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Sustained and Universal Fertility Recuperation in Kazakhstan

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Abstract

The fertility rates of Kazakhstan have reversed to levels not seen since several decades ago. The striking fertility increase poses questions on the extent to which this new development is shared across socio-demographic groups and the nature of fertility recuperation. The current study employs UNICEF Multiple Indicator Cluster Survey data and event-history modelling to analyse parity progressions one to four. The results suggest a sustained fertility increase that is not merely associated with the recuperation of delayed first births, but a genuine increase across all birth orders. This pattern was evident for both main ethnicities in Kazakhstan and across educational groups. The gradual increase of higher-order births, especially among ethnic Kazakhs, indicates either a reversed fertility transition or the fact that the previous fertility decline in the 1990s was not a part of a general transition towards below-replacement fertility but rather reflects a situation where fertility and the business-cycle are positively correlated.

Keywords: fertility, demographic transition, pro-cyclical fertility, ethnicity, Post-Soviet, Kazakhstan, MICS

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Introduction

The Total Fertility Rate (TFR) of Kazakhstan has been on a recent roller coaster, dropping from 2.84 in 1989 to 1.80 in 1999 and rebounding back to 3.00 in 2018 (Demoscope, 2019). These strong fertility fluctuations may at first sight appear puzzling but can be linked to several aspects of social change in Kazakhstan during the transition from a Soviet to a post-socialist independent republic. The decline in fertility in the 1990s can be attributed to the economic crisis and restructuring of the society during the transition to a market economy in the 1990s (Billingsley, 2010; Spoorenberg, 2015). Industries disappeared, inflation skyrocketed, and unemployment and wage arrears were widespread (Alam & Banerji, 2000). In addition, many institutional factors such as childcare provision (Information-Analytic Centre, 2017), maternity leave policies, and other forms of social benefits were significantly reduced during the 1990s (Werner et al., 2017). In contrast, economic measures improved substantially in the 2000s, mostly due to increasing oil prices and foreign investments in extraction industries. The TFR appears to have followed the economic growth of the country. Indeed, a study by Spoorenberg (2015) suggested that 81% of the TFR increase from 2000 to 2011 was due to economic growth.

The more recent developments are also noteworthy because during the 2010s aggregate fertility measures show a sustained upward trend. The dramatic recovery in TFR seems to contradict the irreversibility argument of the logic of both the first and second demographic-transition frameworks (Coleman, 2006; Lesthaeghe, 2020). The recent TFR data indicate that the fertility recuperation studied in Spoorenberg (2015) has persisted over quite an extended period of time. Whereas Spoorenberg (2013, 2015) relied on aggregate data, our study employs individual-level data on parity progressions that will allow us to derive better insight into the underlying patterns of recent fertility change. Individual-level data drawn from records of fertility histories have the capacity to unravel patterns of fertility change that are not masked by compositional changes in the population at hand and allow us to explore the extent to which fertility trends have been universal or specific to different sub-groups of the population.

Specifically, the sweeping changes in Kazakhstan since the collapse of the USSR have been argued to affect the two main ethnic groups in the country differently (Agadjanian, 1999; Agadjanian et al., 2008; Agadjanian et al., 2013). Ethnic Russians and ethnic Kazakhs have long experienced very different fertility profiles, whereby the former group appears to be on track for a situation that is normally ascribed to that of a Second Demographic Transition (Lesthaeghe & Surkyn, 2004), similar to co-ethnics in Russia (Zakharov, 2008). Meanwhile, the latter majority group may still experience fertility change that could belong to patterns of fertility decline that occur during an initial demographic transition. Different reactions to economic and social developments may also have induced different fertility reactions for different socioeconomic groups in Kazakhstan. In particular, it is imperative to study how fertility developments and recent fertility increases have been at play for women of different levels of educational attainment.

In summary, our study extends previous research on reproductive behaviour in Kazakhstan by using more recent demographic data that stretch into the 2010s, by employing event-history analyses of parity-specific fertility transitions, and by analysing socio-demographic differentials in fertility change. In our study, we raise the following research questions: 1) Was the fertility increase that occurred in the early 2000s a temporary deviation from previous trends or part of behavioural change that reflects a more long-term return to more elevated fertility? 2) Was the pattern of fertility recuperation a universal development or did it belong to specific subgroups of the population, reflecting ethnic and socioeconomic differences in behavioural change?

Literature review/Theoretical perspectives

Demographic Transitions

To understand the fertility changes that were observed in Kazakhstan in the 1990s and 2000s, it is first worth positioning these developments within the frameworks of demographic transition theory. Demographic transition theory assumes a development from a situation with high mortality and fertility towards that of low mortality and fertility (Notestein, 1945). This happens as countries make significant progress in reducing mortality, including among infants (Kirk, 1996). Thus, more surviving children indirectly influence fertility considerations. Furthermore, with the development of more efficient contraceptive methods, people gained more control over family planning and can better regulate their fertility (Coale, 1984).

Following the path assumed by the demographic transition framework, the total fertility (TFR) in Kazakhstan decreased from 4.5 in 1959, which was one of the highest levels among the Soviet Republics, to 2.91 in 1981. However, comparisons of aggregate TFR numbers for Kazakhstan across time points are not very informative because massive shifts in the population composition occurred at these times. In particular, the 1960s were associated with a big influx to Kazakhstan of Russian and other Slavic people from the European parts of the USSR, who presumably had already completed their fertility transition by that time (Zakharov, 2008). To disentangle Kazakhstan's fertility trends, one needs more disaggregated data than those based on national averages.

A below-replacement level of fertility in Kazakhstan was achieved in the 1990s. This could have been regarded as evidence of the completion of the country's demographic transition, which would have involved a stabilization of fertility around this level. Unexpectedly, however, the TFR increased gradually in the 2000s to levels only seen decades ago. This development casts doubt on whether the fertility decline in Kazakhstan during the 1990s was in fact belonging to the final phases of the country's demographic transition.

Even though aggregate fertility levels show that the 1990s decline was temporary, it may be the case that at least some parts of the country's population experienced the final stage of the classical demographic transition (Blue & Espenshade, 2011) or even belonged to developments typically referred to as the Second Demographic Transition (Lesthaeghe & Surkyn, 2004). The Second Demographic Transition (SDT) is associated with a substantial decline in period fertility rates due to increasing levels of individualization, shifts in values and attitudes, the postponement of marriage and first childbearing, and increases in nonmarital childbearing (Lesthaeghe & Surkyn, 2004). Already in the mid-twentieth century, Russian and other Slavic people were different from the titular ethnicity of Kazakhstan in terms of familial ties, family size, aggregate fertility, and gender roles. Thus, these groups of people could have been forerunners in the formation of new values in the country that were also shared by their co-ethnics in Russia (Zakharov, 2008). Moreover, recent studies show that one-child families have become the most prevalent family form in Russia (Frejka & Gietel-Basten, 2016) and ethnic Russians have among the lowest fertility levels of ethnic groups in Russia (Kazimov & Zakharov, 2021). Thereby, differences in fertility developments between ethnic groups in relation to both the first and second demographic transitions may be relevant to consider in the case of Kazakhstan.

On the other hand, both the first demographic transition and the second demographic transition's irreversibility have been questioned by propositions derived from evolutionary theory. For example, Burger and DeLong (2016) argue that demographic behaviour is partially influenced by genetic factors which make people respond to different social and ecological conditions. Since these conditions can change in different ways, fertility levels may increase or decrease and not remain at stable levels. Furthermore, Burger and DeLong (2016) argue that changes in cultural norms do not always lead to low fertility. In the case of Kazakhstan, we note a combination of new lifestyles coming from more developed societies after the collapse of the USSR, but also a reassessment of its own cultural heritage, traditions, and religion that could affect childbearing behaviour in different directions.

Some of the proponents of the classical demographic transition theory also highlighted the delaying effect of religion on the onset and speed of fertility change. Thus, Coale (1984) pointed out that the fertility decline in Central Asia happened later than in other parts of the USSR and argued that Muslim culture could be particularly resistant to lower fertility. Similarly, Kirk (1996) argued that Muslim countries had been slower to enter the fertility transition, while more recently also Lesthaeghe (2020) questions the applicability of the SDT framework to the context of patriarchal Muslim countries. Considering the changes in the ethnic composition of the country and the increase in religiosity and restoration of traditions and customs among ethnic Kazakhs (Telebaev, 2003; Aydıngün, 2010; Yerekesheva, 2020), we may assume that these factors also have an impact on fertility developments and demographic transition.

Procyclical relationship of fertility with business cycles

Apart from the demographic transition arguments, looking at economic developments may shed light on fertility change in the country. A procyclical relationship between period fertility measures and the business cycle would mean that the aggregate fertility rate may drop during an economic recession while it can increase during periods of economic growth. This has been empirically found in many developed countries (Andersson, 2000; Sobotka et al., 2011; Karaman Örsal & Goldstein, 2018). A similar pro-cyclical association has also been found in post-communist settings (Kohler & Kohler, 2002; Sobotka, 2011). Furthermore, Perelli-Harris (2005) associated low fertility in Ukraine with persistent stopping behaviour after a first birth in relation to an economic crisis. Billingsley (2010) also found that economic crisis in the post-socialist region was associated with stopping behaviour in childbearing, while economic improvement was associated with birth postponement. In a study on Central Asia and Kazakhstan, Spoorenberg (2015) found that fertility was pro-cyclically associated with the growth of GDP and that the increase in fertility rates was not merely due to a reduced pace of childbearing postponement.

However, we do not expect fertility to continue increasing as long as there is economic growth. Under improved economic conditions parents may have more resources to support more children. But apart from better affordability of childrearing under improved economic conditions, people also face higher opportunity costs. Thus, it is expected that fertility recuperates during economic improvement but then stabilizes at some levels: at replacement-level fertility or at levels where the country is otherwise situated during its course of demographic transition.

Educational attainment and fertility

Education within demographic transition theory

According to classical demographic transition theory, increased education among women is associated with fertility decline through the postponement of marriage and first births (Kirk, 1996). In addition, it has been suggested that the timing of fertility decline during the demographic transition was influenced more by women's education than by purely economic factors of modernization and that the transition has been more closely associated with the diffusion of new ideas than economic development (ibid.). At the same time, increases in the returns to education lead to increased spending on education and thereby child-rearing becoming more expensive. Thus, parents tend to spend more resources on each child and this leads to fewer children (Becker, 1981).

Education and economic cycles

Reaction to an economic recession/economic growth and its association with fertility may also depend on women’s and men’s educational attainment. More educated women are more likely to postpone childbearing during times of an economic recession to avoid a decrease in income and career stability (Becker, 1981; Sobotka et al., 2011). In contrast, less educated women may find it even more difficult to get employment during economic recession time and could strive for another "strategy" such as childbearing, especially if it is accompanied by some state financial support (Friedman et al., 1994; Sobotka et al., 2011). Thus, an economic recession may stimulate fertility increase among the less educated and fertility decrease among more educated women. Similarly, Kreyenfeld (2016) found that a secure economic situation is not a uniform prerequisite for childbearing and that this is more important for educated women and those who start their families at later ages. Comolli et al. (2021) instead showed a reversal from heterogeneity to homogeneity in educational differences in birth hazards in relation to the economic uncertainty of the Great Recession of 2008-2009 in the Nordic Region.

In the post-Soviet context, Billingsley (2011) found a uniform decline of second birth rates in Russia within educational groups and occupational classes during the economic crisis and that they did not increase to pretransition levels during the early years of economic recovery (up to 2004). Considering the above-mentioned empirical findings and the transition to a market economy in Kazakhstan during the turbulent 1990s and the subsequent economic improvement during the 2000s, we can assume that people with different educational levels could display different fertility patterns and trends of fertility change.

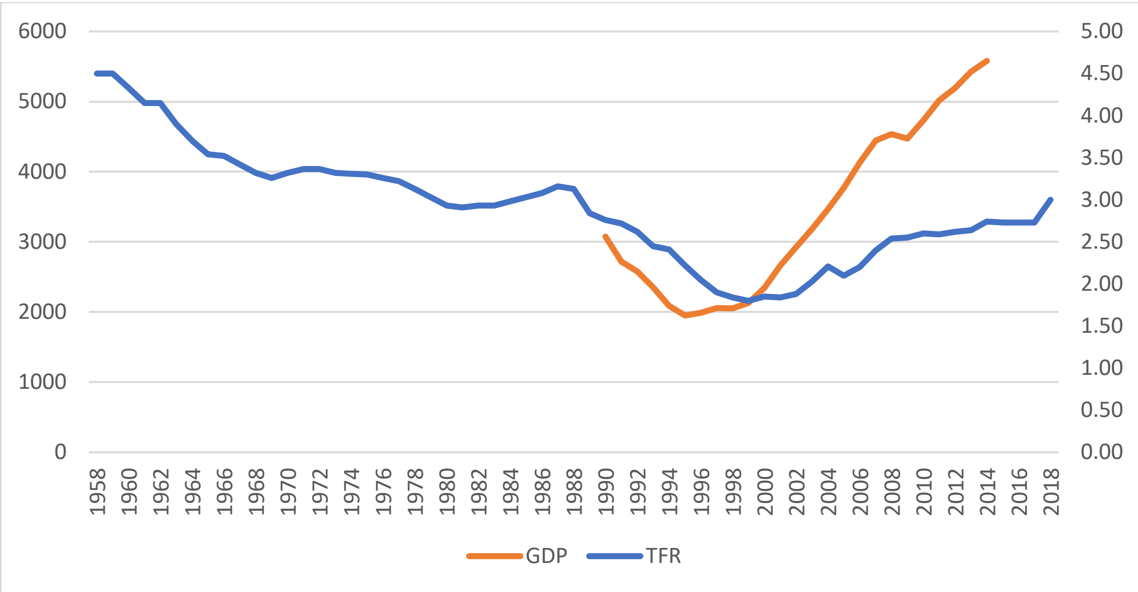
In the next section, I present the background in terms of changes in the economic context in Kazakhstan from 1991 to 2015, as well as changes in family policies and the ethnic composition in the country during the period. That makes the basis for the current study to situate the above-mentioned theories and empirical findings to the context of Kazakhstan.

Kazakhstan case

Economy

In Figure 1, we can see that changes in the Total Fertility Rate (TFR) of Kazakhstan have been following changes in the Gross Domestic Product (GDP) of the country. Since the collapse of the Soviet Union and during the transition to a market economy we can observe a steady decline of the TFR down to an under-replacement level for most of the 1990s. After the turn of century, we can see that the TFR rebounded to levels last seen in the late 1980s.

Figure 1: Gross Domestic Product per capita, 1990-2014 and Total Fertility Rate in Kazakhstan, 1958-2018



Source: TFR constructed using data available at http://www.demoscope.ru/weekly/ssp/sng__tfr.php and GDP is taken from TransMonee Database, UNICEF

Gaining independence and transitioning to a market economy was first associated with a significant economic crisis. The whole economy that was centrally planned during the Soviet time needed to be restructured and many industries and jobs disappeared, meaning that returns to education for many people became insignificant. The turbulent 1990s in Kazakhstan were associated with hyperinflation, a high level of unemployment, but also that even those who were employed either did not receive salaries for many months (wage arrears) or received salaries in non-cash contributions (Alam & Banerji, 2000). Thus, the standards of living deteriorated massively, income levels dropped and GDP per capita decreased at least by a third during the 1990s in comparison with pre-independence time. However, Kazakhstan was later able to develop better and achieve economic growth that led to the surpassing of late USSR levels of GDP in the early 2000s and almost a doubling of GDP per capita by 2014 (TransMonee Database, 2020).

Family policies

Early independence years were also associated with the deterioration of the social protection that people were used to during the Soviet time. Thus, we can observe a dramatic decrease in the number of available preschools. The number of preschool settings in Kazakhstan was eight times lower in 2000 than in the year preceding the collapse of the Soviet Union (Information-Analytic Centre, 2017). Kazakhstan was only able to match the number of preschool settings of 1990 in 2015. The participation rates for 3-6-year-olds in early childhood education and care were above 50% during the years before independence and dropped dramatically to 12% in most of the turbulent 1990s (TransMonee Database, 2020). Only from the early 2000s has there been a gradual increase in enrolment rates, and the pre-independence rates were only achieved in the early 2010s. The provision of childcare can substantially influence fertility decisions (see Baizan 2009 for Spain; Rindfuss et al., 2010 for Norway; Fukai, 2017 for Japan, Wood, 2019 and Wood & Neels, 2019 for Belgium) and thereby we can assume that it could have an impact in Kazakhstan as well.

There have been several changes in policies related to childbearing during the time under the analysis of this study. First, in 1981 the Soviet Union started a pronatalist policy that included for the first time an allowance for mothers of a first child. Maternity leave was 70 days before childbirth and 56 days after childbirth. Additionally, women could take leave with about 20% of the average wage from the end of maternity leave to the day a child reached 18 months, and also, they could take unpaid leave to look after children from 18 months to 3 years after childbirth with the workplace preserved for the mother (see Zakharov, 2008 for a more detailed description of the policy).

Since the independence up until 1999, this policy did not change in Kazakhstan. However, since the payments to pregnant women and mothers (the same period of maternity leave as before) were made by employers, it was increasingly likely that they were not paid on time considering high wage arrears in general. In 1999 (with implementation in 2000) a new Labour Law was passed. Maternity leave remained the same but unpaid leave with the keeping of a workplace was decreased from 3 years to the time until a child reached 18 months. The provision of leave that offered about 20% of the average wage was dropped. Later on, a new Labour Code was passed in 2007 (implemented in 2008). It offered an unpaid leave until a child turned 3 years. Maternity leave remained the same and was paid by the employer. But, additionally, a new allowance was added to the maternity leave that was paid by the State Social Insurance Fund in connection with caring for a child until age 1 (40% of pre-birth individual income)[1]. Thus, there were changes in the legislation that could have affected fertility decisions and these changes were highly correlated with the economic cycles in the country.

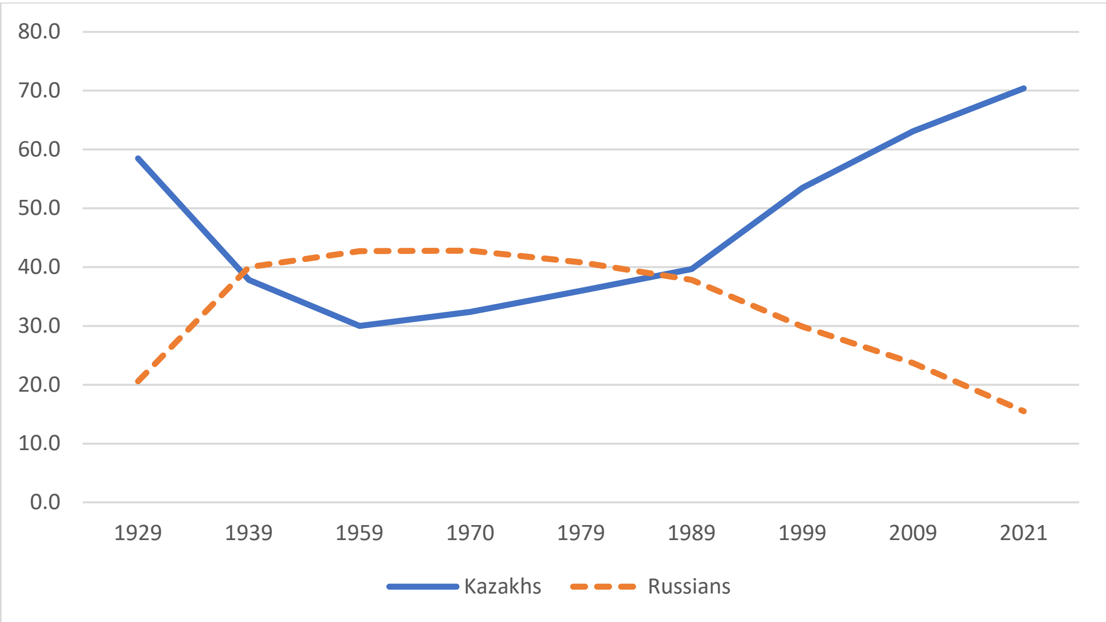
Ethnic composition

The ethnic composition of Kazakhstan should also be considered when studying fertility trends in the country. Thus, several studies (Spoorenberg 2013, 2015) point out that changes in the ethnic composition of Kazakhstan can be a driving force for a large part of recent aggregate fertility changes. During the Soviet time, there was an officially sponsored

[1] All legislative changes are taken from the Information and legal system of regulatory legal acts of the Republic of Kazakhstan that is publicly available at https://adilet.zan.kz/

inter-republic migration (Rakowska-Harmstone, 1977) and a big influx of Russians and other European-origin people within development programmes in industry and agriculture in Kazakhstan and the rest of Central Asia. The linguistic prevalence of the Russian language in all Soviet cities boosted Russian mobility and allowed Russians to perceive the entire Soviet Union as their motherland (Oka, 2007). Kazakhstan was even a unique case among the other Soviet republics because Russian and other European-origin people outnumbered the titular ethnicity for a long time. Thus, from the population composition in Figure 2, we can see that it has been a predominantly Russian republic for a long time, culturally closer to Russia than to Central Asia.

Figure 2: Population composition of Kazakhstan, 1929-2021, %



Source: constructed using data from Agency of Statistics of the Republic of Kazakhstan (censuses 2009, 2021) and Demoscope Weekly USSR historical data.

After gaining independence many Russians and other European-origin ethnic groups (German, Polish, Ukrainian, and others) emigrated from Kazakhstan, while at the same time the new state initiated a programme of repatriation of ethnic Kazakhs from the countries and republics to where they had migrated during Soviet time, including from China, Mongolia, Uzbekistan, Russia, Turkmenistan, Kyrgyzstan, Iran, Afghanistan, and Pakistan. The recent official statistics state that ethnic Kazakhs made up 70.4 % of the country's population in 2021, while Russians are still the second biggest ethnicity (Kazakhstan Statistics Committee, 2022).

Relatedly, a pronounced spatial variation and regional differences can be observed in the country. The Northern and Eastern parts of Kazakhstan, which are geographically closer to Russia, have a higher proportion of Russian and other Slavic populations and are more culturally connected to Russia. While those who live in the Southern and Western parts of Kazakhstan, which are closer to the other Central Asian States are culturally more connected to the Turkic and Muslim World.

Also, several studies (Telebaev, 2003; Aydıngün, 2010; Yerekesheva, 2020) link the nation-building process after gaining independence with an increase in religiosity among ethnic Kazakhs who were searching for self-identification after the collapse of the Soviet Union. They point out that Kazakhs were using religion as a proxy for understanding how to be "a Kazakh" and thus the restoration of traditions, customs, and Muslim norms could affect the family formation and fertility among ethnic Kazakhs.

Expectations

In this study, recent parity-specific fertility developments in Kazakhstan are studied, including the assessment of possible differences in fertility trends by ethnicity and socioeconomic status. Based on the theoretical framework of fertility developments, the following expectations will be assessed:

1. If a reversal of the demographic fertility transition is in place, we can expect gradual fertility increase at all birth orders throughout the 2000s, but especially at higher-order births.

2. If the decline of fertility in the 1990s was temporary and caused by the economic crisis, we would expect fertility increases in the early periods of economic improvement but further stabilization at later stages.
3. If the Second Demographic Transition is developing in Kazakhstan, we can expect lower rates of first births and lower progressions to higher parities for a) highly educated women due to their role as forerunners in other contexts; b) ethnic Russian women due to their connections to Russians in other parts of the former Soviet Union.
4. We expect increasing rates of progressions to parenthood among highly-educated women in periods of economic growth in line with findings from other contexts.
5. We expect decreasing rates of progression to third and fourth births in general but especially among highly educated women in line with the progression of the fertility transition.

Data and Methods

Data

Three rounds of the Kazakhstan Multiple Indicator Cluster Survey (MICS) collected in 2006, 2011, and 2015 have been used for analysis. The sample sizes were 14719, 14228, and 12910 women for each round, respectively, with an average response rate of 98%. Only completed interviews – 41243 (98.5% of the full sample) were used for the analysis.

MICS data do not contain complete fertility histories and there are only dates of the first and the last birth in a woman's fertility history. However, the birth dates of all children under 18 who live in the household are known. Thus, the survey does not provide information on the exact birth dates of children who are not last or first unless they live in the household.

In addition, there is information about a mother's identification number only for children under 18. For these reasons, the sample includes only the youngest cohorts to study higher-order births: women in the 2006 round were excluded if they gave birth to a first child before 1989, before 1994 for women surveyed in 2011, and before 1998 for women surveyed in 2015.

The sample, therefore, is slightly selected based on the survival of children or living together with the mother between the first and the last birth. Thus, for example, if a women's second child died/left the house and she has ever given three births we cannot study her risks of a second birth because there is no information about the age (the date of birth) of the second child. These exclusion criteria do not affect women who have not yet given birth to three or more children. Thus, the sample sizes for the analysis are as follows: first birth – 41243 women (no restrictions), second birth – 16920 women (or 93.6% of women from young cohorts that gave first birth not earlier than 17 years before an interview that allows us to analyse in-between births), third birth – 10274 (or 90.6 % of women from young cohorts who have at least two children), fourth birth – 3821 (or 79% of women from young cohorts who have at least three children).

Moreover, for birth date information taken from the household roster (covering any births between the first and last), the 2006 household dataset does not contain information on the month of births other than first and last births. Thus, the month of birth was randomly imputed for around 7 % of cases for the study of second-birth risks and around 4% of cases for the study of third and fourth-birth risks.

Description of variables:

Woman's age is the basic time factor to study the risk of first birth and it is a time-varying variable. The trajectory is followed from age 15 until the arrival of the first birth or the time of the interview, whichever comes first (the respondents consist only of women age 15-49, so there is no need to create an upper limit of 50).

Duration since last birth is the basic time factor to study the risk of second/third/fourth birth and it is a time-varying variable. The trajectory is followed from the first/second/third birth until the arrival of the second/third/fourth birth or the time of the interview, whichever comes first.

Age at last previous birth is a time-constant variable to study second/third/fourth birth risks.

Ethnicity is one of the key predictors of the study and it is a time-constant variable. The actual description of the variable in the raw dataset is the ethnic group of household head, and this is a limitation of the data. However, according to the 2009 census, out of all registered marriages, less than 4% of Kazakhs and 15% of Russians were involved in interethnic marriages (78% of Russians were not involved in interethnic marriages while 7% were married to culturally close Ukrainians and Germans). The Assembly of People of Kazakhstan (a national body representing different ethnicities) reports that only 6% of marriages in 2017 were interethnic.

Education. To avoid anticipatory analyses of educational attainment and first birth risks we follow the advice of Hoem and Kreyenfeld (2006) to pursue dynamic modelling of educational trajectories. Educational histories are reconstructed using variables that give information about the highest educational level a respondent had achieved at the time of the interview. The reconstruction procedure assumes a trajectory of rigid educational progress with no breaks in studying, repeating of school years, or postponement of the entrance of a subsequent level. It traces respondents from the legal age of primary school entry (age 7) to their highest achieved educational level. The variable "the highest grade at that level" helps to specify the exact number of years a respondent has spent at the highest attained educational level. A new academic year starts in September and ends the following May.

Primary school consists of 4 years of schooling; secondary school of 7 years (or 6 years if the person started before 1987), but if a student chooses his/her subsequent level as a secondary specialized (vocational) school instead of university he/she only makes 5 years of secondary school; secondary specialized school consists of 3 additional years. Higher education can consist of 4 to 6 years (or more if a doctoral degree is pursued). Before joining the Bologna educational system people were supposed to study for 5 years for a “specialist” degree; nowadays it is 4 years for a bachelor’s degree and 2 additional years for a Master’s degree. Information on the highest grade attained allows for differentiating all of this. A time-varying binary variable was constructed to indicate periods in and out of education. The respondents are coded as being in education all time before they attained the level reported in the interview. Thus, the variable “education” is time-varying and consists of 5 levels: in education, none/primary/not completed secondary, completed secondary, secondary specialized, and higher. This time-varying variable is used in the first-birth models.

For the analyses of the progressions to second, third, and fourth parities, the educational attainment at the time of interview is used, based on the assumption that women rarely continue their education after entering parenthood.

Calendar year is a time-variant covariate and the main variable of interest in this study. Using a period approach, changes in behaviour are observed for synthetic cohorts over time: “which is an imaginary group of people who experience, hypothetically, the demographic conditions of that period throughout life” (Willmoth, 2005, p. 234). Women contribute to the period estimates as they pass through different years at each given parity. The following calendar year groups are used in the study of first birth risks: 1971-1980, 1981-1990, 1991-

1995, 1996-2000, 2001-2005, 2006-2010, and 2011-2015. The first two periods cover the Soviet time and are split into two periods to see the dynamics in reproductive behaviour over this relatively long period, including the 1980s with its pro-natalist policies; the next two periods cover the economic crisis time, and the last three periods cover the economic recovery time. The periods for the study of second/third/fourth birth risks are slightly different because of the peculiarities of the dataset and the possibility to study only the more recent cohorts for higher-order births. In this case, calendar years are aggregated into 1989-1994, 1995-2000, 2001-2005, 2006-2010, and 2011-2015. The last years of the Soviet time had to be combined with the first years of the economic crisis.

Summary statistics of exposures and occurrences by every variable and each parity are presented in Tables A, B2, C2, and D in our Appendix.

Methods

To analyse first, second, third, and fourth birth rates, I apply event history analysis, which is useful when analysing time-dependent processes and allows the characteristics of the respondent to change over time. I present findings as parity-specific relative risks of giving birth during 1971-2015, adjusted for age of a woman or duration since the last birth, ethnicity, and education. Concerning second, third, and fourth births, mothers are excluded from a given parity sample if they had multiple births the first, second, or third time, respectively.

Results

First birth risks

According to Table 1, we can observe that the first birth risks are the highest at the relatively young age of 21-26 and then gradually decrease with age. Contrary to expectations in which we would see postponed parenthood among population subgroups that may be on a more advanced stage of a second demographic transition, we note that ethnic Russian women become mothers earlier than ethnic Kazakh women. Education shows a negative gradient with the timing of first birth; the higher the educational level achieved the lower the risks of first birth. As regards calendar period, we can observe that relative risks of first birth increased in 1981-1990, in line with the pronatalist policies of the late Soviet period. Moreover, the first years of independence also show an increase, even with an economic crisis at play. During the later stages of the economic crisis, we can observe a decline in relative first-birth risks, but they were still higher than in the earliest period. The decline continued in the first period of economic growth (2001-2005) but in the latest periods of economic recovery time, the risks of firth birth gradually increased again.

Table 1: Relative risks of first birth for Kazakhstan women by age, ethnicity, education and calendar period 1971-2015

	Relative Risk	S. E.	P>z
age			
15-17	0.08	0.00	0.000
18-20	0.57	0.01	0.000
21-23	1.00		
24-26	0.91	0.02	0.000
27-29	0.70	0.02	0.000
30-32	0.48	0.02	0.000
33-35	0.39	0.02	0.000
36-38	0.20	0.02	0.000
39-41	0.14	0.02	0.000
42+	0.04	0.01	0.000
ethnicity			
Kazakh	1.00		
Russian	1.19	0.02	0.000
other	1.14	0.02	0.000
education			
in education	0.37	0.01	0.000
none/primary/not completed secondary	0.91	0.05	0.097
secondary	1.00		
secondary vocational	0.84	0.01	0.000
higher	0.72	0.01	0.000
calendar period			
1971-1980	1.00		
1981-1990	1.28	0.04	0.000
1991-1995	1.48	0.05	0.000
1996-2000	1.14	0.04	0.000
2001-2005	1.08	0.04	0.026
2006-2010	1.19	0.04	0.000
2011-2015	1.35	0.06	0.000
_cons	0.02	0.00	0.000
# of subjects	41179		
# of failures	28338		
time at risk	3873261		
Log likelihood	-30313.076		
Prob > chi2	0.0000		

Table 2 shows the survival rates of the Kaplan-Meier function at specific ages, calculated as synthetic cohorts for our calendar periods, by ethnicity, which can be interpreted as the share of women at a given age that would become a mother given the transition rates in that time period. We can observe that the difference between the two ethnicities in first birth estimates by age 25 was fairly small in the post-Soviet era, but larger in the period characterized by Soviet pronatalist policies. Almost all women enter parenthood by age 35 (over 90 %) and there is no trend over time to indicate increased childlessness, nor increasing differences between the two ethnicities.

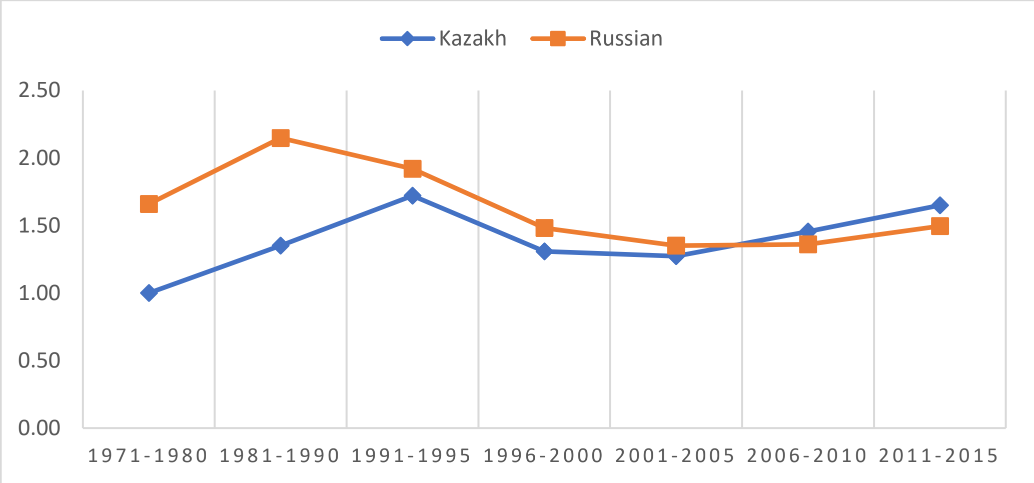
Table 2: First birth estimates for Kazakh and Russian women in Kazakhstan across six time periods, Kaplan-Meier function, by age 25 and 35

	Kazakh		Russian		All ethnicities	
	Age 25	Age 35	Age 25	Age 35	Age 25	Age 35
1981-1990	0.67	-	0.81	-	0.71	-
1991-1995	0.73	0.94	0.76	0.92	0.75	0.93
1996-2000	0.62	0.88	0.66	0.88	0.64	0.88
2001-2005	0.59	0.87	0.61	0.87	0.60	0.87
2006-2010	0.62	0.89	0.60	0.88	0.62	0.89
2011-2015	0.65	0.91	0.62	0.92	0.66	0.92

Note: KM function values at specific ages. 1971-1980 is not included because there are no women over age 20 contributing to this synthetic cohort. Age 35 is not included for 1981-1990 because there were no women over age 30 contributing this synthetic cohort.

Figure 3 shows the interaction between ethnicity and calendar period in first-birth risks. We observe that both Kazakhs and Russians experience an increase in relative risks in 1981-1990, while during the first years of independence there was a decrease in relative risks among Russians but an increase among Kazakhs. In the later period of the 1990s and early 2000s, we see that the relative risks of firth birth decreased for Kazakhs and Russians alike. It was followed by the increase for both ethnic groups in the latter two periods, which was somewhat more pronounced among Kazakhs whose relative risks of first birth became even higher than among Russians. Taken together, we can observe a convergence of first birth risks of the two ethnicities over time.

Figure 3: Relative risks of first birth, interaction between ethnicity and calendar period (reference Kazakh 1971-1980), controlling for all other factors

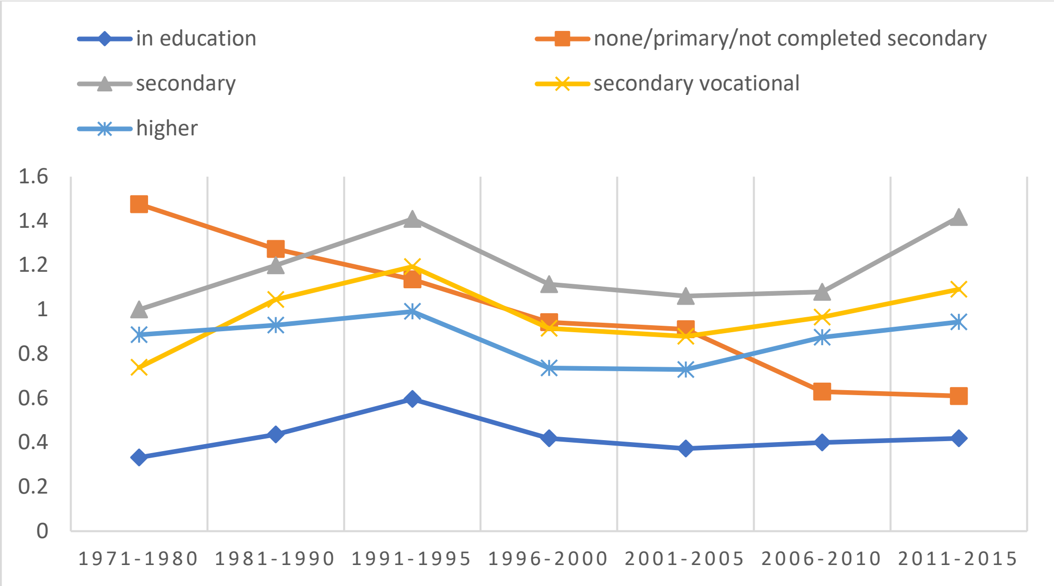


Note: the interaction is significant according to likelihood-ratio test. LR chi2(12) = 199.37. Prob>chi2=0.000. Interaction also improves the model fit according to AIC/BIC criterion.

Figure 4 shows the interaction between education and calendar period. Apart from the none/primary/non-completed secondary category that gradually decreased its first-birth risks across periods, we observe quite a uniform trend across the other four categories. So, the relative risks of first birth first increased in 1981-1990 and 1991-1995 among the other four educational categories and then uniformly decreased in the 1996-2000 and 2001-2005 periods. This is followed by a subsequent increase in the 2006-2010 and 2011-2015 among the same four educational categories.

Additionally, a three-way interaction between ethnicity, education, and calendar period (see Appendix, Figure A) did not show any contrasting pattern of relative risks of first birth across the periods between the two ethnicities depending on educational level.

Figure 4: Relative risks of first birth, interaction between education and calendar period (reference completed secondary 1971-1980), controlling for all other factors



Note: the interaction is significant according to likelihood-ratio test. LR chi2(24) = 57.18. Prob>chi2=0.000. Interaction also improves the model fit according to AIC criterion.

Second birth risks

The relative risks of second birth for most of the control variables demonstrate expected relationships (Table 3): second birth rates were lower when the age at the first birth was higher; the higher the educational level achieved the lower the second birth rates, and the transition rate increased within the first three years after the first child was born and decreased after this point. We also observe that the second birth risks are around two and a half times higher for Kazakh women than for Russian women. The calendar period shows that second parity transitions were stable during the 1990s, while during the post-Socialist periods of economic recovery there was a gradual increase in the relative risks of second birth.

Table 3: Relative risks of second birth for Kazakhstan women by duration since first birth, age at first birth, ethnicity, education, and calendar period 1989-2015

	Relative risk	S.E.	P>z
duration since the first birth			
0-1 years since first child born	0.51	0.01	0.000
2-3 years since first child born	1.00		
4-5 years since first child born	0.76	0.02	0.000
6-7 years since first child born	0.63	0.02	0.000
8-9 years since first child born	0.48	0.02	0.000
10 and more years since first child born	0.26	0.02	0.000
age at first birth			
19 or less	0.96	0.03	0.113
20-24	1.00		
25-29	0.82	0.02	0.000
30-34	0.54	0.03	0.000
35+	0.22	0.03	0.000
ethnicity			
Kazakh	1.00		
Russian	0.38	0.01	0.000
other	0.70	0.02	0.000
education			
none/primary/not completed secondary	0.95	0.05	0.275
secondary	1.00		
secondary vocational	0.76	0.02	0.000
high	0.69	0.02	0.000
calendar period			
1989-1994	1.00		
1995-2000	0.96	0.04	0.372
2001-2005	1.09	0.05	0.048
2006-2010	1.39	0.06	0.000
2011-2015	1.64	0.08	0.000
_cons	0.03	0.00	0.000
# of subjects	16890		
# of failures	10219		
time at risk	928047		
Log likelihood	-18054.52		
Prob > chi2	0.0000		

Table 4 shows survivor fractions of the Kaplan-Meier function at selected durations since first birth, calculated for our synthetic cohort calendar periods, by ethnicity, which can be interpreted as the share of women at a given duration that had a second child given the transition rates in that time period. We observe that the second birth estimates at a duration of

4 years since the first birth were uniformly decreasing in 1995-2000 but at different levels for the two ethnicities. The estimates for ethnic Kazakhs were almost two and half times larger by 2001, and the difference further increased in the later periods to become up to three times larger than the estimates for ethnic Russians. At the duration of 6 years since the first birth, the estimates were stable for ethnic Russians until 2006. After 2006 there was a slight increase in second birth estimates among Russian mothers. The respective estimates for Kazakh women show that after some decrease in the late 1990s and early 2000s, there was a gradual increase in the subsequent periods. Almost all Kazakh one-child mothers in the most recent period had a second child by 10 years after the first birth (86 %) and there is a clear trend over time to indicate an increased progression toward second births among ethnic Kazakhs. A trend of increased progression to second births is also observed among ethnic Russians and 61% of Russian one-child mothers then had a second child within 10 years of the first birth.

Table 4: Transition to a second birth of one-child women in Kazakhstan, by ethnicity across five time periods, Kaplan-Meier estimates

	Kazakh			Russian			All ethnicities		
	4 years	6 years	10 years	4 years	6 years	10 years	4 years	6 years	10 years
1989-1994	0.58	0.74		0.27	0.34		0.51	0.64	
1995-2000	0.51	0.65	0.77	0.21	0.32	0.46	0.56	0.64	0.68
2001-2005	0.53	0.67	0.80	0.19	0.32	0.50	0.44	0.58	0.73
2006-2010	0.61	0.75	0.85	0.23	0.38	0.58	0.51	0.65	0.78
2011-2015	0.69	0.79	0.86	0.24	0.40	0.61	0.58	0.69	0.81

Note: KM function values at specific duration since first birth.

Additionally, an interaction between ethnicity and calendar period did not improve the model fit. These results show that even though the two main ethnicities in Kazakhstan have very different initial levels of progression to a second birth, ups and downs in the second birth rates across these periods were shared in parallel by both groups.

The interaction between education and calendar period (see Appendix, Figure B2) did also not improve the model fit according to BIC criteria, thus also not revealing any specific responses by educational level. Additionally, a three-way interaction between ethnicity, education, and calendar period (see Appendix, Figure B3) did not show any contrasting pattern of relative risks of second birth across the periods between the two ethnicities depending on educational level.

Third birth risks

Table 5 shows that Kazakh two-child mothers are four times more prone to give birth to a third child than Russian women. The relative risks for most of the control variables demonstrate expected relationships: third birth rates are lower when the age at second birth is higher; the higher the educational level achieved the lower the third birth rates, and the transition rate was the highest within two to seven years after the second child was born, and decreased after this point. The relative risks were higher in 2006-2010 and 2011-2015 than in the previous years.

Table 5: Relative risks of third birth for Kazakhstan women, by duration since second birth, age at second birth, ethnicity, education, and calendar period 1989-2015

	Relative risk	S.E.	P>z
duration since the second birth			
0-1 years since second child born	0.44	0.02	0.000
2-3 years since second child born	1.00		
4-5 years since second child born	1.03	0.05	0.564
6-7 years since second child born	0.93	0.05	0.186
8-9 years since second child born	0.67	0.05	0.000
10 and more years since second child born	0.49	0.04	0.000
age at second birth			
19 or less	0.76	0.11	0.056
20-24	1.00		
25-29	0.85	0.03	0.000
30-34	0.57	0.03	0.000
35+	0.28	0.04	0.000
ethnicity			
Kazakh	1.00		
Russian	0.24	0.02	0.000
other	0.61	0.03	0.000

education			
none/primary/not completed secondary	1.05	0.08	0.507
Secondary	1.00		
Secondary vocational	0.71	0.03	0.000
High	0.66	0.03	0.000
calendar period			
1989-1994	1.00		
1995-2000	0.92	0.12	0.535
2001-2005	0.91	0.12	0.474
2006-2010	1.49	0.19	0.002
2011-2015	1.42	0.19	0.007
_cons	0.01	0.00	0.000
# of subjects	10230		
# of failures	3747		
time at risk	588916		
Log likelihood	-7946.4824		
Prob > chi2	0.0000		

Table 6 shows the survival rates from the Kaplan-Meier function at selected durations since second birth, calculated for synthetic cohort calendar periods, by ethnicity. We can observe that the third birth estimates at a duration of 4 years since second birth were decreasing among ethnic Kazakhs in the late 1990s and early 2000s with increases and stabilization in later periods. The corresponding estimates for Russians were stable at far much lower levels until 2011 when they decreased even further. By 6 years after second birth, only 14% of two-child Russian mothers had a third child and this pattern was stable over time. In contrast, more than half of Kazakh two-child mothers had a third child within 6 years of their second birth and we can observe an increase in this level in the most recent periods. Around two-thirds of Kazakh two-child mothers had a third child by 10 years after their second birth and we observe a gradual increase in this level over time. The corresponding numbers for Russian two-child mothers are just 25%. The third-birth rates increased also for this group, albeit at a much lower level.

Table 6: Transition to a third birth of two-child mothers in Kazakhstan, by ethnicity across five time periods, Kaplan-Meier estimates

	Kazakh			Russian			All ethnicities		
	4 years	6 years	10 years	4 years	6 years	10 years	4 years	6 years	10 years
1989-1994	0.31			0.07			0.25		
1995-2000	0.28	0.40	0.54	0.10	0.14	0.17	0.25	0.36	0.47
2001-2005	0.25	0.38	0.56	0.09	0.13	0.20	0.22	0.34	0.51
2006-2010	0.35	0.55	0.72	0.10	0.14	0.29	0.30	0.47	0.64
2011-2015	0.33	0.51	0.67	0.05	0.14	0.25	0.27	0.43	0.58

Note: KM function values at specific duration since second birth.

The interaction between ethnicity and calendar period (see Appendix, Figure C2) did not improve the model fit. Similar non-significant results were found for the model with an interaction between education and calendar period. Additionally, a three-way interaction between ethnicity, education, and calendar period (see Appendix, Figure C3) did not show any significant contrasting pattern in the relative risks of third birth.

Fourth birth risks

Table 7 shows that Kazakh three-child mothers are 2.5 times more prone to give a fourth birth than Russian women. The relative risks for most of the control variables demonstrate expected relationships: fourth birth rates were lower when the age at the third birth was higher; a negative gradient is also found for the duration since third birth and educational level.

Table 7: Relative risks of fourth birth for Kazakhstan women, by duration since third birth, age at third birth, ethnicity, education, and calendar period 1992-2015

	Relative risk	S.E.	P>z
duration since the third birth			
0-1 years since third child born	0.53	0.04	0.000
2-3 years since third child born	1.00		
4-5 years since third child born	0.79	0.07	0.005
6-7 years since third child born	0.70	0.08	0.002
8-9 years since third child born	0.63	0.11	0.007
10 and more years since third child born	0.40	0.13	0.007
age at third birth			
19 or less	1.54	0.90	0.461
20-24	1.00		
25-29	0.84	0.07	0.045
30-34	0.59	0.06	0.000
35+	0.31	0.05	0.000
ethnicity			
Kazakh	1.00		
Russian	0.39	0.07	0.000
other	0.74	0.07	0.003
education			
None/Primary/Some Secondary	0.90	0.13	0.463
Secondary	1.00		
Secondary vocational	0.87	0.06	0.042
High	0.74	0.06	0.000
calendar period			
1992-2000	1.00		
2001-2005	1.05	0.11	0.660
2006-2010	1.28	0.13	0.013
2011-2015	1.21	0.13	0.075
_cons	0.02	0.00	0.000
# of subjects	3637		
# of failures	1207		
time at risk	155386		
Log likelihood	-2735.932		
Prob > chi2	0.0000		

Table 8 shows the survival function from the Kaplan-Meier model at selected durations since third birth, calculated for the calendar periods by ethnicity. We can observe that the fourth birth estimates at a duration of 4 years since the third birth were stable over time among ethnic Kazakhs except for some increases in 2006-2010. We also can see a decreasing trend over time for ethnic Russians at the same duration since third birth. A similar gradual decrease is observed for Russians at 6 and 10 years since third birth for the periods where data are available. Thus, only 20% of Russian three-child mothers gave birth to a fourth child within 10 years of the third birth. While for ethnic Kazakhs, we observe increased transition rates since 2006 at the more extended durations since third births. Two-thirds of Kazakh three-child mothers had given birth to a fourth child by 10 years after their third birth.

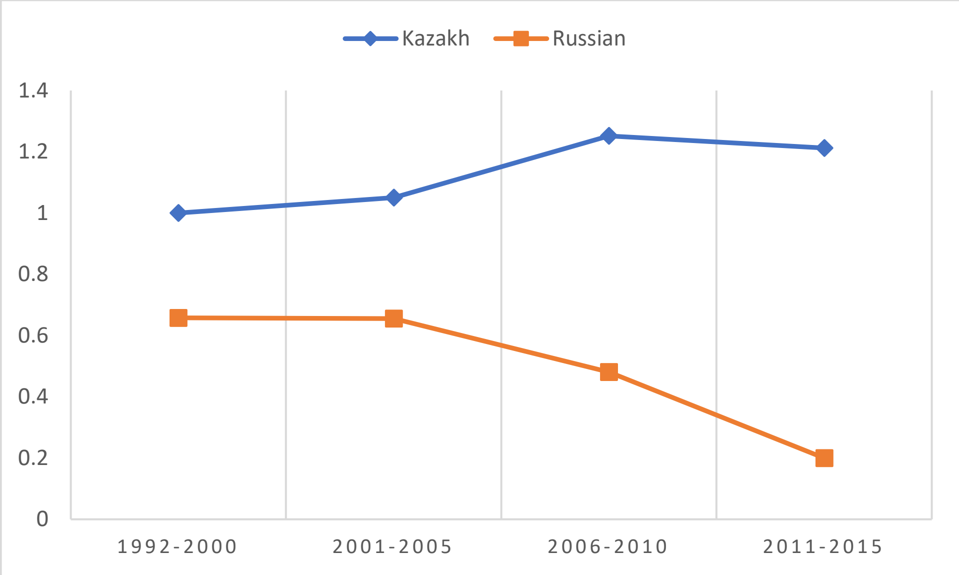
Table 8: Transition to a fourth birth of three-child mothers in Kazakhstan, by ethnicity across four time periods, Kaplan-Meier estimates

	Kazakh			Russian			All ethnicities		
	4 years	6 years	10 years	4 years	6 years	10 years	4 years	6 years	10 years
1992-2000	0.30	0.43		0.26			0.29	0.41	
2001-2005	0.34	0.45	0.60	0.29	0.37		0.32	0.43	0.57
2006-2010	0.40	0.51	0.70	0.19	0.30	0.30	0.39	0.50	0.68
2011-2015	0.33	0.49	0.66	0.07	0.10	0.20	0.30	0.47	0.63

Note: KM function values at specific duration since third birth.

Figure 9 shows the relative risks of fourth birth in the model with an interaction between ethnicity and calendar period. We can observe relative stability of relative risks of both Kazakhs and Russians, though at different levels, until 2001-2005 and then an increase in the calendar period 2006-2010 among the Kazakhs. Among Russians, the earlier stability was followed by a gradual decrease in four-birth rates in 2006-2015.

Figure 9: Relative risks of fourth birth, interaction between ethnicity and calendar period (reference Kazakh 1992-2000), controlling for all other factors



Note: the entire interaction is significant according to a likelihood-ratio test. LR chi2 (6) =13.95. Prob>chi2=0.0302. Interaction also improves the model fit according to AIC criterion.

The interaction between education and calendar period (see Appendix, Figure D1) did not improve the model fit. Additionally, a three-way interaction between ethnicity, education, and calendar period (see Appendix, Figure D2) did not show any further significant patterns of fourth-birth risks across all three categories.

Discussion and conclusions

This study aimed to explore whether fertility increases that had previously been observed for Kazakhstan in the early 2000s were merely a temporary phenomenon or rather part of a return to a period of persistently high fertility levels. In addition, the study assessed whether the pattern of fertility recuperation was universal or restricted to certain subgroups of the population, reflecting any ethnic and socioeconomic status differences in behaviour and outcomes.

In line with the proposition that the fertility part of Kazakhstan's demographic transition may have gone into reverse, we observed a gradual increase in fertility rates at all birth orders after the turn of the century. This is especially striking for higher-order births, for which fertility developments can most convincingly be linked to any changes in the progress of the demographic transition. Further, we do not notice any decreasing rates of first births during the study period that may have indicated that forces of fertility postponement were at play and which could have been seen as evidence of any progress of a second demographic transition. Though we can observe some indication of fertility postponement among ethnic Russian women in the early 20th century, this trend later stabilized and we do not observe a continuous postponement for this group either. In particular, we do not observe any indication of a continuous trend towards a postponement of becoming a mother among the majority group of ethnic Kazakh women.

A pattern of very low progression rates to second and third births among ethnic Russian women could possibly be seen as some evidence of progress toward the second demographic transition. However, these progression rates did not show any evidence of decline during the period we study. In particular, the estimates for ethnic Kazakhs show increasing rates for all higher-order births that reflect a development that is rather contrary to what would be expected from the classical demographic transition. Nevertheless, the trends by ethnicity are quite similar even though Kazakh and Russian women have entirely different levels of parity progressions. This suggests that other contextual factors are at play in shaping fertility change.

Business cycles and social policy provision may affect childbearing decisions and it would be plausible to expect somewhat different reactions to changes in these factors by women at different levels of educational attainment. However, contrary to expectations the results did not reveal any educational trend differentials in parity-specific fertility across the periods we cover. This homogeneity can indicate that childbearing is still an integral part of society in Kazakhstan and that the presumed higher opportunity costs for childbearing and childrearing for more educated women do not prevent them from progressing to higher-order births. It could also be seen as support for the notion of a broad-based re-traditionalization of the society.

This study extends the literature on different paths of demographic change and the possibility of reversals of fertility transitions to the context of post-Soviet Central Asia. As Burger and DeLong (2016) argued, trend reversals could be driven by changes in cultural norms that are not always necessarily moving towards more modernist values such as in more developed countries. Thus, the Kazakh case may be closer to the experience of, for example, Iran after the Islamic Revolution when the demographic transition stalled and temporarily even went into reverse (Aghajanian, 1991). It may also resemble patterns in other oil-rich countries in the Middle East where fertility patterns do not necessarily match economic development (Omran & Roudi, 1993; Hakimian, 2006).

This study also contributes to the literature on predominantly Muslim countries as a case where public gender equality in relation to women's education as well as labour force participation is high. Thus, the so-called "MENA paradox" of a mismatch between high educational attainment and low labour force participation (Buyukkececi & Engelhardt, 2021) as a possible explanation for high fertility does not apply to Kazakhstan.

The limitations of this study are driven by the characteristics of the available data, with a slight selectivity of the sample of survey respondents and their children based on the survival of children and co-residence with children in-between the first and last birth, which limits the sample to more recent birth cohorts. More accurate measures of ethnicity, religion, and time-varying data on rural-urban residence could also be beneficial for future research if they become available.

Future research may explore the role of religion and gender inequality in keeping fertility at high levels. Patterns of parity-specific contraceptive use can also be studied to assess the change in contraceptive use and how this may have contributed to the trend reversal we observe in fertility. If better time-varying data become available in the future, it is worth exploring the effect of income changes as well as family policy designs on parity progressions to assess the role of widening wealth inequalities and dependence on social support in fertility change.

In sum, the study provides new evidence of a sustained fertility increase in Kazakhstan during the 2000s that is associated with a genuine increase in birth rates across all birth orders, ethnicities, and educational groups. Kazakhstan appears to make an example of a reversed fertility transition with increasing progressions to higher-order births and little fertility postponement. The study also suggests that aggregate contextual factors that affect all sectors of Kazakhstan society are at play in affecting childbearing behaviour. The parity-specific trends are remarkably similar for ethnic and socioeconomic groups that otherwise have had different levels and patterns of childbearing.

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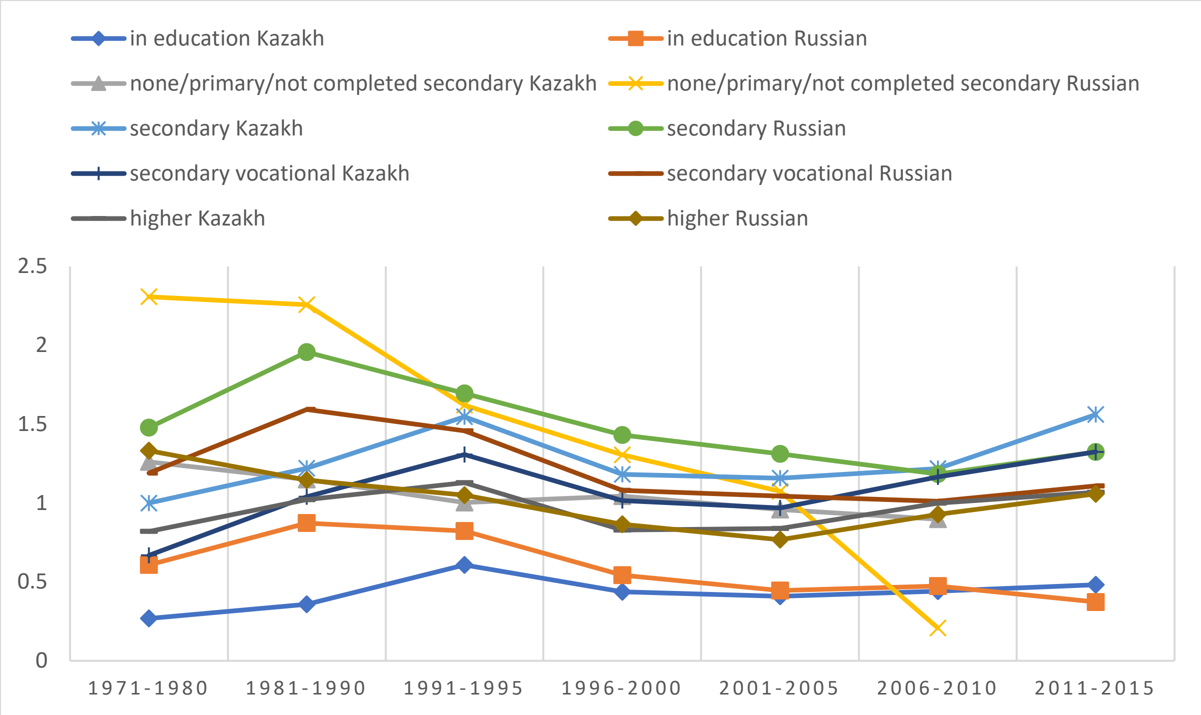
Appendix

Table A: Exposure distributions for all variables to the study of first birth risks

	Person-month	Failures	Rate	[95% Conf.	Interval]
age					
15-17	1405088	1212	0.001	0.001	0.001
18-20	1120335	9084	0.008	0.008	0.008
21-23	641573	10046	0.016	0.015	0.016
24-26	310331	4799	0.015	0.015	0.016
27-29	159782	1896	0.012	0.011	0.012
30-32	90899	735	0.008	0.008	0.009
33-35	57412	372	0.006	0.006	0.007
36-38	37469	122	0.003	0.003	0.004
39-41	25078	56	0.002	0.002	0.003
42+	25294	16	0.001	0.000	0.001
ethnicity					
Kazakh	2619154	18347	0.007	0.007	0.007
Russian	815451	6449	0.008	0.008	0.008
other	438656	3542	0.008	0.008	0.008
education					
in education	1548966	3386	0.002	0.002	0.002
none/primary/not completed secondary	42164	335	0.008	0.007	0.009
secondary	1045468	10015	0.010	0.009	0.010
secondary vocational	750384	9074	0.012	0.012	0.012
higher	486279	5528	0.011	0.011	0.012
Total	3873261	28338	0.007	0.007	0.007
calendar period					
1971-1980	271974	980	0.004	0.003	0.004
1981-1990	939899	7128	0.008	0.007	0.008
1991-1995	569771	5396	0.009	0.009	0.010
1996-2000	630392	4512	0.007	0.007	0.007
2001-2005	747454	4864	0.007	0.006	0.007
2006-2010	508843	3662	0.007	0.007	0.007
2011-2015	204928	1796	0.009	0.008	0.009
Total	3873261	28338	0.007	0.007	0.007

Figure A: Relative risks of first birth, three-way interaction between ethnicity, education and calendar period (reference Kazakh completed secondary 1971-1980), controlling for all other factors



Note: the interaction is significant according to likelihood-ratio test. LR chi2(92) = 381.46. Prob>chi2=0.000. Interaction also improves the model fit according to AIC criterion.

Table B1: Exposure distributions for all variables for the study of second birth risks

	Person-month	Failures	Rate	[95% Conf.	Interval]
duration since the first birth					
0-1 years since first child born	362437	3310	0.009	0.009	0.009
2-3 years since first child born	214754	3620	0.017	0.016	0.017
4-5 years since first child born	132039	1634	0.012	0.012	0.013
6-7 years since first child born	85428	870	0.010	0.010	0.011
8-9 years since first child born	57230	444	0.008	0.007	0.009
10 and more years since first child born	76159	341	0.004	0.004	0.005
age at first birth					
19 or less	139631	1554	0.011	0.011	0.012
20-24	486365	5957	0.012	0.012	0.013
25-29	212110	2171	0.010	0.010	0.011
30-34	70809	474	0.007	0.006	0.007
35+	19132	63	0.003	0.003	0.004
ethnicity					
Kazakh	535694	7428	0.014	0.014	0.014
Russian	276535	1564	0.006	0.005	0.006
other	115818	1227	0.011	0.010	0.011
education					
none/primary/not completed secondary	36717	431	0.012	0.011	0.013
secondary	258253	3485	0.013	0.013	0.014
secondary vocational	302573	3026	0.010	0.010	0.010
higher	330504	3277	0.010	0.010	0.010
calendar period					
1989-1994	68056	700	0.010	0.010	0.011
1995-2000	211548	2140	0.010	0.010	0.011
2001-2005	296922	3054	0.010	0.010	0.011
2006-2010	233380	2781	0.012	0.011	0.012
2011-2015	118141	1544	0.013	0.012	0.014
Total	928047	10219	0.011	0.011	0.011

Table B2: Second birth estimates for Kazakh and Russian women in Kazakhstan across five time periods, Kaplan-Meier estimates with confidence intervals

	Kazakh				Russian			
	Failure function	Std. error	[95%	conf.int.]	Failure function	Std. error	[95%	conf.int.]
1989-1994								
4 years since first birth	0.58	0.02	0.55	0.62	0.27	0.03	0.22	0.34
6 years since first birth	0.74	0.03	0.68	0.79	0.34	0.04	0.27	0.43
1995-2000								
4 years since first birth	0.51	0.01	0.49	0.53	0.21	0.01	0.18	0.24
6 years since first birth	0.65	0.01	0.63	0.67	0.32	0.02	0.28	0.35
10 years since first birth	0.77	0.01	0.74	0.79	0.46	0.03	0.41	0.51
2001-2005								
4 years since first birth	0.53	0.01	0.51	0.55	0.19	0.01	0.17	0.21
6 years since first birth	0.67	0.01	0.65	0.69	0.32	0.02	0.29	0.35
10 years since first birth	0.80	0.01	0.79	0.82	0.50	0.02	0.46	0.53
2006-2010								
4 years since first birth	0.61	0.01	0.59	0.63	0.23	0.02	0.20	0.26
6 years since first birth	0.75	0.01	0.73	0.76	0.38	0.02	0.35	0.41
10 years since first birth	0.85	0.01	0.83	0.86	0.58	0.02	0.54	0.62
2011-2015								
4 years since first birth	0.69	0.01	0.66	0.71	0.24	0.02	0.20	0.29
6 years since first birth	0.79	0.01	0.76	0.81	0.40	0.03	0.35	0.45
10 years since first birth	0.86	0.01	0.84	0.88	0.61	0.03	0.56	0.66

Note: There are no women with spacing over 6 years contributing to 1989-1994 synthetic cohort

Figure B1: Second birth estimates for synthetic cohorts of one-child mothers in Kazakhstan, Kaplan-Meier estimates

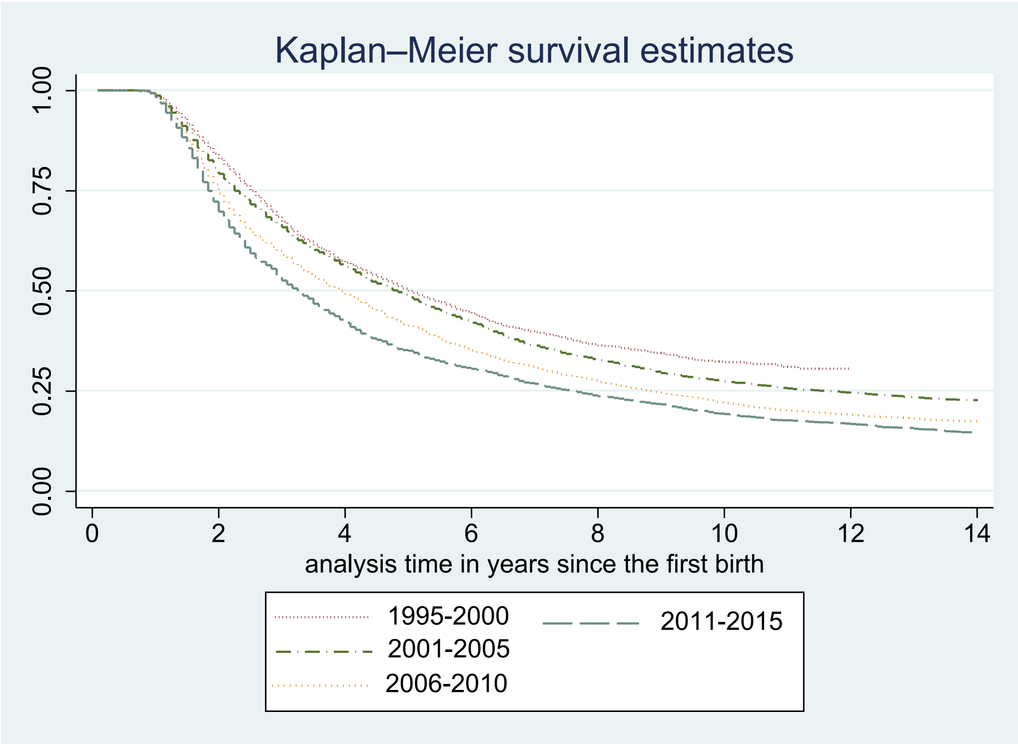
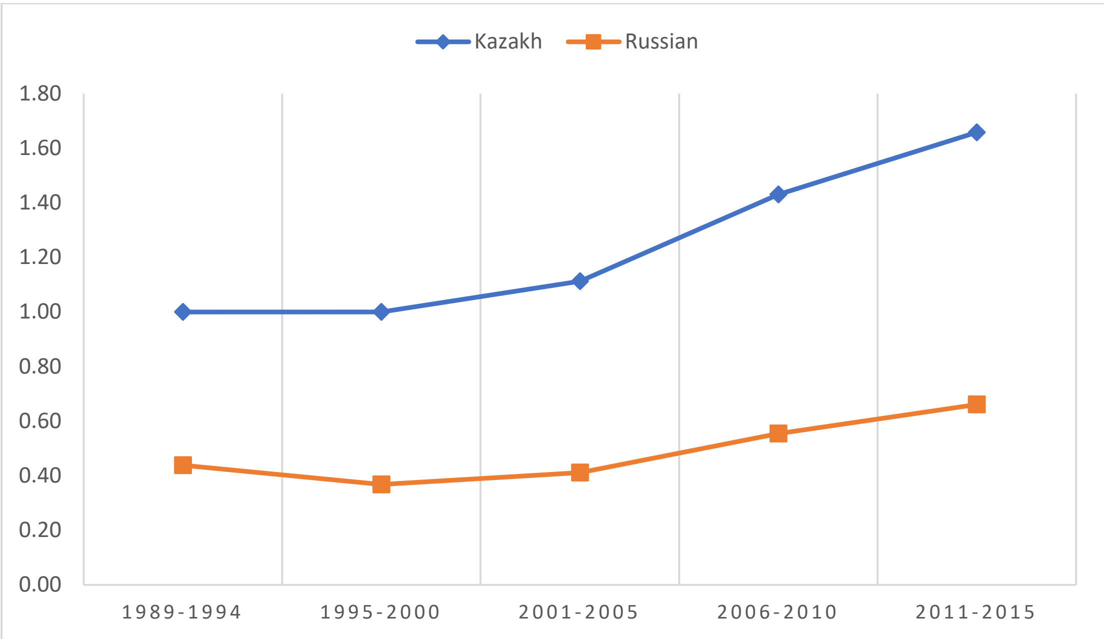
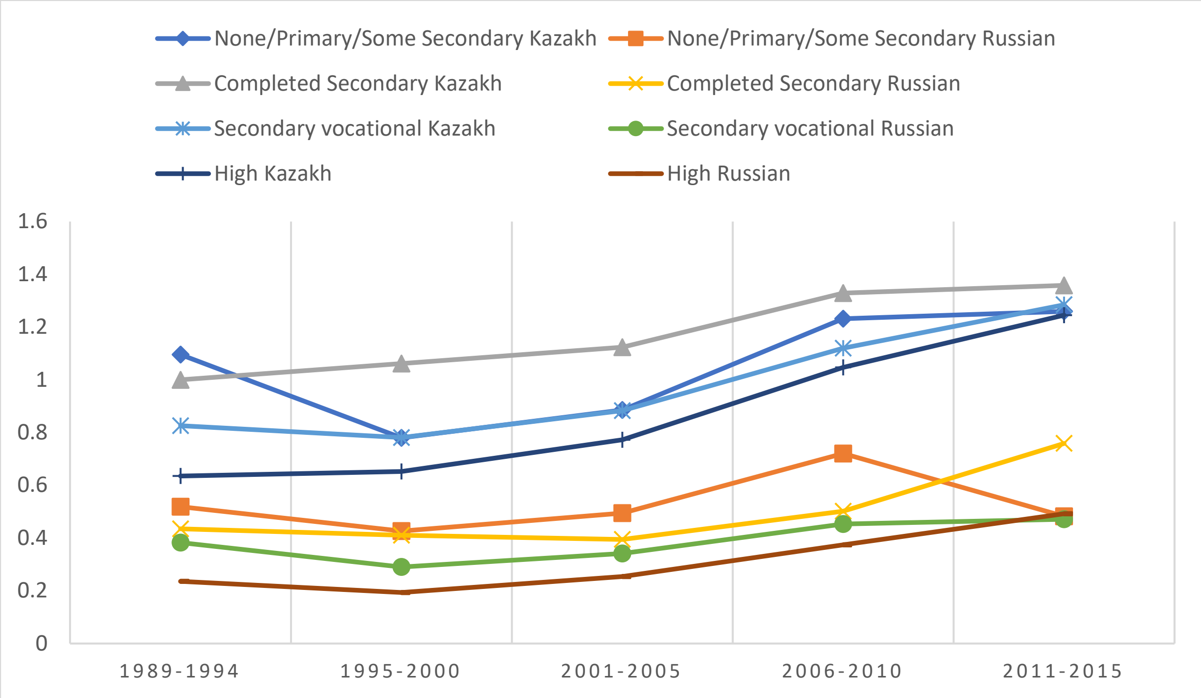


Figure B2: Relative risks of second birth, interaction between ethnicity and calendar period (reference Kazakh 1989-1994), controlling for all other factors



Note: the entire interaction is not significant according to likelihood-ratio test. LR chi2 (8) =7.27. Prob>chi2=0.5082. Interaction also does not improve the model fit according to AIC/BIC criterion.

Figure B3: Relative risks of second birth, three-way interaction between ethnicity, education and calendar period (reference Kazakh completed secondary 1989-1994), controlling for all other factors



Note: the interaction is significant according to likelihood-ratio test. LR chi2(50) = 89.29. Prob>chi2=0.0005. However, interaction does not improve the model fit according to AIC/BIC criterion.

Table C1: Exposure distributions for all variables for the study of third birth risks

	Person-month	Failures	Rate	[95% Conf.	Interval]
duration since the second birth					
0-1 years since second child born	219735	845	0.004	0.004	0.004
2-3 years since second child born	148608	1272	0.009	0.008	0.009
4-5 years since second child born	95518	829	0.009	0.008	0.009
6-7 years since second child born	59089	462	0.008	0.007	0.009
8-9 years since second child born	35608	204	0.006	0.005	0.007
10 and more years since second child born	30358	135	0.004	0.004	0.005
age at second birth					
19 or less	10343	52	0.005	0.004	0.007
20-24	211701	1627	0.008	0.007	0.008
25-29	245780	1591	0.006	0.006	0.007
30-34	96666	420	0.004	0.004	0.005
35+	24426	57	0.002	0.002	0.003
ethnicity					
Kazakh	413559	3152	0.008	0.007	0.008
Russian	102267	209	0.002	0.002	0.002
other	73090	386	0.005	0.005	0.006
education					
none/primary/not completed secondary	24195	177	0.007	0.006	0.008
secondary	198229	1551	0.008	0.007	0.008
secondary vocational	184013	998	0.005	0.005	0.006
higher	182479	1021	0.006	0.005	0.006
calendar period					
1989-1994	13993	65	0.005	0.004	0.006
1995-2000	103554	583	0.006	0.005	0.006
2001-2005	189146	996	0.005	0.005	0.006
2006-2010	173910	1356	0.008	0.007	0.008
2011-2015	108313	747	0.007	0.006	0.007
Total	588916	3747	0.006	0.006	0.007

Table C2: Third birth estimates for Kazakh and Russian women in Kazakhstan across five time periods, Kaplan-Meier estimates with confidence intervals

	Kazakh				Russian			
	Failure function	Std. error	[95%	conf.int.]	Failure function	Std. error	[95%	conf.int.]
1989-1994								
4 years since second birth	0.31	0.05	0.23	0.41	0.07	0.04	0.02	0.20
1995-2000								
4 years since second birth	0.28	0.01	0.26	0.31	0.10	0.02	0.06	0.15
6 years since second birth	0.40	0.02	0.37	0.43	0.14	0.03	0.09	0.21
10 years since second birth	0.54	0.03	0.49	0.59	0.17	0.04	0.11	0.25
2001-2005								
4 years since second birth	0.25	0.01	0.23	0.27	0.09	0.02	0.07	0.13
6 years since second birth	0.38	0.01	0.35	0.40	0.13	0.02	0.10	0.17
10 years since second birth	0.56	0.01	0.54	0.59	0.20	0.03	0.15	0.25
2006-2010								
4 years since second birth	0.35	0.01	0.32	0.37	0.10	0.02	0.07	0.14
6 years since second birth	0.55	0.01	0.52	0.57	0.14	0.02	0.11	0.18
10 years since second birth	0.72	0.01	0.70	0.75	0.29	0.03	0.23	0.36
2011-2015								
4 years since second birth	0.33	0.02	0.30	0.36	0.05	0.01	0.03	0.09
6 years since second birth	0.51	0.02	0.48	0.54	0.14	0.02	0.10	0.19
10 years since second birth	0.67	0.02	0.64	0.71	0.25	0.04	0.19	0.33

Note: There are no women with spacing over 4 years contributing to 1989-1994 synthetic cohort

Figure C1: Third birth estimates for synthetic cohorts of two-child mothers in Kazakhstan, Kaplan-Meier estimates

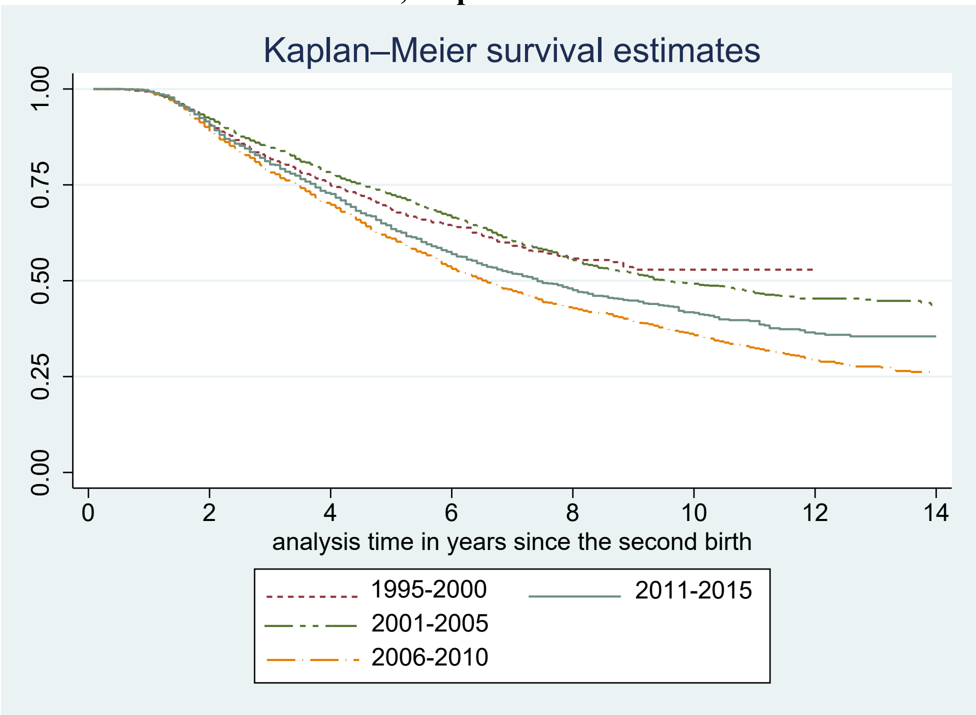
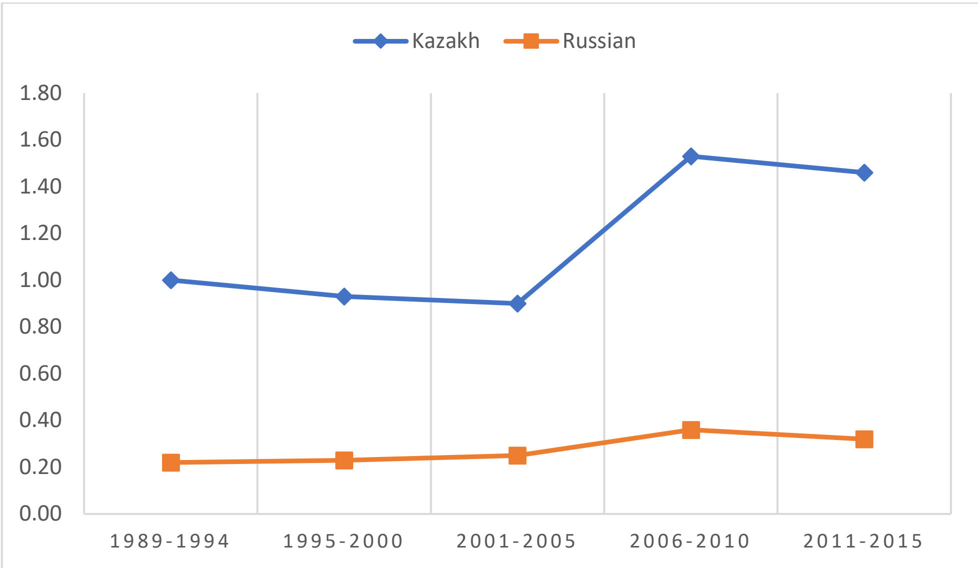
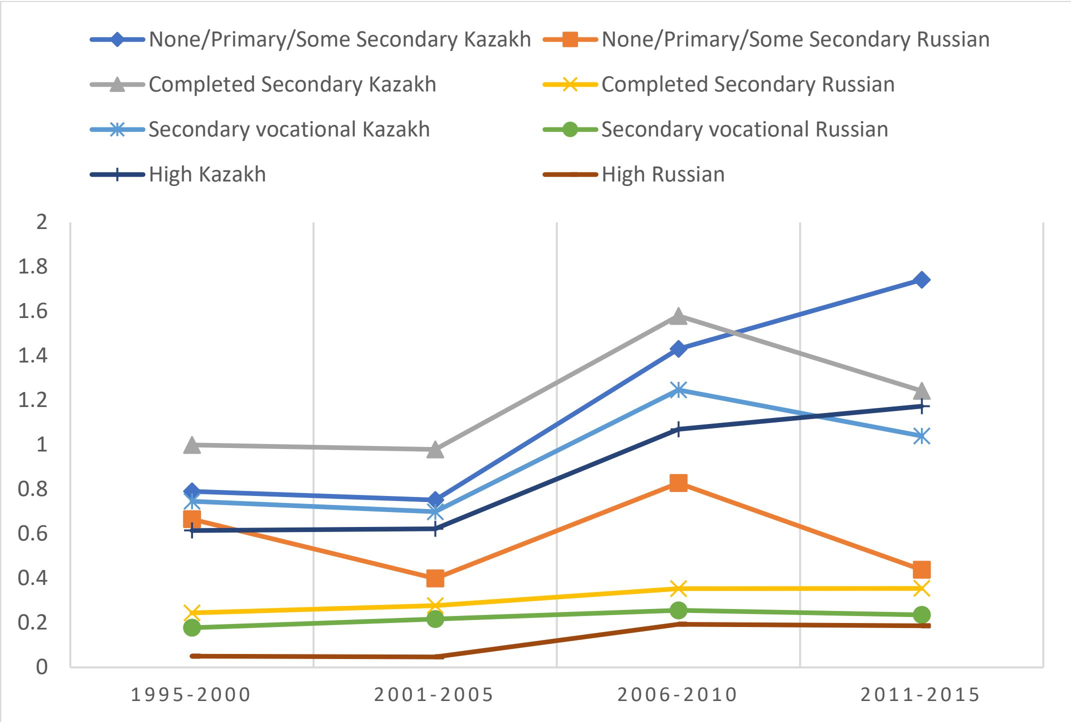


Figure C2: Relative risks of third birth, interaction between ethnicity and calendar period (reference Kazakh 1989-1994), controlling for all other factors



Note: the entire interaction is not significant according to likelihood-ratio test. LR chi2 (8) =4.31. Prob>chi2=0.8279. Interaction also does not improve the model fit according to AIC/BIC criterion.

Figure C3: Relative risks of third birth, three-way interaction between ethnicity, education and calendar period (reference Kazakh completed secondary 1989-1994), controlling for all other factors



Note: the interaction is significant according to likelihood-ratio test. LR chi2(50) = 87.83. Prob>chi2=0.0008. However. interaction does not improve the model fit according to AIC/BIC criterion.

Table D1: Exposure distributions for all variables for the study of fourth birth risks

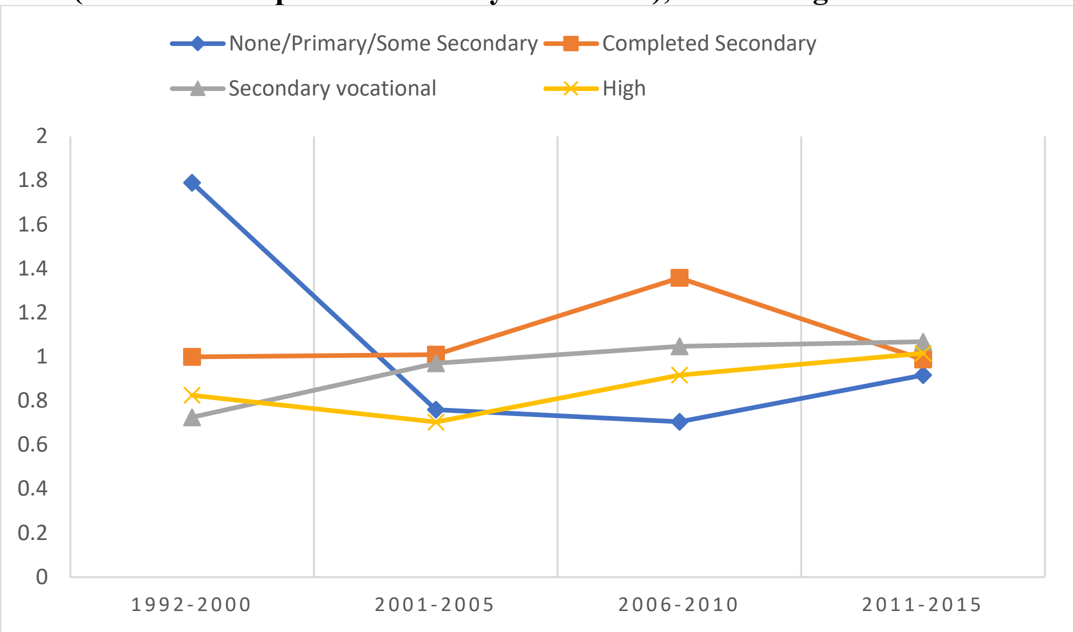
	Person-month	Failures	Rate	[95% Conf.	Interval]
duration since the third birth					
0-1 years since third child born	73231	420	0.006	0.005	0.006
2-3 years since third child born	41223	450	0.011	0.010	0.012
4-5 years since third child born	22667	198	0.009	0.008	0.010
6-7 years since third child born	11462	92	0.008	0.007	0.010
8-9 years since third child born	5006	38	0.008	0.006	0.010
10 and more years since third child born	1797	9	0.005	0.003	0.010
age at third birth					
19 or less	165	3	0.018	0.006	0.056
20-24	16529	180	0.011	0.009	0.013
25-29	72141	655	0.009	0.008	0.010
30-34	48836	309	0.006	0.006	0.007
35+	17715	60	0.003	0.003	0.004
ethnicity					
Kazakh	129092	1057	0.008	0.008	0.009
Russian	9695	35	0.004	0.003	0.005
other	16599	115	0.007	0.006	0.008
education					
none/primary/not completed secondary	7765	58	0.007	0.006	0.010
secondary	65121	578	0.009	0.008	0.010
secondary vocational	43757	323	0.007	0.007	0.008
higher	38743	248	0.006	0.006	0.007
calendar period					
1992-2000	18527	133	0.007	0.006	0.009
2001-2005	48248	355	0.007	0.007	0.008
2006-2010	49872	423	0.008	0.008	0.009
2011-2015	38739	296	0.008	0.007	0.009
Total	155386	1207	0.008	0.007	0.008

Table D2: Fourth birth estimates for Kazakh and Russian women in Kazakhstan across four time periods, Kaplan-Meier estimates with confidence intervals

	Kazakh				Russian			
	Failure function	Std. error	[95%	conf.int.]	Failure function	Std. error	[95%	conf.int.]
1992-2000								
4 years since third birth	0.30	0.03	0.25	0.35	0.26	0.12	0.10	0.57
6 years since third birth	0.43	0.04	0.36	0.51				
2001-2005								
4 years since third birth	0.34	0.02	0.30	0.38	0.29	0.07	0.17	0.46
6 years since third birth	0.45	0.02	0.41	0.49	0.37	0.09	0.23	0.57
10 years since third birth	0.60	0.03	0.55	0.65				
2006-2010								
4 years since third birth	0.40	0.02	0.36	0.43	0.19	0.06	0.10	0.35
6 years since third birth	0.51	0.02	0.46	0.55	0.30	0.09	0.16	0.50
10 years since third birth	0.70	0.03	0.64	0.75	0.30	0.09	0.16	0.50
2011-2015								
4 years since third birth	0.33	0.02	0.29	0.37	0.07	0.04	0.02	0.20
6 years since third birth	0.49	0.02	0.44	0.53	0.10	0.05	0.04	0.25
10 years since third birth	0.66	0.04	0.59	0.73	0.20	0.10	0.07	0.50

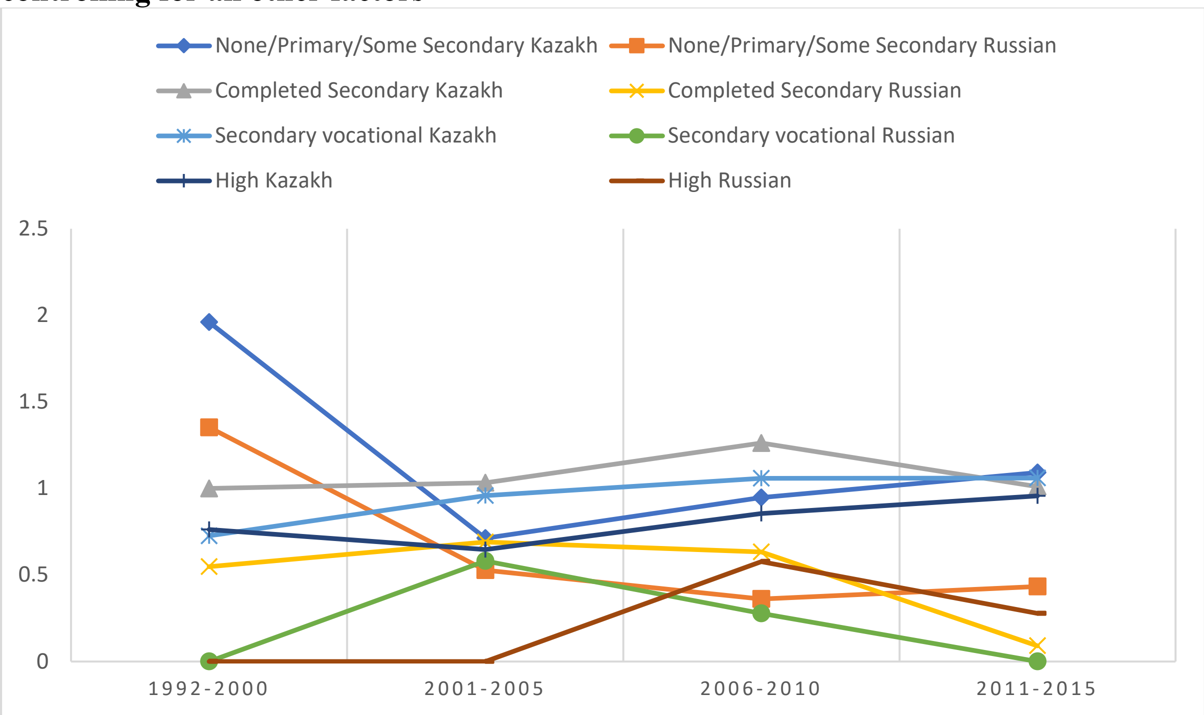
Note: There are no women with spacing over 4 years contributing to 1992-2000 synthetic cohort among Russians and over 6 years among Kazakhs.

Figure D1: Relative risks of fourth birth, interaction between education and calendar period (reference completed secondary 1992-2000), controlling for all other factors



Note: the entire interaction is not significant according to likelihood-ratio test. LR chi2 (9) =13.43. Prob>chi2=0.1439. Interaction also does not improve the model fit according to AIC/BIC criterion.

Figure D2: Relative risks of fourth birth, three-way interaction between ethnicity, education and calendar period (reference Kazakh completed secondary 1992-2000), controlling for all other factors



Note: the entire interaction is not significant according to likelihood-ratio test. LR chi2(39) = 44.13. Prob>chi2=0.2636. Interaction does not improve the model fit according to AIC/BIC criterion.

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