Segregation, Fertility and Son Preference: The Case of the Roma in Serbia*

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Abstract

We study the link between residential segregation and fertility for the socially excluded and marginalized Roma ethnic minority. Using original survey data we collected in Serbia, we investigate whether fertility differs between ethnically homogeneous and mixed neighborhoods. Our results show that Roma in less segregated areas tend to have significantly fewer children (around 0.8). Most of the difference arises from Roma in less segregated areas waiting substantially more after having a boy than their counterparts in more segregated areas. We exploit variation in the share of Serbian sounding first names to provide evidence that a mechanism at play is a shift in preferences towards lower fertility and sons rather than daughters induced by a higher exposure to the Serbian majority culture.

Keywords: fertility, residential segregation, ethnic minority, culture

JEL classification codes: J13, J15, R23, Z10

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1 Introduction

The Roma population, like many other marginalized minority groups, is characterized by high levels of fertility and severe residential segregation. Yet, both the direction of causality and the mechanism responsible for this correlation remain unclear. Is it that minorities more inclined towards a higher fertility tend to crowd out other types from their neighborhoods and become segregated as a result or that groups that are initially isolated tend to be biased towards larger families? Alternatively, it could be that a third factor causes both segregation and high fertility.[1]

The aim of this paper is to use variation in the severity of residential segregation of Roma settlements to shed some light on the association between segregation and fertility.[2] A further goal is to investigate the different pathways that can link segregation to fertility. Our analysis has two important limitations that the reader should keep in mind. First, we are not able to formally infer causal links as the heterogeneity in residential segregation does not stem from quasi-experimental variation. Second, the data we exploit suffers from selection issues that do not guarantee its representativity of the Roma population.[3]

Despite those limitations, we believe that providing answers to these questions, even if only suggestive, is of primary importance. Indeed it improves our understanding of whether policies favoring social diversity may be helpful to reduce what some consider as a fertility burden, which prevents parents from investing in the quality of their children.[4] Understanding better the link between segregation and fertility is also crucial as policies favoring social diversity may target access to different amenities, such as housing, schools or jobs, and some may prove more efficient than others.

In particular, we have in mind five mechanisms through which segregation may affect fertility: (i) people in less segregated areas may have access to better employment possibilities and therefore have a higher opportunity cost of time (Doepke, 2015); (ii) people in less segregated areas may face higher returns to education and therefore prefer to invest in quality rather than quantity of children (Galor, 2012); (iii) people in segregated areas may be closer to the grandparents' location and raising children would consequently be less costly (Compton and Pollak,

[1]Minorities speaking a language that is very distant from that of the majority for instance should tend to be more isolated and disadvantaged on the labor market, which decreases the opportunity cost of having children.

[2]Settlements and neighborhoods are used interchangeably, except when further defined.

[3]Section 2.2 discusses in detail the different selection issues and how we try to mitigate them.

[4]There exists an important literature showing that the decline in fertility known as the demographic transition is a prior to the economic take-off. See for instance the seminal contributions by Galor and Weil (1999, 2000) and subsequent articles building on the issue like Kalemli-Ozcan (2002), Li and Zhang (2007), Klemp and Weisdorf (2016) and Cervellati and Sunde (2015).

2014); (iv) the cost of space could be lower in segregated areas as fewer people desire to live there (Boustan, 2012; Boustan and Margo, 2013), thus facilitating a higher fertility (Simon and Tamura, 2009); (v) people in less segregated areas may be more exposed to the Serbian majority culture and its low fertility norm (Fernández and Fogli, 2006, 2009).

We investigate further the idea of cultural transmission from the majority group by exploring the timing of births and in particular how timing patterns depend on the gender of the last born child. Indeed longer intervals after a son versus a daughter signals a preference for boys, which is widely recognized as a culturally transmitted trait and is particularly prevalent in Serbia and surrounding countries (Abramishvili et al., 2019). On top of pointing at the cultural pathway as a crucial mechanism of fertility change, documenting a preference for boys also raises other policy relevant issues, such as the promotion of gender equity.

For the purpose of our analysis, we use primary data collected through an extensive survey conducted in Belgrade, Serbia. In the Fall of 2010, we interviewed 300 Roma households in 13 different settlements of the city. These households were randomly selected among households with at least one child attending primary schools involved in a remedial education program introduced in Serbia in 2009.[5] Our study de facto focuses on the intensive margin of fertility (or fertility of mothers). We discuss this point in Subsection 2.2.

We first document that there exists heterogeneity within the Roma community in Serbia in terms of both segregation and fertility. Residential segregation is measured as the proportion of Roma living in a settlement and we distinguish between *only Roma*, *mostly* or *few Roma*. In our sample, 27% of the households live in *only Roma* neighborhoods, 62% in *mostly Roma* and 9% in *few Roma* settlements. We establish that households in *few Roma* settlements tend to have fewer children than those in *only Roma* (0.8 children). Incorporating controls for the different mechanisms previously described, either in isolation or altogether, can only partially account for the gap.

We then investigate whether this fertility gap is accompanied by a preference towards sons rather than daughters. Using a proportional hazard duration model, we show that the difference in fertility is not accompanied by any sizeable difference in age at first birth or spacing after having a girl. However, we document that parents in *few Roma* settlements wait significantly longer after having a boy than similar parents in more segregated settlements. Looking at a

[5]Data were collected to examine the impact of a remedial education program targeting primary school-age Roma children on parental expectations. More details can be found in Battaglia and Lebedinski (2015, 2017).

sample of non-Roma Serbs from the UNICEF Multiple Indicator Cluster Survey (MICS 2010), we check that this pattern of longer inter-birth spells after having a boy also holds among Serbs, making the case for cultural porosity between *few Roma* settlements and the Serbian majority. We moreover document consistent results when investigating the sex ratio at last birth, another indicator of son preference, particularly relevant in the absence of sex-selective abortion. Our contribution is threefold. First, we describe substantial spatial disparities in fertility behavior within an ethnic minority, in our case the Roma community. An extense literature documents fertility gaps across religious and ethnic groups in many different contexts. Manski and Mayshar (2003) and Berman (2000) for instance document substantial fertility gaps across different groups in Israel. Poston et al. (2006) offer the same kind of analysis applied to minority groups in China. Adsera (2006) look at different religious affiliations in Spain, while Coleman and Dubuc (2010) document them for minority ethnic groups in the UK.

Directly connected to our study, Sedlecky and Rašević (2015) quantify the fertility differences between Roma living in settlements and the Serbian majority using the UNICEF Multiple Indicator Cluster Survey (MICS) as well as a qualitative survey. They document large differences in fertility, driven by early marriages and first births, as well as very low usage of modern contraception. The qualitative survey highlights the importance of traditional views on marriage and contraception, poor employment perspectives and low perceived returns to education.

However, much fewer studies point at the heterogeneity within those ethnic groups, as in the present article. The heterogeneity within the Roma community is a crucial point as it can help us understand how social change happens and in particular whether diffusion of norms is an important factor. There exist some sociological and anthropological accounts for Hungary. For instance, Spéder and Kamarás (2008) draw a link between a study by Hablicsek (2008), which documents regional variation in the fertility patterns of Roma people in Hungary, and anthropological work by Durst (2002) who points at the "ghettoization" of the Roma population to explain the increased fertility in some deprived villages of Northern Hungary. Further, Janky (2006) also documents geographic variation within the Roma population in Hungary and links it mainly to differences in the level of integration into the education system and the labor market. Interestingly enough, he also mentions a sharp distinction between the more integrated but also more recently settled community affiliated to the Beás culture and dialect, as opposed to those identifying to the Olah culture. However, we are not aware of any study systematically correlating fertility differences within the Roma community to residential segregation using econometric techniques.

Our second contribution is to document that the lower fertility in less segregated areas is accompanied by a higher preference for sons over daughters. This is of importance in its own right, as son preference has drastic consequences on gender differences in health, education and labor outcomes.[6] Once in utero sex detection technologies become available, son preference may also translate into a skewed sex ratio at birth, the consequences of which are a concern for many Asian countries.[7] However this is also informative so as to how behavioral change happens. Indeed low fertility and son preference are also very prevalent in the ethnic Serbian population. Our findings therefore point at a process of cultural diffusion from the majority group to the less segregated minority populations, which is an important point for policy makers to keep in mind. Anukriti (2018) evaluates the impact of one such policy in India, called Devi Rupak, which seeks to lower fertility and the sex ratio, and finds that financial incentives have little effect, pointing at a substantial role of cultural persistence.

Several contributions in economics have now documented the importance of cultural norms, on top of purely economic drivers, in the transition to a low fertility regime.[8] This fairly recent interest of economists for cultural norms of fertility prolongs a long-standing debate in demography and sociology, regarding not only the transition from high to low fertility but also fertility differences across ethnic and religious groups. The sociological literature refers to three hypothesis: (i) the characteristics hypothesis (or in demography, the structuralist view), which states that, once accounted for differences in socio-demographic characteristics, fertility differences should disappear, (ii) the cultural hypothesis, according to which fertility differences persist due to the slow process of acculturation of minorities to the majority culture (known as the diffusionist view in demography) and (iii) the minority status hypothesis, which posits that minority group membership may have an independent effect on fertility, either positive or negative due to the desire and perceived possibility of upward social mobility.

[6] See Altindag (2016) and Jayachandran and Pande (2017) for evidence in the context of Turkey and India.

[7] Anukriti et al. (2018) find that the detrimental effects of son preference on daughters' outcomes are somewhat mitigated by the introduction of ultrasound technology allowing sex-selective abortions, as they decrease the number of unwanted births. Hesketh and Xing (2006) discuss the possible consequences of skewed sex ratios, gender imbalances and missing women on the marginalization of single men, the prevalence of antisocial behavior, violence and sex trafficking.

[8] de la Croix and Perrin (2018) analyze fertility and schooling data for XIXth century France and find that a purely economic model may explain 38% of the cross-county variation in fertility and more than 75% of the variation in schooling decisions. Residuals from the model correlate well with cultural proxies, such as family structure and linguistic barriers. Daudin et al. (2018) use similar data to highlight the role of internal migration from and to Paris as a vector for cultural diffusion. Spolaore and Wacziarg (2016) document that cultural distance (as measured by genetic and linguistic distance) was a key driver to the diffusion of low fertility norms across European populations prior and during the industrial revolution.

These hypothesis have been revisited by the economics literature. The seminal contributions by Fernández and Fogli (2006, 2009) bring to light the correlation between the behavior of second generation migrant women to the US and the Total Fertility Rate in their country of origin to give strong empirical support to the existence of the cultural channel.[9] Chabé-Ferret (2013) show that the characteristics hypothesis does not allow to explain fully the fertility gap between non-Hispanic Whites and African Americans in the US and give some evidence pointing at the importance of the cultural channel.

Goldscheider and Uhlenberg (1969) were the first to propose the concept of minority status hypothesis, which gave rise to a substantial literature that tried to prove or disprove them. Forste and Tienda (1996) provide a critical review of ten of the most influential contributions in that "first generation" of sociological studies of fertility differential. In the economics literature, Chabé-Ferret and Melindi Ghidi (2013) build a theoretical model that suggests economic uncertainty as the mechanism underlying the minority status hypothesis. They find that middle-sized minority groups should tend to have a higher fertility than comparable natives while small minorities should tend to have fewer children.

Our work is also related to the literature on residential segregation and neighborhood effects that studies the relevance of neighborhoods and one's peers in influencing socioeconomic outcomes.[10] For instance, segregation of African Americans has been identified as one of the reasons for the persistence of inner city poverty in the US (Cutler and Glaeser, 1997). Moreover, the neighborhood where one lives can clearly affect one's labor market (Clark and Drinkwater, 2002; Edin et al., 2003; Bayer et al., 2008; Boeri et al., 2015) and educational outcomes (Card and Rothstein, 2007). The ethnic composition of a municipality can also be important for the quality of local public goods such as schools (Alesina et al., 1999; La Ferrara and Mele, 2006). Manley et al. (2011) suggests that the evidence base for social mixing is far from robust. Our setting allows to better isolate the link between segregation and fertility for a minority group, given that we can observe different levels of segregation for the same ethnic minority, which is the largest in Europe.

Our third contribution is to provide primary data in a context where data are scarce, the Roma community, an understudied ethnic minority that has endured a history of discrimination

[9]See Blau et al. (2013), Stichnoth and Yeter (2016) and Chabé-Ferret (2019) for further explorations of the cultural channel at play in fertility behavior.

[10]For an excellent review of the literature on neighborhood effects, see Durlauf (2004) and Blume and Durlauf (2006).

and marginalization. We collected data at a very detailed level of geographical disaggregation - the street, which, despite several limitations discussed in Section 2, represents an important contribution in and of itself. We complement work that has been done on Roma communities in other countries. Aisa et al. (2017) for instance examine the fertility patterns of Roma in Spain and find that family businesses play an important role. In the presence of a family business, parents exert their authority to influence the fertility decision of their adult children in the view of maximizing future labor resources at the disposal of the family. While the paper makes an important contribution, we believe that this finding is not relevant for our context where families are mostly nuclear. Family businesses involving extended family members and vertical hierarchy across generations are not common among Roma in Serbia. Kertesi and Kézdi (2013) document the extent of segregation in the primary school system in Hungary, while Kertesi and Kézdi (2011b,a) and Hajdu et al. (2017) explore the consequences in terms of Roma/non-Roma gaps respectively in test scores, employment and health outcomes. Rauh (2018) also documents large Roma/non-Roma gaps for Romania, in terms of school attendance, educational attainment, housing conditions and employment, as well as in the extent of the gender gap in those outcomes. Aisa and Larramona (2014) and Aisa et al. (2016) uncover similar patterns in terms of labor market outcomes and self-reported health in Spain.

The rest of the paper is organized as follows. Section 2 describes the way the survey has been designed and the data collected. It provides some descriptive statistics. Section 3 presents the estimation strategy and the results. Section 4 discusses findings and concludes.

2 Data and Descriptive Statistics

2.1 Official data on Roma

Roma are the largest ethnic minority in Europe. In all the countries where they live, they experience severe social exclusion and poverty. They mainly perform low skilled jobs, live in segregated areas of the main cities and do not participate in the political and cultural life (Open Society Institute, 2007). Their living conditions are often so different from those of the majority population that it is difficult to find official data documenting their situation. For most Central and Eastern European countries where the majority of the Roma population lives, official data on them are scarce and inaccurate. The 2011 Serbian Census counts 147,604 Roma, corresponding to 2.05% of the total Serbian population, while the Open Society Institute (2007) estimates a number between 350,000 and 500,000, approximately 6% of the overall population. In Belgrade, the 2011 Census records 27,325 Roma (1.65% of the population) and the Open Society Institute (2007)'s numbers are three times higher: they are roughly 80,000 (5%).

The UNICEF Multiple Indicator Cluster Survey (MICS) from 2010 and the Living Standard Measurement Survey (LSMS) from 2007 are valuable sources of information on the living conditions of the Roma population in Serbia. However, the MICS does not report information on where the households interviewed live and therefore cannot be used in our study. Furthermore the LSMS only interviewed a boosted sample of internally displaced people, making it a very selected sample.

We make use of these sources in order to compare the characteristics of the Roma and non-Roma population. As reported in Table A in the appendix, the average Roma household is composed of 5.6 members versus a national average of 3.5. The average number of children aged 18 or below is 2.4 per Roma households, while the population average is only 0.86. Almost half of the Roma population (43%) is below 18 years old and the average age is 25, whereas the national average is 35. Half of the Roma households are poor: their average consumption is below the absolute poverty line.[11] While male employment rates are comparable to those of the majority population (56%), female employment remains very low with only one woman out of ten working versus a national average of 40%. Only 89% of children from Roma settlements aged 6 to 15 attend school and among the adults, 29% have not finished primary school.[12] Conversely, 99% of Non-Roma aged 6 to 15 are enrolled in school and only 4% of adults have not completed primary school.

2.2 The Sample

We use first-hand collected data obtained through a survey conducted with 300 Roma households of Belgrade, originally aimed at evaluating a remedial education program introduced in Serbia in 2009.[13] All surveyed households have at least one child in the lower four grades of primary school in the year of the survey. They were randomly selected among pupils attending primary

[11]The percentage of the extremely poor among the Roma interviewed in LSMS is 11.9%. Those who are considered extremely poor are those who cannot satisfy even their basic needs for food.

[12]In Serbia, school is compulsory until the age of 15 and primary school lasts 8 years. Children enrol at primary school if they are above 6.5 years of age at the start of the scholastic year in September. Since 2010 the attendance of at least 9 months of a free preschool program is compulsory.

[13]The Roma Teaching Assistant Program is the main program in Central and Eastern Europe aimed at improving inclusion of Roma in education. For a more extensive description of the program see Battaglia and Lebedinski (2015).

schools that were involved in the program at different points in time.

Belgrade is divided in 17 municipalities, among which 10 have Roma settlements, as defined by a population of at least 15 households or 100 individuals (Jaksic and Basic, 2010). Five of these municipalities are included in our survey design, as the five remaining had no schools involved in this initial stage of the remedial program.[14] We suspect that schools in those municipalities did not satisfy the eligibility criterion of having a share of Roma pupils between 5 and 40%.[15] The municipalities included in the final sample host 59% of all Belgrade schools. Using MICS (2010), we estimate that our survey design amounts to randomly select pupils from schools enrolling 40% of all Roma children in primary school age.[16] The survey took place in Fall 2010. The response rate was 93.46%: 321 households had been contacted and 300 answered. Households were not compensated for their participation.

We acknowledge our survey design suffers from some limitations: we consider women with (i) at least one child aged 6 to 10; (ii) the child needs to be enrolled in a school; (iii) schools need to have between 5 and 40% of Roma pupils. While we agree that this pool is certainly different in various ways from the universe of all Roma women, we nonetheless think that the concerns relative to the representativeness of the sample can be mitigated. Indeed, in Serbia, enrollment of Roma aged 6 to 10 into schools is close to universal and there are not any documented gender differences that could affect our results. Dropouts from primary schools usually arise after the first cycle of four years, when children are supposed to enter the second cycle of primary education (Battaglia and Lebedinski, 2015; Open Society Institute, 2007). Since schools with less than 5% of Roma pupils are not selected in the program, we are aware that we might have under-sampled families living in settlements with few Roma households. Nonetheless, the lack of available official data on the actual distribution of Roma in Belgrade does not allow us to quantify the resulting bias. MICS 2010 Roma sample itself is formed by excluding all enumeration areas with 17 or less Roma households, sampling thus from a pool of 46% of the all Roma households. We believe though that we most likely underestimate differences associated to segregation as we trim the sample from its most desegregated households.

The design of the sample also implies that all households observed count at least one child. This may distort the representativity of the results in terms of fertility of the whole Roma

[14] The five municipalities are Voždovac, Zvezdara, Zemun, Palilula, and Čukarica.

[15] Most probably, the share of Roma pupils in those schools was lower than 5%, as opposed to higher than 40%, as these municipalities had smaller shares of Roma overall.

[16] The number of Roma children aged 6 to 9 in Belgrade is 3,029 (MICS, 2010) and the number of Roma children aged 6 to 9 in the schools from our survey is 1,170.

Population as it de facto removes the extensive margin of the fertility decision (or childlessness as put by Gobbi (2013); Baudin et al. (2015)). Using Census data for 2011, we obtain that the rate of childlessness of women over 39 in the Belgrade region was of 7% for Roma and 13% for Serbs. Though substantial, the magnitude of this difference is not likely to explain fully the much higher fertility of Roma women. We thus consider that studying only the intensive margin of the fertility decision is an important step per se.

Figure 1 displays a map of Belgrade with the 13 settlements where the survey was carried out. We use the definition of settlements from an NGO called the Society for Improvement of Roma Settlement, which made an inventory of the Roma presence in Belgrade in 2002 and classified it into clusters based on geographic concentration, natural and urban frontiers, as well as origin and time of in-migration. The number of households selected from each settlement is proportional to its size.

We classify settlements as composed of either *only Roma* people, *mostly Roma* people or *few Roma* people. In the survey, we asked respondents whether in their community/neighborhood, defined as the area corresponding to 200 square meters around their house, there were only Roma people or both Roma and Non-Roma. In the latter case, we further asked whether Roma were a minority or a majority. Notice that the definition of neighborhoods here does not exactly coincide with our settlements. Indeed a neighborhood generally does not cover the entirety of a settlement, but conversely, the neighborhood of someone living at the periphery of the settlement may extend besides the settlement's limits. This is why we use the median perception about own neighborhood in the settlement. In almost two-third of the settlements, all households have the same perception. In the remaining third, there are either a few *only Roma* in a settlement otherwise perceived as *mostly Roma*, or the other way around. We believe that taking the median perception, because it smoothes out potential outliers in individual perceptions, actually gives a relatively accurate and reliable representation of the reality.

We do not use metrics that are more commonly employed in the segregation literature like the index of dissimilarity since there are no available information on the total Roma population residing in one particular area of Belgrade. The lack of official data on ethnic composition at the municipality level is one of the reason why our data - though with some limitations - are a useful source of information.

Our data include household members' demographic characteristics, such as education level, religion, language spoken at home and information on their dwellings. We also have detailed

Figure 1: Map of Belgrade with settlements

information on their settlement of residence from the database of Roma settlements, such as the number of inhabitants and main current utilities.

Panel A in Table 1 reports households' characteristics for the 13 settlements in our sample in column (1). Overall, they are in line with official data (MICS 2010 and LSMS 2007), as reported in Table B in the appendix. On average, women in our sample are 32.5 years old, which is slightly older than the MICS sample. This is consistent with our conditioning on having at least one child enrolled in the four lower grades of primary school. As a consequence of this age difference, we also observe that women in our sample are slightly less educated (as educational attainment has risen slightly in recent cohorts), that the share of children below 6 is smaller, while that of children between 6 and 14 is larger, and that the number of adults in the household, and particularly older adults, is smaller. However and importantly for our analysis, the age at first birth as well as the total fertility rate in our sample are very similar to those found in the MICS.[17] The slightly larger fertility in the MICS may come from the fact that we measure fertility as the number of children alive at the time of the survey. This way, unlike the MICS, we disregard any child who did not survive.

Wealth is measured by the first component of a principal component analysis on the presence in the household of various durables and utilities.[18] Women received an average monthly income of 3,600 Serbian dinars, which is worth around 35US$, while men made over four times that amount, about 15,000 Serbians dinars, or 150US$. Households mainly receive income from labor, either in the formal or informal sector, rather than social transfers.[19]

Almost all households in the sample are nuclear with on average a little over two adults, although there are a few exceptions with more than four. They are most likely Muslim and never moved from the settlement they are currently living in. 30% of households comprise adults named with only Serbian names.[20] They expect that one extra year of schooling increases monthly income by roughly 17US$, corresponding to 5% of the minimum wage.[21] Roma people usually do not perform jobs for which high levels of education are required. They mainly work in the informal sector, without written contracts, often self-employed especially in flea markets and more rarely in factories (LSMS 2007).[22]

Columns (2), (3) and (4) report separately means for *only*, *mostly* and *few Roma* settlements. Households are overall comparable in terms of observable characteristics across settlement types: many normalized differences are smaller than 1/4th of the combined sample variation, suggesting that linear regression methods are unlikely to be sensitive to specification changes (Imbens and Wooldridge, 2009). The differences in means are not statistically significant in almost all cases

[17]The total fertility rate is obtained by summing all the age-specific fertility rates over the reproductive cycle conventionally defined as age 15-49. It represents the total number of children a woman would have at the end of her reproductive cycle were she to experience successively all the age-specific rates of a given year. This measure does not depend on the age structure of the population.

[18]Filmer and Pritchett (2001) showed that an index obtained through the first principal component can provide reasonable estimates of the wealth level effects in situations where wealth data are not directly available.

[19]Source of income is equal to 1 when the main source of income is a job in the formal sector, 2 when it is social benefits and 3 when it is a job in the informal sector.

[20]Examples of Serbian names are Aleksandar, Borislav, Ivan, Jelena, Katarina, Slobodan. Examples of Romani names are Alvin, Djemila, Djulijana, Ersijana, Nuredin, Roberto, Valentino. Romani names are different enough from Serbian names to clearly identify the ethnicity one belongs to (Behind the name, 2017).

[21]Expected returns to education were computed using questions in our survey about the salary parents expected for their children in different scenarios: no schooling, primary, secondary. We construct Mincerian expected returns by regressing log-income on years of education. We find that one more year of schooling increases expected log earning by 9.4% for boys and 8.1% for girls, in line with what is observed in the literature (Baudin et al., 2015; Jensen, 2010; Nguyen, 2008; Duflo, 2001; Montenegro and Patrinos, 2013; Hanushek and Welch, 2006).

[22]More information on the Roma labour market in Serbia can be found in Battaglia and Lebedinski (2017).

Table 1: Households' and Settlements' Characteristics

Variable	All	Only Roma Settlements	Mostly Roma Settlements	Few Roma Settlements	Normalized Differences		
					(3)-(2)	(4)-(2)	(4)-(3)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
A. Households' characteristics							
mother's age	32.474	32.297	32.435	33	.018	.102	.072
	(5.606)	(4.799)	(6.092)	(4.961)			
mother's literacy (=1)	.793	.74	.811	.739	.125	-.120	-.005
	(.406)	(.442)	(.397)	(.449)			
(monthly) mother's income in dinars[a]	3566	2336	4168	3405	.179	.105	-.064
	(7793)	(5835)	(8397)	(8365)			
(monthly) father's income in dinars[b]	15114	14061	16040	13189	.100	-.045	-.135
	(14460)	(12789)	(15101)	(14793)			
household wealth[c]	.092	-.097	-.015	.938	.036	**.440**	**.437**
	(1.594)	(1.720)	(1.476)	(1.604)			
household source income (=1 if formal sector job)	.489	.527	.478	.459	-.069	-.095	-.026
	(.501)	(.503)	(.501)	(.505)			
household source income (=1 if social benefits)	.158	.149	.161	.162	.025	.026	.001
	(.365)	(.358)	(.369)	(.374)			
household source income (=1 if informal sector job)	.353	.324	.360	.378	.053	.079	-.026
	(.479)	(.471)	(.482)	(.492)			
number of adults	2.272	2.500	2.168	2.27	**-.268**	-.154	.215
	(.859)	(1.037)	(.682)	(1.071)			
muslim (=1)	.702	.865	.708	.351	**-.274**	**-.865**	**-.536**
	(.458)	(.344)	(.456)	(.484)			
mother born in the same settlement (=1)	.772	.716	.770	.892	.087	**.318**	.231
	(.42)	(.454)	(.422)	(.315)			
only serbian names (adults) (=1)	.176	.203	.303	.405	.098	**.506**	**.406**
	(.382)	(.268)	(.267)	(.498)			
(monthly) expected returns to education in dinars (street)[d]	1694	1681	1720	1607	.040	-.083	-.155
	(613)	(770)	(561)	(463)			
Obs.	272	74	161	37			
B. Settlements' characteristics							
urban (=1)	.417	.333	.429	.667	.121	**.408**	**.303**
	(.515)	(.577)	(.535)	(.577)			
distance from school	17.931	22.539	17.278	13.3015	**-.599**	**-1.521**	**-.469**
(minutes)	(6.771)	(4.592)	(7.492)	(3.973)			
distance from hospital	20.694	27.249	19.331	15.630	**-.839**	**-1.446**	**-.607**
(minutes)	(6.75)	(7.635)	(5.55)	(2.514)			
Obs.	12	3	7	3			
C. Fertility outcomes							
number of children	3.25	3.581	3.199	2.811	-0.207	**-0.437**	**-0.251**
	(1.243)	(1.434)	(1.161)	(1.023)			
proportion of boys	0.539	0.495	0.551	0.578	0.148	0.195	0.064
	(0.278)	(0.269)	(0.267)	(0.334)			
Obs.	272	74	161	37			

Columns (5), (6) and (7) represent normalized differences, in bold when statistically significant at the 5% level.
[a] 3643 dinars correspond to roughly 35 euro (1 RSD = 0.009626 Euro, November 2011).
[b] 15209 dinars correspond to roughly 146 euro (1 RSD = 0.009626 Euro, November 2011).
[c] The wealth index ranges between -3.135 and 2.865.
[d] 1709 dinars correspond to roughly 17 euro (1 RSD = 0.009626 Euro, November 2011).

between *only* and *mostly*. More substantial differences are found between *only* or *mostly* and *few*. Wealth and households with only Serbian names are higher in *few Roma*, while share of Muslims are lower.

Panel B of Table 1 reports the characteristics of the settlements. Households are equally located in urban and suburban areas, but *only Roma* settlements are more likely to be located in suburban areas.[23] Settlements do also vary in their access to schools and hospitals, *few Roma* settlements being better connected. While those could influence fertility through their impact on infant mortality, access to contraceptives or family planning services, as well as the cost of child quality, we believe that these differences should not play a role in the gender imbalances in terms of birth timing, therefore not compromising our general conclusions.

On average, Roma women in our sample have 3.2 children currently alive, of which 54% are boys (Panel C of Table 1). A preliminary investigation of our outcome of interest shows that the number of children is significantly lower in *few Roma* settlements than in the other types of settlements.[24] On average, in *few Roma* neighborhoods there are 2.8 children per household, while in *mostly Roma* and in *only Roma* neighborhoods there are respectively 3.2 and 3.6 children per household. The proportion of boys is not significantly different across the three groups, with slightly more boys in families in *few Roma* settlements.

3 Empirical Strategy and Results

3.1 OLS results

The summary statistics show that households in *only Roma* settlements have a higher fertility. Nonetheless they could be the reflection of different age structures, socio-economic conditions, family arrangements or returns to education. In this section, we test whether the gap in fertility across more or less segregated settlements persists once we take into account household and settlement characteristics. To do so, we estimate the following regression equation using OLS:[25]

$$F_{ijs} = \beta_0 + \beta_1 mostly\_roma_s + \beta_2 few\_roma_s + \gamma_1 X_{ijs} + \delta_1 S_s + \epsilon_{ijs} \quad (1)$$

[23] We define as urban area a local community with more than 35,000 inhabitants, in line with the definition of the Municipality of the City of Belgrade that distinguishes between urban and suburban areas on its own territory.

[24] We observe only children alive at the time of the survey and not the number of children ever born.

[25] We also use a Poisson model in order to take into account the fact that fertility is a count variable. Results are consistent and reported in Table C in the appendix.

where F_{ijs} stands for number of living children for a woman i in household j in settlement s. $mostly\_roma_s$ and few_roma_s are dummies equals to 1 if the household j lives in a *mostly* or *few Roma* settlement, respectively, the omitted category being *only Roma*.

The set of individual and household characteristics X_{ijs} and the vector of observable settlement characteristics S_s include controls for different mechanisms that could affect fertility. First, mother's age and age squared are present in all specifications, in order to make sure that our results are not driven by differences in the age structure of the female population across settlements. Columns (2) through (6) in all tables test each of the mechanisms mentioned in the introduction. In column (2), we include mothers' literacy and income, which are our closest proxies for the opportunity cost of female time, husband's income, as more bargaining power to men may translate in a larger family, household wealth, because richer household may afford more children, and the main source of income (either from social benefits, informal or formal employment).[26] In column (3) instead, we add expected returns to education, which may influence the way parents allocate resources to quality versus quantity of children.[27] In column (4), we use the number of adults in the household, to capture the fact that grandparents may help in taking care of larger cohorts of children. In column (5), we control for whether the settlement is in an urban or suburban area as a proxy for the cost of space. In column (6), we include cultural variables such as religion and whether parents' names are of Serbian origin.[28] Indeed families who declare being Christian Orthodox or whose first names sound typically Serbian might have been more influenced by Serbian cultural and social norms, among which that of having a small number of children.[29] Finally in column (7), we keep controls for all mechanisms and test their robustness.

Robust standard errors are clustered at the settlement level with Moulton confidence intervals in case of linear regressions (Imbens and Kolesár, 2016). Results of specification (1) are presented in Table 2.

The first striking result is that fertility differences documented in the descriptive statistics

[26] Ashraf et al. (2014) find that a larger bargaining power of women did increase contraceptive use and reduce fertility in the context of an experiment in Zambia.

[27] See the contributions by Kaufmann and Attanasio (2014); Jensen (2010); Nguyen (2008) for the impact of perceived returns to education on investment in education.

[28] More precisely, the religion dummy takes value 1 when Muslim and 0 when Christian Orthodox and other religions, but only 0.73% of our sample declares to practice another religion. We make use of the sounding of first names to capture acculturation in the spirit of recent papers like Algan et al. (2013); Abramitzky et al. (2016); Jurajda and Kovač (2016); Fouka (2019).

[29] In Serbia, 84% of the population is Christian Orthodox, 5% is Catholic, 3% is Muslim. The remaining 8% includes other religions, Atheists and people who do not declare their faith (Census, 2011).

Table 2: Number of children - OLS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All columns are estimated using OLS						
level of segregation - only roma (baseline)							
mostly roma	-0.341*	-0.290**	-0.326**	-0.337	-0.352*	-0.273	-0.215**
	(0.185)	(0.117)	(0.125)	(0.222)	(0.189)	(0.168)	(0.094)
few roma	-0.791***	-0.561***	-0.816***	-0.788***	-0.818***	-0.507	-0.459***
	(0.189)	(0.153)	(0.150)	(0.206)	(0.198)	(0.294)	(0.140)
mother's literacy		-0.150					-0.152
		(0.208)					(0.207)
mother's income		-0.027***					-0.021***
		(0.004)					(0.006)
father's income		0.009**					0.009*
		(0.004)					(0.005)
household wealth		-0.209***					-0.186***
		(0.055)					(0.057)
source income - formal sector job (baseline)							
social benefits		0.198					0.305
		(0.165)					(0.208)
informal sector job		0.316*					0.302
		(0.164)					(0.174)
expected returns to education			-0.350***				-0.293***
			(0.084)				(0.078)
number of adults				0.012			0.139
				(0.142)			(0.128)
urban					0.067		-0.040
					(0.157)		(0.102)
muslim						0.166	-0.021
						(0.202)	(0.213)
only serbian names						-0.682**	-0.403
						(0.234)	(0.280)
Mother's age and age squared	x	x	x	x	x	x	x
Obs.	272	271	272	272	272	272	271
r2	0.059	0.205	0.089	0.059	0.060	0.116	0.239
Test for the difference in coefficientes							
mosly roma and few roma (P-value)	0.0125	0.1386	0.0105	0.0129	0.0087	0.3724	0.1498

Robust standard errors clustered at the settlement level with Moulton confidence intervals in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

persist once controlled for individual, household and settlement characteristics. In particular, women living in *mostly Roma* settlements seem to have about between a third and a quarter fewer children than those in *only Roma* locations, but the coefficient is not always precisely estimated. More importantly women in *few Roma* settlements have around 0.5 to 0.8 fewer children than similar women in *only Roma* locations, and that difference is significant at the 1% level in all specifications. Such a large fertility gap across settlement is surprising as differences in individual characteristics did not seem particularly large (see Table 1) but also because Roma are usually regarded as a culturally homogeneous group.

The second observation is that adding controls in columns (2) to (6) tends to reduce the fertility gap, while including all controls reduces it by even more, as shown in column (7). Among significant controls, mothers' income and household wealth are strongly negatively associated to fertility, suggesting that the poorest households and households where mothers have a lower opportunity cost of time tend to have larger families. These results confirm previous findings, for instance by Jensen (2012), who finds that improved labor market opportunities not only substantially increase women's investment in education but as well delay marriage and fertility. The source of income instead does not seem to matter, while husband's income is positively related to a larger family. This suggests that a higher fertility is associated to a more pronounced specialization in the household.

Similarly, number of adults in the household and urban status, which are included to capture respectively different types of family arrangements and different housing prices, barely affect fertility. Higher perceived returns to education instead are strongly associated with a lower fertility, which illustrates the presence of a quality/quantity trade-off. A one standard deviation change in perceived returns to education is associated with a fall in fertility of 0.2 child. Battaglia and Lebedinski (2017) use the same data to show how enhancing people's perceived returns to education can impact positively labor market prospects and educational attainment.

Finally, religious affiliation does not seem to matter much, whereas exposure to the Serbian culture, as measured by whether parents hold Serbian sounding first names, is a strong predictor of a lower fertility. Indeed, shifting the prevalence of Serbian names from that in *few Roma* settlements down to the one observed in *only Roma* locations is associated with an increase in fertility of about 0.14 child.

When all controls are included together, the gaps between *mostly Roma* and *only Roma* and between *only Roma* and *few Roma* decrease in size but remain highly statistically significant.

Most of the channels that appear significant taken separately remain significant, except Serbian names. However the fact that it is not enough to close the gap indicates that several of these factors are probably confounded and that we do not estimate causal effects.

In Table D in the appendix, we focus on the subsample of women who reside in their settlement of birth. The rationale for this exercise is to avoid that what we claim is associated to segregation is actually due to recent migration patterns. Mothers who were born in the settlement in which they reside tend to be richer and to have significantly fewer children on average. Examination of the Table however shows that the exact same pattern emerges regarding the comparison between *only*, *mostly* or *few Roma* settlements. We can therefore be reassured that recent migration waves were not responsible for the higher fertility observed in more segregated areas.

We finally investigate the robustness of these associations using alternative measures of segregation in Table E in the appendix. Results remain qualitatively consistent using the median perception about whether the neighborhood is *only*, *mostly* or *few Roma* at the street level rather than at the settlement level.

3.2 Birth timing and son preference

In the previous subsection, we have examined the number of children women have controlling for a second order polynomial in their age. It implicitly imposes a structured, though quite flexible, relationship between age and the number of children that is common to all women in the sample. Our conclusions are therefore valid for completed fertility if birth timing does not differ significantly across settlement types.

In this subsection instead, we do away with this assumption by analyzing the pace at which women give birth instead of their total number of children only. In addition to confirming the conclusions drawn from the analysis of total number of children, looking at birth timing allows to investigate whether there are gender specific patterns. Indeed, in a context where sex-selective abortion is not significantly used, looking at the sex ratio at birth is not informative. Instead, son preference can be detected by looking either at the difference in waiting time after having a boy versus having a girl or at the sex ratio of last birth as originally suggested by Dalla Zuanna and Leone (2001).

To this end, we start by using a proportional hazard model, which leaves the baseline hazard rate unspecified and assumes that it is shifted multiplicatively by covariates.[30] We look separately at first births and then all subsequent births. In the first case, we define the at-risk period as starting at age 14, while we make it start 9 months after the previous birth we observe in the latter case. We acknowledge a potential limitation for first births as we observe only children still in the household at the time of the survey, which may differ from the universe of all births. Indeed some of the oldest mothers in the sample may have had an early child who already left the sample and whom we consequently do not observe. Imbalances in the sex-ratio of first born children confirm our hypothesis, as reported in Figure B in the appendix. The at-risk period ends either with a birth or with the woman actually leaving the sample (that is when the running variable reaches her age at the time of the survey). Notice that now the unit of observation is the post birth spell and not the mother, hence the increase in the number of observations. Covariates are assumed to affect the baseline hazard multiplicatively, so that the equation we estimate is the following:

$$h(t|x_c) \quad = \quad h_0(t)e^{x_c\beta_x} \tag{2}$$

where x_c includes the same controls as in the previous subsection. Robust standard errors are clustered at the settlement level with Moulton confidence intervals.

The baseline results shown in Table 3 shed some further light on the findings from the previous subsection. Panel A indicates that there are no significant differences in the timing of first births, while Panel B adds that women living in *few Roma* settlements have subsequent children at a significantly slower pace than their *mostly* or *only Roma* counterparts. The coefficient -0.449 on *few Roma* in column (1) corresponds to women in these neighborhood being 36% less likely to have an extra child than comparable women living in an *only Roma* settlement. Controlling for potential mechanisms reduces but does not close the gap between settlements with different levels of segregation. As before, we investigate the robustness of the analysis by using an alternative measure of segregation at the street level. Results remain consistent, as reported in Table F in the appendix.

Then we turn to whether birth timing differs according to the gender of the previously born child. To this end, we interact our measure of segregation with a dummy indicating whether

[30]We test the proportional hazard assumption. As reported in Figure A in the appendix, the curves representing the log(-log(survival)) versus the log of survival time for different settlement types are roughly parallel, providing evidence its favor.

Table 3: Birth spacing by settlement type

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All columns are estimated using a Cox proportional hazard model						
Panel A: Timing of first births							
level of segregation - only roma (baseline)							
mostly roma	0.052	0.108	0.058	0.025	0.032	0.094	0.128
	(0.085)	(0.077)	(0.091)	(0.093)	(0.085)	(0.059)	(0.082)
few roma	-0.019	0.067	-0.024	-0.041	-0.085	0.072	0.077
	(0.060)	(0.057)	(0.105)	(0.075)	(0.125)	(0.094)	(0.115)
Obs.	272	271	271	272	272	272	271
Panel B: All subsequent births							
level of segregation - only roma (baseline)							
mostly roma	-0.157	-0.144	-0.134	-0.128	-0.171	-0.122	-0.097
	(0.126)	(0.109)	(0.101)	(0.151)	(0.126)	(0.130)	(0.133)
few roma	-0.449***	-0.397***	-0.466***	-0.427***	-0.477***	-0.322*	-0.326**
	(0.156)	(0.126)	(0.137)	(0.158)	(0.159)	(0.191)	(0.136)
Mother's age and age squared	x	x	x	x	x	x	x
Opportunity cost of time ch.		x					x
Expected return to education			x				x
Number of adults				x			x
Urban					x		x
Cultural ch.						x	x
Obs.	881	879	864	881	881	881	879

Robust standard errors clustered at the settlement level with Moulton confidence intervals in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

the previously born child was a male or a female.[31] To make sure that children leaving the household early on does not introduce too much error in the measurement of the gender of the previously born or first born child, we choose to restrict the sample to mothers below 33 years of age.[32] Results are presented in Table 4.

The main result to highlight in this table is that the difference in birth spacing across settlement types comes mostly from the difference in birth spacing after a boy was born. Indeed, households in *only Roma* and *mostly Roma* do not exhibit significantly different spacing pattern after boys or girls. However, households living in a *few Roma* settlement tend to space substantially more after a boy, which is illustrated by the coefficient on "*few Roma* - male". The coefficients in column (1) indicate that the hazard ratio of having an extra child after a male is 23% smaller than after a girl for households in *only Roma* settlements (but this difference is not

[31]This is related in spirit to a recent contribution by Dimri et al. (2017) who analyze the patterns of birth spacing in function of the gender of the next born, in the presence of sex-selective abortions.

[32]Figure B in the appendix plots the sex-ratio of children in the sample as we vary the upper age limit of mothers. It shows very clearly that sex-ratios are around the biological level for mothers aged 33 or below, while they become very skewed when we include older mothers. We suspect that this is because daughters tend to leave the household earlier than sons.

Table 4: Birth Spacing by settlement type and gender of previously born child - sample of women aged 33 or less

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All columns are estimated using a Cox proportional hazard model						
previously born: female - level of segregation: only roma (baseline)							
female - mostly roma	-0.091	-0.031	-0.104	-0.062	-0.101	-0.071	0.019
	(0.123)	(0.114)	(0.109)	(0.135)	(0.156)	(0.132)	(0.135)
female - few roma	-0.113	0.032	-0.132	-0.091	-0.124	0.031	0.187
	(0.091)	(0.143)	(0.082)	(0.093)	(0.100)	(0.205)	(0.189)
male - only roma	-0.258	-0.247	-0.275	-0.257	-0.256	-0.245	-0.238
	(0.195)	(0.186)	(0.202)	(0.195)	(0.202)	(0.176)	(0.170)
male - mostly roma	0.097	0.018	0.106	0.095	0.099	0.099	0.025
	(0.258)	(0.271)	(0.265)	(0.258)	(0.256)	(0.245)	(0.255)
male - few roma	-0.604*	-0.490*	-0.581**	-0.621**	-0.606**	-0.565***	-0.493**
	(0.260)	(0.273)	(0.273)	(0.252)	(0.265)	(0.215)	(0.233)
Mother's age and age squared	x	x	x	x	x	x	x
Opportunity cost of time ch.		x					x
Expected return to education			x				x
Number of adults				x			x
Urban					x		x
Cultural ch.						x	x
Obs.	554	552	550	554	554	554	552

Robust standard errors clustered at the settlement level with Moulton confidence intervals in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

statistically different from zero), while it is 58% smaller in the case of *few Roma* households. This latter difference is significantly different from zero at the 5% level. The same pattern emerges as controls are added: they allow to close only partially the gap in birth timing across settlement types.

3.3 Comparing son preference across Roma and non-Roma communities in Serbia

In this subsection, we attempt to give further evidence that a cultural transmission process is at work. We use data on Roma and non-Roma populations from the MICS 2010 to analyze how their birth spacing patterns depend on the gender of the previously born child. We illustrate those patterns comparing the Kaplan-Meier survival curves for all births following a male baby to those following a female baby (which requires that we exclude first births) for both Roma and non-Roma. Results are shown in Figure 2. It appears that Roma and non-Roma Serbs exhibit a very similar pattern of shorter spells after a female baby. Table G in the appendix confirms that non-Roma populations do exhibit a low fertility - 1.73 children per woman on average - and a longer spacing after boys than after girls. While this in theory could be driven by common determinants across communities, we believe it points at a phenomenon of cultural assimilation from the Roma minority into the Serbian majority. Indeed, our data reveals that these specific gender patterns are dominantly prevalent in Roma settlements where they are a minority surrounded by non-Roma populations, as shown in Figure 3.

Figure 2: Kaplan-Meier survival curves by gender of the previously born child using MICS 2010 data

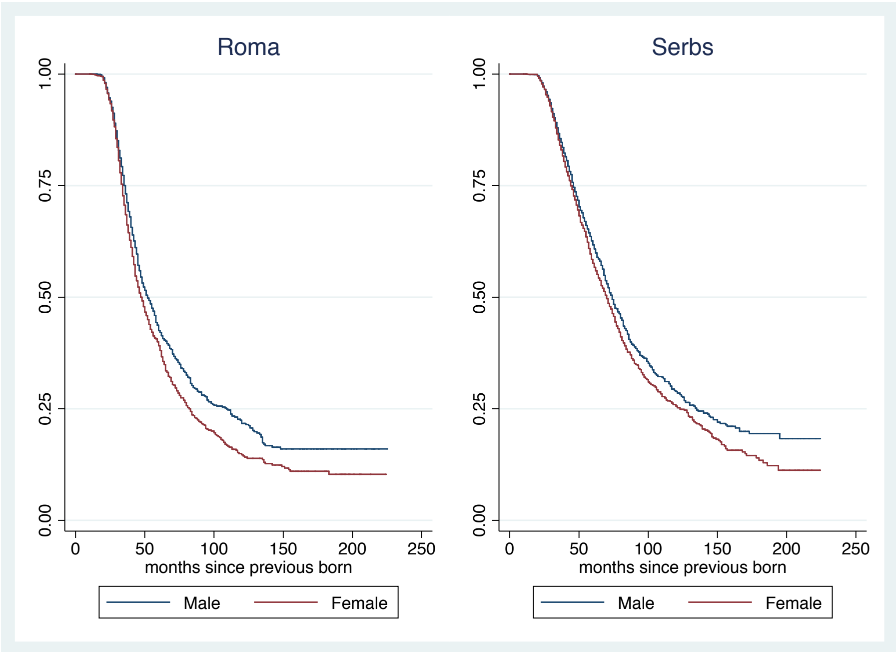
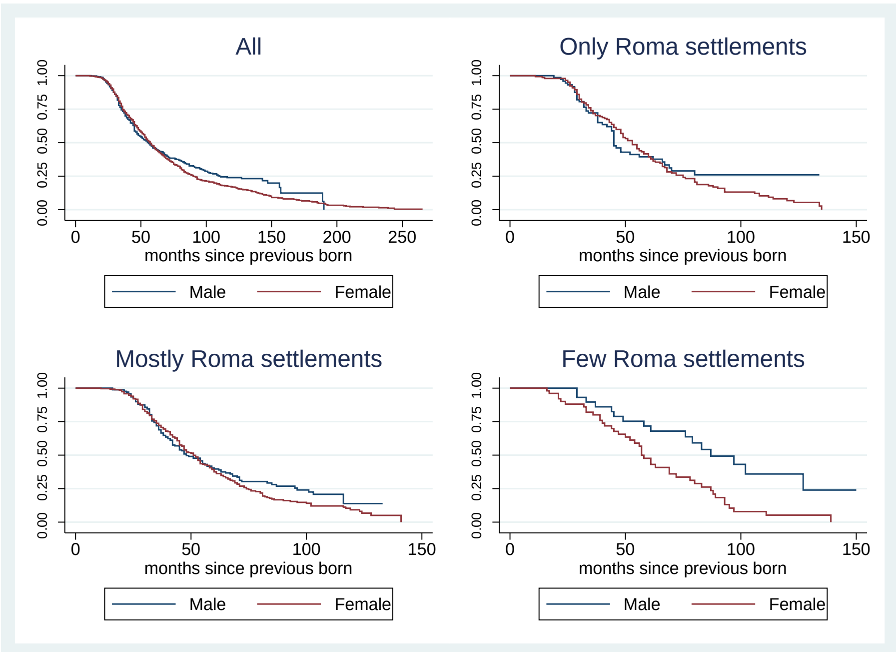


Figure 3: Kaplan-Meier survival curves by gender of the previously born child



While we are not aware of other studies documenting higher birth spacing after boys in

Serbia or in other countries of the Western Balkans, high sex ratios at birth have been recently observed in several countries of the region (UNFPA, 2012).[33] According to Guilmoto and Duthé (2013), together with the fertility decline and the development of modern healthcare services, the persistence of traditional patriarchal values is central to the son preference observed in these countries. Conversely, traditional Roma societies, especially in rural areas, show a female-biased sex ratio at birth and invest more heavily in daughters since they are more likely than sons to help their parents in taking care of siblings (Bereczkei and Dunbar, 1997, 2002).

As a final check that the birth spacing patterns observed do reveal a higher son preference in less segregated Roma settlements as well as in non-Roma communities, we look at the the sex ratio at last birth. Indeed, as originally suggested by Dalla Zuanna and Leone (2001), the sex ratio at last birth captures gender biased preferences in a context where couples decide to halt fertility after the birth of a son. To focus on last births, we include women who have at least one child and have not had children in the past five years. The sex ratios at last birth are shown in Table H in the appendix for our data on the left panel and for Roma and non-Roma in the MICS on the right panel.

The sex-ratio at last birth appears to be significantly higher than 0.5 for Roma both in our data, at 0.596, and in the MICS, at 0.564. Our data reveals that this skewness is largely driven by a very unbalanced ratio in *few Roma* settlements at 0.778. The sex ratio at last birth for non-Roma in the MICS is much lower than that, at 0.528, but statistically different from 0.5 and measured on a much larger sample. Ideally we would like to measure the sex ratio at last birth of non-Roma populations that are in contact with Roma settlements. Unfortunately it is not something the MICS allows us to do. Ultimately, the sex-ratio at last birth is an additional element pointing at a cultural transmission channel from the Serbian majority to the least segregated Roma communities.

The sex-ratio at last birth points at the importance of differential stopping behavior. For comparison purposes, we reproduce Table 4 on a restricted the sample limited to all censored inter-birth spells and censored post-birth spells of less than five years. The idea is to check whether inter-birth spacing behavior (excluding therefore differences in stopping behavior) also differs across settlement types. Results are shown in Table I. Although it appears that *few Roma* communities consistently space more after boys than girls, the picture is less clearcut

[33] In Albania, the sex-ratio hovers around 110 (a normal sex ratio is 105). In Montenegro, for the period 2009-2011, the sex ratio at birth was 109.8. In Kosovo, for the period 2011-2013, the sex ratio at birth was 110.4. In Serbia, for the period 2000-2005, the sex ratio at birth was 107.

than in the overall sample, as *mostly Roma* do so as well to some extent. Additionally, *few Roma* also space comparatively more after girls than *mostly* and *only Roma*. Altogether these results show that both spacing and stopping happen at a different rate after a son and after a daughter, but differential stopping behavior is key in order to get a clear picture about the higher son preference in *few Roma* communities.

4 Conclusion

We provide evidence of substantial spatial disparities in fertility behavior across neighborhoods within a given supposedly homogeneous minority group. We find that fertility is lower and son preference more pronounced in Roma settlements which are less segregated from the rest of the Serbian society. Our analysis of the potential mechanism points to the greater exposure of less segregated areas to the Serbian culture, in which fertility tends to be low and boys preferred.

Our results suggest that cultural diffusion (or lack thereof) is an important factor to take into account while designing policies. Indeed, policies aiming at changing economic incentives of marginalized populations may remain inefficient for a while if these populations are severely segregated away from other fringes of the population. Policies promoting social mixing on the other hand could go a long way as exposure to different cultural norms seems conducive to rapid behavioral change. This could prove all the more powerful in the context of fertility choices as more evidence shows that decreasing fertility has been a key element triggering the take-off to the modern growth regime (Chatterjee and Vogl, 2017).

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A Appendix

A.1 Additional tables

Table A: Characteristics of Roma versus Non-Roma

Demographic characteristics	Roma	Non-Roma
Household size	5.60	3.50
Number of children younger than 18 (in household)	2.40	0.86
Age (average)	24.75	35.65
Population younger than 18	0.43	0.25
Employment rate* (males)	0.57	0.56
Employment rate* (females)	0.11	0.40
Individuals below the poverty line*	0.46	0.07
Education		
Children between 6 and 15 not enrolled in school	0.11	0.01
Unfinished primary school	0.29	0.04

Source: Serbia - MICS 2010, except * source: Serbia - LSMS 2007

Table B: Households' Characteristics - Comparison

Variable	Our data Roma (1)	MICS 2010 Roma (2)	MICS 2010 Non-Roma (3)
total fertility rate	2.34	2.7	1.7
Households' characteristics			
age	32.51	28.12	31.84
	(5.66)	(5.71)	(4.56)
age at first birth	20.15	20.12	26.10
	(4.07)	(3.82)	(4.42)
mother's years of schooling	5.36	7.46	12.87
	(3.14)	(2.47)	(2.16)
number of children below 6	0.78	1.10	0.60
	(0.81)	(0.96)	(0.75)
number of children 6 to 14 years	2.16	0.98	0.37
	(0.93)	(1.13)	(0.68)
number of adults	2.24	3.45	2.98
	(.82)	(1.47)	(1.23)
number of adults older than 65	0.04	0.10	0.39
	(0.21)	(0.36)	(0.65)
born in Serbia* (=1)	0.84	0.90	0.91
Obs.	274	1711	6392

Source: Own data and MICS, except * Serbia - LSMS 2007. Standard deviations reported in parenthesis, except for total fertility rate that has only one observation by sample at hand.

Table C: Number of children - POISSON

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All columns are estimated using a Poisson model						
level of segregation - only roma (baseline)							
mostly roma	-0.101*	-0.083***	-0.095**	-0.099	-0.104*	-0.079*	-0.057**
	(0.054)	(0.032)	(0.037)	(0.064)	(0.055)	(0.047)	(0.027)
few roma	-0.249***	-0.180***	-0.254***	-0.248***	-0.257***	-0.459*	-0.137***
	(0.057)	(0.047)	(0.047)	(0.062)	(0.059)	(0.092)	(0.046)
literacy		-0.043					-0.041
		(0.057)					(0.055)
mother's income		-0.010***					-0.008***
		(0.001)					(0.002)
father's income		0.003**					0.003**
		(0.001)					(0.001)
household wealth		-0.063***					-0.056***
		(0.016)					(0.017)
source of income - formal sector job (baseline)							
social benefit		0.062					0.090
		(0.049)					(0.062)
informal sector job		0.096*					0.088
		(0.050)					(0.054)
expected return to education			-0.104***				-0.083***
			(0.023)				(0.021)
number of adults				0.003			0.043
				(0.044)			(0.040)
urban					0.021		-0.013
					(0.048)		(0.029)
muslim						0.052	-0.004
						(0.062)	(0.063)
only serbian names						-0.232***	-0.144
						(0.077)	(0.091)
Mother's age and age squared	x	x	x	x	x	x	x
Obs.	272	271	272	272	272	272	271

Robust standard errors clustered at the settlement level with Moulton confidence intervals in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The omitted category is *only Roma* settlements.

Table D: Number of children - OLS
sample of women who always reside in the same settlement

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All columns are estimated using OLS						
level of segregation - only roma (baseline)							
mostly roma	-0.369*	-0.360**	-0.417**	-0.355*	-0.361	-0.294**	-0.289**
	(0.184)	(0.161)	(0.177)	(0.197)	(0.231)	(0.131)	(0.111)
few roma	-0.841***	-0.691***	-0.894***	-0.831***	-0.827***	-0.454	-0.433*
	(0.176)	(0.147)	(0.217)	(0.173)	(0.188)	(0.289)	(0.208)
literacy		-0.173					-0.211
		(0.264)					(0.267)
mother's income		-0.023***					-0.011
		(0.006)					(0.007)
father's income		0.010**					0.007*
		(0.004)					(0.004)
household wealth		-0.187***					-0.130***
		(0.038)					(0.041)
source income - formal sector job (baseline)							
social benefit		0.192					0.250
		(0.156)					(0.202)
informal sector job		0.285					0.276
		(0.177)					(0.165)
expected returns to education			-0.330***				-0.350***
			(0.069)				(0.079)
number of adults				0.028			0.091
				(0.143)			(0.127)
urban					-0.032		-0.178
					(0.220)		(0.108)
muslim						0.493**	0.394
						(0.211)	(0.257)
only serbian names						-0.545*	-0.324
						(0.264)	(0.361)
Mother's age and age squared	x	x	x	x	x	x	x
Obs.	210	209	210	210	210	210	209
r2	0.077	0.209	0.105	0.078	0.078	0.224	0.305

Robust standard errors clustered at the settlement level with Moulton confidence intervals in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The omitted category is *only Roma* settlements.

Table E: Number of children: Alternative measures of residential segregation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All columns are estimated using OLS						
mostly roma street	-0.593***	-0.452***	-0.505***	-0.589**	-0.592**	-0.481**	-0.281*
	(0.186)	(0.129)	(0.128)	(0.216)	(0.197)	(0.181)	(0.139)
few roma street	-0.963***	-0.628***	-0.865***	-0.961***	-0.962***	-0.723***	-0.420**
	(0.231)	(0.192)	(0.189)	(0.245)	(0.235)	(0.228)	(0.175)
share only roma	0.010***	0.008***	0.009**	0.010**	0.011***	0.007**	0.004
	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)
Mother's age and age squared	x	x	x	x	x	x	x
Opportunity cost of time ch.		x					x
Expected return to education			x				x
Number of adults				x			x
Urban					x		x
Cultural ch.						x	x
Obs.	272	271	272	272	272	272	271

Robust standard errors clustered at the settlement level with Moulton confidence intervals in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The omitted category is *only Roma* street.

Table F: Birth Spacing - Alternative measure of residential segregation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All columns are estimated using a Cox proportional hazard model						
mostly roma street	-0.263**	-0.225**	-0.246**	-0.243*	-0.267**	-0.207*	-0.177
	(0.115)	(0.106)	(0.098)	(0.134)	(0.117)	(0.123)	(0.142)
few roma street	-0.468***	-0.371***	-0.464***	-0.459***	-0.471***	-0.355**	-0.292**
	(0.138)	(0.108)	(0.137)	(0.149)	(0.137)	(0.139)	(0.124)
share onlyroma	0.005**	0.004**	0.005**	0.005*	0.005**	0.004*	0.003
	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)
Mother's age and age squared	x	x	x	x	x	x	x
Opportunity cost of time ch.		x					x
Expected return to education			x				x
Number of adults				x			x
Urban					x		x
Cultural ch.						x	x
Obs.	881	879	864	881	881	881	879

Robust standard errors clustered at the settlement level with Moulton confidence intervals in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The omitted category is *only Roma* street.

Table G: Birth spacing - gender differences using previously born children - Serbs

	(1)	(2)	(3)
	COX	COX	COX
average number of children: 1.73 (0.737)			
male	-0.100***	-0.111**	-0.132***
	(0.042)	(0.043)	(0.047)
age mother		0.057	0.170**
		(0.061)	(0.071)
age mother sq		-0.002**	-0.004***
		(0.001)	(0.001)
Obs.	4701	4701	4701

Robust standard errors clustered at the district level in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. In column (1) no additional controls are added; in column (2) we only control for mother's age and age squared; in column (3) we also control for the ranking among children, mother's level of education, wealth and district fixed effects. Source: MICS 2010.

Table H: Gender of the last born child

	Our data				MICS 2010	
	(1)	(2)	(3)	(4)	(5)	(6)
	All	Only Roma	Mostly Roma	Few Roma	Roma	Non-Roma
Boy(=1)	0.596**	0.585	0.555	0.778***	0.574**	0.539**
	(.492)	(.499)	(.499)	(.424)	(.496)	(.499)
Obs.	178	41	110	27	204	686

The sample is composed of women with at least one child, who have not had a child in the past five years. Standard deviations reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table I: Birth Spacing - sample of women aged 33 or less - excluding suspected stopping behavior

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All columns are estimated using a Cox proportional hazard model						
previously born: female - level of segregation: only roma (baseline)							
female - mostly roma	0.088	0.082	0.058	0.093	0.072	0.107	0.078
	(0.152)	(0.121)	(0.146)	(0.168)	(0.162)	(0.154)	(0.150)
female - few roma	-0.211	-0.220**	-0.260**	-0.205	-0.223*	-0.235	-0.257*
	(0.131)	(0.100)	(0.117)	(0.153)	(0.133)	(0.149)	(0.142)
male - only roma	-0.056	-0.091*	-0.128***	-0.054	-0.061	-0.057	-0.143***
	(0.045)	(0.053)	(0.038)	(0.039)	(0.041)	(0.045)	(0.042)
male - mostly roma	-0.277***	-0.244***	-0.212**	-0.280***	-0.269**	-0.272**	-0.206**
	(0.101)	(0.090)	(0.103)	(0.100)	(0.106)	(0.112)	(0.099)
male - few roma	-0.326***	-0.235**	-0.307**	-0.327***	-0.316***	-0.294**	-0.222
	(0.113)	(0.117)	(0.156)	(0.114)	(0.111)	(0.141)	(0.184)
Mother's age and age squared	x	x	x	x	x	x	x
Opportunity cost of time ch.		x					x
Expected return to education			x				x
Number of adults				x			x
Urban					x		x
Cultural ch.						x	x
Obs.	669	668	657	669	669	669	656

The sample is composed of all censored inter-birth spells and uncensored post-birth spells of less than 5 years.
Robust standard errors clustered at the settlement level with Moulton confidence intervals in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

A.2 Additional figures

Figure A: Test of the proportional hazard assumption

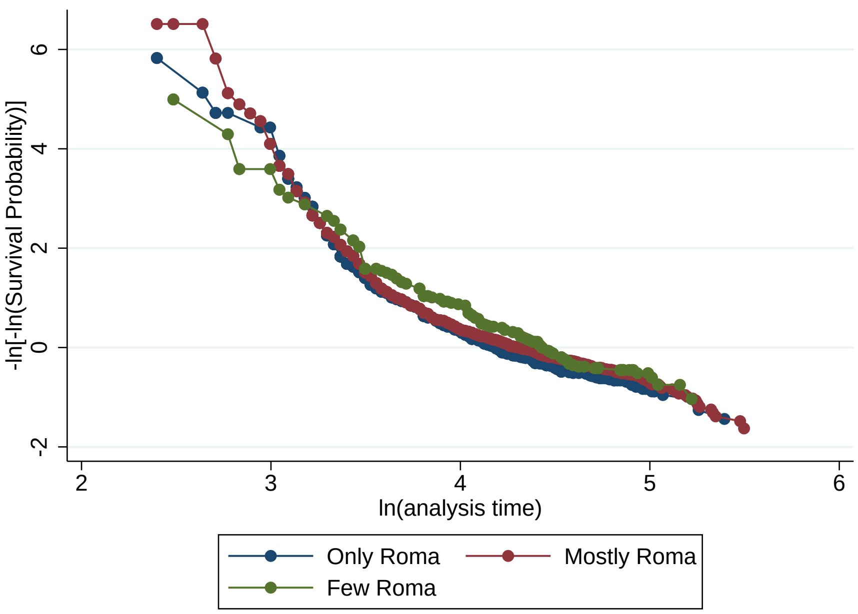

Figure B: Sex ratio by upper limit on mother's age