3.74)	0.487 (3.83)	-0.112 (-1.55)
Ln Y_{0i}	-0.130 (-2.76)	0.0133 (1.18)	-0.0205 (-1.012)	-0.0210 (-1.052)	0.0658 (4.69)
Implied λ	*0.028*	*0.0027*	*0.0069*	*0.011*	*-0.0068*
Adjusted R^2	0.047	0.0026	0.00028	0.002	0.069
Coastal provinces					
Constant	0.458 (1.46)	0.428 (3.90)	0.614 (3.55)	0.836 (3.05)	-0.0804 (-0.73)
Ln Y_{0i}	-0.071 (-1.03)	-0.0127 (-0.71)	-0.0497 (-1.62)	-0.0681 (-1.69)	0.0617 (3.04)
Implied λ	*0.015*	*0.0026*	*0.017*	*0.035*	*-0.0064*
Adjusted R^2	0.001	-0.0085	0.044	0.075	0.067
Central provinces					
Constant	1.483 (3.44)	0.225 (1.79)	0.753 (4.23)	1.481 (6.61)	-0.237 (-1.57)
Ln Y_{0i}	-0.323 (-3.28)	0.016 (0.70)	-0.0927 (-2.69)	-0.181 (-4.96)	0.0868 (2.88)
Implied λ	*0.078*	*-0.0032*	*0.032*	*0.1*	*-0.0091*
Adjusted R^2	0.18	-0.012	0.19	0.58	0.076
Western provinces					
Constant	0.892 (1.96)	0.252 (1.91)	0.533 (2.11)	0.764 (3.39)	-0.0212 (-0.15)
Ln Y_{0i}	-0.186 (-1.68)	0.0052 (0.21)	-0.0545 (-1.083)	-0.0770 (-2.016)	0.0492 (1.69)
Implied λ	*0.041*	*-0.001*	*0.019*	*0.04*	*-0.005*
Adjusted R^2	0.051	-0.022	0.007	0.15	0.023

Estimated equation: $LnY_{ti} - LnY_{0i} = Constant + (1 - e^{-\lambda t})LnY_{0i} + \varepsilon_i$
t statistics in parenthesis.

Apart from the cross-sectional analyses, the Panel Data approach has also been advocated to address the issue of absolute β-convergence. Such pooled analysis may help to resolve the possible significance problem in the sub-periods which is caused by the shortening of sampling period. The sampling period of 1953-2002 are divided into 10 groups and each of them carries a time span of 5 years. The analyses have pooled the 30 Chinese provinces and municipalities, with and without Hong Kong and Macau for integrated studies. In addition, estimations on the regional level are also conducted to examine the growth pattern of each geographical region of Mainland China. Besides, the restriction of a common constant is also applied in the estimations. The estimation results focusing just on the Chinese provinces are shown in Table 5.8.

Concerning the pre-reform period, as indicated in Table 5.8, absolute β-convergence is found only in the central region, meaning that the provinces in this region were able to converge their income levels toward the regional mean, with the initially poorer provinces in the region having a higher growth rate. This convergence process could probably be explained by the industrialization policies imposed by the authorities in the pre-reform period. For strategic and security reasons, most of the beneficiaries of these policies were located in the central region of the country. As a result, these provinces were able to grow at a similar and relatively high rate to achieve income convergence. The catching-up process in the central region has dominated and contributed to bring about overall absolute income convergence on the provincial level, between the 30 provinces and municipalities of Mainland China. In the meantime, neither the coastal nor the western region has gone through any form of unconditional income convergence from a statistical point of view. These findings are consistent with those in the cross-sectional analyses.

In the post-reform period of 1978 to 2002, some provinces in the country could manage to sustain their high pace of economic growth to firstly catch up, and then out-perform the other provincial economies. As a result, no clear evidence of absolute income convergence can be found on both the provincial and regional levels. When the adjusted R square is considered, a negative value is found for all the regional analyses and it reveals a poor significance for all the estimations. Perhaps it is necessary to break the post-reform period down to two sub-periods, namely 1978 to 1992 and 1993 to 2002, to reflect the structural adjustments that have taken place in the post-reform period. Despite these findings, absolute income convergence is observed on the regional level in some of the sub-period estimations, for example, the central region in the periods of 1978 to 1992 and 1993 to 2002, and the western region in the period of 1993 to 2002. On the contrary, there is no tendency of absolute convergence in the coastal region in all the sub-periods of the post-reform era. This evidence may suggest that the economic reforms and open door policies which have favoured the coastal region disproportionately, have also brought about divergence to the region as these policies have affected different coastal provinces in an uneven way, leading to absolute income divergence. For the central and western regions, though they are not the major beneficiaries of the reforms and open door policies, most of those provinces, especially those which were adversely affected by the biased policies in the pre-reform period, could be able to derive certain advantages from these policies and grow faster. Thus, income convergence is observed, for example, in the western region. Considering the entire sampling period of 1953 to 2002, the estimation results have displayed absolute income divergence for the coastal and central regions, as well as on the aggregate levels. It indicates that due to the biased policies of the government to favour the industrialized regions in the pre-reform period and coastal regions in the post-reform period, the initially richer provinces in these groupings could enjoy a higher growth rate than the initially poorer provinces or perhaps the initially poorer provinces have expanded so fast that they have out-performed the initially richer provinces and therefore, there is no evidence of absolute β-convergence nor catching-up process in this period.

Table 5.9: Basic Convergence Regressions in Panel Data Analysis: Chinese Provinces together with Hong Kong and Macau

Time period	1963-1977	1978-2002	1978-1992	1993-2002	1963-2002
Constant	0.376 (4.25)	0.452 (9.57)	0.377 (6.35)	0.841 (10.51)	0.296 (7.50)
Ln Y_{0i}	-0.0333 (-1.74)	-0.0244 (-3.11)	-0.0153 (-1.45)	-0.0778 (-6.44)	-0.00298 (-0.42)
Implied λ	*0.0068*	*0.0049*	*0.0051*	*0.040*	*0.00037*
Adjusted R^2	0.024	0.052	0.01	0.39	-0.003
Coastal provinces with Hong Kong and Macau					
Constant	0.390 (3.70)	0.646 (9.05)	0.508 (6.21)	1.145 (9.00)	0.438 (7.83)
Ln Y_{0i}	-0.0265 (-1.26)	-0.050 (-4.63)	-0.0301 (-2.29)	-0.114 (-6.58)	-0.0229 (-2.52)
Implied λ	*0.0054*	*0.01*	*0.010*	*0.061*	*0.0029*
Adjusted R^2	0.016	0.23	0.10	0.61	0.049
Central provinces with Hong Kong and Macau					
Constant	0.271 (2.67)	0.531 (8.76)	0.348 (5.98)	1.014 (13.84)	0.333 (6.04)
Ln Y_{0i}	-0.0197 (-0.96)	-0.040 (-4.22)	-0.0133 (-1.38)	-0.104 (-9.93)	-0.0153 (-1.65)
Implied λ	*0.004*	*0.0082*	*0.0045*	*0.055*	*0.0019*
Adjusted R^2	-0.003	0.24	0.03	0.82	0.02
Western provinces with Hong Kong and Macau					
Constant	0.341 (3.00)	0.456 (8.02)	0.298 (4.30)	0.779 (11.58)	0.375 (7.29)
Ln Y_{0i}	-0.0267 (-1.15)	-0.033 (-3.65)	-0.00715 (-0.61)	-0.0795 (-8.02)	-0.0232 (-2.66)
Implied λ	*0.0054*	*0.0067*	*0.0024*	*0.041*	*0.0029*
Adjusted R^2	0.014	0.19	-0.02	0.75	0.073

Estimated equation: $LnY_{ti} - LnY_{0i} = Cons\tan t + (1 - e^{-\lambda t})LnY_{0i} + \varepsilon_i$
t statistics in parenthesis.

When Hong Kong and Macau are considered, due to the enormous differentials between Mainland China and the SARs, the regression results in Table 5.9 could not reveal any evidence of absolute income convergence in the pre-reform period of 1963 to 1977, on both the national and regional levels. On the other hand, absolute income convergence is reported on all the levels, including the national, coastal, central and western regions in the post-reform period of 1978 to 2002. All the initially poorer Chinese regions can benefit from the reforms to grow faster than the initially richer Hong Kong and Macau economies. Amongst them, taking advantage of its geographical position and the preferential policies and probably increased autonomy, the coastal region which covers the SEZs is able to converge its income level to that of Hong Kong and Macau at the highest speed of 1% a year, followed by the central region's 0.82%. The western region, which is far away from the SARs and has the poorest endowments in the country, can only achieve the lowest speed of convergence at 0.67%. In the meantime, the speed of income convergence for all the Chinese provinces and municipalities is just 0.49%. It is because it would be more difficult and lengthy for all the Chinese provinces to narrow their income gap with Hong Kong and Macau. In contrast, income convergence toward the regional mean, like what the Chinese regions have been achieving, would be easier and also faster.

When the post-reform period is split into two sub-periods, absolute income convergence can be found in the coastal region, but not in the central and western regions, nor on the national level in the earlier period of 1978 to 1992. It shows that the economic reforms did allow some of the Chinese provinces, particularly the coastal provinces in which the SEZs and open coastal cities are located to grow faster and earlier. The coastal region was able to catch up with Hong Kong and Macau at 0.61% a year in the early reform period, despite there is no evidence of absolute convergence among the coastal provinces themselves. In the later period of 1993 to 2002, the economic reforms have been fully implemented in almost all the provinces in the country, then absolute income convergence is observed on all the levels. On the national level, Mainland China is able to have its per capita RGDP converging towards that of Hong Kong and Macau at a rate of 1.6% a year. On the regional level, the coastal region is still the one which has the highest speed of income convergence, at 2.4% a year. The paces of income convergence for the central and western regions, meanwhile, are 2.2% and 1.7% respectively. When the paces of convergence of the two sub-periods are compared, it appears that the speed of income convergence has accelerated in the second half of the reform period. This estimation result matches the sequence of the economic reforms that has initiated in the coastal region in the 80s, then gradually took place in the central and western region in the 90s. The transmission process allows the central and western regions to achieve rapid economic growth, as well as to catch up with Hong Kong and Macau as what the coastal region has experienced as early as in the 80s.

To conclude, the basic estimations conducted by different methodologies have displayed rather similar and consistent results. When the Chinese provinces are focused, the pooled analysis indicates income convergence between the central provinces in the pre-reform period due to the similar industrialization policies that they were subjected to. Income convergence across all the provinces is also found simultaneously. After the economic reforms, there is no evidence of absolute income convergence across all the provinces since some of the provinces are able to derive more benefits from the reforms than the others. However, absolute convergence has taken place in the central and western regions. When the pre- and post-reform periods are considered as a whole, absolute income divergence is found on all the levels throughout the period of 1953 to 2002, except for the western region. When Hong Kong and Macau are taken into account, the process of absolute income convergence between all the Chinese provinces, Hong Kong and Macau have only started since 1993. It indicates that it is time consuming for the reform policies to be fully implemented and come into practices to speed up economic growth. The timing of this process matches perfectly with that of the economic integration, and this coincidence could be viewed as a kind of linkage between these two processes. When absolute convergence on the regional level is concerned, the coastal region, which is the first to be opened, is an exception as it has attained absolute convergence with the SARs since 1978, while the other two regions can manage to initiate the process only after the 90s. Besides, the coastal region, which has much better endowments and a geographical advantage, is also the region with the highest speed of convergence. This result indicates that the economic reforms and open door policies have allowed some of the Chinese provinces, mainly the coastal provinces, to catch up earlier and faster with Hong Kong and Macau. Eventually, all the initially poorer Chinese provinces and municipalities or regions could take advantage of their backwardness, to grow at a much faster pace to catch up with Hong Kong and Macau to narrow the income gap.

Conditional Income Convergence

If the initially poorer economies cannot grow faster than the initially richer one, then they should have failed to catch up with and reduce their income gap with the initially richer economies. Nevertheless, they may still be able to converge their income level to their respective steady state income levels, which are determined by some growth related factors. Based on this belief, the conditional income convergence test will be performed to estimate if the catching-up and convergence process will take place after imposing controls on the growth potential of these economies, despite no tendency of absolute income convergence. In practice, the following specification which has been explained above will be employed:

$$LnY_{ti} - LnY_{0i} = Cons\tan t + (1 - e^{-\lambda t})LnY_{0i} + \gamma_1 Ln(s)_i + \gamma_2 Ln(n + g + \delta)_i + \gamma_3 Ln(\sec)_i$$
$$+ \gamma_4 Ln(open)_i + \gamma_5 Ln(FDI)_i + \varepsilon_i \tag{5.7}$$

Similar specification can also be found in Gundlach (1997), Raiser (1998), Demurger (2001), Yao and Zhang (2001a, 2001b) and Jones, Li and Owen (2003), etc. in the discussion on the income inequality issue of Mainland China.

Both the cross-sectional and pooled analyses are applied to test the hypothesis of conditional income convergence. In the first batch of estimations, only two factors additional to the initial income level, namely the investment ratio s_i and effective population growth rate $(n+g+\delta)_i$ are inserted. In the cross-section estimations without Hong Kong and Macau, these two factors appeared to be statistically insignificant in all the sub-periods and have failed to improve or revise the previous findings reported in Table 5.6. In other words, there is no evidence of conditional income convergence between the Chinese provinces and the pace of income growth is independent of investment ratio and effective population growth. There is probably another factor, such as the policies issued by the central planning committee, that determines the pace of growth in Mainland China in the pre-reform period. This result matches some of the findings in Gundlach (1997), Yao and Zhang (2001a) and Jones, Li and Owen (2003). In light of the convergence issue with Hong Kong and Macau, the explanatory power of these two additional variables is still poor and they could neither revise nor improve the estimation results as exhibited in Table 5.7. This result reveals income convergence, suggesting that the catching-up process between Mainland China, Hong Kong and Macau was initiated since the economic reforms. This process has been taking place in an absolute manner, and is almost independent of the investment ratio and effective population growth. The Chinese provinces which have received relatively more investment with lower effective population growth do not necessary achieve higher income growth rate. It is because there are many other factors, such as skill, knowledge, production experience, etc. that can affect economic performance. Without any improvement in these areas, these provinces could still fail to exercise their full potential to grow at a higher speed.

Table 5.10: Regressions on Conditional Income Convergence in Panel Data Analysis: Chinese Provinces Only

All the provinces					
Time period	1953-1977	1978-2002	1978-1992	1993-2002	1953-2002
Constant	0.962 (2.58)	-0.738 (-2.68)	-0.404 (-0.70)	-0.606 (-1.78)	-0.459 (-1.96)
Ln Y_{0i}	-0.182 (-3.66)	-0.0028 (-0.22)	-0.0268 (-1.25)	0.000405 (0.020)	0.0582 (3.42)
Ln s_i	-0.204 (-3.48)	0.0419 (1.21)	0.0324 (0.66)	-0.0355 (-0.62)	-0.00785 (-0.21)
Ln $(n+g+\delta)_i$	0.147 (1.29)	-0.408 (-4.15)	-0.324 (-1.52)	-0.330 (-3.01)	-0.140 (-1.68)
Implied λ	*0.04*	*0.00056*	*0.0055*	*-0.0002*	*-0.006*
Adjusted R^2	0.13	0.10	0.007	0.15	0.07
Coastal provinces					
Constant	-0.288 (-0.55)	-0.261 (-0.62)	0.366 (0.44)	-0.894 (-1.39)	-0.828 (-2.37)
Ln Y_{0i}	-0.110 (-1.52)	-0.0502 (-2.13)	-0.0820 (-2.39)	-0.00350 (-0.077)	0.0327 (1.22)
Ln s_i	-0.236 (-1.91)	0.148 (2.26)	0.155 (1.77)	0.0296 (0.26)	0.0458 (0.71)
Ln $(n+g+\delta)_i$	-0.189 (-1.18)	-0.398 (-3.09)	-0.234 (-0.79)	-0.475 (-3.15)	-0.361 (-3.27)
Implied λ	*0.023*	*0.01*	*0.029*	*0.0018*	*-0.003*
Adjusted R^2	0.08	0.18	0.09	0.32	0.13
Central provinces					
Constant	2.426 (3.06)	-1.276 (-1.85)	-0.863 (-1.04)	0.989 (1.15)	-0.872 (-1.63)
Ln Y_{0i}	-0.364 (-3.91)	-0.0840 (-2.59)	-0.120 (-3.65)	-0.191 (-3.03)	0.100 (2.46)
Ln s_i	-0.275 (-2.80)	0.157 (2.39)	0.093 (1.53)	-0.0717 (-0.52)	-0.122 (-1.35)
Ln $(n+g+\delta)_i$	0.472	-0.812	-0.687	-0.164	-0.142

	(2.43)	(-2.94)	(-2.24)	(-0.41)	(-0.81)
Implied λ	*0.09*	*0.018*	*0.043*	*0.11*	*-0.053*
Adjusted R^2	0.42	0.23	0.34	0.54	0.07
Western provinces					
Constant	3.843 (4.96)	-0.881 (-1.32)	-1.085 (-0.69)	0.430 (0.65)	0.954 (1.95)
Ln Y_{0i}	-0.262 (-2.73)	-0.00290 (-0.091)	-0.0127 (-0.20)	-0.0955 (-1.91)	0.0876 (2.48)
Ln s_i	-0.00545 (-0.056)	0.0350 (0.44)	0.0291 (0.19)	0.0541 (0.73)	-0.00256 (-0.032)
Ln $(n+g+\delta)_i$	1.035 (4.43)	-0.444 (-1.78)	-0.530 (-0.96)	-0.178 (-0.79)	0.437 (2.35)
Implied λ	*0.061*	*0.00058*	*0.0043*	*0.05*	*-0.0092*
Adjusted R^2	0.43	0.007	-0.10	0.09	0.08

Estimated equation: $LnY_{ti} - LnY_{0i} = Cons\tan t + (1-e^{-\lambda t})LnY_{0i} + \gamma_1 Ln(s)_i + \gamma_2 Ln(n+g+\delta)_i + \varepsilon_i$,
t statistics in parenthesis.

Then pooled analyses are performed and the results are summarized in Table 5.10. In general, the results on conditional convergence are very similar to those stated in Table 5.8. Since absolute/unconditional convergence implies conditional convergence, for this reason, conditional convergence/divergence resulted in the estimations in which absolute income convergence/divergence has already been detected. On the aggregate level, due to the uneven distribution on the impacts of the economic reforms, there is no evidence of conditional convergence in the post-reform era for all the sub-periods. It is consistent with the findings in Yao and Zhang (2001a, 2001b). As explained above, investment ratio and effective population growth rate are just two of the factors that may affect growth. A high investment ratio and a low effective population growth rate may be necessary but not sufficient for achieving higher growth rate. Therefore, they are not satisfactory explanatory variables and have failed to explain the growth discipline of the Chinese provinces. On the regional level, the two additional explanatory variables are significant with explicable sign for the coastal and central regions. They have contributed to the conditional convergence of the coastal provinces in the post-reform period of 1978 to 2002, though absolute income convergence was rejected in Table 5.8. Since the coastal provinces are expected to have similar geographical advantages, endowments and probably extent of reforms, a coastal province which have a higher investment ratio and a lower effective population growth could be able to achieve a higher income growth. For similar reason, these additional growth determinants are significant and have sped up the pace of income convergence for the central region. Furthermore, given the extra explanatory variables, conditional convergence is also found between different western provinces in the pre-reform period, while conditional divergence is observed in this region when the entire sampling period of 1953 to 2002 is focused. Apart from these, the speed of convergence has also increased in line with the growing number of explanatory variables. As a whole, the presence of conditional convergence in the regional analyses suggests that different geographical region have diversified economic background. The growth disciplines for the provinces in each of these regions could be very different as well. If geographical regions are not formed and the additional growth determinants are not considered, then different provinces in the region would be hard to catch up with each other to approach a similar income level.

In addition, the estimation results in Table 5.10 indicate that the growth discipline of Mainland China is extremely sensitive to both timing and grouping. Considering the sub-periods in the post-reform era, for the coastal provinces, conditional β-convergence was found only in the early reform period and the catching-up process has probably stopped in the 90s as the initially poorer provinces may have already out-performed the initially richer one. On the contrary, provinces in the central region of Mainland China are able to reduce their income dispersion consistently throughout the pre- and post-reform periods and conditional income convergence is found in almost all of the sub-periods. In the case of the western provinces, conditional β-convergence could only be achieved since the 90s. This variation reveals that the economic reforms and the liberalization policies have brought about distinctive impacts to different provinces and regions in different period of time, leading to both conditional convergence and divergence in Mainland China.

Table 5.11: Regressions on Conditional Income Convergence in Panel Data Analysis: Chinese Provinces together with Hong Kong and Macau

All the provinces, Hong Kong and Macau					
Time period	1963-1977	1978-2002	1978-1992	1993-2002	1963-2002
Constant	-0.407 (-1.16)	-0.361 (-1.30)	-0.258 (-0.54)	0.0637 (0.18)	-0.653 (-3.50)
Ln Y_{0i}	-0.0480 (-2.37)	-0.0265 (-3.44)	-0.0107 (-0.95)	-0.069 (-5.45)	-0.0231 (-3.22)
Ln s_i	0.000827 (0.019)	0.0736 (2.42)	0.0368 (0.84)	0.0429 (0.78)	0.0618 (2.74)
Ln $(n+g+\delta)_i$	-0.326 (-2.21)	-0.333 (-3.57)	-0.243 (-1.50)	-0.273 (-2.24)	-0.423 (-6.12)
Implied λ	*0.016*	*0.0054*	*0.0036*	*0.036*	*0.0029*
Adjusted R^2	0.07	0.17	0.03	0.42	0.17
Coastal provinces with Hong Kong and Macau					
Constant	-0.492 (-0.90)	0.234 (0.61)	0.504 (0.78)	0.417 (0.84)	-0.361 (-1.20)
Ln Y_{0i}	-0.0306 (-1.15)	-0.0499 (-4.79)	-0.0297 (-2.11)	-0.0980 (-4.85)	-0.0375 (-3.99)
Ln s_i	-0.0360 (-0.41)	0.126 (2.72)	0.117 (1.68)	0.0835 (0.91)	0.100 (2.90)
Ln $(n+g+\delta)_i$	-0.313 (-1.28)	-0.208 (-1.66)	-0.0599 (-0.29)	-0.252 (-1.57)	-0.378 (-3.63)
Implied λ	*0.01*	*0.010*	*0.010*	*0.052*	*0.0048*
Adjusted R^2	0.07	0.34	0.13	0.62	0.22
Central provinces with Hong Kong and Macau					
Constant	1.518 (1.30)	0.671 (1.19)	0.130 (0.22)	1.881 (2.47)	-0.105 (-0.23)
Ln Y_{0i}	-0.0349 (-1.31)	-0.0404 (-4.22)	-0.00935 (-0.85)	-0.119 (-9.64)	-0.0296 (-3.22)
Ln s_i	0.0973 (0.92)	0.158 (2.35)	0.102 (1.67)	-0.103 (-0.92)	0.109 (1.90)
Ln $(n+g+\delta)_i$	0.385 (0.98)	-0.0285 (-0.16)	-0.126 (-0.67)	0.316 (1.33)	-0.253 (-1.78)
Implied λ	*0.012*	*0.0082*	*0.0031*	*0.063*	*0.0038*
Adjusted R^2	-0.03	0.32	0.11	0.84	0.20
Western provinces with Hong Kong and Macau					
Constant	-0.0516 (-0.050)	0.440 (0.81)	-0.497 (-0.68)	1.115 (1.75)	-0.190 (-0.54)
Ln Y_{0i}	-0.0290 (-1.21)	-0.0308 (-2.94)	0.00603 (0.40)	-0.0818 (-6.69)	-0.0236 (-2.55)
Ln s_i	0.0981 (0.80)	0.0594 (0.99)	0.0612 (0.67)	-0.0114 (-0.18)	0.0681 (1.23)
Ln $(n+g+\delta)_i$	-0.160 (-0.39)	-0.0276 (-0.15)	-0.294 (-1.19)	0.121 (0.54)	-0.242 (-1.88)

Implied λ	*0.0098*	*0.0063*	*-0.0020*	*0.043*	*0.0030*
Adjusted R^2	-0.06	0.20	-0.014	0.73	0.14

Estimated equation:

$$LnY_{ti} - LnY_{0i} = Constant + (1 - e^{-\lambda t})LnY_{0i} + \gamma_1 Ln(s)_i + \gamma_2 Ln(n + g + \delta)_i + \varepsilon_i,$$

t statistics in parenthesis.

Table 5.11 indicates the results of pooled analyses in which Hong Kong and Macau are being covered. In general, the findings are rather similar to those in Table 5.9, and conditional income convergence is found wherever absolute income convergence has been observed before. A catching-up process conditional to investment ratio and effective population growth is found between Mainland China, Hong Kong and Macau in the post-reform period of 1978 to 2002. This process is so strong that it has even brought about conditional convergence for the sampling period of 1963 to 2002. The Chinese provinces with higher investment ratio and lower effective population growth could find themselves easier to catch up with Hong Kong and Macau. The additional growth determinants have contributed to accelerate the pace of convergence from 0.49% to 0.54% a year for the period of 1978 to 2002. This result indicates that it is easier for an economy to approach to its own steady state income level, which is partially determined by the investment ratio and effective population growth rate, than to approach the group's mean income. On the regional studies, although additional variables have been inserted, they are only statistically significant in some of the groupings, for example, in the coastal and central region analyses for the periods of 1978 to 2002 and 1963 to 2002. Given a similar background in the region, a higher investment ratio induces while a higher effective population growth rate discounts the pace of growth of a province. Perhaps the length of time in the sub-periods is short and it has affected the estimation result and the significance of these two explanatory variables. In the western region, neither the investment ratio nor the effective population growth rate contributes to explain the growth discipline. There are probably some other factors, such as more efficient management, better technology, well developed transportation system, etc. that can better explain the growth pattern of the region. As a whole, these growth determinants have failed to rewrite the estimation results obtained in the absolute convergence analyses, but have accelerated the pace of convergence.

Table 5.12 summaries the results of conditional convergence tests with respect to Chinese provinces in cross-sectional analysis. The estimations differed the previous by the secondary sector output ratio sec_i, the openness ratio $open_i$ and the FDI to GDP ratio FDI_i. The latter two explanatory variables could also be found in Demurger (2001) and Yao and Zhang (2001b) respectively with statistical significance. Given these new variables, conditional income convergence is observed among all the Chinese provinces in the early reform period of 1978 to 1990, regardless of the specification of the regression functions. Such process has also led to conditional convergence for the entire post-reform period of 1978 to 2002. The openness ratio is found to be statistically significant, and has contributed to bring about conditional income convergence to the Chinese provinces. Besides, it has improved the explanatory power of the effective population growth rate. The result depicts the importance of external trade to the growth and development of the country since international trade creates new job opportunities, stimulates efficiency and quality improvements. In contrast, the secondary sector output ratio is found to be insignificant as its impacts could have been reflected by the other dependent variables, and probably by the openness ratio, given the fact that Mainland China exports mostly industrial products. Similar to the previous findings, investment ratio has failed to explain the growth pattern of the Chinese provinces. The coastal dummy has also become insignificant since its explanatory power has been captured by the openness ratio. This finding suggests that the Chinese provinces that have been conducting more external trade relative to their output are likely to have a higher income growth rate, and were thus able to achieve conditional income convergence.

Table 5.12: Regressions on Conditional Income Convergence in the Post-Reform period in Cross Sectional Analysis: Chinese Provinces Only

Time period	1978-2002			1978-1990		
Constant	-2.723 (-0.98)	-1.881 (-0.45)	-2.516 (-0.87)	-1.521 (-0.68)	-1.963 (-0.57)	-1.509 (-0.65)
Ln Y_{0i}	-0.610 (-5.17)	-0.618 (-4.12)	-0.601 (-4.86)	-0.319 (-3.94)	-0.304 (-2.59)	-0.319 (-3.83)
Ln s_i	0.300 (0.95)	0.252 (0.69)	0.281 (0.86)	0.189 (1.11)	0.205 (1.02)	0.189 (1.08)
Ln $(n+g+\delta)_i$	-3.248 (-2.88)	-2.932 (-1.92)	-3.121 (-2.56)	-1.710 (-1.89)	-1.842 (-1.53)	-1.711 (-1.84)
Ln sec_i		0.101 (0.22)			-0.0530 (-0.18)	
Ln $open_i$	0.402 (6.35)	0.370 (3.39)	0.377 (3.74)	0.165 (3.49)	0.168 (2.36)	0.168 (2.42)
Coastal Dummy		0.0529 (0.35)	0.0483 (0.33)		-0.00398 (-0.039)	-0.00598 (-0.061)
Implied λ	*0.039*	*0.04*	*0.038*	*0.032*	*0.030*	*0.032*
Adj R^2	0.65	0.61	0.63	0.38	0.31	0.35
Time period	1991-2002					
Constant	-2.043 (-1.45)	-1.252 (-0.88)	-1.027 (-0.69)	-1.326 (-0.96)	-0.983 (-0.70)	1.281 (0.68)
Ln Y_{0i}	-0.120 (-1.17)	-0.0147 (-0.19)	-0.0469 (-0.43)	-0.0816 (-0.83)	-0.0385 (-0.51)	-0.157 (-1.32)
Ln s_i	-0.109 (-0.52)	-0.113 (-0.53)	-0.173 (-0.79)	-0.190 (-0.95)	-0.176 (-0.83)	-0.0976 (-0.46)
Ln $(n+g+\delta)_i$	-1.432 (-2.56)	-0.981 (-1.88)	-0.853 (-1.37)	-0.969 (-1.68)	-0.817 (-1.58)	-0.443 (-0.70)
Ln sec_i						0.364 (1.86)
Ln $open_i$	0.178 (3.50)		0.0110 (0.11)	0.0763 (1.09)		-0.0196 (-0.20)
Ln FDI_i		0.125 (3.80)	0.0685 (1.08)		0.0731 (1.57)	0.118 (1.80)
Coastal Dummy			0.141 (1.38)	0.181 (2.00)	0.144 (1.52)	0.141 (1.46)
Implied λ	*0.012*	*0.0013*	*0.0044*	*0.0077*	*0.0036*	*0.016*
Adj R^2	0.45	0.47	0.48	0.51	0.50	0.53

Estimated equation:

$$LnY_{ti} - LnY_{0i} = Cons\tan t + (1-e^{-\lambda t})LnY_{0i} + \gamma_1 Ln(s)_i + \gamma_2 Ln(n+g+\delta)_i + \gamma_3 Ln(\sec)_i$$
$$+\gamma_4(open)_i + \gamma_5(FDI)_i + \varepsilon_i$$

t statistics in parenthesis.

Since the 90s, the conditional convergence process on both the provincial and coastal levels has stopped and this finding matches those in Table 5.6. The economic reforms may have brought about diversified impacts to different economies. Some provinces are able to maintain a continuous and high income growth to out-perform the others, and thus there is no absolute or conditional income convergence in the period. Moreover, it is likely that the openness ratio and FDI ratio are correlated with each other. The explanatory power of these two factors tends to deteriorate when these two factors are used simultaneously. In light of the sub-period of 1990 to 2002, the estimations show that the income growth of a province is proportional to its trade development or stock of FDI, but independent of the initial income level and the other growth determinants, such as investment ratio or effective population growth rate. Once a province is able to conduct more trade and attract more inward FDI, it is then able to accelerate its pace of growth regardless of its initial income level. Subsequently, the openness and FDI ratios have become the major determinants of economic growth in the period of 1991 to 2002.

Afterwards, Hong Kong and Macau are considered in the cross-sectional estimations and the results are shown in Table 5.13. The openness ratio is statistically significant in all the estimations, and conditional income convergence is found in all the specifications and sampling periods. Unlike the results in Table 5.7, conditional income convergence is also found in the sub-period of 1978 to 1990, and the speed of income convergence has experienced a significant growth when the openness ratio is inserted into the estimations. It reveals that trade transactions can speed up the growth pace of the Chinese provinces, and thus allowing these initially poorer economies to catch up with the SARs at a faster speed. In light of the factors of investment ratio and effective population growth rate, they are insignificant variables and have failed to explain the catching-up process between Mainland China, Hong Kong and Macau for most of the time. It suggests that given the diversified background of the Chinese provinces, a higher investment ratio and a lower effective population growth rate may be necessary but still insufficient to bring about a higher income growth. Therefore, these two factors are insignificant in the estimations.

Table 5.13: Regressions on Conditional Income Convergence in the Post-Reform period
Cross Sectional Analysis: Chinese Provinces together with Hong Kong and Macau

Time period	1978-1990	1991-2002		
Constant	-0.559 (-0.22)	-0.745 (-0.56)	0.778 (0.61)	0.977 (0.53)
Ln Y_{0i}	-0.153 (-2.39)	-0.305 (-6.58)	-0.276 (-6.64)	-0.117 (-2.70)
Ln s_i	0.0850 (0.44)	-0.0282 (-0.18)	-0.166 (-1.15)	0.0353 (0.18)
Ln $(n+g+\delta)_i$	-0.977 (-0.97)	-1.405 (-3.00)	-0.836 (-1.87)	-0.387 (-0.61)
Ln sec_i			0.304 (3.09)	0.359 (2.53)
Ln $open_i$	0.133 (2.50)	0.218 (5.11)	0.206 (5.52)	
Implied λ	*0.014*	*0.033*	*0.029*	*0.011*
Adjusted R^2	0.14	0.71	0.78	0.55
with coastal dummy				
Constant	-0.491 (0.19)	-0.154 (-0.12)	1.0744 (0.92)	1.365 (1.06)
Ln Y_{0i}	-0.173 (-2.46)	-0.297 (-7.03)	-0.273 (-7.13)	-0.222 (-6.12)
Ln s_i	0.0981 (0.51)	-0.0290 (-0.20)	-0.149 (-1.13)	-0.0751 (-0.53)
Ln $(n+g+\delta)_i$	-1.0489 (-1.03)	-1.080 (-2.43)	-0.639 (-1.52)	-0.349 (-0.78)
Ln sec_i			0.266 (2.89)	0.254 (2.50)
Ln $open_i$	0.175 (2.22)	0.118 (2.15)	0.126 (2.58)	
Coastal Dummy	-0.0789 (0.73)	0.223 (2.57)	0.184 (2.36)	0.326 (5.34)
Implied λ	*0.016*	*0.032*	*0.029*	*0.023*
Adjusted R^2	0.11	0.76	0.82	0.77

Estimated equation:

$$LnY_{ti} - LnY_{0i} = Constant + (1 - e^{-\lambda t})LnY_{0i} + \gamma_1 Ln(s)_i + \gamma_2 Ln(n + g + \delta)_i + \gamma_3 Ln(\sec)_i$$
$$+ \gamma_4 (open)_i + \varepsilon_i$$

t statistics in parenthesis.

Another finding is that when a coastal dummy is inserted into the estimation, the estimated coefficient and degree of significance for the openness ratio would decrease. Perhaps the coastal provinces are different from the other provinces in their degree of openness. The coastal dummy which is inserted to capture the deviations between the coastal and the other provinces turns out reflecting the high degree of openness for the region. Subsequently, the openness ratio will become less significant as part of the impacts has already been shown by the coastal dummy.

Table 5.14: Regressions on Conditional Income Convergence in Post-Reform period in Panel Data Analysis: Chinese Provinces Only

All the provinces					
Time period	1978-2002	1978-1992	1993-2002		
Constant	-0.703 (-2.55)	-0.364 (-0.63)	0.0208 (0.058)	0.582 (1.54)	0.710 (1.96)
Ln Y_{0i}	-0.0750 (-3.92)	-0.111 (-3.38)	-0.0961 (-3.84)	-0.0938 (-3.94)	-0.0828 (-3.79)
Ln s_i	0.0545 (1.68)	0.0508 (1.15)	-0.0258 (-0.54)	-0.0122 (-0.25)	0.00321 (0.067)
Ln $(n+g+\delta)_i$	-0.589 (-6.53)	-0.527 (-2.75)	-0.405 (-4.05)	-0.265 (-2.59)	-0.208 (-2.32)
Ln sec_i	-0.0532 (-1.45)	-0.0911 (-1.63)	0.104 (2.16)	0.229 (4.08)	0.246 (4.53)
Ln $open_i$	0.0648 (6.08)	0.0724 (4.73)	0.0699 (5.27)	0.0251 (1.15)	
Ln FDI_i				0.040 (2.59)	0.0543 (5.76)
Implied λ	*0.016*	*0.039*	*0.051*	*0.049*	*0.043*
Adjusted R^2	0.33	0.30	0.43	0.55	0.54
Coastal provinces					
Time period	1978-2002	1978-1992	1993-2002		
Constant	-0.398 (-0.78)	-0.259 (-0.27)	1.020 (1.35)	1.382 (1.83)	1.296 (1.84)
Ln Y_{0i}	-0.0861 (-2.56)	-0.0915 (-1.62)	-0.139 (-2.83)	-0.125 (-2.63)	-0.130 (-2.91)
Ln s_i	0.0977 (1.28)	0.0763 (0.77)	0.109 (1.09)	0.128 (1.33)	0.117 (1.30)
Ln $(n+g+\delta)_i$	-0.530 (-3.88)	-0.452 (-1.50)	-0.236 (-1.53)	-0.145 (-0.92)	-0.172 (-1.27)
Ln sec_i	-0.0303 (-0.50)	-0.122 (-1.32)	0.267 (3.30)	0.337 (3.83)	0.321 (4.25)
Ln $open_i$	0.0629 (2.76)	0.0625 (1.86)	0.0397 (1.63)	-0.0156 (-0.38)	
Ln FDI_i				0.0641 (1.66)	0.0519 (2.40)
Implied λ	*0.018*	*0.032*	*0.075*	*0.067*	*0.070*
Adjusted R^2	0.26	0.22	0.60	0.63	0.65

Central provinces					
Constant	-1.473 (-2.24)	-1.244 (-1.27)	0.380 (0.42)	0.665 (0.69)	1.160 (1.28)
Ln Y_{0i}	-0.127 (-2.98)	-0.135 (-2.43)	-0.264 (-3.61)	-0.255 (-3.37)	-0.209 (-3.04)
Ln s_i	0.150 (2.36)	0.103 (1.66)	-0.0454 (-0.34)	-0.006 (-0.042)	-0.0331 (-0.23)
Ln $(n+g+\delta)_i$	-0.985 (-3.61)	-0.843 (-2.81)	-0.638 (-1.36)	-0.566 (-1.17)	-0.240 (-0.56)
Ln sec_i	-0.0814 (-0.93)	-0.127 (-1.17)	0.140 (1.32)	0.128 (1.12)	0.0988 (0.86)
Ln $open_i$	0.0423 (1.78)	0.0205 (0.73)	0.0588 (1.50)	0.0529 (1.29)	
Ln FDI_i				0.0263 (0.86)	0.0345 (1.12)
Implied λ	*0.027*	*0.048*	*0.15*	*0.15*	*0.12*
Adjusted R^2	0.31	0.44	0.58	0.58	0.56
Western provinces					
Constant	-0.756 (-1.17)	0.269 (0.24)	-0.485 (-0.87)	0.139 (0.24)	0.133 (0.23)
Ln Y_{0i}	-0.0763 (-1.89)	-0.289 (-3.59)	-0.0465 (-1.21)	-0.0433 (-0.79)	-0.0116 (-0.25)
Ln s_i	0.108 (1.66)	0.400 (3.00)	0.0387 (0.71)	-0.0113 (-0.18)	-0.0269 (-0.43)
Ln $(n+g+\delta)_i$	-0.571 (-2.80)	-0.678 (-1.87)	-0.388 (-2.27)	-0.249 (-1.32)	-0.161 (-0.93)
Ln sec_i	-0.176 (-2.11)	-0.611 (-3.38)	-0.124 (-2.18)	0.163 (0.85)	0.147 (0.76)
Ln $open_i$	0.0553 (2.05)	0.146 (2.78)	0.0352 (1.42)	0.0422 (1.11)	
Ln FDI_i				0.00875 (0.39)	0.0230 (1.26)
Implied λ	*0.016*	*0.11*	*0.024*	*0.022*	*0.0058*
Adjusted R^2	0.38	0.57	0.52	0.33	0.31

Estimated equation:

$$LnY_{ti} - LnY_{0i} = Constant + (1-e^{-\lambda t})LnY_{0i} + \gamma_1 Ln(s)_i + \gamma_2 Ln(n+g+\delta)_i + \gamma_3 Ln(\sec)_i + \gamma_4 Ln(open)_i + \gamma_5 Ln(FDI)_i + \varepsilon_i$$

t statistics in parenthesis.

The results of the pooled analyses, which only cover the Chinese provinces, with secondary sector output ratio, openness and FDI ratios as the explanatory variables are exhibited in Table 5.14. In the aggregate analyses, conditional income convergence is observed in all the sub-periods in the post-reform era between all the Chinese provinces.

The introduction of secondary sector output ratio, openness ratio and FDI ratio have contributed to bring about conditional β-convergence and such evidence could not be found in Table 5.10. In fact, the secondary sector output ratio can reflect the degree of industrialization, and the openness ratio shows the intensity of trade. Both of these activities are essential in the development process of China. These factors are significant growth determinants, and have altogether contributed to conditional income convergence between the Chinese provinces. As presented in the upper panel of Table 5.14, the investment ratio is insignificant in all the sub-periods because higher investment alone may not guarantee efficiency and productivity. Furthermore, the secondary sector output ratio is significant only in the second stage of the reforms, but not for the period of 1978 to 1992. This result can probably be explained by the restructuring and modernization process of the industrial sector. In the early reform period, the secondary sector may have started to reform and expand, but the process was only completed in the 90s to bring about a higher income level to the economy. As for the openness and FDI ratios, they are significant in the estimations only when these two factors are not used together. These findings are consistent with those as revealed in the cross-sectional analysis.

On the regional level, the new explanatory variables have led to conditional income convergence between the coastal provinces in the period of 1993 to 2002. Perhaps it is easier for the coastal provinces to approach to their respective steady states when more controls, such as the secondary sector output and openness or FDI ratio are imposed. In addition, the significance of the openness or FDI ratio reflects the importance of foreign transactions to the region. As for the periods of 1978 to 2002, conditional convergence is found as before. Without employing the secondary sector output ratio, conditional convergence is also detected for the period of 1978 to 1992[82]. For the central provinces, even if all the additional explanatory variables are insignificant for most of the time, the estimations still express conditional convergence in all the sub-periods of the post-reform years. It shows that a province in the central region with a developed secondary sector and lots of trade or FDI related activities cannot have a higher growth rate. However, those

[82] When Ln s_i is excluded from the estimation, conditional income convergence is found with estimated coefficient for the initial income level at -0.141 (-3.28). The estimated coefficient for the openness ratio is 0.0772 (2.38) and the adjusted R^2 is recorded at 0.20.

with lower initial income tend to grow at a higher speed to catch up with the initially richer provinces. A possible explanation to this finding is that the government may have introduced certain preferential policies or arrangements to help those initially poorer provinces to allow them to grow faster in order to reduce inequality in the region. Then the initial income level has become the most important determinant of income growth. In view of the western provinces, given the openness ratio, conditional convergence could be seen in the periods of 1978 to 1992 and 1978 to 2002. This process, however, has stopped since 1993, and the openness or FDI ratio has become insignificant in the discussion. In the early reform period, those western provinces with lower initial income, bigger secondary sector and more trade activities can grow faster to catch up with the initially richer ones. In the convergence process, some of these provinces could have completed their transformation to obtain improved efficiency and productivity, which allow them to grow continuously faster in the second stage of reforms, in the absence of secondary sector and trade activities expansion. The diversified economic performance in the 90s then rules out the tendency of conditional income convergence between the western provinces. Comparing with Table 5.10, the speed of convergence measured in Table 5.14 has experienced a remarkable increase and it reflects the contribution of trade or inward FDI to the convergence process. Furthermore, it implies that the increase in the number of control factors tends to bring about a more diversified steady state income, then it would be easier and faster for different provinces in a region to converge to their own steady state. In light of the differentials in the speed of income convergence, the coastal region was only the second fastest after the central region. It may suggest that the reform policies are rather selective even for the coastal provinces and therefore, different coastal provinces could have different growth patterns and it would take a relatively longer period of time before they can achieve conditional income convergence.

With the help of the openness ratio, the issue of conditional convergence between the Mainland China, Hong Kong and Macau is examined by panel data analyses and the results are shown in Table 5.15. On the Greater China level, the expanded model has displayed a higher degree of significance for the initial income level. Similar to the previous findings, investment ratio has failed to explain the growth discipline as its role may have been taken over by the other growth determinants. In contrast, the effective population growth is significant with an expected negative sign in most of the groupings. The secondary sector output ratio is significant only in the sub-period of 1993 to 2002. It may be explained by the economic transition of Mainland China in which the secondary sector could become a growth engine only in the 90s, after the structural adjustments and modernization processes in the early reform period. The openness ratio, on the other hand, is strongly significant in all the estimations and it matches with the results in the cross-sectional analyses. Trade development helps to improve the efficiency and productivity of the Chinese provinces, to allow them to achieve a higher income growth. It has contributed to speed up the catching-up process between Mainland China and the SARs. Comparing with the results in Table 5.11, the implied rate of income convergence in the expanded model has greatly increased to as high as 6.5% a year in the period of 1993 to 2002. When the speed of convergence in the two sub-periods are compared, it has also expressed an acceleration from 2.4% in the period of 1978 to 1992 up to 6.5% in the period of 1993 to 2002. This pattern implies that the deepening of economic reforms and a full scale implementation of the liberalization policies in the later period have allowed all the Chinese provinces to grow more rapidly and catch up faster with Hong Kong and Macau.

On the regional level, the catching-up process has been initiating since 1978 for the coastal and western provinces and coincidentally, the openness ratio is significant in these two regions in the same period. Therefore, trade development has probably brought about a higher speed of convergence to the coastal provinces and the SARs; it is also the driving force of the conditional convergence process between the western provinces, Hong Kong and Macau. For the central provinces, the openness ratio is insignificant in all the sub-periods and brings no impacts to income growth. There could be another factor, such as government's income redistribution policies, that is more influential to the growth process of the region. As a result, although the investment ratio, effective population growth rate, secondary sector output and openness ratios are all insignificant, convergence is still found in the central region in the 90s. Another eye-catching result of Table 5.15 is that the openness ratio is no longer a significant explanatory variable in the regional studies in the 90s, despite its magnitude in the early reform period and the aggregate analysis. As the economic reforms proceed to the second stage, a success in trade expansion alone may no longer guarantee a higher growth rate. It is necessary for a province to develop other kinds of economic activities, for example, industrialization for the coastal region in order to achieve a higher growth rate and thus converges its income with the SARs. In fact, apart from the openness ratio, factors including the investment ratio, effective population growth and secondary sector output ratio are also found to be insignificant in the regional studies since the 90s. In other words, these factors cannot explain the growth pattern of the regional economies of Mainland China and the SARs. As mentioned before, taking advantage of the reforms and open door policies, these regions may have succeed in advancing its efficiency and productivity level in the early reform period. Given such improved prospects, even without the growth stimulus, such as high investment, low effective population growth, expansion in secondary sector and trade development, these regions are still able to achieve higher growth rate than Hong Kong and Macau in the 90s, and to catch up with the SARs.

Table 5.15: Regressions on Conditional Income Convergence in Post-Reform Period in Panel Data Analysis: Chinese Provinces with Hong Kong and Macau

All the provinces, Hong Kong and Macau				
Time period	1978-2002	1978-1992	1993-2002	
Constant	-0.128 (-0.51)	0.315 (0.69)	0.354 (1.23)	0.115 (0.37)
Ln Y_{0i}	-0.0829 (-7.28)	-0.0703 (-4.10)	-0.0997 (-6.70)	-0.122 (-7.77)
Ln s_i	0.0498 (1.79)	0.0297 (0.72)	-0.0512 (-1.06)	-0.0130 (-0.27)
Ln $(n+g+\delta)_i$	-0.414 (-4.91)	-0.209 (-1.41)	-0.290 (-2.77)	-0.403 (-3.73)
Ln sec_i			0.131 (3.79)	
Ln $open_i$	0.0668 (6.34)	0.0634 (4.50)	0.0655 (4.86)	0.0711 (4.70)
Implied λ	*0.017*	*0.024*	*0.053*	*0.065*
Adjusted R^2	0.35	0.22	0.65	0.57
Coastal provinces with Hong Kong and Macau				
Time period	1978-2002	1978-1992	1993-2002	
Constant	0.243	0.677	0.360	0.415

	(0.64)	(1.04)	(0.91)	(0.86)
Ln Y_{0i}	-0.0852 (-4.79)	-0.0710 (-2.85)	-0.0773 (-2.76)	-0.127 (-4.35)
Ln s_i	0.0704 (1.35)	0.0764 (1.01)	-0.0576 (-0.65)	0.00896 (0.085)
Ln $(n+g+\delta)_i$	-0.292 (-2.27)	-0.107 (-0.51)	-0.243 (-1.79)	-0.315 (-1.92)
Ln sec_i			0.194 (3.49)	
Ln $open_i$	0.0613 (2.49)	0.0669 (2.11)	0.0365 (1.21)	0.0499 (1.37)
Implied λ	*0.018*	*0.025*	*0.040*	*0.068*
Adjusted R^2	0.38	0.20	0.75	0.63
Central provinces with Hong Kong and Macau				
Constant	0.804 (1.44)	0.316 (0.50)	1.766 (2.23)	1.788 (2.31)
Ln Y_{0i}	-0.0790 (-3.38)	-0.0302 (-1.14)	-0.135 (-4.00)	-0.143 (-4.72)
Ln s_i	0.124 (1.80)	0.0879 (1.39)	-0.167 (-1.24)	-0.139 (-1.15)
Ln $(n+g+\delta)_i$	-0.0923 (-0.53)	-0.117 (-0.62)	0.210 (0.78)	0.217 (0.82)
Ln sec_i			0.0589 (0.52)	
Ln $open_i$	0.0472 (1.80)	0.0220 (0.87)	0.0444 (1.00)	0.0341 (0.87)
Implied λ	*0.016*	*0.010*	*0.073*	*0.077*
Adjusted R^2	0.35	0.10	0.83	0.84
Western provinces with Hong Kong and Macau				
Time period	1978-2002	1978-1992	1993-2002	
Constant	1.288 (2.46)	0.911 (1.033)	1.122 (1.61)	1.255 (1.93)
Ln Y_{0i}	-0.112 (-4.83)	-0.0982 (-2.13)	-0.102 (-4.58)	-0.101 (-4.64)
Ln s_i	0.0565 (1.08)	0.0913 (1.09)	0.00765 (0.11)	-0.00561 (-0.089)
Ln $(n+g+\delta)_i$	0.0155 (0.095)	-0.124 (-0.53)	0.0829 (0.36)	0.103 (0.46)
Ln sec_i			-0.0598 (-0.62)	
Ln $open_i$	0.0990 (3.84)	0.112 (2.37)	0.0143 (0.36)	0.0305 (1.05)
Implied λ	*0.024*	*0.042*	*0.054*	*0.053*
Adjusted R^2	0.40	0.16	0.72	0.73

Estimated equation:

$$LnY_{ti} - LnY_{0i} = Cons\tan t + (1-e^{-\lambda t})LnY_{0i} + \gamma_1 Ln(s)_i + \gamma_2 Ln(n+g+\delta)_i + \gamma_3 Ln(\sec)_i + \gamma_4 (open)_i + \gamma_5 (FDI)_i + \varepsilon_i$$

t statistics in parenthesis.

5.5. Stochastic Convergence

As shown in the above estimations, the initially poorer Chinese provinces have been growing faster to catch up with the initially richer Hong Kong and Macau economies in the post reform period. Given this process, the income gap between these economies has also been narrowed and both absolute and conditional β- and δ-convergence are observed. Despite the narrowing trend, a considerable income gap still persists across these economies and it is still very far from income equalization. This finding reconfirms the result in the previous chapter that there is no stochastic convergence[83] between Mainland China, Hong Kong and Macau, although the prerequisite of this process, for example, β-convergence has been achieved.

The concept of stochastic convergence has been employed in Karras (1997), Ben-David (1997, 2001), Yao, Newbery and Pedroni (2000), Zhang, Liu and Yao (2001) and Yao and Zhang (2001a). Rather than requiring cointegrated output levels with [1, -1] as the cointegrated vector, stochastic convergence in these studies requires the output level relative to the group's average, or the gap between an economy's income and the sample mean to be stationary without any unit root. The ADF test is the method to be applied in examining the statistical property of the series.

To examine if the per capita RGDP of Mainland China/Guangdong, Hong Kong and Macau have achieved stochastic convergence in the unit root approach, the income level of Mainland China and Guangdong, relative to Hong Kong and Macau, in a total of 4 different income ratios, will be composed and the ADF test will be employed to examine their statistical property. In the process, a time trend will be introduced and it contributes to explain the dynamic of the series over time. If the null hypothesis of having a unit root

[83] Based on the definition of Bernard and Durlauf (1995).

is rejected, as suggested in Zhang, Liu and Yao (2000) and Yao and Zhang (2001a), the relative income series tends to follow a stationary process and all the shocks will only bring about temporary impacts, and the relative income tends to return to its steady-state level in the long-run, with a tendency to achieve stochastic convergence. In contrast, if the null hypothesis cannot be rejected, then the relative income may not converge to its steady state, and is regarded as diverging.

Table 5.16: Unit Root Test Results on Relative Income Level

ADF test	Level			First Differences		
1967-2002	intercept / trend[a]	Test Statistics	Estimated Coefficient of the trend[b]	intercept / trend	Test Statistics	Estimated Coefficient of the trend
HK/Mainland China	Both (2)	1.02	-0.0016 (-2.89)	Both (1)	-5.03**	-0.0018 (-3.52)
HK/GD	Both (1)	-0.54	-0.0023 (-3.65)	Both (1)	-5.25**	-0.0024 (-4.49)
1978-2002						
HK/Mainland China	Both (4)	0.72	-0.0025 (-2.07)	Both (3)	-3.64*	-0.0030 (-3.23)
HK/GD	Both (4)	-1.86	-0.0058 (-3.90)	Both (3)	-4.54**	-0.0034 (-4.23)
1982-2002						
Macau/Mainland China	Both (3)	-5.16**	-0.015 (-5.39)			
Macau/GD	Both (3)	-3.06	-0.026 (-2.98)	Both (1)	-2.19*	0.00066 (0.60)

*Significance at the 5% level.
**Significance at the 1% level.
a. The number of lags in parentheses.
b. t-statistics in parentheses.
The sampling series are logged relative incomes. HK/Mainland China refers to the per capita RGDP of Hong Kong in USD divided by that of Mainland China's in logarithm.

The details of the ADF test has already been discussed in the previous chapter and the estimation results are exhibited in Table 5.16. As shown, all the relative incomes, except for the Macau/Mainland China one, are non-stationary with a unit root. It indicates that there is no bivariate stochastic convergence between Mainland China/Guangdong, Hong Kong and Macau in both the pre- and post-reform periods, except for the Mainland China and Macau economies in which stochastic convergence is found between them in the post-reform period. These relative income series have failed to return to their long-term steady state level after a shock and the income levels of these pairs of economies carry diverging pattern. This result repeats the conclusion in the previous chapter when the Bernard and Durlauf (1995)'s definition of stochastic convergence was employed. Despite the absence of stochastic convergence, when the estimated coefficients of the time trend are reviewed, all of them are statistically significant and negative though they are small in size. It can be interpreted as the relative income or the income gap between Mainland China and the SARs has been contracting continuously. However, they still have no tendency to stabilize and return to their steady state level. Perhaps the income ratios are going to encounter continuous adjustments before they can contract further to return to their long-run steady state level to achieve stochastic convergence. As long as the catching-up process sustains, with the initially poorer Chinese economies growing faster than the initially richer SARs, it is expected that stochastic convergence could take place following the processes of β- and δ-convergence.

5.6. Reduction of Income Dispersion

This section goes a step further to address the role of these growth determinants, attempting to quantify their influence on the size of the income gap between the Chinese provinces, Hong Kong and Macau. The objective is to search for the correlation between the income gap and these growth determinants, then it would be possible to provide suggestions on how to reduce the existing income gap between these economies.

In order to explore the correlation of the income ratio with the other factors, estimations are formulated to regress the income ratio between Hong Kong and different Chinese provinces against the previously mentioned growth determinants, consisting of investment ratio, effective population growth, secondary sector output ratio, openness ratio, FDI to GDP ratio and a coastal dummy. The results are then summarized in Table 5.17.

Table 5.17: Analysis on the Income Ratio in Post-Reform Period

Time period	1978-2002		1985-2002	
Constant	2.355 (7.88)	2.648 (8.95)	0.760 (1.88)	1.886 (5.03)
Ln s_i	-0.312 (-6.91)	-0.388 (-8.46)	-0.595 (-8.07)	-0.664 (-10.02)
Ln $(n+g+\delta)_i$	0.202 (1.99)	0.237 (2.38)	-0.214 (-1.60)	0.00454 (0.038)
Ln sec_i	-1.072 (-17.60)	-1.011 (-16.77)	-1.108 (-12.68)	-0.990 (-12.55)
Ln $open_i$	-0.280 (-23.80)	-0.217 (-14.13)		
Ln FDI_i			-0.142 (-13.50)	-0.0775 (-6.99)
Coastal Dummy		-0.213 (-5.99)		-0.427 (-11.08)
Adjusted R^2	0.65	0.67	0.54	0.63

The dependent variable is the income ratio measured by the per capita RGDP of Hong Kong divided by that of the Chinese provinces (except for Tibet and Chongqing), all in 1995 price and have been converted into USD using 1995 USD exchange rate. The other variables have already been used in the previous convergence analyses. t statistics in parenthesis.

It could be found that almost all the growth determinants can successfully explain the size of the income ratio and in general, the presence of a high investment ratio, a high secondary sector output ratio, a high openness ratio and a low effective population growth in a province tend to reduce its income gap with Hong Kong. This result is very much theoretically sound. Besides, it is suggested that the coastal provinces have a smaller income gap with Hong Kong, up to 20% less than the other provinces for the period of 1978 to 2002. It is because the coastal provinces are the earliest to be opened and they have a better approach to foreign investments and markets. Consequently, they can grow faster than the other provinces and have a smaller income gap with Hong Kong. In the estimation, the secondary sector output ratio is found to carry the highest estimated coefficient. Therefore, to reduce income disparity, the most effective way is perhaps to accelerate the development of the secondary sector, which may than help to strengthen the economy's production capacity and exportability, and eventually to speed up income growth to reduce disparity. Investment and trade are both significant factors, but they are less controversial than the secondary sector output ratio in determining the output ratio.

Nevertheless, the expansion of these economic activities can still contribute to reduce the income gap between the Chinese provinces and Hong Kong. In light of the effective population growth, this factor carries only moderate significance in the estimation. It suggests that population control may be constructive in bringing about a smaller income gap. Since lower population growth could not accelerate income growth, but helps to increase the per capita income level. Therefore, it is probably the least effective or a passive way among the other alternatives.

Then the FDI to GDP ratio is introduced in the discussion. In general, the estimation results are as satisfactory as before and a high investment ratio, a high secondary sector output ratio and a high FDI ratio could help to reduce the income gap with Hong Kong. As shown in the last two columns of Table 5.17, the secondary sector output ratio remains to be the most important factor in the estimation. Therefore, developing the secondary sector is still the most effective way to reduce income gap with Hong Kong. Given the FDI ratio, the estimated coefficient of the investment ratio has almost doubled and an improvement is also found in the level of significance. It may imply that FDI improves the productivity of local gross fixed capital formation and increases its significance in the estimations. This finding exhibits that policies which can promote FDI inflow and investment can help to reduce the income gap between a Chinese province and Hong Kong. In contrast, the effective population growth has lost all its significance in the analyses and provinces with lower effective population growth does not necessarily have smaller income ratio. Given the FDI ratio, population control is no longer a good suggestion if the intention is to reduce the income gap. Another finding which is not displayed in the table is that when the openness and FDI ratios are used together, they tend to discount the explanatory power of the regression. This incident could be explained by the correlation of these two factors which has affected the result of the estimation. In the last column, the coastal dummy is found to be statistically significant in explaining the income gap with Hong Kong. Its negative size suggests that the coastal provinces have a smaller income gap with Hong Kong than the other provinces. As most inward FDI would find their destinations in the coastal provinces, therefore, part of the impacts of the FDI ratio could have been reflected by the coastal dummy. As a result, the presence of this dummy has reduced the estimated coefficient of the FDI ratio by half.

5.7. Chapter Summary

5.7.1. The Findings from the Descriptive Analysis

The economic performance of Mainland China, Hong Kong and Macau are distinctively different in the pre-reform period, and it has brought about substantial income gap between these economies. In the pre-reform period, due to the relatively poorer performance on the Mainland side, the income ratio between Mainland China and Hong Kong, measured as the per capita RGDP of Hong Kong divided by that of Mainland China, has been expanding. This ratio has once arrived at 50 or 15 in 1980, that is, Hong Kong's per capita RGDP was 50 or 15 times that of Mainland China when USD or PPP is used as the unit. Similar situation can also be found on the regional level and the income ratios of the coastal, central and western regions dominated by USD were once 47, 65 and 80 respectively in 1980. The coastal region, which had certain advantages on endowments, geographical location and policies' treatments, tended to have a smaller income gap than the other regions. In light of the city level income disparity, due to their special political status, the municipalities of Mainland China had smaller income gap with Hong Kong relative to the national and regional counterparts. Their income ratios with Hong Kong dominated by USD were 18, 19 and 12 for Beijing, Tianjin and Shanghai respectively in 1980. Besides, there was no clear increasing or declining trend for these income ratios in the pre-reform period due to the consistent preferential policies toward these municipalities. As for Guangdong, its condition was similar to the other coastal provinces and its income ratio had a value similar to the coastal average.

The economic reforms and the associated open door and liberalization policies have significantly improved the economic prospects of Mainland China, leading to rapid income growth for the whole country. Consequently, the income ratio between Mainland China and Hong Kong in USD has reduced from 54 in 1980 to 21 in 2002, the income ratio in PPP has dropped from 16 to just 6 in the same period. The income ratio between Mainland China and Macau in USD, meanwhile, has also declined from 48 in 1985 to 18 in 2002. Similar contraction pattern is exhibited in the regional income ratios. The coastal region, which was the major beneficiary of the reforms, was the one with the lowest income ratio with Hong Kong, at 13 in 2002, while that of central and western regions stayed at 24 and 35 respectively. On the city level, attributed to the full implementation of liberalization and open door policies, Shanghai was able to reduce its income ratio from 13 in 1980 to 5 in 2002. For Beijing and Tianjin, their income ratios have also fallen to single digit level, at 8.43 and 8.32 respectively in 2002. Relative to the other coastal provinces, Guangdong could have better utilized the reform policies to accelerate its income growth. As a result, its income ratio was 1.5 points below the coastal average, at 11 in 2002.

The coefficient of variation is also measured to estimate the actual income disparity between Mainland China, Hong Kong and Macau, to assess whether there is δ-convergence between them. The Greater China CV indicates δ-convergence on the income level between Mainland China and the SARs in the post-reform period. The CV has been declining continuously from 3.4 in 1981 to 1.9 in 2002, implying lower income disparity between Mainland China, Hong Kong and Macau. When the Chinese provinces are focused, the corresponding CV has failed to show any clear tendency of contraction throughout the post-reform period. In other words, there is no δ-convergence between different Chinese provinces. The index decreased from 0.71 in 1980 to 0.62 in 1990, then increased again to 0.69 in 1998 and stayed at 0.64 in 2002. This result can be explained by the economic reforms which have brought about different impacts to different provinces in different stages. In the case of the regional CVs, they were affected by various economic and political campaigns and have been fluctuating in the pre-reform period with no evidence of convergence. Since the 80s, a clear declining trend was found for the coastal, central and western indices and it implies δ-convergence between each of the geographical regions and the SARs in the post-reform period. Amongst, the coastal CV was the smallest one, while the western CV was the largest. It is because the coastal region was the earliest to be opened and it was also the region that was most affected by the reforms the most. Consequently, it has taken advantages of all the adjustments and was able to grow faster to reduce its income gap with the SARs. The western region, however, was probably the latest to be opened and with inferior endowments. The income growth of the region was lower than the others and therefore, it had the largest income gap with the SARs among all the regions in Mainland China.

5.7.2. The Findings from the Parametric Analysis

In addition to the δ-convergence test, the chapter has attempted to show whether there is any evidence of β-convergence between Mainland China, Hong Kong and Macau. In the basic convergence test, the results indicate no evidence of absolute convergence between the 32 Chinese provinces and municipalities in both the pre- and post-reform periods. The initially poorer Chinese provinces have failed to grow faster than the initially richer ones due to their diversified economic backgrounds and the biased policies faced by these economies. After inserting a coastal dummy into the specification, the estimation results reveal β-convergence in the sub-period of 1978 to 1990, and the initially poorer coastal provinces could be benefited by the reforms to grow faster and catch up with the initially richer ones. However, as some of the fast-growing coastal provinces might be able to continuously derive disproportional greater benefits from the reforms, their speed of growth might out-perform the others. Hence, the process of β-convergence has disappeared since the 90s. The pooled analyses exhibit similar result as the cross-sectional counterpart and there is no evidence to support absolute β-convergence on both the provincial and regional levels for the period of 1978 to 2002. The increased number of observations in the pooled analysis, however, has rewritten the previous result to bring about absolute β-convergence in the pre-reform period between all the Chinese provinces. In the regional studies, Chinese provinces and municipalities are grouped into different geographical regions. It significantly reduces the disparities between the members in a region and has brought about absolute β-convergence to the central and western regions in the period of 1993 to 2002. The process of absolute β-convergence, however, is not found between the coastal provinces in the post-reform period.

When Hong Kong and Macau are considered, there is no absolute β-convergence in the pre-reform period in both the cross-sectional and pooled analyses. Then this process is observed since the 90s and the initially poorer Chinese provinces have taken advantages of the economic reforms to grow faster than the initially richer Hong Kong and Macau economies. It allows the economies on the Mainland side to catch up with the SARs to reduce their income gap to achieve δ-convergence. The pooled analyses indicate that absolute β-convergence between the coastal region and the SARs initiated in as early as 1978, which is a decade earlier than the other groups. This pattern can be explained by the geographical position, endowments and reform time table of the coastal region. The speed of income convergence for the coastal region is also the fastest in the country. The positive impacts of the economic reforms were eventually transferred to the central and western regions in the 90s, to allow these regions to grow faster to catch up with Hong Kong and Macau. Then the central and western regions and the Mainland China as a whole can achieve absolute β-convergence with the SARs since the 90s.

After the absolute income convergence tests, additional growth determinants, such as investment ratio, effective population growth rate, openness and FDI to GDP ratios are inserted with the purposes of estimating the contribution of these factors to the convergence process. Considering the Chinese provinces, the additional explanatory variables, particularly the openness or the FDI to GDP ratio, are significant in both the cross-sectional and pooled analysis. They have contributed to bring about conditional income convergence in the post-reform period to the Chinese provinces, despite there is no absolute convergence. Similar conditional convergence process has also taken place within each of the geographical regions of the country. This result reflects that the difference in trade and FDI development could be the causes of diversified economic performance of the country. Only after controlling these factors, different provinces or regions of Mainland China are able to converge their income levels towards their own steady state. The investment ratio, effective population growth rate and the secondary sector output ratio, however, are significant only in certain sampling periods for certain groups. It implies that a high investment ratio and a low effective population growth are the necessary, but not the sufficient conditions of achieving conditional income convergence. Furthermore, the growth process of a certain region, such as the central region, could be dominated by the government's policies and the investment and population factors are independent of the income growth of the region, while income convergence is still found in the region.

In light of the convergence issue on the Greater China level, there is no conditional income convergence in the pre-reform period due to the remarkably different performance of these economies. In the post-reform period, on top of absolute income convergence, conditional income convergence is also observed. The adoption of additional factors, particularly the secondary sector output and the openness and FDI ratios, have accelerated the pace of income convergence between Mainland China, Hong Kong and Macau. The speed of the process is proportional to the number of significant growth determinants. Perhaps when more restrictions are imposed and more sources of disparities are controlled, it would be easier for the initially poorer Chinese economies to grow faster to reach their respective steady states. Similar to the previous findings, the investment ratio and effective population growth rate are significant only in certain sampling period for certain groups. In light of the openness and FDI ratios, they are correlated in a certain extent and cannot be employed together, or the estimation result could be seriously affected. Since 1993, these two factors have become statistically insignificant though the result of conditional convergence between Mainland China, Hong Kong and Macau is not affected. This result suggests that after a decade of economic reforms, a higher trade volume or a success in attracting inward FDI cannot guarantee the achievement of higher growth rate. An economy should focus on a wider array of factors before its growth rate can be further boosted.

Regarding the issue of stochastic convergence, the ADF tests on income ratios exhibit the presence of unit root, which rejects stochastic convergence between Mainland China/Guangdong, Hong Kong and Macau on their income levels in the entire sampling and post-reform periods. The income ratios between Mainland China/Guangdong, Hong Kong and Macau are non-stationary with no tendency to return to their means given a shock. This result together with the negative and significant time trend found in the ADF tests may imply that the β- and δ-convergence process between Mainland China, Hong Kong and Macau would continue. The income gap between these economies could be reduced further in the future before the income ratios become stationary to reach stochastic income convergence.

Economic integration and convergence in both absolute and conditional manner are found between Mainland China, Hong Kong and Macau in the post-reform period, particularly in the 90s. This coincidence suggests a connection between these two processes and the economic reforms could probably be the driving force behind them. In addition, as the initially poorer Chinese economies can always have a higher income growth rate than the initially richer Hong Kong and Macau economies, while trade or FDI transactions can at most speed up the convergence process, it implies that economic integration and the associated expansion in trade or FDI transactions is not a determinant of the income convergence process. Instead, it contributes to shorten the time it takes for Mainland China, Hong Kong and Macau to converge to their income level.

To reduce the income disparities between Mainland China, Hong Kong and Macau, the most effective way is to expand the secondary sector and in the process, the efficiency and production capacity of the province may be improved, and a higher growth rate may be achieved. Besides, developing trade activities, attracting more incoming foreign capital and promoting fixed capital investment are also workable ways. Amongst these suggestions, developing trade activities is probably more powerful than the other two alternatives due to its possible contributions to efficiency and technology improvement. In addition, population control may also be of some help in reducing the income gap with Hong Kong, although it may not be the most powerful policy. Furthermore, since the income gap between the coastal region and Hong Kong is the lowest among all the Chinese regions. The authorities could also consider continuing with all the preferential policies that they have been adopting in the coastal region and further extending them to the central and western regions. In this way, these two regions could become more "coastal like", tending to achieve a higher income level and hence narrowing their income gap with Hong Kong.

Chapter 6: Total Factor Productivity Convergence between Mainland China, Hong Kong and Macau

In line with the economic reforms and economic integration, β- and δ-convergence on per capita RGDP between Mainland China, Hong Kong and Macau have been observed, and trade and FDI flows are the controversial growth determinants in the process. Nevertheless, it is still unclear if the productivity level of Mainland China can catch up with the SARs simultaneously. For this reason, the productivity level of Mainland China will be measured and analyzed in this chapter with an intention to assess if the economic reforms have brought about any improvement in technology and efficiency. Rather than focusing on the partial productivity of labour and capital, the total factor productivity (TFP) will be measured and decomposed. The result can reflect the ability of a country in transforming capital and labour inputs into output. Besides, it also helps to distinguish whether it is improved efficiency or better technology that dominates the process of output growth. In addition, a comparative study on TFP will also be conducted to investigate the issue of productivity differentials between Mainland China, Hong Kong and Macau in the post-reform period. Finally, the phenomenon of productivity convergence, which is a branch of convergence study according to Islam (1998), will be addressed again with an intention to test if there is any tendency of productivity convergence between Mainland China, Hong Kong and Macau.

6.1. Total Factor Productivity in Stochastic Frontier Approach

Total factor productivity (TFP) is regarded as the portion of output that cannot be explained by the stocks of labour and capital inputs, or it is the average output growth unexplained by the growth of capital, labour and human capital. To measure the total factor productivity, the growth accounting approach has been widely used in the available literature as an estimation method. In this approach, the Cobb-Douglas production function serves as the base of the specification, and TFP is the portion of output growth that could not be explained by the growth in factor inputs. In Li (2002), TFP is measured as:

$$\frac{\dot{Y}}{Y} = g + \left(\frac{F_K K}{Y}\right) \times \left(\frac{\dot{K}}{K}\right) + \left(\frac{F_L L}{Y}\right) \times \left(\frac{\dot{L}}{L}\right) \quad (6.1)$$[84]

where $\left(\frac{F_K K}{Y}\right)$ and $\left(\frac{F_L L}{Y}\right)$ are the shares of capital and labour factor in total output and their sum is 1 according to the assumption of constant returns to scale. The $\left(\frac{\dot{K}}{K}\right)$ and $\left(\frac{\dot{L}}{L}\right)$ are the growth of capital and labour respectively, and g is the total factor productivity or the Solow residual.

As the residual term in the growth accounting approach is employed as TFP, any measurement error in computing the stock or growth of the input factors would seriously distort the value of TFP. To avoid this problem, an alternative approach based on econometric estimation of production function is introduced in the form of:

$$LnQ_t = c + \alpha LnL_t + \beta LnK_t + \varphi t + u_t \quad (6.2)$$[85]

[84] Li (2002), p.5
[85] Felipe(1997), p.8

where φ is the average rate of TFP growth to be estimated and it is viewed as a shift of the production function over time.

The stochastic frontier approach is developed based on the above estimation and a maximum output which refers to the best practice or technological frontier is defined. In this approach, the maximum production capacity or the best possible output which is known as the frontier output level will be estimated. Then it will be used to compare with the actual output which can be lower or higher than the level of frontier output. If the former is the case, then there exists technical inefficiency in the economy. In addition, the production frontier could change over time and if it shifts upward, then technological progress will take place and the best possible output tends to increase over time. The stochastic frontier approach is distinguished from the other methods, for example, Slow (1957)'s estimation on TFP in that it separates the growth of TFP to technological progress, TP, and changes in technical efficiency, TE. It interprets output growth as the combined results of input growth and TFP growth and it further decomposes TFP growth into TP and changes in TE. The stochastic frontier approach depicts that even without any input expansion or technological progress, output growth can still be achieved due to improvement in technical efficiency. The Solow's residual, on the other hand, attributes the growth in observed output to input growth and technological progress and TFP is the measurement error in the production function estimation.

In Wu (1995, 2000a), the stochastic frontier approach was employed and the growth of TFP was estimated based on the following specification:

$$\log Y_i(t) = \alpha + \beta_1 t + \beta_2 t^2 / 2 + (\gamma_1 + \gamma_2 t)\log L_i(t) + (\eta_1 + \eta_2 t)\log K_i(t) + e_i(t)$$

where $e_i(t) = v_i(t) + u_i(t)$[86] (6.3)

α, β, γ and η are the parameters to be estimated. $Y_i(t)$, $L_i(t)$ and $K_i(t)$ represent GDP, labour and capital of the ith economy at time t. The βs are the rates of technological

[86] Wu (2000a), p.48.

progress. $e_i(t)$ is the error term consisting of a random term, $v_i(t)$, and a term associated with technical inefficiency, $u_i(t)$.

Then the equation could be evolved to:

$$\dot{Y}_i(t) = (\beta_1 + \beta_2 t + \gamma_2 \log L_i(t) + \eta_2 \log K_i(t)) + (\gamma_1 + \gamma_2 t)\dot{L}_i(t) + (\eta_1 + \eta_2 t)\dot{K}_i(t) + T\dot{E}_i(t) \quad (6.4)$$

where the dots indicate percentage changes. This equation suggests that output growth can be decomposed into technological progress, input growth, and changes in technical efficiency. The growth in total factor productivity, meanwhile, is measured as the output growth that is not attributed to input growth, which is also the sum of technological progress and changes in technical efficiency.

$$T\dot{F}P_i(t) = TP_i(t) + T\dot{E}_i(t) \quad (6.5)$$

According to Gumbau-Albert (2000), the idea of the stochastic frontier approach in TFP measurement was firstly introduced by Farrell (1957) and extended by Aigner, Lovell and Schmidt (1977) and Meeusen and van den Broeck (1977), and has been employed in a series of studies on total factor productivity. In Gumbau-Albert (2000), incorporating a translog production function, this approach has been applied to study the technical efficiency on the Spanish regional economy. Similar application is also found in Mahadevan and Kim (2003) in which the stochastic frontier approach has been adopted to measure the TFP growth of four selected South Korean manufacturing industries. The TFP growth of the manufacturing sector in Australia, the manufacturing industries in South Korea, as well as the manufacturing sector and services sector in Singapore have also been estimated in Mahadevan (2002a), Kim and Han (2001), Mahadevan and Kalirajan (2000) and Mahadevan (2002b) respectively by using the stochastic frontier approach, with either the translog or the Cobb-Douglas production function as the specification.

In the case of Mainland China, the stochastic frontier approach is a popular method in measuring TFP growth. It can be found in Wu (2000a, 2000b) in which the TFP growth of some Chinese provinces, Hong Kong and Taiwan as well as on the growth rate for the whole country in the post-reform period were estimated. In Lau and Brada (1990) and Wu (2003), the translog production function was employed to estimate and decompose the TFP growth of Mainland China on the industrial and national levels. Another two disaggregate studies on TFP growth are offered by Wu (1995) and Tong and Chan (2003). Based on a Cobb-Douglas production function, Wu (1995) has attempted to examine and decompose the TFP growth of the Chinese industries, namely the state industry, rural industry and agriculture on the provincial level. In Tong and Chan (2003), the authors have placed their emphasis on the provincial Township and Village Enterprises, TVEs, of Mainland China with an intention to measure their efficiency and productivity levels for the period of 1988 to 1993.

6.2. Total Factor Productivity Measurement

6.2.1. Technical Efficiency (TE)

It is a common consensus that the economic reforms and the open door policies of Mainland China, the implied adjustments in ownership structure, FDI inflows and trade expansion have altogether contributed to improve working incentives, upgrade technology and strengthen efficiency of the country. For this reason, it would be more appropriate to adopt the stochastic frontier approach in estimating the TFP growth of Mainland China. In such a way, it is possible to distinguish between improvement in technical efficiency and technological progress, as well as to quantify and compare their magnitude in the growth process of Mainland China. In fact, similar rationale has already been mentioned in Lau and Brada (1990) in its frontier estimations on the TFP growth of Chinese industries.

In practice, a translog production function will be adopted and estimated by applying the panel data approach with fixed effect. Such specification allows time-varying and regional specific technical efficiency and technological progress. This is an advantage over the conventional Cobb-Douglas function specification which fails to distinguish the technological progress between different economies. As stated in Gumbau-Albert (2000), the translog function is preferred to the Cobb-Douglas as it permits the estimation of different growth rates of technological progress for each region. In functional form, the translog production function is written as:

$$LnY_{it} = \alpha_0 + \alpha_1 t + \frac{1}{2}\alpha_2 t^2 + (\beta_0 + \beta_1 t)LnL_{it} + (\gamma_0 + \gamma_1 t)LnK_{it}$$
$$+\frac{1}{2}(\eta_1 LnL_{it}LnL_{it} + 2\eta_2 LnL_{it}LnK_{it} + \eta_3 LnK_{it}LnK_{it}) + \varepsilon_{it} \qquad (6.6)$$

where $\varepsilon_{it} = v_{it} - u_{it}$

Y, L and K are the real GDP, number of labours and capital stock respectively, t represents time trend. ε_{it} is the error term which can be further decomposed into a random error v_{it} which are normally distributed with zero mean and variance σ_v^2 and technical efficiency u_{it}. u_{it} represents production loss due to inefficiency and $u \geq 0$. This series is assumed to be independent of the statistical error v, independently distributed and has a normal distribution with zero mean and variance σ_u^2.

In order to work out the time-varying regional specific technical efficiency and technological progress, a pooled estimation with fixed effect similar to those applied by Wu (1995), Gumbau-Albert (2000) and Wu (2000b) will be run. To measure the technical efficiency, it is necessary to separate u_{it} from the error term v_{it}. Taking advantage of the time-varying and regional specific property of the former, Wu (1995, 2000a) have introduced a two-step approach to decompose ε_{it} into technical efficiency and random error. In practice, u_{it} is assumed to be a quadratic function of time t, which is specified as:

$$u_{it} = \theta_{0i} + \theta_{1i}t + \theta_{2i}t^2 \qquad (6.7)$$

In calculation, the translog production function in natural logarithm will firstly be estimated in a pooled analysis with fixed effect. The estimated residuals ε_{it} will be recorded and regressed against t and t^2 based on the quadratic function specification. Then the fitted value of the specification μ_{it} becomes an indicator of technical efficiency.

$$\mu_{it} = \phi_{0i} + \phi_{1i}t + \phi_{2i}t^2 \qquad (6.8)$$

where μ_{it} is the fitted value of the technical efficiency u_{it} and t is time trend.

Afterwards, μ_{it} will be normalized as $TE_{it}=\exp(\mu_{it}-\mu_{max})$ such that the estimated technical efficiency TE_{it} can fulfill the constraint of $0 \le TE_{it} \le 1$.

6.2.2. Technological Progress (TP) and Total factor Productivity (TFP)

The major driving forces for output growth are growth in input factors, improvement in production efficiency (technical efficiency change) and better production method (technological progress) and in Wu (1995), it is defined as:

$$\dot{Y}_{it} = \beta + \sum \gamma_j \dot{X}_{ijt} + T\dot{E}_{it} \quad (6.9)$$

[87]

where β is technological progress and the dots represent percentage change and *X*s are inputs.

As TFP growth is the portion of output growth that cannot be explained by input growth, it should be the sum of changes in technical efficiency and technological progress. In the absence of any input changes, improvements in production efficiency or the launching of new production technology can still bring about output growth, thus:

$$\Delta TFP = \Delta TE + TP \quad (6.10)$$

Therefore, to measure the growth rate of TFP, it is necessary to calculate the value of TP, apart from just knowing the level of TE and its rate of change. In light of technological progress, it is understood as the increase in output over time due to improvement in production technology and is specified as:

$$TP_{it} = \alpha_1 + \alpha_2 t + \beta_1 LnL_{it} + \gamma_1 LnK_{it} \quad (6.11)$$

where α_1, α_2, β_1 and γ_1 are the estimated coefficients of the translog production function stated above. Similar specification can also be found in Lau and Brada (1990), Gumbau-Albert (2000), Kim and Han (2001) and Wu (2003).

[87] Wu(1995), p.211.

6.2.3. Data Issue

To perform an empirical estimation on the TE, TP and TFP of Mainland China on the provincial level, Hong Kong and Macau, statistics of the total number of labours and capital stocks are required. The labour statistics of the Chinese provinces are available in the *Comprehensive Statistical data and Materials on 50 years of New Mainland China* under the name of "Total Number of Employed Persons", while more recent data can be found in the *Statistical Yearbook of Mainland China*. As for those of Hong Kong and Macau, they are available in *Hong Kong Monthly Digest of Statistics* and *Statistical Yearbook of Macau*, respectively, but in a much shorter time series.

Although statistics of the capital stock are not directly reported in any official statistical sources, a series of researches have been organized to estimate them. In Li (2002, 2003), for example, the author has estimated and reported the capital stock statistics of different Chinese provinces and Hong Kong. In these researches, the capital stock statistics are measured by the methodology used in Mahadevan and Kalirajan (2000) and Wu (2000a, 2003) in which:

$$K_{it} = K_{i,t-1}(1-\delta) + \Delta K_{it} \qquad (6.12)$$

where δ is the depreciation rate, $K_{i,t-1}$ is the capital stock in the last period and ΔK_{it} is investment, all the factors in real terms.

In practice, the suggestion in Li (2002) will be followed by setting depreciation rate at 5% a year for all the sampling regions. The initial capital stock of Mainland China, Hong Kong and Macau are assumed to be 5 times the investment level of the same year. The gross fixed capital formation is used as a proxy of the change in capital stock each year. All the nominal statistics are deflated by their own regional deflator, which is the ratio of nominal to real GDP, respectively with 1995 to be the base year. For comparison purpose, all the capital stock statistics are converged to USD using the 1995 exchange rate.

Since the processes of economic integration and income convergence have initiated only after the economic reforms. It is then expected that major improvement in efficiency and technology as well as significant productivity growth could only take place after the economic reforms. In addition, the statistics on the total number of employed people prior to 1978 are incomplete and the data of gross fixed capital formation for some provinces, for example Guangdong, is only available after 1978. For the above reasons, the following analysis will have its emphasis placed on the post-reform period from 1978 to 2002, with attempts to measure and compare the growth rate of TFP, TE and TP of the Chinese provinces, Hong Kong and Macau, to examine if there is any productivity convergence as well as to find out the connection between this process and that of economic integration and income convergence.

6.3. Estimation Results

The translog production function is estimated in panel data approach and fixed effect is applied in order to allow the diversified regional economies to have their individual drift and the estimation results are shown in Table 6.1.

As indicated, increases in both capital and labour do not only bring no immediate stimulation to output growth, but tend to reduce the existing output scale. It may imply that it takes time for the newly increased capital and labour inputs to become productive and certain amount of outputs have to be scarificed in this learning process. Afterwards, when the new and existing capital and labour work together, output level could be expanded. Therefore, the square of these inputs are significant growth determinants and a time lag may exist before capital and labour could bring about higher output level. Incorporating with the time trend, labour force contributes while capital stock discounts the output growth over the long-run. It probably reflects the strong productivity of experienced labour and the adverse impacts of outdated capital goods. When the estimated coefficient of the time trend is considered, its positive and significant pattern suggests that output tends to grow automatically over time due to better technology. In addition, given the positive coefficient[88] of t^2, it implies that the existing production technology tends to improve over time.

Table 6.1: Estimation results on the Translog Production Function

Parameter	Estimated Coefficient	t-statistics
t	0.096	5.79
$\frac{1}{2}t^2$	0.0012	4.91
LnL_{it}	-0.71	-2.25
LnK_{it}	-0.26	-2.24
$t\, LnL_{it}$	0.0039	1.93
$t\, LnK_{it}$	-0.0099	-6.26
$\frac{1}{2} LnL_{it}\, LnL_{it}$	0.15	3.20
$\frac{1}{2} LnK_{it}\, LnK_{it}$	0.087	4.83
$LnL_{it}\, LnK_{it}$	-0.0058	-0.30
Adjusted R^2	0.99	

Regression is run by pooling up all the Chinese provinces and municipalities, Hong Kong and Macau for the period of 1978 to 2002. Due to the availability of statistics, estimation on Macau begins only since 1982. Dependent variable is RGDP in 1995 price converged to USD using 1995 USD exchange rate.

6.3.1. Technical Efficiency

The TE of the Chinese provinces and municipalities, Hong Kong and Macau are estimated by regressing the estimated residuals of the translog production function against time trend and its square. The fitted value of the dependent variable then indicates the level of technical efficiency for the sampling economies. After normalization, this index is able to reflect the level of efficiency of an economy. A value of 1 suggests that production is on the frontier and outputs are produced in the most efficient way.

[88] In Gumbau-Albert (2000) and Wu (2000b), the estimated coefficients for the time trend and its square are negative. The author of the latter article has considered this negative trend as the adverse impact of economic restructuring on technological progress.

Table 6.2: Estimated Technical Efficiency of Chinese Province, Municipalities and SARs

Year	Beijing	Tianjin	Shanghai	Guangdong	Hong Kong	Macau
1978	0.798	0.797	1.000	0.662	0.547	n.a.
1979	0.785	0.772	0.946	0.667	0.581	n.a.
1980	0.772	0.750	0.898	0.673	0.614	n.a.
1981	0.760	0.730	0.855	0.678	0.645	n.a.
1982	0.750	0.713	0.818	0.683	0.675	0.759
1983	0.740	0.699	0.785	0.688	0.703	0.772
1984	0.731	0.687	0.755	0.692	0.728	0.783
1985	0.723	0.677	0.730	0.697	0.750	0.790
1986	0.715	0.670	0.708	0.701	0.769	0.795
1987	0.709	0.664	0.689	0.705	0.785	0.797
1988	0.703	0.660	0.673	0.709	0.797	0.796
1989	0.698	0.659	0.659	0.713	0.805	0.791
1990	0.693	0.659	0.649	0.717	0.809	0.784
1991	0.690	0.661	0.640	0.720	0.810	0.774
1992	0.687	0.665	0.634	0.723	0.806	0.762
1993	0.685	0.672	0.631	0.727	0.798	0.747
1994	0.683	0.680	0.629	0.729	0.787	0.729
1995	0.682	0.690	0.630	0.732	0.772	0.709
1996	0.682	0.703	0.633	0.735	0.753	0.687
1997	0.682	0.718	0.638	0.737	0.731	0.664
1998	0.683	0.735	0.646	0.739	0.707	0.638
1999	0.685	0.755	0.656	0.741	0.680	0.612
2000	0.688	0.778	0.669	0.742	0.650	0.584
2001	0.691	0.804	0.684	0.744	0.619	0.556
2002	0.695	0.833	0.702	0.745	0.586	0.527
Average						
1978-1990	0.737	0.703	0.782	0.691	0.708	0.785
1991-2002	0.686	0.725	0.649	0.735	0.725	0.666
1978-2002	0.712	0.713	0.718	0.712	0.716	0.717

Author's calculation. Macau's measurement begins at 1982.

Table 6.3: Estimated Technical Efficiency of Mainland China on the Regional Level

Year	National Average	Average of Coastal Provinces	Average of Central Provinces	Average of Western Provinces
1978	0.726	0.731	0.745	0.702
1979	0.722	0.723	0.739	0.704
1980	0.718	0.717	0.734	0.705
1981	0.715	0.711	0.729	0.707
1982	0.713	0.706	0.725	0.709
1983	0.711	0.703	0.721	0.712
1984	0.709	0.700	0.718	0.714
1985	0.708	0.698	0.715	0.716
1986	0.707	0.696	0.712	0.718
1987	0.707	0.695	0.710	0.719
1988	0.707	0.695	0.708	0.720
1989	0.707	0.696	0.706	0.721
1990	0.707	0.697	0.705	0.722
1991	0.707	0.699	0.704	0.722
1992	0.708	0.701	0.703	0.722
1993	0.709	0.704	0.702	0.721
1994	0.710	0.707	0.702	0.720
1995	0.711	0.711	0.702	0.719
1996	0.712	0.716	0.702	0.717
1997	0.714	0.721	0.702	0.715
1998	0.716	0.727	0.703	0.713
1999	0.718	0.733	0.704	0.710
2000	0.720	0.740	0.706	0.708
2001	0.723	0.748	0.707	0.705
2002	0.726	0.757	0.709	0.701
Average				
1978-1990	0.712	0.705	0.721	0.713
1991-2002	0.714	0.722	0.704	0.715
1978-2002	0.713	0.713	0.713	0.714

Author's calculation.

As reported in Table 6.2, the level of technical efficiency for different Chinese economies, Hong Kong and Macau are close to each other. The post-reform average of these TEs stay at around 71%. When their evolutions are considered, the TEs of the 3 municipalities are found to have a similar development pattern in which these indices were declining in the early reform period until the 90s, then started to improve in the following decade. It implies that a restructuring process may have taken place in these municipalities following the economic reforms, and have adversely affected the efficiency level of these economies. After an adjustment period and operating under a new market-oriented economic system, these economies are able to show certain efficiency improvement in the late 90s. This development pattern is just the opposite of Hong Kong and Macau. The TEs of the SARs were increasing since the economic reforms and had maximized in the early 90s. Following the economic restructuring of the SARs and the northward relocation of their manufacturing industries, the overall technical efficiency of Hong Kong and Macau have began to drop since the early 90s. The economic recessions and transitions in recent years have further deteriorated their performance and have brought about a record low level of efficiency to these SARs. As for Guangdong, attributed to the province's ever expanding external trade and incoming FDI as well as its social contacts with Hong Kong and Macau, its TE has experienced a continuous growth from a relatively low level of around 66% in 1978 to 72% in 1990, and has reached 75% in 2002. This finding[89] is consistent with the results in Wu (2000a, 2000b) in which an improvement in TE was observed for Mainland China as a whole, and Guangdong as well as Fujian since the economic reforms. In contrast, the efficiency levels of Hong Kong and Macau has been declining continuously since the late 80s.

The technical efficiency levels of Mainland China's coastal, central and western regions are summarized in Table 6.3. For the national average, due to the economic transition, the TE had experienced a slight decrease in the early reform years, and has resumed its growth progress since the early 90s when the country has began its new phase of reforms. This pattern is very similar to that inherited in the coastal average. As for the central region, the biased policies which favoured the coastal region or the removal of the pre-reform's preferential polices have brought about certain negative impacts to the region. Its efficiency level has been declining from 75% in 1978 to 70% in 1997. Afterwards, moderate improvement could be observed and the efficiency level stayed at 71% in 2002. In light of the western region, attributed to the agricultural reforms, the technical efficiency has been improving since the beginning of the reforms. Since the early 90s, as the focus of the reforms was switched to the urban area, the performance of the agricultural-oriented western region has been discounted. For these reasons, the

[89] The TE of Fujian is also estimated but not shown in Table 6.2. It increases from 57% in 1978 to 72% in 1990 and 85% in 2002.

coastal region has become the most efficient region of the country with a TE level of 76% in 2002, followed by central region's 71% and western region's 70%. The national average TE was recorded at 73% in the same year.

By 2002, the above measurement[90] exhibits that the technical efficiency level of the Chinese provinces and municipalities has already exceeded that of Hong Kong's and Macau's which was only 59% and 53% respectively. It implies that the Chinese provincial economies were able to produce more efficiently than the SARs.

6.3.2. Technological Progress

The estimated technological progress of Mainland China at different levels and that of Hong Kong and Macau are exposed in Tables 6.4 and 6.5. As stated in Table 6.4, the TP of Beijing has been fluctuating within a narrow range of 3.6% to 3.9% throughout the post-reform period. It has increased from 3.69% in 1978 to 3.87% in 1983, then began to drop to 3.57% in 1989. After an expansion period in the early 90s, the technological progress has started to slow down again since the mid 90s to 3.63% in 2002. In view of Tianjin, an increasing trend is found and its TP has increased slightly from 3.69% in 1978 to 3.91% in 2002. In contrast, the technological progress of Shanghai has been declining continuously from 3.81% in 1978 to 3.19% in 2002. Similar contraction pattern could also be found in Guangdong in which its TP has been falling from 4.03% in 1978 to 3.4% in 2002. Probably, Shanghai and Guangdong were able to gain access to better technology in the pre-reform period given their special status and geographical position. Then they tend to have less room for technological improvement in the post-reform period as compared with the other provinces. Despite the diversified development pattern of TP, the new technology alone has allowed these Chinese economies to produce around 3% more output a year, and the disparities on TP is small. In light of the performance of Hong Kong and Macau, benefited from the economic reforms of Mainland China and their own middleman's role, the technological progress that these economies could enjoy has been increasing. As Hong Kong had got the most advanced technology in the Greater China

[90] The estimation shows that in 2002, amongst all the Chinese provinces, Fujian had the highest TE at 85%, while Guizhou had the lowest at 60%.

region in the late 70s, the technological progress that it could enjoy was also the lowest. In the sampling period, the territory was able to expand its TP from a low level of 0.53% in 1978 to 1.87% in 2002, but it was still the lowest in the region. The TP of Macau, meanwhile, has increased from 3.61% in 1982 to 4.4% in 2002 due to its transition from an industrial to a service-oriented economy.

On the national level, as recorded in Table 6.5, the economic reforms have brought about technological progress to Mainland China and the average TP has been increasing from 3.92% in 1978 to 4.34% in 2002. On the regional level, the relatively backward central and western regions of Mainland China have experienced a continuous improvement in their technological progress, while that of the coastal region has stabilized. Amongst, the western provinces of Mainland China have experienced the highest extent of technological improvement, with an average TP of 4.68% for the period of 1978 to 2002. An average TP of 3.92% and 4.17% were recorded for the coastal and central regions respectively for the same period. Perhaps the technology level of the western provinces was relatively poorer at the beginning of the economic reforms. Then these economies would have bigger rooms to upgrade their production methods, and could have experienced more fruitful technological progress than the other regions. The coastal provinces, especially the municipalities, may have already achieved a certain extent of technological advancement in the pre-reform period, they will then tend to have smaller room for improvement in the post-reform period.

Comparing the estimated national average TP in Table 6.5 with the findings in Wu (2003), the 4.22% TP here is much higher than the 1.23% to 1.31% technological progress for the period of 1982 to 1997 as suggested in this article. However, the estimation here is close to the estimation results in Wu (1995) which indicated a 3.35%, 4.41% and 4.48% of technological progress in the state industries, rural industries and agricultural sector of Mainland China respectively in 1991.

Table 6.4: Estimated Technological Progress of Chinese Province, Municipalities and SARs

Year	Beijing	Tianjin	Shanghai	Guangdong	Hong Kong	Macau
1978	0.0369	0.0369	0.0381	0.0403	0.0053	n.a.
1979	0.0371	0.0373	0.0381	0.0401	0.0055	n.a.
1980	0.0372	0.0377	0.0381	0.0398	0.0056	n.a.
1981	0.0378	0.0382	0.0380	0.0394	0.0060	n.a.
1982	0.0386	0.0385	0.0376	0.0388	0.0064	0.0361
1983	0.0387	0.0387	0.0373	0.0386	0.0069	0.0359
1984	0.0384	0.0387	0.0369	0.0382	0.0076	0.0360
1985	0.0378	0.0384	0.0364	0.0379	0.0082	0.0362
1986	0.0372	0.0384	0.0359	0.0377	0.0089	0.0361
1987	0.0364	0.0384	0.0353	0.0377	0.0094	0.0363
1988	0.0358	0.0384	0.0347	0.0376	0.0100	0.0364
1989	0.0357	0.0388	0.0346	0.0377	0.0105	0.0366
1990	0.0359	0.0393	0.0346	0.0376	0.0111	0.0368
1991	0.0365	0.0395	0.0348	0.0377	0.0117	0.0367
1992	0.0372	0.0396	0.0349	0.0372	0.0121	0.0364
1993	0.0372	0.0397	0.0347	0.0361	0.0127	0.0362
1994	0.0372	0.0397	0.0340	0.0353	0.0133	0.0363
1995	0.0364	0.0397	0.0332	0.0346	0.0138	0.0368
1996	0.0360	0.0396	0.0324	0.0343	0.0144	0.0378
1997	0.0359	0.0396	0.0320	0.0342	0.0148	0.0385
1998	0.0355	0.0395	0.0319	0.0340	0.0154	0.0394
1999	0.0354	0.0389	0.0311	0.0338	0.0162	0.0404
2000	0.0354	0.0390	0.0312	0.0339	0.0170	0.0416
2001	0.0354	0.0391	0.0315	0.0340	0.0178	0.0429
2002	0.0363	0.0391	0.0319	0.0340	0.0187	0.0441
Average						
1978-1990	0.0372	0.0383	0.0366	0.0386	0.0078	0.0363
1991-2002	0.0362	0.0394	0.0328	0.0349	0.0148	0.0389
1978-2002	0.0367	0.0388	0.0348	0.0368	0.0112	0.0378

Author's calculation. Macau's measurement begins at 1982.

Table 6.5: Estimated Technological Progress of Mainland China on the Regional Level

Year	National Average	Average of Coastal Provinces	Average of Central Provinces	Average of Western Provinces
1978	0.0392	0.0388	0.0372	0.0417
1979	0.0396	0.0391	0.0378	0.0421
1980	0.0401	0.0393	0.0384	0.0427
1981	0.0407	0.0398	0.0392	0.0435
1982	0.0411	0.0399	0.0398	0.0441
1983	0.0415	0.0401	0.0402	0.0447
1984	0.0416	0.0400	0.0404	0.0450
1985	0.0416	0.0398	0.0404	0.0451
1986	0.0416	0.0395	0.0406	0.0453
1987	0.0417	0.0393	0.0408	0.0457
1988	0.0419	0.0393	0.0412	0.0461
1989	0.0424	0.0395	0.0418	0.0467
1990	0.0428	0.0398	0.0424	0.0473
1991	0.0433	0.0401	0.0430	0.0478
1992	0.0434	0.0400	0.0433	0.0482
1993	0.0433	0.0395	0.0433	0.0484
1994	0.0432	0.0391	0.0433	0.0487
1995	0.0432	0.0387	0.0434	0.0489
1996	0.0432	0.0385	0.0435	0.0492
1997	0.0433	0.0384	0.0437	0.0495
1998	0.0433	0.0383	0.0438	0.0496
1999	0.0432	0.0380	0.0437	0.0497
2000	0.0433	0.0381	0.0438	0.0498
2001	0.0434	0.0382	0.0438	0.0498
2002	0.0434	0.0383	0.0438	0.0498
Average				
1978-1990	0.0412	0.0396	0.0400	0.0446
1991-2002	0.0433	0.0387	0.0435	0.0491
1978-2002	0.0422	0.0392	0.0417	0.0468

Author's calculation

6.3.3. Growth in Total Factor Productivity

Table 6.6: Estimated Total Factor Productivity Growth of the Chinese Province, Municipalities and SARs

Year	Beijing	Tianjin	Shanghai	Guangdong	Hong Kong	Macau
1979	2.008	0.571	-1.602	4.832	6.717	n.a.
1980	2.111	0.897	-1.263	4.775	6.205	n.a.
1981	2.270	1.242	-0.938	4.702	5.721	n.a.
1982	2.451	1.553	-0.636	4.622	5.242	n.a.
1983	2.557	1.865	-0.327	4.565	4.779	5.314
1984	2.625	2.153	-0.024	4.501	4.325	4.943
1985	2.666	2.418	0.273	4.442	3.877	4.582
1986	2.696	2.701	0.566	4.394	3.437	4.205
1987	2.717	2.997	0.852	4.365	2.985	3.849
1988	2.755	3.294	1.140	4.324	2.538	3.486
1989	2.849	3.628	1.469	4.303	2.090	3.137
1990	2.967	3.971	1.823	4.274	1.644	2.788
1991	3.122	4.286	2.197	4.254	1.206	2.412
1992	3.287	4.589	2.551	4.170	0.758	2.009
1993	3.386	4.900	2.889	4.038	0.329	1.626
1994	3.482	5.198	3.172	3.923	-0.107	1.271
1995	3.506	5.495	3.447	3.827	-0.544	0.961
1996	3.569	5.790	3.729	3.764	-0.969	0.697
1997	3.648	6.092	4.045	3.724	-1.409	0.407
1998	3.709	6.382	4.386	3.684	-1.832	0.142
1999	3.803	6.625	4.671	3.631	-2.226	-0.115
2000	3.902	6.931	5.047	3.611	-2.623	-0.355
2001	4.003	7.252	5.439	3.594	-3.017	-0.574
2002	4.192	7.555	5.844	3.567	-3.399	-0.814
Average						
1979-1990	2.556	2.274	0.111	4.508	4.130	4.038
1991-2002	3.634	5.925	3.951	3.816	-1.153	0.639
1978-2002	3.095	4.099	2.031	4.162	1.489	1.998

Author's calculation.

Table 6.7: Estimated Total Factor Productivity Growth of Mainland China on the Regional Level

Year	National Average	Average of Coastal Provinces	Average of Central Provinces	Average of Western Provinces
1979	3.680	3.168	3.170	4.874
1980	3.756	3.276	3.272	4.881
1981	3.845	3.396	3.389	4.902
1982	3.913	3.490	3.481	4.907
1983	3.976	3.591	3.555	4.910
1984	4.014	3.663	3.610	4.886
1985	4.035	3.717	3.653	4.840
1986	4.065	3.773	3.706	4.814
1987	4.102	3.835	3.766	4.794
1988	4.150	3.910	3.838	4.784
1989	4.224	4.017	3.935	4.789
1990	4.300	4.128	4.036	4.794
1991	4.371	4.236	4.127	4.796
1992	4.413	4.304	4.194	4.779
1993	4.432	4.341	4.233	4.753
1994	4.450	4.376	4.272	4.727
1995	4.474	4.420	4.321	4.700
1996	4.508	4.484	4.369	4.680
1997	4.547	4.557	4.423	4.657
1998	4.576	4.628	4.469	4.615
1999	4.598	4.686	4.501	4.577
2000	4.635	4.775	4.545	4.538
2001	4.672	4.869	4.588	4.495
2002	4.710	4.969	4.628	4.447
Average				
1978-1990	4.005	3.664	3.618	4.848
1991-2002	4.532	4.554	4.389	4.647
1978-2002	4.269	4.109	4.003	4.747

Author's calculation.

The estimated total factor productivity growth, which is the sum of change in technical efficiency and technological progress, are exhibited in Tables 6.6 and 6.7. As shown in Table 6.6, the TFP growth rate for the 3 municipalities expresses an increasing trend throughout the post-reform period. The total factor productivity levels of these economies have been growing at an increasing rate. In contrast, a declining trend is observed for Guangdong, which indicates that its productivity level has been growing at a declining rate since the TP of the province is low. In light of Hong Kong and Macau, their TFP growth rates have been declining continuously due to the contractions in both changes in

TE and TP, and have gradually become negative with contractions in total factor productivity levels since the late 90s. In 2002, the estimated TFP growth of Tianjin was 7.56% which ranked second in Mainland China after Tibet's 9.49%. The TFP growth for Beijing, Shanghai and Guangdong were 4.19%, 5.84% and 3.57% respectively in the same year. All of these Chinese economies had higher TFP growth rates than Hong Kong and Macau which stayed at -3.40% and -0.81% respectively.

As for the TFP growth of the whole country, as stated in Table 6.7, the TFP growth rate has been increasing from 3.68% in 1979 by more than 1 percentage point to 4.71% in 2002. Cooperating with the statistics in Tables 6.3 and 6.5, it is apparent that in the early reform period, a large extent of this growth process can be explained by technological progress which has also become the major driving force of productivity growth. It copes with the fact that the country had imported huge amounts of capital goods from abroad in the early reform period to modernize its productions. Similar pattern was also exhibited in Wu (2003) in which the TP had a deterministic role in forming the TFP growth of Mainland China on the national level. In the 90s, after a decade's importation of more advanced foreign technology, it becomes more important to make use of the available technology to produce more and better, improvement in technical efficiency has then replaced TP to be the dominant factor in the process of TFP growth. In relation to Hong Kong and Macau, the TFP contraction that has been happening recently is mainly caused by a decline in technical efficiency which could be partially explained by their unemployment and structural shift problems. The pace of efficiency deterioration has exceeded the corresponding technical progress, leading to an overall TFP contraction in these two SARs.

On the regional level, the coastal and central regions of Mainland China have experienced positive TFP growth since the economic reforms. The coastal provinces which open the earliest and have the closest contacts with the external economies are those with the highest TFP growth rate. Their average TFP growth pace has accelerated from 3.17% a year in 1979 to 4.13% in 1990 and 4.97% in 2002. Although the pace of their TFP growth are not as fast as their coastal neighbours, benefited from the reforms and probably their adjacent position with the coastal region, the central provinces could have managed to expand their annual TFP growth rate from 3.17% in 1979 to 4.04% in 1990 and 4.63% in 2002. Although their TFP growth rate were the highest in the country at the beginning of the reforms, as most of the attentions have been paid to the coastal region, the TFP growth pace for the remote western provinces have been declining slightly from 4.87% in 1979 to 4.79% in 1990 and 4.45% in 2002. Despite the variations in the development pattern, the TFP growth differentials for the Chinese regions are still small, at only 0.34% and 0.52% between the coastal and its central and western neighbours. Given this small TFP growth gap, the deviations in economic growth rate between the three geographical regions would be attributed to the differences in input growth.

6.4. Convergence in Technical Efficiency, Technological Progress and Total Factor Productivity

As shown in the previous section, the TFP growth pace of Mainland China has been accelerating in line with the economic reforms. Simultaneously, the rate of productivity growth for Hong Kong and Macau has been deteriorating since the early 80s, and has become negative in the recent years due to recession. Given this development pattern, the disparity in the pace of productivity growth between Mainland China and its SARs should have therefore narrowed, and the growth pace of Mainland China may have already surpassed that of Hong Kong's and Macau's.

Taking Hong Kong as an example, as shown in Table 6.8, the territory's TFP growth rate was still higher than that of the three Chinese regions as well as the national average by 2 to 4 percentage points in the early 80s. Among all the Chinese economies, the western region was one of those with the smallest gap and it was recorded at 1.84 percentage points in 1979. Following the economic reforms, the TFP of the Chinese regions has experienced a higher growth rate than that of Hong Kong's. For this reason, their TFP growth gap have been narrowing. The continuous acceleration in TFP growth has also allowed the Chinese regions to catch up and out-perform Hong Kong in terms of productivity.

Table 6.8: TFP Growth Differential with Hong Kong, percentage point

Year/Region	Coastal Average	Central Average	Western Average	Guangdong	National Average
1979	-3.549	-3.547	-1.843	-1.885	-3.037
1980	-2.928	-2.933	-1.324	-1.430	-2.448
1981	-2.325	-2.332	-0.819	-1.019	-1.876
1982	-1.752	-1.760	-0.334	-0.620	-1.329
1983	-1.188	-1.224	0.130	-0.214	-0.803
1984	-0.662	-0.715	0.560	0.175	-0.311
1985	-0.160	-0.224	0.963	0.565	0.158
1986	0.336	0.269	1.377	0.957	0.628
1987	0.850	0.781	1.809	1.380	1.117
1988	1.372	1.300	2.246	1.786	1.612
1989	1.926	1.845	2.699	2.212	2.134
1990	2.484	2.392	3.150	2.630	2.656
1991	3.030	2.921	3.590	3.048	3.165
1992	3.546	3.436	4.021	3.412	3.655
1993	4.012	3.904	4.424	3.709	4.103
1994	4.484	4.379	4.834	4.030	4.557
1995	4.964	4.865	5.244	4.371	5.018
1996	5.453	5.338	5.648	4.733	5.477
1997	5.966	5.832	6.066	5.133	5.956
1998	6.460	6.301	6.447	5.516	6.408
1999	6.913	6.728	6.804	5.857	6.825
2000	7.398	7.168	7.161	6.234	7.258
2001	7.886	7.605	7.512	6.611	7.689
2002	8.367	8.026	7.846	6.966	8.109

Author's calculation. TFP growth gap is calculated as the TFP growth rate of the Chinese region minus that of Hong Kong.

In 2002, the TFP growth rate of the coastal provinces is 8.37 percentage points higher than that of Hong Kong's. In light of Guangdong, its TFP growth pace is 6.97 percentage points ahead of Hong Kong. As for the national average, its TFP growth rate has exceeded that of Hong Kong's by 8.11 percentage points in 2002. Economies on the Mainland side have taken advantage of their backwardness and are able to improve significantly their efficiency and technologies in line with the implementation and deepening of the economic reforms. In contrast, after the northward relocation of their factories, Hong Kong and Macau have lost their traditional growth engines since the early 90s. In the restructuring process, the efficiency, technological progress and productivity level of the

SARs have deteriorated and are out-performed by the Chinese provinces and municipalities.

Table 6.9: Coefficient of Variation between Mainland China, Hong Kong and Macau

Year	CV on Technical Efficiency	CV on Technological Progress	CV on Total Factor Productivity
1979	0.156	0.222	0.610
1980	0.131	0.217	0.565
1981	0.108	0.215	0.520
1982	0.088	0.211	0.482
1983	0.070	0.204	0.439
1984	0.056	0.201	0.408
1985	0.046	0.197	0.381
1986	0.040	0.191	0.354
1987	0.038	0.189	0.333
1988	0.040	0.189	0.316
1989	0.043	0.190	0.301
1990	0.046	0.189	0.290
1991	0.049	0.187	0.285
1992	0.051	0.185	0.288
1993	0.052	0.184	0.298
1994	0.052	0.185	0.313
1995	0.053	0.187	0.332
1996	0.053	0.188	0.354
1997	0.054	0.189	0.380
1998	0.056	0.190	0.407
1999	0.061	0.191	0.434
2000	0.067	0.191	0.463
2001	0.077	0.190	0.493
2002	0.088	0.188	0.524

The CVs cover all the Chinese municipalities and provinces, Hong Kong and Macau with 30 sampling economies, with Chongqing being excluded from the sample. Macau is covered in the estimation since 1982.

6.4.1. δ-convergence

To further discuss the spatial pattern of efficiency improvement, technological progress and productivity growth, the coefficient of variation, CV, on TE, TP and TFP growth are calculated with an objective to examine whether there is a growing disparity between the Chinese municipalities and provinces, Hong Kong and Macau. Similar analyses have been conducted in Gouyette and Perelman (1997) and Carree, Klomp and Thurik (2000) to measure the disparity in TFP and labour productivity between different OECD member states. In Tong and Chan (2003), CV was applied to measure the inequality in technical efficiency level of the TVEs in different geographical regions of Mainland China. In Miller and Upadhyay (2002), the authors have calculated the standard deviation of TFP in order to test if there was any δ-convergence between a group of developing and developed countries.

In light of the TE, as reflected in Table 6.9, δ-convergence is found since the beginning of the economic reforms until the late 80s, and the associated CV has been declining from 0.156 in 1979 to 0.038 in 1987. This pattern could probably be explained by the rural reforms of Mainland China which might have improved the efficiency level of the agricultural provinces. Consequently, the overall efficiency gap has been narrowed. The full scale enterprises reforms since the early 90s might have widened the efficiency gap between the agricultural- and industrial-based provinces. Furthermore, the structural adjustments in Hong Kong and Macau in the period have hindered their efficiency improvement, leading to a continuous enlargement in CV between Mainland China and the SARs with respect to TE, implying δ-divergence in efficiency's performance. In 2002, the CV on TE has increased to 0.77, which was very close to the level of the early 80s.

The CV on TP has been declining from 0.222 in 1979 to 0.190 in 2002. It implies that the economies on the Mainland side are able to have access to newer and better production technology similar to those of Hong Kong and Macau in the post-reform period, after the liberalization of trade and FDI transactions. Then the extent of technological progress experienced by the Chinese provinces and municipalities, Hong Kong and Macau has become more similar during the reform period. For this reason, the sizes of the CVs are declining and there is a tendency of δ-convergence on technological progress. The relatively stable pattern of these indices implies that new technology does not come to any individual economy all of a sudden, but goes through a lengthy learning process. Comparing with the variation index on TE, the value of CV on TP is much bigger in size.

It implies that disparity[91] with respect to technological progress still persisted across the Greater China economies.

When the CV on TFP growth is considered, a U-shaped pattern is found to characterize its evolution and it can be explained by the discipline of the CV on TE, which declines in the early reform period but increases again since the 90s. The difference in TFP growth rate between the Chinese provinces and municipalities, Hong Kong and Macau has been declining until the 90s. It has resulted in a contraction in CV from 0.610 in 1979 to a trough of 0.285 in 1991 to achieve δ-convergence. After a decade of TFP growth convergence, an enlargement is observed in TFP growth differentials and since then, the CV increases again to a record high level of 0.493 in 2002. Such development record can be regarded as a process of δ-divergence. As discussed above, this pattern matches the stages of the economic reforms in Mainland China in which the relatively poorer agricultural provinces can improve their efficiency and productivity during the rural reforms to catch up with the industrial provinces and the SARs in the 80s. Nevertheless, the urban reforms in the 90s, which have benefited the industrial provinces the most, tend to enlarge once again the efficiency and productivity gap, and δ-divergence is then resulted between Mainland China, Hong Kong and Macau.

6.4.2. β-convergence

The discussion on the coefficient of variation suggests δ-convergence with respect to TE and TFP in the early reform period, and δ-divergence in the 90s following an expansion in the value of the CVs. Meanwhile, the TP has carried a stable declining trend throughout the whole reform period to reach δ-convergence. After estimating the trends for the actual efficiency, technology and productivity gap between Mainland China, Hong Kong and Macau, the issue of β-convergence is addressed to examine if the initially poorly-performed economies could have a higher growth rate with respect to TFP than the initially well-performed economies. In Gumbau-Albert (2000), to test the catching-up

[91] For example, in 2002, a 1.87% TP is observed in Hong Kong, while Tibet can enjoy a 6.4% TP. For this reason, the value of the CV on TP is larger than that of TE, despite its relatively stable pattern over time.

phenomenon across different Spanish regions, TFP growth was regressed on initial labour productivity. The panel data analysis then indicated a statistically significant and negative estimated coefficient and it implied β-convergence in TFP in which an economy with lower initial productivity could have a higher productivity growth rate. In the study of Miller and Upadhyay (2002), the convergence issue was tested by adopting the conventional approach introduced in Baumol (1986), Barro (1991) and Mankiw, Romer and Weil (1992), etc. In practice, the TFP growth was regressed on its initial level with an intention to test the presence of β-convergence between a couple of developing and developed countries. The panel data approach with fixed effect has been employed in the estimation and the results suggested both absolute and conditional convergence, and countries with lower initial productivity level tended to have a higher productivity growth rate.

In Gouyette and Perelman (1997), since the stochastic frontier approach was the method adopted to measure total factor productivity, therefore, only the TFP growth rate and its components were estimated, while the initial TFP level was not available. To test for β-convergence, the initial efficiency level, TE, was considered as an explanatory variable to replace the initial TFP level. If a higher TFP growth rate was associated with a lower initial efficiency level, then it could be viewed as an evidence to support β-convergence in productivity. Apart from the initial efficiency level, an additional variable - the growth rate of the capital to labour ratio was also inserted into the estimation as an explanatory variable. The estimation result displayed a negative and statistically significant correlation between TFP growth and the initial efficiency level for 13 OECD countries and it suggested β-convergence in TFP. Apart from this, the TFP growth rate was also found to have a direct relationship with the capital to labour ratio.

The convergence test on TFP conducted here follows the approach applied in Gouyette and Perelman (1997). In order to examine the hypothesis of productivity convergence, the initial efficiency level and capital per labour are used as explanatory variables and TFP growth is estimated in the following specification:

$$TFPgrowth_{it} = \alpha_{it} + \beta_t LnTEinitial_i + \gamma_{it} Ln\frac{K_{it}}{L_{it}} + \varepsilon_{it} \qquad (6.13)$$

in which $TFPgrowth_{it}$ is the growth rate of TFP for economy i at time t, $TEinitial_i$ is the initial level of TE for economy i, $\frac{K_{it}}{L_{it}}$ is the capital per labour for economy i at time t.

In addition, an alternative regression will also be run and the initial per capita RGDP, *Yinitial* will replace the initial efficiency level as the explanatory variable to test if an initially poorer economy can have a higher TFP growth rate.

$$TFPgrowth_{it} = \eta_{it} + \lambda_t LnYinitial_i + \nu_{it} Ln\frac{K_{it}}{L_{it}} + e_{it} \qquad (6.14)$$

In order to show the correlation between trade transactions and the process of productivity convergence, the openness ratio in natural logarithm, $Lnopen_{it}$, will also be inserted into the above specifications in order to examine its role in the process of productivity convergence. In practice, the panel data approach similar to that used in the income convergence studies in the last chapter will be employed and the sampling period of 1978 to 2002 will be divided into 5 sub-periods of 5 years in each group. The average growth rate of TFP in each sub-period will then be regressed on the initial efficiency or income level of the period, together with the average capital to labour and openness ratio of the period. The estimation results of all the sub-periods will then be pooled together for the final results.

Table 6.10: Results of β-convergence Test on TFP with Initial Efficiency Level

Explanatory Variables	Estimated Coefficients		
Sample	Greater China		
Intercept	0.381 (0.68)	2.682 (2.95)	2.445 (1.63)
TEinitial$_i$	-10.963 (-6.85)	-10.944 (-7.03)	-10.919 (-6.72)
$\frac{K_{it}}{L_{it}}$		-0.304 (-3.16)	-0.278 (-1.84)
Openness$_{it}$			-0.0143 (-0.103)
Adjusted R^2	0.23	0.27	0.24
Sample	Coastal Provinces, Hong Kong and Macau		
Intercept	-0.0216 (-0.023)	3.276 (2.28)	4.991 (2.09)
TEinitial$_i$	-11.120 (-4.21)	-10.291 (-4.08)	-10.363 (-3.83)
$\frac{K_{it}}{L_{it}}$		-0.376 (-2.90)	-0.545 (-2.31)
Openness$_{it}$			0.323 (1.02)
Adjusted R^2	0.20	0.28	0.23
Sample	Central Provinces, Hong Kong and Macau		
Intercept	0.188 (0.17)	3.953 (2.99)	8.946 (2.88)
TEinitial$_i$	-10.223 (-3.22)	-10.198 (-3.66)	-9.632 (-3.51)
$\frac{K_{it}}{L_{it}}$		-0.481 (-4.09)	-0.929 (-3.34)
Openness$_{it}$			0.532 (1.77)
Adjusted R^2	0.15	0.35	0.37
Sample	Western Provinces, Hong Kong and Macau		
Intercept	0.809 (0.74)	5.606 (3.68)	7.235 (1.93)
TEinitial$_i$	-10.227 (-3.27)	-10.151 (-3.70)	-10.265 (-3.62)
$\frac{K_{it}}{L_{it}}$		-0.608 (-4.05)	-0.764 (-2.13)
Openness$_{it}$			0.179

			(0.47)
Adjusted R^2	0.15	0.35	0.34

Dependent variable is the growth rate of TFP, t-statistics in parenthesis.

Table 6.11: Results of β-convergence Test on TFP with Initial per capita RGDP level

Explanatory Variables	Estimated Coefficients		
Sample	Greater China		
Intercept	6.975 (10.57)	3.742 (4.37)	6.788 (5.06)
$Yinitial_i$	-0.483 (-4.42)	-2.359 (-6.48)	-3.180 (-7.99)
$\frac{K_{it}}{L_{it}}$		1.903 (5.36)	2.296 (6.53)
$Openness_{it}$			0.520 (3.52)
Adjusted R^2	0.11	0.24	0.31
Sample	Coastal Provinces, Hong Kong and Macau		
Intercept	7.402 (7.52)	5.141 (4.17)	5.810 (2.51)
$Yinitial_i$	-0.554 (-3.76)	-2.459 (-3.56)	-2.716 (-3.85)
$\frac{K_{it}}{L_{it}}$		1.835 (2.82)	1.993 (2.88)
$Openness_{it}$			0.266 (0.84)
Adjusted R^2	0.16	0.24	0.23
Sample	Central Provinces, Hong Kong and Macau		
Intercept	6.681 (8.02)	6.360 (3.99)	13.227 (4.29)
$Yinitial_i$	-0.491 (-3.80)	-0.678 (-0.85)	-1.476 (-1.80)
$\frac{K_{it}}{L_{it}}$		0.191 (0.24)	0.229 (0.30)
$Openness_{it}$			0.893 (2.56)
Adjusted R^2	0.20	0.19	0.27
Sample	Western Provinces, Hong Kong and Macau		
Intercept	8.491 (8.93)	4.311 (2.56)	11.199 (3.23)
$Yinitial_i$	-0.697 (-4.61)	-2.472 (-3.96)	-3.166 (-4.64)

$\frac{K_{it}}{L_{it}}$		1.904 (2.92)	1.847 (2.89)
$Openness_{it}$			0.902 (2.24)
Adjusted R^2	0.28	0.37	0.42

Dependent variable is the growth rate of TFP, t-statistics in parenthesis.

Absolute Productivity Convergence

The results of the β-convergence tests on TFP are exhibited in Tables 6.10 and 6.11. In the model with initial efficiency, there are evidences to support unconditional productivity convergence in the post-reform period on the Greater China level, as well as on the regional levels. The initial technical efficiency level is found to be strongly significant in all the estimations. Its negative sign depicts that the initially less efficient economies would have bigger rooms for improvement. They can take advantage of their "backwardness" and tend to attain a higher TFP growth rate than the initially more efficient ones. Consequently, the Chinese provinces and municipalities or different geographical regions of Mainland China can manage to achieve absolute productivity convergence with Hong Kong and Macau. This result is consistent with the convergence conclusion made in Bernard and Jones (1996) Carree, Klomp and Thurik (2000), Miller and Upadhyay (2002), Gouyette and Perelman (1997) in which the first three of these articles have regressed the TFP growth rate on its initial level, while the last one has employed initial efficiency as the explanatory variable. In Table 6.11 in which the initial per capita RGDP is utilized, it has a negative and significant correlation with the TFP growth pace on all the levels, except for the central region. The estimation results indicate that the initially poorer economies, which could be lack of capital input with poorer endowments, could find it easier to improve themselves and tend to have a higher rate of productivity growth, leading to unconditional productivity convergence.

Conditional Productivity Convergence

Conditional convergence on TFP between Mainland China, Hong Kong and Macau is already expected, given absolute TFP convergence, tests are still organized to address the role of the additional determinants, such as capital per labour and openness ratio in the process of productivity convergence. As reported in columns 3 and 4 of Table 6.10, the capital per labour is a significant determinant on all the levels, and has contributed to accelerate the pace of productivity convergence. Its negative estimation coefficients implied that a capital abundant economy tend to have a lower TFP growth rate and *vice-versa*. This pattern can be explained by the diminishing returns on capital. Economies with more capital relative to their work force are likely to have a lower capital productivity or lower returns on capital, which may discount their total factor productivity growth. The openness ratio is an insignificant dependent variable in Table 6.10. Perhaps the influence of the openness ratio has been partially reflected by the initial efficiency level, then this ratio becomes insignificant in the estimation given the presence of initial efficiency level.

Conditional productivity convergence is also observed in Table 6.11 on all the levels. Given initial per capita RGDP in the estimation, the capital per labour is statistically significant on all the levels, except for the central region in which the multicollinearity problem is serious and conditional convergence is rejected. Unlike the previous estimations, a positive sign is associated with this ratio. This finding shows that given a lower initial income level, a higher capital per labour provides additional stimulus to speed up the productivity growth of the economy, and eventually accelerate the pace of TFP convergence.

When the openness ratio is considered, it is statistically significant with a positive sign in all the estimations, except for the coastal region. It suggests that in line with the expansion in trade transactions, the growth pace of total factor productivity tends to accelerate. Economies with lower initial income but more capital per labour and higher trade volume can have higher productivity growth pace and could catch up faster with the initially well-performed economies. It further infers that economic integration and the subsequent development in trade has contributed to accelerate productivity convergence, although this catching-up process would have happened even without taking trade turnovers into account.

6.5. Chapter Summary

6.5.1. The Findings from the Descriptive Analysis

The stochastic frontier approach is employed and the TFP growth of Mainland China, Hong Kong and Macau are estimated based on the translog production function. For this measurement method, the best possible output would be used as the standard of comparison and its difference with the actual output indicates TE. When the best possible output grows overtime, then it suggests TP. The sum of changes in TE and TP indicates the estimated TFP growth rate.

By applying this method, the TE, TP and TFP growth of Mainland China, Hong Kong and Macau have been estimated. The TE of Beijing, Tianjin and Shanghai stayed at 0.695, 0.833 and 0.702 in 2002, that is, the actual output was around 70%, 83% and 70% of the best possible output respectively. The TE of Guangdong was 0.745, the national average recorded at 0.726, while that of Hong Kong and Macau were 0.586 and 0.527 respectively. A U-shaped pattern is found for the TE of the municipalities and the national average. On the contrary, the TE of Hong Kong and Macau carries an inversed U-shape to increase in the early reform period, and decline sine the early 90s. The TE of Guangdong, meanwhile, has been increasing continuously since the beginning of the reform. It reflects the diversified impacts of the economic reforms to different economies, depending on the initial situation, geographical position and endowments of each.

In view of the TP, the differences across provinces and municipalities are moderate. The figures for Beijing, Tianjin and Shanghai were 0.0363, 0.0391 and 0.0319 in 2002 respectively. This means the best possible output of these municipalities could expand by 3.6%, 3.9% and 3.2% a year even there is no input growth in the period. The TP for Guangdong and the national average were 0.034 and 0.043, while that of Hong Kong and Macau were 0.0187 and 0.0441 in the same period. Apart from the similarity in size across different places, TP is also relatively stable over time for almost all the Chinese provinces. It implies that similar new production technology can be received in a relatively handy way by different Chinese provinces after the reforms. In addition, it would be hard for any province to experience a sudden breakthrough and expand its output by a large scale.

Then TFP growth, which is the sum of changes in TE and TP, is measured. The TFP growth for Beijing, Tianjin and Shanghai were 4.2%, 7.6% and 5.8% respectively in 2002. The performance for Guangdong and the national average were 3.6% and 4.7%, and that of Hong Kong and Macau were -3.4% and -0.8%. The development pattern of the TFP growth suggests that all the Chinese provinces and municipalities are able to improve continuously their productivity level in the post-reform period due to the open door and liberalization policies. The increasing pace of TFP growth for the municipalities and the national average in recent years can be explained by the improved TP. In light of Guangdong, its TFP has been increasing at a decreasing speed due to the slow progress in efficiency and productivity improvement in recent years. The structural adjustments of Hong Kong and Macau since the early 90s and the adverse external shocks have dampened their growth prospects to bring about economic slump and recession to them. The recession-led deterioration in efficiency and sluggish improvement in technology altogether have resulted in a negative TFP growth in the late 90s.

6.5.2. The Findings from the Parametric Analysis

The studies on δ-convergence have found evidence to support δ-convergence for technical efficiency in the early reform period when the CV declines continuously since the beginning of the reforms until the late 80s. Since the 90s, the convergence process of TE has stopped and an increased dispersion or δ-divergence is found. This pattern is probably attributed to the reforms-led continuous efficiency improvement which allowed some provinces to catch up with the others on efficiency level in the 80s. Then they out-performed the others in the 90s to bring about divergence since the 90s. Such development pattern has offset the convergence trend of technological progress, which is found throughout the reform period due to the transition of similar technology in line with development in trade and FDI activities. It has also dominated the development pattern of the TFP growth, bringing about δ-convergence and δ-divergence in the 80s and 90s respectively.

As for β-convergence on TFP, absolute β-convergence is found between Mainland China, Hong Kong and Macau in the post-reform period. It is believed that the economies on the Mainland side which have relative inferior initial conditions in terms of efficiency and income level, can benefit from their relative backwardness to achieve a more rapid productivity growth. These economies are then able to catch up with the initially well-performed or richer economies with respect to total factor productivity. This productivity convergence process is so strong that it not only has narrowed the productivity dispersion between the members in the Greater China to bring about δ-convergence with respect to TE, TP and TFP growth in the early 80s, but has also led to δ-divergence in TE and TFP growth in the 90s, given the much faster pace of efficiency and productivity improvement on the Mainland side.

Given absolute convergence, conditional β-convergence on TFP between Mainland China, Hong Kong and Macau is also found on all the levels in all the specifications. The factors of capital per labour and openness ratio have different characteristics in different specifications. Given an initial efficiency level, a higher capital per labour implies lower returns on capital or lower capital productivity, and it turns out reducing the pace of growth of TFP. The openness ratio is insignificant in the estimation due to its possible correlation with the efficiency level. In the estimations which focus on initial income level, conditional β-convergence on TFP is also detected and the capital per labour is statistically significant with a positive relation with the TFP growth since it can compensate the low initial income to accelerate productivity growth. In addition, the openness ratio in the estimations is also significant as trade could transfer knowledge and experience to bring about productivity improvement.

Given the significant openness ratio in the conditional convergence tests on TFP, it seems that economic integration has posed certain impacts on the process of productivity convergence through trade transactions. Similar linkage has already been observed between economic integration and income convergence. The statistically sound openness ratio can be viewed as an evidence to support the conventional belief of trade-led knowledge transfer and the subsequent improvement in efficiency, technology and productivity of the Chinese provinces towards the respective steady-state levels of the Greater China economies. In light of the perfect match in the timing of economic integration, income and productivity convergence between Mainland China, Hong Kong and Macau, it implies that these processes are probably connected in some ways and could be dominated by Mainland China's economic reforms and its associated policies. The economic reforms are probably the ultimate driving force of the productivity convergence process which can also explain the economic integration and income convergence process between Mainland China, Hong Kong and Macau.

Chapter 7: Conclusion, Policy Implications and the Future Prospects of Economic Integration

This research contributes to the economic literature by pooling together the economies of Mainland China, Hong Kong and Macau for the first time to assess quantitatively the degree of economic integration that they have achieved. Besides, focus has also been placed on the consequences of this economic integration on the processes of income and productivity convergence between Mainland China, Hong Kong and Macau. In addition, the linkage of these three mechanisms has also been discussed and the results are summarized in the following paragraphs.

7.1. The Economic Integration between Mainland China, Hong Kong and Macau

Both descriptive and parametric approaches have been employed to estimate the degree of economic integration between Mainland China, Hong Kong and Macau. Generally speaking, the economic cooperation between these economies are still in the form of "front shop, back factory"[92] and a complementary economic relationship can also be found between them. The degree of economic integration between Mainland China, Hong Kong and Macau is found to be the highest, relative to the achievements between Mainland China and the other economies, such as the United States, the EU and Japan.

In the descriptive analysis, similar to Jones, King and Klein (1992), Ash and Kueh (1993), Tuan and Ng (1995), Cheng and Tsang (1996), Lin (1999), Guo (1999), Wu (2000), Lin and Lin (2001) and Keng (2001), trade and investment transactions are employed as the basis of this assessment. In the study, Hong Kong is found to be one of the most important trade partners of Mainland China. A considerable portion of Mainland China's exports and imports have gone through the territory to their final destinations. After the economic reforms, Hong Kong's role as the most important entrepôt in the southern part of Mainland China has been further strengthened. This finding repeats the descriptions made

[92] Suggested in Sit (1999).

in Jones, King and Klein (1992, 1993) and Ash and Kueh (1993). In the case of the re-export activities between Mainland China and Hong Kong, a portion of these transactions are generated by trade involving outward-processing activities between them in which some production steps are completed in Mainland China for cost saving purpose and the semi-finished goods will be transported back to Hong Kong for further processing and exports. These outward-processing activities, as suggested in Dale (1997), are the driving force of the integration process between Mainland China and Hong Kong. In addition, Mainland China is also the largest supplier of importing products for both Hong Kong and Macau. Restricted by its limited economic scale and infrastructure, re-export activities are underdeveloped in Macau. Instead, the territory serves as a place for leisure and vacation in the region. On the provincial level, a tight trade relationship is observed between Guangdong, Hong Kong and Macau. The province has a dominant role in Mainland China in accommodating and facilitating trade activities with Hong Kong and Macau. In view of the numerical measurement, similar to Dale (1997), the trade intensity index indicates that both Hong Kong and Macau have intensive trade relationships with Mainland China, with a disproportionately high trade share with the country. The index was measured at 8.35 and 7.00 for Hong Kong and Macau in 2002 which was significantly higher than the US's 0.96 or Japan's 2.75. The declining trend of these indices, on the other hand, shows that Mainland China has been diversifying its market and the SARs have started to lose their magnitude in Mainland China's trade account. The trade complementarity index, which was 0.91/0.54 and 0.68/0.30 for Hong Kong and Macau in 2002, reveals that the trade transactions between Mainland China, Hong Kong and Macau followed a complementary pattern. It suggests that these economies can exercise their comparative advantages in the process of trade.

Apart from the tight trade relationship, statistics suggest that Hong Kong is also the most important source of FDI of Mainland China, and a dominating portion of capital that the country has received is injected through the territory. In the meantime, most of these investments are absorbed by Guangdong. Nevertheless, since the mid 90s, Mainland China has had a success in attracting FDI from the other economies and consequently the importance of Hong Kong in the provision of FDI to Mainland China has been weakened.

In light of the inward FDI of Hong Kong, Mainland China has already become the 3rd largest investor of the territory after the handover and is also the largest investor after those off-shore financial centers. On the regional level, extensive development in both trade and FDI transactions are also found between Guangdong and Hong Kong. As for Macau, its limited economic strength has restricted the development of the territory's investment in Mainland China. However, direct investment in both directions, for example, Macau's investment in Mainland China and Mainland China's investment in Macau have been developing since the economic reforms and intensified after the handover. In light of the human flows, Mainland China is the most popular destination for Hong Kong visitors, and the country has also become the most important market for the tourist sector of both Hong Kong and Macau. Furthermore, there are immigrants from Mainland China moving to both Hong Kong and Macau and the social contacts between these economies are intensive since the economic reforms. In light of the achievement on trade, capital and human contacts, according to Lin and Lin (2001), these linkages can already be regarded as evidences of economic integration between Mainland China, Hong Kong and Macau.

In the quantitative analysis, the correlation matrices, which have been used in Yao (1996) and Lin (2001), depicted that the per capita RGDP of Mainland China, its geographical regions, Guangdong, Hong Kong and Macau are closely connected even in the pre-reform period. Such linkage have further tightened in the post-reform period and the correlation coefficient has arrived to 0.93 and 0.94 for the Mainland China-Hong Kong and Guangdong-Hong Kong pair for the period of 1978 to 2002. The income correlation between Guangdong and Hong Kong is also found to be the most intimate one among all the Chinese provinces and regions. This analysis result suggests that the business cycles of Mainland China, Hong Kong and Macau on both national and regional levels tend to comove and synchronize in the post-reform period. According to Caporale, Pittis and Prodromidis (1999), cointegrated output levels implied economic integration. For this reason, the Johansen Cointegration Test is employed to assess whether the per capita RGDP levels of Mainland China, Hong Kong and Macau are cointegrated with an associating or long-term equilibrium relationship between them. The investigation has rejected the presence of cointegration on the multivariate basis between Mainland China, Hong Kong and Macau, but displays cointegration on the bivariate basis between Mainland China-Hong Kong and Mainland China-Macau since the 90s. On the regional level, Guangdong's per capita income is also found to cointegrate with that of Hong Kong and Macau. The estimation exhibits a direct and significant correlation between the per capita incomes of these economies. On top of the cointegrating relationship, the VECM is adopted to estimate the short-run dynamic and the causality between these income factors. The income levels of Mainland China, Guangdong and Macau, as shown in the estimations, would respond to temporary shocks to adjust until they return to their long-run equilibrium. Besides, a series of one-way causality, for example, Hong Kong's income causing that of Guangdong, Mainland China's income causing that of Macau, and Guangdong's income causing that of Macau are discovered. Given the long-run equilibrium relationship on income levels, the short-run dynamics and causality, the closely correlated income levels, together with the high trade intensity, the complementary trading relationship and the continuous expansion in capital and human flows between Mainland China and the SARs, all these evidences suggest that since the 90s, a high degree of economic integration has been achieved between Mainland China, Hong Kong and Macau on both the Greater China and regional levels.

As equilibrium relationship with respect to per capita income is established between Mainland China, Hong Kong and Macau, the income levels of these economies are linked together and the income gap between them tends to stabilize. Over time, the income levels of these economies will even have a tendency to converge, and a lower income gap would be found when the degree of integration deepens. In order to prove this hypothesis, a study on income disparity between Mainland China, Hong Kong and Macau is formulated to address this issue.

7.2. Income Convergence between Mainland China, Hong Kong and Macau

In Karras (1997) and Ben-David (1996, 2001), evidences have been found to support the connection between trade development and income convergence. In these articles, in the cases of the EU(6), the United States and Canada, the income disparity between trade partners has been declining in line with the expansion in export and import transactions. Such kind of correlation, however, was not found in the ASEAN. As economic integration has been taking place between Mainland China, Hong Kong and Macau, if income convergence is also found to be undergoing in these economies, then it can be regarded as an additional evidence to support the linkage between integration, trade development and income convergence; while income convergence can also be viewed as the consequence of economic integration. In practice, both descriptive and parametric approaches have been employed to address the issue of income convergence between Mainland China, Hong Kong and Macau, especially in the post-reform period after the occurrence of economic integration. In the descriptive analysis on income ratios, it is observed that the income gap between Mainland China, Hong Kong and Macau was enormous in the pre-reform period, but has been declining rapidly on all the levels after the reforms. It suggests that the income gap has been narrowing in the post-reform period, especially after the 90s. The analysis also depicts that the coastal region tends to have a smaller income gap with the SARs than the other geographical regions of Mainland China. Simultaneously, the municipalities in the coastal region, such as Beijing, Tianjin and Shanghai seem to have a even smaller income gap with the SARs than the other coastal provinces. When the internal disparity problem between the three Chinese regions is focused, it was found worsened since the economic reforms and an enlarged income gap is found between the coastal and western regions of Mainland China.

Afterwards, income convergence is examined following the methods as applied in Baumol (1986), Mankiw, Romer and Weil (1992), Chen and Fleisher (1996), Jian, Sachs and Warner (1996), Gundlach (1997), Raiser (1998), Zhang (2001) and Yao and Zhang (2001a, 2001b), etc. Regressions have been run to examine if there is any absolute or conditional β-convergence with respect to the income levels of Mainland China, Hong Kong and Macau. The results indicate absolute or unconditional β-convergence in both the cross-sectional and pooled analyses. The initially poorer Chinese provinces are found to have a higher growth rate than the initially richer Hong Kong and Macau economies. These Chinese economies are also able to catch up with the SARs to narrow the income gap between them. This process of income convergence is found to initiate since 1978, intensified since 1990 and has then been happening in all the geographical regions of the country, including the coastal, central and western regions. The coastal region, meanwhile, could manage to start its convergence process in 1978 which is a decade earlier than the other regions. In the studies on conditional convergence, additional explanatory variables, for example, investment ratio, effective population growth rate, secondary sector's output ratio, openness ratio and FDI to GDP ratio are inserted into the estimations. These factors did not reshape the previous findings on income convergence. That is, the income convergence process between Mainland China, Hong Kong and Macau has been on its way since the economic reforms, regardless of the presence of additional variables. These factors, however, have contributed to improve the explanatory power of the estimations, as well as to accelerate the pace of income convergence or the speed of the catching-up process. The openness ratio, for example, is statistically significant in most of the sub-periods on all the levels, and have a direct relationship with the per capita RGDP. This result confirms the constructive role that trade activities have played, implies that the development in international trade has induced the economic growth and catching-up process of Mainland China. When the FDI to GDP ratio is used to replace the openness ratio, this factor is also found to be statistically significant with a positive sign. It indicates that apart from international trade, FDI, which is correlated with trade, can also speed up the economic growth and income convergence process of the country. For example, in the panel data analysis, the openness ratio has contributed to accelerate income convergence between Mainland China, Hong Kong and Macau from 0.54% a year to 1.7% a year for the period of 1978 to 2002. This evidence suggests that trade transactions, which is one of the driving forces of the economic integration process between Mainland China, Hong Kong and Macau, is not the factor that initiated the income convergence process (given absolute income convergence), but it has contributed to accelerate the pace of convergence.

When the issue of income convergence within Mainland China is considered, the estimation results do not reveal any tendency of absolute income convergence across the whole country in both the pre-and post-reform periods. In contrast, given the openness ratio in the estimations, conditional income convergence is observed within each of the geographical regions after the economic reforms. This result reveals the role of trade in the process of growth, suggesting the formation of growth clubs in Mainland China in which the dispersion of income within each club has been declining. The disparity problem between different growth clubs, on the other hand, tends to deteriorate, especially after the 90s. This finding is consistent with the conclusion of "club divergence" as made in Yao and Zhang (2001a).

In addition to the convergence analyses in which regressions in cross-sectional and panel data methods have been employed, the issue of stochastic convergence has also been addressed. The result obtained from the cointegration test has rejected stochastic convergence between Mainland China, Hong Kong and Macau, given Bernard and Durlauf (1995)'s definition. Utilizing the ADF test, an alternative method which was adopted in Karras (1997), Ben-David (1997, 2001), Yao, Newbery and Pedroni (2000), Zhang, Liu and Yao (2001) and Yao and Zhang (2001a) has been employed to test for stochastic convergence. In practice, the statistical property of the bilateral income ratios between Mainland China, Hong Kong and Macau is examined. The ADF test suggests the presence of a unit root in these data series, and it shows that these relative income levels are non-stationary. This result once again implied that Mainland China together with its SARs have failed to achieve stochastic convergence on per capita RGDP, despite the necessary condition of β-convergence has been fulfilled. Nevertheless, the statistically significant and negative trend in the ADF test exhibits a declining pattern for the income ratios between Mainland China, Hong Kong and Macau, showing a tendency of further contraction in the income ratios and a likeliness of income convergence in the long-run.

In view of the test of δ-convergence, the coefficient of variation with respect to per capita RGDP in different groupings is measured. The declining trend of this index indicates δ-convergence, suggests that as a consequence of β-convergence and the associated catching-up process, the income dispersion between Mainland China, Hong Kong and Macau has been declining since the economic reforms. Apart from δ-convergence on the

Greater China level, δ-convergence is also observed on the regional level between each of the geographical regions and the SARs due to the ongoing β-convergence process.

To reduce the income disparity between Mainland China, Hong Kong and Macau, the Chinese government could consider speeding up the industrialization process of the country. It is because the secondary sector's output ratio is found to be negatively related to the income gap (income ratio) between Mainland China and Hong Kong. In addition, developing trade or attracting incoming FDI and promoting investment are also regarded as effective ways of reducing the income gap between these economies.

7.3. Convergence in Total Factor Productivity between Mainland China, Hong Kong and Macau

In the post-reform period, the initially poorer Chinese economies are able to grow at a faster pace and catch up with the initially richer Hong Kong and Macau economies in terms of per capita RGDP. Consequently, the income dispersion between these economies is getting smaller. In order to understand if the satisfactory growth rate of Mainland China is attributed to an increase in inputs, improvement in efficiency or advancement in production technology, the total factor productivity of Mainland China, Hong Kong and Macau are measured, decomposed and compared. The intention is to investigate the nature and driving force of the growth process, and to understand if productivity convergence, which is a branch of convergence study as stated in Islam (1998), will take place along with income convergence. Employing the translog production function which was applied in Lau and Brada (1990), Gumbau-Albert (2000), Wu (2000b) and Wu (2003), the technical efficiency, technological progress and total factor productivity growth of all the Chinese provinces, Hong Kong and Macau have been estimated. The result indicates that in line with the economic reforms, the TFP of Mainland China has been growing with a remarkable improvement in efficiency and a significant achievement in technological progress. In 2002, the efficiency level has reached 73% for the national average, 76% for the coastal average and that of Guangdong was 75%. In light of the technological progress, a 4.3% improvement was recorded for the country as a whole, a 3.8% and 3.4% achievement were found for the coastal provinces and Guangdong respectively. As for the growth rate of TFP, in 2002, a rate of 4.7% was found for the national average, while that of the coastal provinces and Guangdong were found at 5.0% and 3.6% respectively. The rapid economic growth of Mainland China in the reform period, therefore, should have been brought about by input expansion, as well as efficiency improvement, technological progress and the resulted TFP growth. In contrast, the level of technical efficiency in Hong Kong and Macau has been declining since the 90s and were recorded at 59% and 53% in 2002. At the same time, the technological progress of Hong Kong and Macau stood at 1.9% and 4.4% respectively. The poor performance on both technical efficiency and technological progress has weakened the growth pace of Hong Kong's and Macau's TFP which were contracting at 3.4% and 0.8% respectively in 2002. Consequently, the TFP's growth pace of Mainland China has out-performed that of Hong Kong's and Macau's.

The convergence test, which is similar to Gouyette and Perelman (1997), then shows that in the post-reform period, the initially poorly performed or poorer economies are able to achieve higher TFP growth rate than the initially well-performed or richer one. Hence, absolute β-convergence with respect to TFP is attained on both the Greater China and regional levels. This finding is rather similar to the convergence conclusion made in Bernard and Jones (1996), Gouyette and Perelman (1997), Wu (2000), Carree, Klomp and Thurik (2000) and Miller and Upadhyay (2002), although these articles have employed slightly different estimation models with initial TFP level as the explanatory variable. Incorporating the finding of absolute β-convergence on income level, it can be found that the Chinese economies with lower initial income level tend to have higher income as well as total factor productivity growth rate than the initially richer Hong Kong and Macau economies. In addition, conditional convergence is also detected on the Greater China and regional levels, except for the central region. The capital per labour is found to be a significant factor in explaining the pattern of productivity growth. The openness ratio, however, is significant only in the specification with initial income level. It contributes to improve the explanatory power of the regression, accelerating the pace of productivity growth for the economies with more external transactions. This pattern is very similar to that inherited in the income convergence process.

As a consequence of β-convergence, there is continuous improvement on productivity level on the Mainland side which turns out reducing its productivity gap with Hong Kong and Macau. This catching-up process has also brought about δ-convergence in the early 80s and the CVs on TE and TFP were also declining in this period. Since the late 80s, the performance of the Chinese economies on efficiency improvement has been surpassing that of Hong Kong and Macau, and a diverging pattern is found on TE of these economies. As a result, the TFP growth rate of Mainland China has out-performed that of Hong Kong and Macau. Subsequently, there is a widening of productivity growth gap between these economies and δ-divergence in TFP growth is also observed despite the presence of β-convergence and productivity catching-up process.

Finally, a coincidence of economic integration and productivity convergence is found in the post-reforms period. Probably economic integration and the implied trade contacts have brought about skill, knowledge, technology, experience and competition to Mainland China which have contributed to improve the efficiency, technology and productivity of the country. Given the significant trade turnover, there is evidence to support the conventional belief of trade-led knowledge and experience transfer, resulting in efficiency, technology and productivity convergence between Mainland China, Hong Kong and Macau.

7.4. Economic Reforms as the Ultimate Driving Force of the Integration and Convergence Processes

The timing of the economic integration, income and productivity convergence between Mainland China, Hong Kong and Macau suggests that these processes could only take place after the introduction of the economic reforms and the launching of the open door policies. As shown in the estimation analyses, the per capita RGDP of Mainland China, Hong Kong and Macau are cointegrated only after the economic reforms since the 90s.

The income convergence process, meanwhile, initiated only after 1978 with no evidence of convergence before the economic reforms. Furthermore, before the economic reforms, the RGDP growth rate of Mainland China was much smaller than the corresponding growth pace of Hong Kong and Macau, and it implies a lower level of technical efficiency, a limited extent of technological progress as well as poorer performance in TFP growth than that of the SARs. Convergence in productivity, for this reason, would be unlikely to take place before the reforms.

The findings here suggest that the processes of economic integration, income and productivity convergence are connected in certain ways. The cointegrated income levels and the long-run equilibrium relationship, for example, tend to bring about a contraction in income dispersion between Mainland China, Hong Kong and Macau. Besides, the initially backward Chinese economies tend to achieve higher income and productivity growth altogether and it allows the country to converge its per capita income and productivity with Hong Kong and Macau. Furthermore, the integration-led expansion in external transactions has played a positive role, speeding up the two convergence processes simultaneously. Notwithstanding these connections, without the initiation of the economic reforms, Mainland China would still remain to be a relatively closed economy with negligible flow of external contacts with Hong Kong, Macau as well as the rest of the world. It would then be impossible for the country to integrate economically with the SARs given underdeveloped transactions on direct trading, re-exports, capital and human flows. In addition, given a centrally-planned system, the efficiency, technology and productivity levels of the country would be undermined and it would be hard for Mainland China to utilize its potential to achieve more rapid economic growth than Hong Kong and Macau in order to catch up with their income levels. And for the same reason, given no economic reforms, it would be difficult for Mainland China to improve its technical efficiency, upgrade its technological progress and advance its productivity level. Consequently, the country would not be able to attain a productivity growth that is high enough to out-perform or catch up with Hong Kong and Macau. For these reasons, the economic reforms and the associated open door policies should be regarded as the ultimate driving force of the integration process between Mainland China, Hong Kong and Macau. Simultaneously, the economic reforms have also brought about income and productivity convergence to these Chinese economies.

7.5. Policy Implications and the Future Prospects of the Integration and Convergence processes

As shown in the analyses, the economic reforms of Mainland China can be regarded as the most controversial event that promotes the processes of economic integration, income and productivity convergence. Extending, deepening and widening the economic reforms should then be contributive to these three processes. If there is an intention to tighten the degree of economic integration, speed up the income and productivity convergence processes between Mainland China, Hong Kong and Macau, as well as to extend these mechanisms to the world level, then emphases should be continuously placed on strengthening the market mechanism and further liberalizing the controls and restrictions persisted in the economy, particularly in the financial market, to avoid unnecessary interference which may distort the proper functioning of the market. The long-run objective of the economic reforms is perhaps to restructure the existing Socialist Market Economy so as to cope with the needs of the country on the one hand, and to accommodate the development of the country's external economic cooperation on the other. In the new phase of economic reforms, the successful open door policies should be extended in order to allow the country to form more mutually beneficial intensive economic linkages with the rest of the world. In the process, the authorities could make good use of the various experiences that it has accumulated from the country's economic cooperation with Hong Kong, Macau as well as the rest of the world. The resulted new development in trade and FDI transactions could bring about new rounds of trade- and FDI-led knowledge and skill transfers which would eventually help to upgrade the efficiency, technology and productivity levels of Mainland China. Consequently, the country would be able to sustain its remarkable growth pace and as a whole, Mainland China not only would be able to continue catching-up with Hong Kong and Macau with respect to both income and productivity levels, but will also be approaching to the world's advance level of income and productivity over the long-run.

In fact, the above mentioned strategies have been advocated by the authorities and a couple of liberalization policies in relation to external economic cooperation have been introduced. Since the beginning of this millennium, agreements have been reached between the Chinese government and different foreign economic organizations and economies. The accession of Mainland China to the WTO in December 2001, the signatory of the "Closer Economic Partnership Agreement (CEPA)" with Hong Kong and Macau in 2003, the consensus between Mainland China and the ASEAN on the construction of a free trade area in 10 years in 2004 and the formation of the Pan-Pearl River Delta (Pan-PRD) Regional Cooperation and Development Forum between 9 Chinese provinces, Hong Kong and Macau in 2004 are some of the major achievements. Amongst, the accession to the WTO is regarded as the most influential event. After its accession, Mainland China is required to comply with the WTO's principles on low tariff, trade liberalization, relieved controls on foreign investments and capital flows and exchange rate system's reform, etc. in exchange for reciprocal preferential treatments. This agreement tends to reshape the international trade order to bring about significant economic impacts to both Mainland China and the world economies. As for the consensus between Mainland China and the ASEAN on transition toward a FTA, the degree of liberalization and integration implied in this transition is much deeper than that associated in the WTO membership, despite the fact that a relatively smaller number of participants are involved. As for the regional economic cooperation, CEPA marks the introduction of a conditional free trade and investment liberalization agreement between Mainland China, Hong Kong and Macau. The Pan-PRD economic cooperation intends to provide further encouragements to stimulate the economic contacts, including trade and investment activities between Hong Kong, Macau and 9 Chinese provinces in which 2/3 of them are central or western provinces.

In light of the nature of these international and regional economic arrangements, in practice, they could be viewed as packages of liberalization policies. The implementation of these policies, on the trade side, would bring about lower or even zero tariffs, removals of discriminatory trade terms, adjustments of internal policies with trade distortion impacts and an improvement in accessibility to the Mainland China market. In relation to capital flows, the Chinese government is expected to loosen its control over capital transactions, to liberalize the restrictions on foreign investment, in particular, to allow foreign investors to increase their involvement in the banking, finance and insurance sectors. On the monetary side, the Chinese government is also obliged to continue its reforms on monetary and exchange rate policies, to eventually build up international convertibility for the RMB and to liberalize its controls on capital mobility.

The implications of these sets of policies would be an expansion in external trade, growth in incoming foreign capital and investment and perhaps more transparent and flexible monetary policies. Given a lower rate of tariff and the elimination of certain trade obstacles by the rest of the world, Mainland China could be able to expand its exports further to capture an increasing market share in the world, particularly in the area of labour-intensive industrial products where its comparative advantage lie. In the meantime, an increasing flow of imports could also find their destinations in Mainland China under the new and liberalized trade terms. Subsequently, there would be severe competition, leading to market or even economic restructuring in the country. Furthermore, given the liberalization policies on capital flows, it is expected that Mainland China would be able to attract an increasing flow of inward investment and capital, especially in the relatively closed banking and financial area. It could accelerate the improvement and development of the banking and financial sector of Mainland China, at the costs of losing dominance, governance or independence. The relatively inefficient and underdeveloped local banking and financial institutions would also suffer from the liberalization policies and face more competition pressure once foreign firms are allowed to have full operation in the Mainland China market. As a whole, major structural adjustments would take place in both the Mainland China and world economies and a change in income level is also expected. It is also believed that Mainland China could build up much closer economic linkages and connections with the other members in the economic organization to achieve a higher degree of economic integration with them. The income and productivity levels of the country would also have a tendency to catch up and approach to the level of these economies given their tightened economic connections.

In view of the implications to the economic integration, income and productivity convergence between Mainland China, Hong Kong and Macau, benefits from the country's WTO accession, the transition toward a FTA with the ASEAN and the launching of the CEPA and Pan-PRD cooperation, all these processes are expected to intensify and widen. In the case of Mainland China's accession to the WTO and the FTA transition, it could perhaps bring about indirect but significant impacts to both Hong Kong and Macau. As Mainland China is obliged to reform and liberalize its trade, capital control as well as exchange rate policies, it would gradually become more attractive and accessible, and a surge in almost all forms of external economic activities is expected. In the process, even if an increasing number of foreign traders or investors choose to do business directly with Mainland China without going through Hong Kong or Macau; Hong Kong, being a major entrepôt and a regional banking and financial centre in the southern part of Mainland China, it's role as the stepping stone of Mainland China would not be easily replaced in the near future. The territory could still be able to derive certain benefits given the huge amount of potential economic transactions that Mainland China would perform with the rest of the world. The level of economic integration between Mainland China and Hong Kong would be expanded consequently. As a major tourists' spot in the region, Macau would also be able to attract more visitors from Mainland China, Hong Kong as well as the rest of the world, given the expected economic and income growth of these economies. As for CEPA and the Pan-PRD cooperation, these involve Hong Kong and Macau directly and more liberalized terms relative to the WTO standard are prescribed in these arrangements. After the full implementation of CEPA, a limited free trade area will be built between Mainland China, Hong Kong and Macau since zero tariff is applied to a list of the SARs' domestic exports, and the SARs impose no tariff on all their imports. The arrangement then tends to strengthen further the degree of trade integration between these economies, despite the limited exportability of the SARs with respect to merchandizing trade. Furthermore, the implementation of CEPA would also lead to an expansion in capital transactions as preferential treatments will be offered to the investors from the SARs who can enjoy improved conveniences and increased freedom when they invest in Mainland China. Businessmen from the SARs would be the major beneficiaries of CEPA since they have privileges over the others, such as the competitors from the other WTO member states. CEPA may also contribute to improve the ability of Hong Kong and Macau in attracting FDI. When foreign investors consider the territories as the gateways to zero tariff and more preferential terms on investment, they would be more willing to invest in Hong Kong and Macau with an intention of exporting the finished products to, or opening subsidiaries in Mainland China under preferential terms. The Pan-PRD cooperation, meanwhile, tends to strengthen and redistribute the economic activities between Mainland China, Hong Kong and Macau. It can probably tighten the degree of economic integration between the central and western regions of the country, Hong Kong and Macau, without sacrificing the connections between Guangdong and the SARs.

Given the new integration progress on both the international and regional levels, the income gap between Mainland China, Hong Kong and Macau is expected to decline continuously. Given the research result that trade or FDI transactions tend to accelerate the income growth of Mainland China, the expanded trade and capital flows caused by these trade agreements and economic cooperation would contribute to extend the catching-up and convergence processes between Mainland China, Hong Kong and Macau to narrow the income gap between these economies. On the regional level, the Pan-PRD economic cooperation, which promotes economic cooperation between 9 Chinese provinces, Hong Kong and Macau, would probably speed up the pace of growth of the relatively poorer central and western regions of Mainland China. The cooperation tends to accelerate the income convergence process between the central and western regions, Hong Kong and Macau to further narrow the associated income gap. Income convergence between the three geographical regions of Mainland China could probably be another outcome in the long-run.

To shed light on the issue of productivity convergence, the new round of liberalization would further improve the efficiency and technology levels of Mainland China; extending the growth process of total factor productivity. In the new liberalization arrangements, a considerable number of protective measures on both trade and investment aspects will be removed and local enterprises are subject to more external competition. These firms will be forced to strengthen their efficiency and upgrade their technology in order to survive and for this reason, the technical efficiency, technological progress as well as total factor productivity of Mainland China would experience further improvement after a transition and adjustment period, at the expenses of more bankruptcies. In the case of Hong Kong and Macau, since the second half of 2003, the economic condition of these territories has been improving. Such revival process tends to correct the inefficiency problem, resume the technological progress and eventually bringing up their pace of total factor productivity growth. Given total factor productivity growth on both the Mainland China and SARs' sides, it would be hard to project if the process of productivity convergence will continue. Generally speaking, the productivity level of Mainland China could probably grow faster than that of Hong Kong and Macau due to its inferior initial condition and backwardness. It is expected that the convergence process tends to continue, but it may only be proceeding at a slower speed due to the improved performance of the SARs.

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Appendix

A 1.1: Normalized Technical Efficiency of Difference Chinese Provinces and SARs

Year	Beijing	Tianjian	Hebei	Shanxi	Inner Mongolia	Liaoning	Jilin	Heilong-jiang	Shanghai	Jiangsu	Zhejiang	Anhui	Fujian
1978	0.798	0.797	0.700	0.714	0.663	0.822	0.727	0.950	1.000	0.736	0.590	0.783	0.572
1979	0.785	0.772	0.699	0.713	0.669	0.804	0.722	0.911	0.946	0.726	0.606	0.773	0.584
1980	0.772	0.750	0.698	0.712	0.676	0.788	0.717	0.876	0.898	0.716	0.621	0.764	0.597
1981	0.760	0.730	0.697	0.711	0.682	0.773	0.712	0.844	0.855	0.708	0.636	0.756	0.609
1982	0.750	0.713	0.696	0.711	0.688	0.759	0.708	0.815	0.818	0.701	0.650	0.748	0.621
1983	0.740	0.699	0.696	0.710	0.693	0.746	0.705	0.789	0.785	0.695	0.664	0.740	0.634
1984	0.731	0.687	0.696	0.710	0.699	0.735	0.702	0.766	0.755	0.690	0.677	0.733	0.646
1985	0.723	0.677	0.696	0.709	0.703	0.725	0.700	0.745	0.730	0.686	0.689	0.727	0.658
1986	0.715	0.670	0.697	0.709	0.708	0.715	0.698	0.726	0.708	0.684	0.701	0.721	0.670
1987	0.709	0.664	0.698	0.709	0.712	0.707	0.697	0.709	0.689	0.682	0.711	0.715	0.682
1988	0.703	0.660	0.699	0.709	0.716	0.700	0.697	0.694	0.673	0.681	0.721	0.710	0.695
1989	0.698	0.659	0.701	0.709	0.719	0.694	0.697	0.681	0.659	0.682	0.730	0.705	0.707
1990	0.693	0.659	0.703	0.709	0.722	0.688	0.697	0.670	0.649	0.684	0.738	0.701	0.719
1991	0.690	0.661	0.705	0.709	0.724	0.684	0.698	0.661	0.640	0.686	0.745	0.697	0.731
1992	0.687	0.665	0.708	0.709	0.727	0.680	0.700	0.653	0.634	0.690	0.751	0.694	0.743
1993	0.685	0.672	0.711	0.710	0.728	0.678	0.702	0.647	0.631	0.695	0.756	0.691	0.754
1994	0.683	0.680	0.714	0.710	0.730	0.676	0.705	0.642	0.629	0.701	0.760	0.688	0.766
1995	0.682	0.690	0.718	0.711	0.731	0.675	0.708	0.639	0.630	0.708	0.763	0.686	0.777
1996	0.682	0.703	0.722	0.712	0.731	0.675	0.712	0.637	0.633	0.716	0.765	0.684	0.789
1997	0.682	0.718	0.727	0.713	0.731	0.676	0.716	0.637	0.638	0.725	0.766	0.683	0.800
1998	0.683	0.735	0.731	0.714	0.731	0.677	0.721	0.638	0.646	0.736	0.765	0.682	0.811
1999	0.685	0.755	0.737	0.715	0.730	0.680	0.727	0.641	0.656	0.748	0.764	0.681	0.822
2000	0.688	0.778	0.742	0.716	0.729	0.683	0.733	0.645	0.669	0.761	0.761	0.681	0.833
2001	0.691	0.804	0.748	0.717	0.728	0.688	0.740	0.651	0.684	0.776	0.758	0.681	0.843
2002	0.695	0.833	0.755	0.718	0.726	0.693	0.748	0.658	0.702	0.792	0.753	0.681	0.854

Author's Calculation

A 1.2: Normalized Technical Efficiency of Difference Chinese Provinces and SARs

Year	Jiangxi	Shandong	Henan	Hubei	Hunan	Guang-dong	Guangxi	Hainan	Sichuan	Guizhou	Yunnan	Tibet
1978	0.703	0.701	0.701	0.669	0.795	0.662	0.718	0.673	0.992	0.667	0.664	0.839
1979	0.698	0.698	0.706	0.674	0.786	0.667	0.716	0.675	0.948	0.683	0.676	0.810
1980	0.694	0.696	0.711	0.678	0.778	0.673	0.715	0.676	0.907	0.699	0.688	0.784
1981	0.690	0.694	0.715	0.683	0.770	0.678	0.714	0.678	0.871	0.713	0.698	0.760
1982	0.687	0.693	0.719	0.687	0.763	0.683	0.713	0.680	0.838	0.725	0.708	0.740
1983	0.685	0.692	0.722	0.691	0.755	0.688	0.712	0.683	0.808	0.736	0.716	0.722
1984	0.684	0.692	0.725	0.695	0.748	0.692	0.711	0.685	0.782	0.745	0.724	0.707
1985	0.684	0.692	0.727	0.699	0.741	0.697	0.710	0.688	0.757	0.752	0.730	0.694
1986	0.684	0.692	0.728	0.703	0.734	0.701	0.710	0.691	0.735	0.758	0.735	0.683
1987	0.685	0.693	0.729	0.706	0.727	0.705	0.709	0.694	0.716	0.761	0.739	0.674
1988	0.686	0.695	0.729	0.710	0.721	0.709	0.709	0.698	0.699	0.763	0.741	0.668
1989	0.689	0.697	0.728	0.713	0.715	0.713	0.709	0.702	0.683	0.762	0.743	0.663
1990	0.692	0.699	0.727	0.716	0.708	0.717	0.708	0.706	0.670	0.760	0.743	0.660
1991	0.696	0.702	0.726	0.719	0.702	0.720	0.708	0.710	0.658	0.756	0.742	0.659
1992	0.701	0.706	0.723	0.722	0.697	0.723	0.709	0.714	0.648	0.750	0.739	0.660
1993	0.706	0.709	0.720	0.724	0.691	0.727	0.709	0.719	0.640	0.742	0.736	0.663
1994	0.712	0.714	0.717	0.727	0.686	0.729	0.709	0.724	0.633	0.732	0.731	0.668
1995	0.719	0.719	0.713	0.729	0.680	0.732	0.710	0.729	0.628	0.721	0.725	0.675
1996	0.727	0.724	0.708	0.731	0.675	0.735	0.710	0.735	0.624	0.708	0.718	0.684
1997	0.736	0.730	0.703	0.733	0.670	0.737	0.711	0.741	0.622	0.693	0.710	0.695
1998	0.746	0.736	0.697	0.735	0.665	0.739	0.712	0.747	0.621	0.677	0.701	0.708
1999	0.757	0.743	0.691	0.736	0.660	0.741	0.713	0.753	0.622	0.660	0.691	0.724
2000	0.768	0.751	0.684	0.738	0.656	0.742	0.714	0.760	0.624	0.641	0.680	0.742
2001	0.781	0.759	0.676	0.739	0.651	0.744	0.715	0.767	0.627	0.622	0.668	0.763
2002	0.795	0.768	0.669	0.740	0.647	0.745	0.716	0.774	0.632	0.601	0.655	0.786

Author's Calculation

A 1.3: Normalized Technical Efficiency of Difference Chinese Provinces and SARs

Year	Shaanxi	Gansu	Qinghai	Ningxia	Xinjiang	Hong Kong	Macau
1978	0.690	0.595	0.696	0.559	0.617	0.547	n.a.
1979	0.698	0.605	0.699	0.581	0.632	0.581	n.a.
1980	0.706	0.614	0.701	0.603	0.646	0.614	n.a.
1981	0.712	0.624	0.703	0.624	0.660	0.645	n.a.
1982	0.718	0.634	0.706	0.644	0.673	0.675	0.759
1983	0.723	0.644	0.708	0.663	0.685	0.703	0.772
1984	0.727	0.653	0.709	0.681	0.696	0.728	0.783
1985	0.730	0.663	0.711	0.697	0.707	0.750	0.790
1986	0.733	0.673	0.712	0.713	0.716	0.769	0.795
1987	0.734	0.683	0.714	0.727	0.724	0.785	0.797
1988	0.735	0.694	0.715	0.739	0.731	0.797	0.796
1989	0.735	0.704	0.716	0.750	0.737	0.805	0.791
1990	0.734	0.714	0.716	0.759	0.742	0.809	0.784
1991	0.732	0.724	0.717	0.766	0.746	0.810	0.774
1992	0.729	0.735	0.717	0.771	0.748	0.806	0.762
1993	0.725	0.745	0.717	0.775	0.749	0.798	0.747
1994	0.721	0.755	0.717	0.776	0.749	0.787	0.729
1995	0.716	0.766	0.717	0.776	0.748	0.772	0.709
1996	0.710	0.776	0.717	0.774	0.746	0.753	0.687
1997	0.703	0.787	0.716	0.770	0.743	0.731	0.664
1998	0.695	0.797	0.715	0.764	0.738	0.707	0.638
1999	0.687	0.808	0.714	0.756	0.732	0.680	0.612
2000	0.678	0.819	0.713	0.746	0.725	0.650	0.584
2001	0.669	0.829	0.712	0.735	0.717	0.619	0.556
2002	0.658	0.840	0.710	0.722	0.708	0.586	0.527

Author's Calculation

A 2.1: Technological Progress of Difference Chinese Provinces and SARs

Year	Beijing	Tianjian	Hebei	Shanxi	Inner Mongolia	Liaoning	Jilin	Heilong-jiang	Shanghai	Jiangsu	Zhejiang	Anhui
1978	0.0369	0.0369	0.0346	0.0350	0.0398	0.0328	0.0381	0.0332	0.0381	0.0380	0.0378	0.0398
1979	0.0371	0.0373	0.0347	0.0359	0.0402	0.0334	0.0387	0.0339	0.0381	0.0383	0.0385	0.0407
1980	0.0372	0.0377	0.0353	0.0367	0.0410	0.0343	0.0395	0.0345	0.0381	0.0385	0.0389	0.0417
1981	0.0378	0.0382	0.0361	0.0377	0.0419	0.0352	0.0403	0.0348	0.0380	0.0389	0.0396	0.0428
1982	0.0386	0.0385	0.0366	0.0385	0.0425	0.0357	0.0412	0.0348	0.0376	0.0386	0.0401	0.0433
1983	0.0387	0.0387	0.0372	0.0390	0.0428	0.0363	0.0416	0.0350	0.0373	0.0384	0.0407	0.0435
1984	0.0384	0.0387	0.0376	0.0391	0.0429	0.0365	0.0419	0.0351	0.0369	0.0382	0.0410	0.0432
1985	0.0378	0.0384	0.0376	0.0390	0.0429	0.0365	0.0419	0.0351	0.0364	0.0376	0.0407	0.0430
1986	0.0372	0.0384	0.0379	0.0390	0.0432	0.0365	0.0422	0.0352	0.0359	0.0370	0.0405	0.0427
1987	0.0364	0.0384	0.0383	0.0392	0.0436	0.0363	0.0425	0.0353	0.0353	0.0366	0.0402	0.0427
1988	0.0358	0.0384	0.0386	0.0397	0.0439	0.0360	0.0428	0.0356	0.0347	0.0361	0.0401	0.0430
1989	0.0357	0.0388	0.0392	0.0403	0.0444	0.0363	0.0435	0.0361	0.0346	0.0362	0.0404	0.0435
1990	0.0359	0.0393	0.0398	0.0410	0.0450	0.0367	0.0440	0.0368	0.0346	0.0364	0.0408	0.0441
1991	0.0365	0.0395	0.0403	0.0417	0.0454	0.0370	0.0444	0.0374	0.0348	0.0365	0.0410	0.0446
1992	0.0372	0.0396	0.0403	0.0422	0.0453	0.0372	0.0448	0.0378	0.0349	0.0361	0.0408	0.0449
1993	0.0372	0.0397	0.0403	0.0425	0.0451	0.0370	0.0445	0.0382	0.0347	0.0354	0.0399	0.0449
1994	0.0372	0.0397	0.0401	0.0428	0.0452	0.0368	0.0445	0.0386	0.0340	0.0349	0.0390	0.0445
1995	0.0364	0.0397	0.0399	0.0434	0.0454	0.0369	0.0445	0.0390	0.0332	0.0346	0.0380	0.0443
1996	0.0360	0.0396	0.0396	0.0439	0.0458	0.0372	0.0445	0.0394	0.0324	0.0344	0.0373	0.0441
1997	0.0359	0.0396	0.0393	0.0443	0.0461	0.0374	0.0448	0.0400	0.0320	0.0342	0.0369	0.0441
1998	0.0355	0.0395	0.0390	0.0443	0.0464	0.0378	0.0450	0.0403	0.0319	0.0339	0.0366	0.0441
1999	0.0354	0.0389	0.0388	0.0444	0.0466	0.0378	0.0446	0.0405	0.0311	0.0336	0.0365	0.0441
2000	0.0354	0.0390	0.0387	0.0445	0.0468	0.0382	0.0445	0.0407	0.0312	0.0335	0.0364	0.0442
2001	0.0354	0.0391	0.0387	0.0446	0.0470	0.0386	0.0445	0.0409	0.0315	0.0335	0.0363	0.0442
2002	0.0363	0.0391	0.0388	0.0446	0.0468	0.0388	0.0447	0.0412	0.0319	0.0333	0.0361	0.0443

Author's Calculation

A 2.2: Technological Progress of Difference Chinese Provinces and SARs

Year	Fujian	Jiangxi	Shandong	Henan	Hubei	Hunan	Guang-dong	Guangxi	Hainan	Sichuan	Guizhou
1978	0.0410	0.0416	0.0334	0.0340	0.0358	0.0373	0.0403	0.0365	0.0591	0.0423	0.0388
1979	0.0414	0.0414	0.0337	0.0346	0.0366	0.0379	0.0401	0.0372	0.0590	0.0420	0.0395
1980	0.0415	0.0416	0.0340	0.0351	0.0374	0.0384	0.0398	0.0377	0.0592	0.0419	0.0404
1981	0.0420	0.0422	0.0344	0.0359	0.0383	0.0393	0.0394	0.0384	0.0591	0.0419	0.0414
1982	0.0423	0.0426	0.0347	0.0365	0.0389	0.0400	0.0388	0.0395	0.0577	0.0418	0.0424
1983	0.0425	0.0430	0.0354	0.0368	0.0393	0.0405	0.0386	0.0404	0.0573	0.0417	0.0432
1984	0.0428	0.0433	0.0352	0.0371	0.0396	0.0412	0.0382	0.0410	0.0561	0.0415	0.0438
1985	0.0429	0.0436	0.0351	0.0372	0.0395	0.0417	0.0379	0.0416	0.0546	0.0413	0.0442
1986	0.0427	0.0439	0.0351	0.0374	0.0397	0.0420	0.0377	0.0420	0.0535	0.0413	0.0447
1987	0.0427	0.0443	0.0350	0.0377	0.0398	0.0423	0.0377	0.0425	0.0528	0.0412	0.0452
1988	0.0430	0.0448	0.0352	0.0380	0.0401	0.0426	0.0376	0.0430	0.0530	0.0412	0.0459
1989	0.0433	0.0454	0.0355	0.0384	0.0409	0.0435	0.0377	0.0439	0.0529	0.0414	0.0468
1990	0.0437	0.0462	0.0359	0.0391	0.0415	0.0441	0.0376	0.0449	0.0524	0.0418	0.0476
1991	0.0441	0.0470	0.0362	0.0396	0.0421	0.0445	0.0377	0.0456	0.0520	0.0423	0.0484
1992	0.0440	0.0472	0.0361	0.0400	0.0424	0.0446	0.0372	0.0460	0.0504	0.0426	0.0489
1993	0.0434	0.0471	0.0357	0.0402	0.0424	0.0445	0.0361	0.0458	0.0491	0.0428	0.0494
1994	0.0425	0.0471	0.0356	0.0403	0.0421	0.0445	0.0353	0.0456	0.0480	0.0429	0.0499
1995	0.0418	0.0473	0.0356	0.0404	0.0417	0.0446	0.0346	0.0456	0.0476	0.0429	0.0502
1996	0.0413	0.0474	0.0363	0.0406	0.0414	0.0445	0.0343	0.0457	0.0477	0.0430	0.0504
1997	0.0408	0.0473	0.0362	0.0407	0.0411	0.0447	0.0342	0.0459	0.0480	0.0430	0.0506
1998	0.0404	0.0473	0.0362	0.0408	0.0409	0.0447	0.0340	0.0460	0.0483	0.0428	0.0507
1999	0.0401	0.0471	0.0355	0.0410	0.0406	0.0445	0.0338	0.0460	0.0484	0.0427	0.0509
2000	0.0401	0.0470	0.0353	0.0414	0.0404	0.0444	0.0339	0.0461	0.0489	0.0427	0.0509
2001	0.0401	0.0470	0.0351	0.0415	0.0403	0.0442	0.0340	0.0462	0.0493	0.0427	0.0507
2002	0.0403	0.0468	0.0350	0.0416	0.0403	0.0442	0.0340	0.0463	0.0498	0.0426	0.0504

Author's Calculation

A 2.3: Technological Progress of Difference Chinese Provinces and SARs

Year	Yunnan	Tibet	Shaanxi	Gansu	Qinghai	Ningxia	Xinjiang	Hong Kong	Macau
1978	0.0385	0.0608	0.0380	0.0367	0.0410	0.0396	0.0398	0.0053	n.a.
1979	0.0387	0.0606	0.0387	0.0374	0.0409	0.0408	0.0401	0.0055	n.a.
1980	0.0391	0.0608	0.0394	0.0387	0.0416	0.0421	0.0404	0.0056	n.a.
1981	0.0398	0.0615	0.0401	0.0399	0.0425	0.0434	0.0407	0.0060	n.a.
1982	0.0405	0.0620	0.0407	0.0410	0.0430	0.0446	0.0408	0.0064	0.0361
1983	0.0411	0.0623	0.0411	0.0424	0.0435	0.0457	0.0409	0.0069	0.0359
1984	0.0415	0.0614	0.0416	0.0434	0.0442	0.0465	0.0409	0.0076	0.0360
1985	0.0418	0.0602	0.0417	0.0441	0.0446	0.0468	0.0408	0.0082	0.0362
1986	0.0422	0.0603	0.0419	0.0447	0.0452	0.0470	0.0408	0.0089	0.0361
1987	0.0427	0.0606	0.0421	0.0454	0.0457	0.0473	0.0409	0.0094	0.0363
1988	0.0432	0.0610	0.0423	0.0461	0.0464	0.0479	0.0410	0.0100	0.0364
1989	0.0438	0.0613	0.0427	0.0468	0.0474	0.0488	0.0412	0.0105	0.0366
1990	0.0446	0.0618	0.0432	0.0469	0.0483	0.0495	0.0417	0.0111	0.0368
1991	0.0449	0.0621	0.0438	0.0476	0.0492	0.0501	0.0419	0.0117	0.0367
1992	0.0450	0.0622	0.0442	0.0482	0.0500	0.0504	0.0418	0.0121	0.0364
1993	0.0449	0.0626	0.0443	0.0489	0.0508	0.0506	0.0415	0.0127	0.0362
1994	0.0450	0.0627	0.0445	0.0495	0.0515	0.0509	0.0411	0.0133	0.0363
1995	0.0452	0.0622	0.0448	0.0501	0.0522	0.0515	0.0411	0.0138	0.0368
1996	0.0454	0.0625	0.0451	0.0506	0.0526	0.0520	0.0413	0.0144	0.0378
1997	0.0456	0.0628	0.0453	0.0509	0.0528	0.0526	0.0417	0.0148	0.0385
1998	0.0456	0.0631	0.0454	0.0513	0.0529	0.0528	0.0416	0.0154	0.0394
1999	0.0456	0.0633	0.0453	0.0516	0.0527	0.0531	0.0417	0.0162	0.0404
2000	0.0459	0.0637	0.0453	0.0517	0.0526	0.0530	0.0420	0.0170	0.0416
2001	0.0462	0.0641	0.0452	0.0518	0.0524	0.0529	0.0423	0.0178	0.0429
2002	0.0464	0.0641	0.0454	0.0520	0.0523	0.0527	0.0425	0.0187	0.0441

Author's Calculation

A 3.1: Total Factor Productivity Growth of Difference Chinese Provinces and SARs

Year	Beijing	Tianjian	Hebei	Shanxi	Inner Mongolia	Liaoning	Jilin	Heilong-jiang	Shanghai	Jiangsu	Zhejiang	Anhui
1979	2.008	0.571	3.245	3.458	5.046	1.182	3.092	-0.692	-1.602	2.369	6.517	2.854
1980	2.111	0.897	3.346	3.549	5.065	1.401	3.244	-0.416	-1.263	2.539	6.417	3.007
1981	2.270	1.242	3.474	3.665	5.098	1.613	3.407	-0.159	-0.938	2.730	6.343	3.174
1982	2.451	1.553	3.572	3.755	5.105	1.793	3.571	0.064	-0.636	2.856	6.248	3.276
1983	2.557	1.865	3.677	3.817	5.082	1.968	3.692	0.307	-0.327	2.990	6.168	3.351
1984	2.625	2.153	3.762	3.843	5.029	2.119	3.794	0.539	-0.024	3.119	6.048	3.384
1985	2.666	2.418	3.816	3.846	4.975	2.250	3.876	0.757	0.273	3.218	5.878	3.412
1986	2.696	2.701	3.888	3.866	4.953	2.370	3.985	0.993	0.566	3.316	5.714	3.442
1987	2.717	2.997	3.978	3.895	4.935	2.473	4.089	1.227	0.852	3.420	5.542	3.495
1988	2.755	3.294	4.051	3.957	4.912	2.578	4.202	1.478	1.140	3.528	5.390	3.583
1989	2.849	3.628	4.156	4.039	4.900	2.732	4.341	1.757	1.469	3.697	5.276	3.690
1990	2.967	3.971	4.265	4.123	4.905	2.896	4.476	2.046	1.823	3.873	5.174	3.800
1991	3.122	4.286	4.363	4.197	4.892	3.055	4.595	2.335	2.197	4.038	5.053	3.909
1992	3.287	4.589	4.415	4.265	4.831	3.206	4.706	2.605	2.551	4.147	4.891	4.001
1993	3.386	4.900	4.455	4.311	4.755	3.310	4.761	2.870	2.889	4.229	4.657	4.056
1994	3.482	5.198	4.486	4.358	4.707	3.416	4.831	3.139	3.172	4.343	4.420	4.068
1995	3.506	5.495	4.512	4.424	4.670	3.558	4.917	3.407	3.447	4.467	4.187	4.104
1996	3.569	5.790	4.531	4.495	4.655	3.713	4.996	3.673	3.729	4.597	3.975	4.144
1997	3.648	6.092	4.545	4.545	4.638	3.864	5.097	3.958	4.045	4.733	3.793	4.195
1998	3.709	6.382	4.565	4.561	4.611	4.024	5.196	4.218	4.386	4.868	3.620	4.253
1999	3.803	6.625	4.591	4.585	4.570	4.158	5.239	4.468	4.671	4.994	3.466	4.307
2000	3.902	6.931	4.633	4.603	4.539	4.325	5.311	4.719	5.047	5.137	3.315	4.371
2001	4.003	7.252	4.675	4.627	4.503	4.488	5.388	4.977	5.439	5.290	3.168	4.436
2002	4.192	7.555	4.735	4.646	4.425	4.641	5.479	5.233	5.844	5.434	3.010	4.498

Author's Calculation

A 3.2: Total Factor Productivity Growth of Difference Chinese Provinces and SARs

Year	Fujian	Jiangxi	Shandong	Henan	Hubei	Hunan	Guang-dong	Guangxi	Hainan	Sichuan	Guizhou
1979	6.273	3.423	2.983	4.245	4.363	2.744	4.832	3.520	6.116	-0.242	6.465
1980	6.247	3.552	3.086	4.211	4.415	2.820	4.775	3.588	6.173	-0.031	6.300
1981	6.253	3.711	3.194	4.199	4.484	2.919	4.702	3.676	6.190	0.190	6.141
1982	6.246	3.859	3.288	4.173	4.518	3.012	4.622	3.800	6.086	0.407	5.981
1983	6.227	4.008	3.425	4.124	4.541	3.077	4.565	3.907	6.069	0.614	5.803
1984	6.213	4.143	3.469	4.062	4.537	3.163	4.501	3.987	5.985	0.822	5.609
1985	6.186	4.284	3.527	3.995	4.512	3.224	4.442	4.061	5.863	1.025	5.394
1986	6.130	4.418	3.593	3.924	4.504	3.273	4.394	4.119	5.785	1.247	5.185
1987	6.088	4.565	3.652	3.873	4.493	3.318	4.365	4.182	5.750	1.462	4.982
1988	6.074	4.728	3.731	3.814	4.495	3.369	4.324	4.255	5.800	1.691	4.797
1989	6.073	4.895	3.835	3.778	4.547	3.471	4.303	4.357	5.824	1.945	4.633
1990	6.074	5.082	3.940	3.759	4.589	3.546	4.274	4.472	5.806	2.212	4.463
1991	6.066	5.267	4.032	3.725	4.622	3.603	4.254	4.565	5.799	2.490	4.282
1992	6.020	5.398	4.086	3.682	4.629	3.628	4.170	4.617	5.667	2.745	4.088
1993	5.919	5.492	4.119	3.618	4.603	3.636	4.038	4.611	5.578	2.992	3.882
1994	5.798	5.603	4.174	3.542	4.548	3.652	3.923	4.608	5.498	3.232	3.680
1995	5.687	5.733	4.238	3.471	4.487	3.677	3.827	4.629	5.485	3.467	3.467
1996	5.591	5.845	4.374	3.400	4.425	3.692	3.764	4.655	5.525	3.701	3.237
1997	5.508	5.949	4.438	3.329	4.376	3.720	3.724	4.695	5.596	3.936	3.006
1998	5.423	6.053	4.497	3.257	4.332	3.739	3.684	4.722	5.657	4.148	2.766
1999	5.359	6.139	4.503	3.193	4.280	3.733	3.631	4.734	5.700	4.376	2.537
2000	5.314	6.243	4.546	3.144	4.235	3.739	3.611	4.765	5.778	4.608	2.294
2001	5.280	6.348	4.598	3.070	4.195	3.746	3.594	4.791	5.853	4.839	2.026
2002	5.254	6.434	4.649	2.998	4.178	3.758	3.567	4.816	5.928	5.066	1.756

Author's Calculation

A 3.3: Total Factor Productivity Growth of Difference Chinese Provinces and SARs

Year	Yunnan	Tibet	Shaanxi	Gansu	Qinghai	Ningxia	Xinjiang	Hong Kong	Macau
1979	5.724	2.543	5.026	5.344	4.476	8.059	6.469	6.717	n.a.
1980	5.600	2.841	4.977	5.461	4.519	7.935	6.329	6.205	n.a.
1981	5.504	3.185	4.931	5.570	4.585	7.808	6.203	5.721	n.a.
1982	5.403	3.518	4.870	5.665	4.604	7.671	6.046	5.242	n.a.
1983	5.301	3.830	4.798	5.788	4.634	7.528	5.891	4.779	5.314
1984	5.166	4.023	4.724	5.872	4.670	7.356	5.728	4.325	4.943
1985	5.030	4.186	4.620	5.933	4.684	7.137	5.550	3.877	4.582
1986	4.903	4.477	4.522	5.978	4.723	6.904	5.386	3.437	4.205
1987	4.790	4.790	4.420	6.029	4.750	6.682	5.239	2.985	3.849
1988	4.670	5.111	4.323	6.090	4.788	6.493	5.088	2.538	3.486
1989	4.573	5.430	4.249	6.148	4.860	6.326	4.940	2.090	3.137
1990	4.481	5.761	4.183	6.141	4.931	6.150	4.824	1.644	2.788
1991	4.350	6.079	4.120	6.197	4.993	5.958	4.690	1.206	2.412
1992	4.190	6.379	4.048	6.248	5.047	5.746	4.515	0.758	2.009
1993	4.018	6.704	3.944	6.298	5.104	5.515	4.320	0.329	1.626
1994	3.864	7.010	3.842	6.347	5.149	5.300	4.119	-0.107	1.271
1995	3.717	7.247	3.752	6.393	5.188	5.109	3.959	-0.544	0.961
1996	3.580	7.567	3.668	6.429	5.203	4.915	3.816	-0.969	0.697
1997	3.433	7.890	3.577	6.452	5.195	4.726	3.695	-1.409	0.407
1998	3.267	8.211	3.461	6.476	5.179	4.500	3.528	-1.832	0.142
1999	3.112	8.531	3.344	6.489	5.141	4.284	3.382	-2.226	-0.115
2000	2.973	8.865	3.226	6.485	5.103	4.038	3.249	-2.623	-0.355
2001	2.840	9.203	3.100	6.487	5.057	3.782	3.119	-3.017	-0.574
2002	2.704	9.494	3.000	6.486	5.016	3.523	2.980	-3.399	-0.814

Author's Calculation