The Effect of Schooling, Wages, Marriage, and Socio-Economic Circumstances on Fertility Behavior in Russia

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Abstract:

The total fertility rate in Russia has been falling over the past several decades from above the replacement fertility level in the early 1960's (2.42 children) to significantly below the 'safety zone' in 2000 (1.20 children). The low fertility rate is accompanied by the highest death rate among all countries with at least moderate development, suggesting a projected 30% decline in the Russian population by 2053. This research applies the rich longitudinal data found in the Russia Longitudinal Monitoring Survey (1994-2006) to study life-cycle fertility decisions leading to the massive fertility reduction in the transition countries of Central and Eastern Europe. Specifically, I estimate a comprehensive model of female life-cycle behavior, which accounts explicitly for the interdependence of annual reproductive choices, educational, employment, and marriage decisions as well as earnings outcomes and controls for individual- and community-level heterogeneity. In addition to demonstrating the importance of endogeneity correction, the findings indicate that fertility policies should be directed away from supplementation of non-labor income, as it is observed now, and toward macro-stabilization efforts and the reconciliation of the incompatibility of the career demands of the new market system with the requirements of motherhood.

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1. Introduction

Over the past several decades, Russia has experienced a dramatic fertility decline, with the total fertility rate falling from well above the replacement level in 1962 (2.42 children) to significantly below the 'safety zone' in 2000 (1.2 children).[1] A large decrease in fertility took place in the 1960's when the total fertility rate (TFR) declined to almost 2.01, which is consistent with vital statistics for most developed countries (Hotz et al., 1997).[2] The most recent decline in the number of children born originated in the early 1990's when the TFR decreased from 1.89 in 1990 to 1.34 in 1995 and then to 1.20 in 2000. Similar trends are shared by most transition economies of Central and Eastern Europe, which, during only a ten-year period, lost their position as the region with the highest fertility rate in Europe and became the one with the lowest (see Sobotka, 2004).

This low fertility rate is of significant concern for Russia, which has also witnessed an unusually high death rate from preventable causes (e.g., alcoholism). If current fertility and mortality trends persist, the Russian population is projected to fall below 100 million by 2053, from its 2003 level of 143 million (World Bank 2005). In addition to record population declines, the low fertility rate will threaten to alter the age distribution of Russian society, which may lead to additional consequences, such as a growing dependency ratio (Becker, 2006), falling overall saving and investment rates (World Bank 2005), and a reduction in labor productivity and in incentives to invest in human and physical capital (IMF 2004). In other words, the economic growth demonstrated by the Russian economy in the last five years will not be sustainable under such low fertility rates.

The Russian government defines the current birth rate as one of its most critical problems, which is reflected in recent policy measures. As of January 1st, 2007, Russian women receive monthly child allowances during the first 18 months of a child's life: an amount equivalent to 60 US dollars for the first child and $120 for the second child (compared to an average monthly income of $300). In addition to the monthly child allowance, mothers of the second child receive supplementary financial support in the amount of $10,220, which can only

[1] The total fertility rate (TFR) is the number of children born to the average woman over her lifetime, computed as a sum of the current age-specific fertility rates. The replacement fertility rate is considered to be 2.1 children per average woman of reproductive age that allows for full replacement of the population. The total fertility is perceived to be in the 'safety zone' when it is above 1.5 children per woman. In the case of a fertility rate exceeding 1.5, the total population size can be sustained with the help of appropriate migration policies.

[2] This fall in the number of births can be partially associated with the development and spread of contraceptive methods taking place in all developed countries around the same period.

be used for improvements in housing conditions and/or the educational needs of their children. This law introduces sizable financial incentives for having children and imposes a substantial financial cost on taxpayers. However, as Becker (2006) points out, Russia is not alone in its concerns over the declining and aging population, and "the Russian experiment will be carefully watched by many of the almost 100 countries with total fertility rates that are below, many of them far below, replacement levels".

Even though fertility issues have received much attention in the economics literature, the massive fertility reduction in the transition countries of Central and Eastern Europe has only now become a subject of micro-economic analysis. During the 90's, Russia, like most transition economies, experienced many changes in the areas of education, labor markets, and public services that coincided with the observed fertility reduction. The number of college graduates almost tripled from 1990 to 2006 with especially steep growth after 1995. The fertility literature supplies some evidence in support of a direct causal relationship between career achievement aspirations and waiting time until the first birth, as highly-skilled occupations are associated with a longer duration and higher intensity of human capital accumulation both in school and on the job (Moffitt, 1984; Gustafsson, 2001; and Rindfuss et al., 2007). Traditionally, education is also expected to have a negative impact on completed fertility through the substitution effect. Since children are considered to be time-intensive goods, if wages are positively related to education, then women with more advanced education will choose to substitute toward market-purchased goods and away from time-intensive goods. However, if advanced education is rewarded by substantially higher wages, the income effect might theoretically overpower the substitution effect, causing higher education to have pronatalist impacts.

The transition to the market system in Russia changed the entire wage distribution and the variability of non-labor income.[3] Wages are no longer paid according to a centrally defined grid, but instead are allowed to be determined by market forces (Klasen and Launov, 2006). Such a wage formation process is more likely to promote career-motivated behavior and greater labor force attachment among women and, without the provision of appropriate accommodations for working mothers, can result in lower fertility levels. Women's wages have a complicated influence on fertility with its direction and magnitude depending on the relative importance of the income and substitution effects of women's earnings (Arroyo and Zhang, 1997). Also, the

[3] From 1992 to 2004, percentage of men reporting income from work for state-owned organizations more than halved, falling to 30.9% in 2004, whereas percentage of men employed in private and combined ownership organizations more than doubled reaching 32.9% (Mroz et al., 2005). Also, average income paid in privately owned firms surpassed income paid in state-owned ones in 1996 and became 35% larger in 2004.

negative effect of increased educational attainment and labor force attachment on childbearing can be reinforced by a decline in the quality and availability of subsidized child care, which makes school enrollment and, later, employment less compatible with a mother's role (Rindfuss et al., 2007).

Taking into account the above considerations, I estimate a comprehensive model of female life-cycle behavior, which incorporates explicitly the interdependence of annual reproductive choices, educational, employment, and marriage decisions as well as earnings outcomes. The determinants of these fertility-related outcomes are modeled jointly, by applying a discrete factor random effects method with controls for individual- and community-level heterogeneity. Conversely, the estimation of the timing and number of births as an independent decision making process would result in biased and inconsistent results if some factors influencing all or some of the above decisions are unobserved or unaccounted for by a researcher. For example, unobserved career-oriented ambitions may be realized in greater investment in human capital accumulation as well as in postponement of both marriage and the onset of motherhood, resulting in overestimation of the effect of education on the timing of conception. In addition to addressing the endogeneity problem by controlling for both observable and unobservable factors, this joint estimation framework allows for the examination of not only immediate direct effects of the fertility-altering determinants, but also their indirect impact through contemporaneous marital, employment, and educational endogenous decisions and their long term effects. This study is conducted using the Russia Longitudinal Monitoring Survey (1994-2006), which is especially valuable for analyzing fertility since it links detailed individual income, educational, employment and marital information with fertility histories, household, and community characteristics.

Additionally, this analysis considers reproductive behavior in the context of the socio-economic environment, which is captured by a time series of regional socio-economic indicators (e.g., inflation and unemployment rates, marriage and divorce rates). Overall, these indicators demonstrate high volatility during the transition period in Russia. In particular, the economic environment of the 1990's can be characterized by high inflation, reaching 220% with respect to the previous year in 1994 and rising again in 1998 to an annual rate of 84%. Also, real wages fluctuated significantly, experiencing a 32% fall during financial crisis years (1998-99) and then more than doubling by 2004.

My findings indicate that the attainment of a college degree interferes with the maternal role of women, resulting in delayed childbearing and lower overall fertility. However, the increasing proportion of college graduates employed in the economy has a pronatalist effect on both parity transitions. Also, the substitution effect of female earnings is estimated to be more powerful than the income effect, and its effect is stronger for the second birth. Moreover, higher regional wages create better earnings opportunities for women, reinforcing the negative maternal wage effect on the transition to motherhood. Interestingly, simulations of a one time payment of $10,220 (enacted in 2007) produce only a 5.6% increase in the number of first births and actually reduces the number of second births, indicating that the current fertility policy of supplementing non-earned income of mothers is not able to generate the desired result. Overall, my findings show that fertility-stimulating efforts should be directed toward improvement of macro-stabilization policies and the reconciliation of the incompatibility of the career demands of the market system with the requirements of motherhood.

2. Background Literature

Even though fertility issues have received much attention in the economic literature, the massive fertility reduction in the transition countries of Central and Eastern Europe is only now becoming a subject of microeconomic analysis. I know of only two relatively recent microeconomic studies, Chase (2003) and Klasen and Luanov (2006), which go beyond descriptive statistics in their analysis of the fertility-related aspects of the transition process from a centrally planned to a market economy.[4] Chase (2003) studies fertility decline in the Czech Republic and Slovakia during the transition period, attributing the reduction in births to altered economic policies and institutions with new opportunities, costs and constraints (e.g., a reduction of child-care subsidies and allowances). According to probit estimates of the static fertility demand model, Chase (2003) comes to the conclusion that wages and non- labor income are not responsible for the sharp decline in fertility observed during the transition period, whereas age, job uncertainty, and number of older children play a significant role.

Klasen and Luanov (2006) study fertility dynamics during the economic transition in the Czech Republic. They analyze the effect of two groups of variables: socioeconomic variables, such as education, employment history, housing ownership, and place of residence; and belief

[4]On the other hand, implementing descriptive methods, Zakharov and Ivanova (1996) and Vishnevsky (1996) discuss recent demographic changes in Russia, specifically, reproductive trends, concluding that the leading cause of the decline in fertility rates is the second demographic transition and is not social and economic instability.

variables, on the timing of the births and early exit from childbearing for the first two parities. To model a birth process, Klasen and Luanov (2006) use a more flexible continuous time multistate hazard model, allowing for the dependence of the timing of each birth on the fertility history, partially, by incorporating unobserved individual heterogeneity. The analyzed sample is restricted to women between the ages of 16 and 44 with completed education, ignoring the simultaneity and potential endogeneity of educational and reproductive decisions. Klasen and Luanov (2006) find a negative marginal effect of education on the first birth, which is estimated to be larger for the transition period, and increasing with educational attainment. Their results demonstrate a reduced ability or willingness for mothers to combine education and the onset of a career with childbearing. They also find a significant negative effect of residing in a rented apartment on the probability of having a second child during the transition period (about a 10% decline). Because of the lack of income data, the authors are unable to directly estimate the income effect of either earned or non-labor income. Also, their empirical model is constrained by an assumption of time-invariability of individual observed characteristics, arising from their utilization of a cross-sectional data set.

The existing life-cycle literature attempts to explain the dynamic aspects of reproductive behavior, such as the timing and spacing of births, by analyzing income effects, educational choices, and relevant policy interventions. In particular, Heckman and Walker (1990) study the effects of female wages and male income on completed fertility, timing and spacing of births, and childlessness, by estimating 148 specifications of a reduced form duration model of the birth process employing the 1981 Swedish Fertility Survey.[5] Their paper was motivated by the lack of agreement in the empirical findings regarding the importance of female earnings and male income on the decision to have children, due to the scarcity of data sources combining earnings information and birth histories. Even in their analysis, wage information is not at the individual level, but it is represented by age-specific average earnings at the national level. According to almost all specifications, they find a significant negative effect of female wages and a significant positive effect of men's income on the first three parity transition rates and the total number of conceptions. The latter effect declines when marital status is included in the model. In response to Heckman and Walker (1990), Tasiran (1995) also attempts to estimate the impact of female and male wages using the same survey, but with a more accurate approximation for earnings

[5] Earnings information used in Heckman and Walker (1990) study is not individual-level data, but age-specific national average income. The 1981 Swedish Fertility Survey did not record education information, so they do not control for education attainment. Hence, the estimated wage effects in this study can be picking up some education effects as well.

data. The wage and income effects flip signs across different parities and appear to be weaker than in Heckman and Walker (1990). Hence, Tasiran's findings are not supportive of those obtained by Heckman and Walker (1990), which leaves room for further analysis.

Rindfuss et al. (2007 and 2008) add to the literature by analyzing the effect of the availability of high quality and affordable child care as well as female educational attainment on the timing of the first birth (2007) and subsequent births up to the fifth parity (2008) in Norway.[6] The authors hypothesize that institutional changes (e.g., greater availability of child-care facilities) took place to accommodate the increasing number of working mothers and, in turn, these changes resulted in even higher fertility and labor force participation rates. As expected, the improvement in the availability and accessibility of high quality child care has a strong pronatalist effect on women of all ages and, in the case of Norway, can bring the total fertility rate up to the replacement level.[7] They also find that women's school enrollment and educational attainment have significant negative effects on the timing of the first birth, the magnitude of which declines with age. The lack of information on work history, earnings, and marital status necessitates the estimation of a reduced form fertility model. Therefore, the findings on education capture the total effect of a woman's education rather than its effect through different channels such as labor force participation, wages, and marital outcomes.

Angeles, Guilkey, and Mroz (1998 and 2005a,b) study the effectiveness of family planning programs in the reduction of high fertility rates in a number of countries. In these papers, along with the policy variables, they estimate the effect of female education on reproductive choices. In contrast to previous empirical findings, which treated education as an exogenous outcome, Angeles, Guilkey, and Mroz (2005a) present convincing evidence in support of a positive relationship between education and fertility outcomes, by estimating the parameters for woman's education, age at first marriage, and fertility equations jointly.[8] They also demonstrate that not controlling for unobserved heterogeneity and the endogeneity of education will result in significantly biased coefficient estimates for policy variables by underestimating the influence of family planning efforts and overestimating the effect of

[6] In their empirical approach, they incorporate birth interval dependence for all coefficients of the fertility equation and model individual heterogeneity parametrically using the Heckman-Singer procedure with correlation between different birth parities (see Heckman and Singer, 1984).

[7] According to Rindfuss et al. (2008) simulations, if child-care availability is increased from 0% (1973 level) to 60% (1991 or target level) for the entire reproductive lifetime of all cohorts, total fertility goes up by 0.7 children per woman on average.

[8] The importance of endogenizing educational attainment is reinforced by Angeles, Guilkey, and Mroz (1998 and 2005b) estimation of a negative relationship between additional education and fertility when schooling is treated as an exogenous outcome.

improvement of maternal education as an overpowering solution for a wide range of developing countries problems (e.g., high fertility rates, poor health and schooling outcomes). Angeles, Guilkey, and Mroz (1998 and 2005a,b) do not control for labor market outcomes of women; therefore, their education estimates are partially capturing the wage and employment effects.

Overall, the existing studies on the countries in transition provide some background on the importance of different factors related to the decline in total fertility rates. However, further research with an application of rich longitudinal data, such as the Russia Longitudinal Monitoring Survey will allow for greater flexibility in the empirical formulation of the life-cycle fertility model and, therefore, for more accurate conclusions. My contribution to the fertility literature is the estimation of a more comprehensive model of female life-cycle behavior, which accounts explicitly for the interdependence of annual reproductive choices; educational, employment, and marriage decisions as well as earnings outcomes and controls for the individual- and community-level heterogeneity. Modeling these fertility-related outcomes jointly also allows for a correction for the potential endogeneity of education, employment, and marriage choices in the conception equation arising from the existence of unobserved individual or community characteristics shaping all fertility-related choices (e.g. family values or career-oriented ambitions). Additionally, incorporation of detailed controls for socio-economic circumstances, such as regional inflation, unemployment, average earnings and production indicators, as opposed to yearly and regional dummies, adds an additional dimension to the analysis by showing the effect of the environment on fertility outcomes directly and through other life-altering choices.

3. Theoretical Motivation

To inform the specification of the empirical equations presented in the next section and to establish pathways through which fertility-related choices interact within a dynamic framework, I provide a theoretical model with explicit incorporation of the timing aspects of a woman's decision making process. My model is a life-cycle interpretation of the standard neoclassical model of consumer demand for reproductive decisions introduced by Becker (1960) that considers fertility outcomes as parental demand for a lifetime number of children. The theoretical model describes the timing and interdependence of the mother's educational, labor, and marital choices and their impact on contemporaneous and future fertility outcomes. Women are followed from age 14, when they are about to graduate from mandatory middle school and are starting to plan their future careers, including pursuit of additional education. At the same age, a woman is assumed to enter her fecundity period, and her annual life-cycle choices are traced throughout her primary fertility years. In this model, pursuit of an additional year of schooling positively influences the future wages of the woman, but competes for time with working and non-market activities, including motherhood, via the time constraint.[9] The labor market outcome at both the intensive and extensive margins affects income available for adult- and child-related consumption through the budget constraint and influences the woman's future earnings through accumulation of experience and job tenure. Hence, both the acquisition of additional education and greater labor market attachment improve the future wage that, in turn, increases the opportunity cost of all alternative time allocations such as childrearing and leisure. On the other hand, higher wages will secure more financial recourses for the same activities. Changes in marital status impact the woman's choices through two pathways: the budget constraint and contemporaneous utility. The decision to have a child brings additional utility as soon as that child is born. However, childrearing requires significant time and financial contributions, by increasing demand for leisure time and for market-purchased goods.

The woman derives utility from consumption of market-purchased goods and services (C_{it}) (e.g., formal child care) and from her leisure or non-market activities (L_{it}) (e.g., childrearing). The woman derives additional utility from her marital status (M_{it}) and her husband's characteristics if she is married at time *t*.[10] The mother also obtains utility from her children (N_{it}) and additional utility from a newborn ($n_{i,t-1}$). The individual per-period utility also depends on a time-varying schooling- and employment-specific taste shifter ($\mu_{it}^{h,s}$), on an unobserved time-invariant preference parameter (θ_i), reflecting individual family size preferences, career-related ambitions and permanent fecundity, and on a set of exogenous socio-demographic characteristics (D_{it}):

$$U_{it} = U(C_{it}, L_{it}, M_{it}, N_{it}, n_{i,t-1}, \mu_{it}, \theta_i; D_{it}),$$

Women are assumed to derive increasing marginal utility at a decreasing rate from consumption and children. Also, the partial derivative of the utility function with respect to leisure increases with the total number of children and with the presence of a newborn:

[9] Since tuition cost is zero in most public educational institutions in Russia, the only education-related cost considered in this paper is the time cost.

[10] Her husband's characteristics are assumed to be exogenous since her marital status is modeled as an outcome as opposed to a choice.

$$\left.\frac{dU_{it}}{dL_{it}}\right|_{N_{it}=n_2} > \left.\frac{dU_{it}}{dL_{it}}\right|_{N_{it}=n_1}, \forall n_1 \text{ and } n_2 \in N_{it}, s.t.\, n_1 < n_2$$

and .

$$\left.\frac{dU_{it}}{dL_{it}}\right|_{n_{i,t-1}=1} > \left.\frac{dU_{it}}{dL_{it}}\right|_{n_{i,t-1}=0}$$

These properties of the utility function indicate a utility gain from time spent on non-market activities if the woman has children and even greater gain if she has a newborn. The same assumptions are imposed on the marginal utility of consumption of market-purchased goods and services.

Every period, a woman decides whether to have a newborn in the next period or not. This discrete conception choice variable is denoted by n_{it} and takes on value 1 if the woman decides at time *t* to have a newborn at time *t + 1* or 0 otherwise. Women are assumed to have only planned conceptions, and they control their fertility perfectly and costlessly.[11]

In making her optimal fertility, time allocation, and consumption decisions, a woman faces time and budget constraints. She divides her total available time ($\bar{T}$) between leisure (L_{it}), work (H_{it}), and school ($T^s * s_{it}$):

$$\bar{T} = L_{it} + H_{it} + T^s * s_{it},$$

where T^s is time needed for acquiring an additional year of education and s_{it} indicates whether the woman is currently a student ($s_{it} = 1$) or not ($s_{it} = 0$). Time devoted to child upbringing is accounted for in time spent in child-related non-market activities (L_{it}), the value of which increases with the total number of children and the presence of a newborn in the family through the contemporaneous utility function. Overall, having children, especially those under one year old, leaves less time for work and school and, moreover, disutility from work and school increases with every child.

In addition, the total expenditure on annual adult and child-related consumption is financed from the woman's earned and non-earned income of the same year, and depends on the realization of the income shock. The woman's labor income is an increasing function of her acquired education (S_{it}), accumulated job tenure (τ_{it}), and work hours (H_{it}): $w(S_{it}, \tau_{it}) H_{i,t}$. Non-earned income, $I_{it}(M_{it}, s_{it}, N_{it})$, depends on the woman's marital status (M_{it}) through

[11] The estimation technique, employed in this paper, allows for sterility.

husband's income, educational status (s_{it}) through stipend reception, and number of children through the governmental child allowance (N_{it}). In addition to being determined by individual employment and educational decisions over the lifetime and current marital and educational states as well as fertility history, total income is subject to a stochastic shock, ε_{it}, which captures uncertainty about real income associated with the transition period and is present even in the case of unemployment. The value of the income shock becomes known to the woman after she makes her employment and schooling decisions and as she learns more about her economic environment (e.g., inflation, her and her family members' payment structure, etc.). The following per-period budget constraint assumes that capital markets are perfectly imperfect – no lending or borrowing is permitted:

$$w(S_{it}, \tau_{it}) H_{it} + I_{it}(M_{it}, s_{it}) + \varepsilon_{it} = C_{it}.$$

According to the budget constraint, mothers incur a monetary cost associated with raising children through an increase in the consumption of the child-related component of market-purchased goods. Such an increase is driven by the positive dependence of the mother's utility on the amount of purchased goods consumed when children are present in the family. Overall, having children potentially reduces the mother's contemporaneous earned income through the time constraint, by decreasing available time for work, and the magnitude of the respective earnings loss is determined by her current wage. In addition to the immediate effect of high demand for mother's time, childrearing reduces a woman's earned income for the coming years by possibly suppressing educational attainment and labor market attachment (e.g., lowering current work hours and employment due to taking care of children). These considerations describe the opportunity cost of motherhood in terms of lost earnings and direct costs.

Marital status influences available funds for childrearing and consumption through the budget constraint by supplementing non-earned income and thus enters the woman's contemporaneous utility function[12]. In every period the woman faces a probability of being married in this period, and it is formulated by the following function:

$$\Pr(M_{it} = 1) = f(N_{it}, n_{i,t-1}, S_{it}, w_{it}, \theta_i; D_{it}).$$

[12] In the fertility literature, marriage is traditionally viewed as being mainly driven by a decision to enter parenthood (Becker, 1973, 1974, and 1981). Transition to parenthood within marriage is facilitated by pooling the financial resources of the spouses. Moreover, male and female financial contribution capacity for childrearing is modeled as a main criterion for matching by Weiss and Willis (1985), Willis (1995), and Lam (1988).

where M_{it} is an indicator of marital status, and it takes on a value of 1 if the woman is married and 0 otherwise. Hence, marital status is modeled as an outcome, as opposed to a choice, to avoid the complexity of modeling joint marriage decisions with introduction of a husband as separate utility-maximizing agent. The probability of being married at time *t* is expected to be higher if the woman has children (N_{it}) or a newborn from ($n_{i,t-1}$) from the current marriage, and if she possesses unobserved preferences for family and children (θ_i). Marital status also depends on educational attainment (S_{it}), earnings opportunities of the woman (w_{it}) and her community socio-demographic characteristics (D_{it}) (e.g., the ratio of men to women[13]).

The timeline of the woman's choices is summarized as follows. At the beginning of each period, the woman learns her marital status (M_{it}) along with her husband's characteristics if she is married and the realization of the time-varying taste shifters summarized in a vector, $\mu_{it}^{h,s}$. Hence, the information known to the woman at the beginning of period *t* can be summarized in the following vector:

$$Z_{it} = (H_{i,t-1}, N_{it}, n_{i,t-1}, M_{it}, S_{it}, s_{i,t-1}, \tau_{it}, w_{it}, I_{it}, \theta_i, \mu_{it}^{h,s}; D_{it}).$$

Given her knowledge, she decides how to allocate her time optimally between working (H_{it}), schooling (s_{it}), and leisure (L_{it}). Then, the woman observes the value of the economic shock, ε_{it}, and makes her optimal fertility choice (n_{it}). The objective of these individual life-cycle decisions is to maximize the expected present value of discounted life-time utility, subject to time allocation and budget constraints. After substituting for these constraints in the utility function, the present value of lifetime utility associated with the fertility alternative $n_{it} \in \{0, 1\}$, conditional on realization of income shock (ε_{it}), and given particular employment (H_{it}) and schooling (s_{it}) choices in the current period *t* is given by:

$$\begin{aligned} V_{i,t}^{n_{it}}(Z_{it}, H_{it}, s_{it}, \varepsilon_{it}) = U\Big\{ & w(S_{it}, \tau_{it}) H_{it} + I_{it}(M_{it}, s_{it}, N_{it}) + \varepsilon_{it}, \\ & \bar{T} - H_{it} - T^s * s_{it}, N_{it}, n_{i,t-1}, M_{it}, \mu_{it}, \theta_i, D_{it} \Big\}, \\ & + \beta E_{\mu_{it}} \sum_{M_{i,t}=0}^{1} \Pr(M_{i,t+1} \mid N_{i,t+1}, n_{it}, S_{i,t+1}, w_{i,t+1}, \theta_i, D_{i,t+1})\, G\ (Z_{i,t+1}) \end{aligned}$$

where $G(Z_{i,t+1})$ is the total life-time expected utility at time *t* and β is a discount factor.

[13]According to Willis (1995) and Lam (1988), the equilibrium marriage outcomes depend on the numerical proportion of women to men.

Solving this expected utility maximization problem over the years of fecundity will yield a period-specific demand function for conceptions as a function of Z_{it}, H_{it}, and s_{it} and a demand function for education as well as a labor supply function expressed in terms of Z_{it}.

4. Empirical Model

As was discussed in the theoretical model, fertility decisions are closely interconnected with other major life-changing choices such as education, employment, and marriage. Estimation of the determinants of the fertility outcomes as an independent decision making process will result in biased and inconsistent results if some factors influencing all or some of the above decisions are unobserved or unaccounted by a researcher. For example, unobserved career-oriented ambitions may be realized in greater investment in human capital through acquisition of an advanced academic degree as well as in postponement of both marriage and the onset of motherhood. Therefore, estimation techniques (e.g., Logit, Probit, Ordinary Least Squares) that ignore the endogeneity of education overestimate the negative effect of education, by not isolating unmeasured individual characteristics from the effect of an advanced degree obtainment. Alternatively, if the woman's family-oriented values are most likely to be realized in an early transition to motherhood, early and long-lasting marriage, low labor-market attachment, and minimal investment in human capital then the positive effect of marriage and the negative impacts of education and employment on the probability of conception will be overestimated. In my preferred estimation method, I simultaneously estimate the determinants of fertility, maternal education, employment, work hours, and marital outcomes, by applying a maximum likelihood random effects method, with explicit modeling of individual- and community-level heterogeneity. Another approach used in the literature to control for heterogeneity in panel-data studies is to treat an unobserved factor as an individual fixed effect. There are several drawbacks associated with this method. First, it requires at least two observations for each individual and, in the case of a nonlinear model, it needs an even larger number of observations for each individual in order to produce consistent results (Angeles, 1998). The fixed effects model results in a significant loss in degrees of freedom due to the introduction of additional parameters, substantially exceeding those required for estimation of the discrete random effects model. The fixed effects approach also reduces the variability of explanatory variables by employing only over-time changes to identify a particular effect, which might yield imprecise estimates for variables demonstrating little time variation such as acquired education and marital status. For similar reasons, the fixed effects method amplifies measurement error problems. On the other hand, in addition to addressing the endogeneity problem arising from the dependence of the life-cycle individual choices on the unobserved permanent preference parameter, the joint estimation framework (or discrete random effects model) allows the examination of not only the direct contemporaneous impact of all modeled choices and policy variables on fertility outcomes, but also their indirect effect through the various pathways described in the theoretical model.

The description of the empirical specification follows the timeline of per-period choices as it is outlined in the theoretical model. Before defining my equation of primary interest – the fertility equation- I present the marital outcome and then joint schooling, employment and hours of work decisions. All empirical equations *e, where e=K, M, S, L, and H,* share a similar error structure, where unobserved determinants are decomposed into permanent individual, λ^e, and community, ω^e, components and an idiosyncratic term, η_{it}^e. The individual heterogeneity term is intended to capture individual-specific tastes for family and children, career ambitions, and the degree of fecundity. The community heterogeneity parameter embodies local beliefs regarding family size and local values defining the socially accepted role of a woman in the community. Unobserved personal and community factors are assumed to correlate across equations.

4.1. Marriage Equation

Following the theoretical model, the marital status in every year *t* from the age of 14 is modeled by a discrete time annual renewal hazard model as a function of the one period lagged choice variables:[14]

$$\ln\left[\frac{\Pr(M_{ijt}=1)\,|\,\lambda^M,\omega^M}{\Pr(M_{ijt}=0)\,|\,\lambda^M,\omega^M}\right]=D_{ijt}\alpha^M+Z_{i,j,t-1}\beta^M+P_{jt}^M\gamma^M+\lambda^M+\omega^M .$$

The dependent variable M_{ijt} takes the value 1 if a woman *i* from community *j* is married at time *t,* and 0 otherwise. The lagged variables reflect the dependence of the probability distribution of marital status in every period *t* on the history of variables known at the beginning of time *t* including previous decisions. All modeled choices are made after learning the current period's marital status. The annual hazard of being married is influenced by exogenous

[14] The logistic form of the marital equation specification relies on an assumption that the serially-uncorrelated error term, η_{it}, follows the Extreme Value distribution.

individual and household variables, D_{ijt}, such as the woman's age, ethnicity and dwelling ownership, and previous endogenous outcomes, $Z_{i,j,t-1}$, such as the number of children ever born, her fertility decision in the previous period, past year school enrollment, highest educational degree obtained, and current potential wage. Marital status also depends on community and regional time-varying characteristics, P_{jt}^{M}, including ratios of marriages and divorces to adult population, female to male ratio, etc. Terms λ^{M} and ω^{M} are individual and community characteristics unobserved by researchers that are most likely correlated with personal outcomes included in the equation.

Since labor earnings are not available for unemployed women, potential wages are predicted for all women to capture the shadow prices of their time. They are predicted based on computed parameters of the offered wage estimated jointly with labor force participation and education equations. The education equation is included as part of the maximum likelihood estimation to control for endogeneity of education in the wage equation, whereas the labor force participation equation corrects for sample selection bias since wages are observed only for the working population of women.[15] Following the theoretical model, the log wage function is given by:[16]

$$\ln w_{ijt} = \alpha_0 + \alpha_1 S_{it} + \alpha_2 \tau_{it} + \alpha_3 \tau^2{}_{it} + P_{jt}^{w}\gamma^{w} + \lambda^{w} + \omega^{w} + \eta_{it}^{w}.$$

In addition to providing estimates of the effects of the key variables on fertility through their impact on marriage outcome, the marriage equation controls for the endogeneity of marital status and non-earned income in the other equations.

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[15] A substantial number of working women do not report any earnings. This number is the highest during the first three rounds reaching 35% in 1998, which to the large degree can be attributed to the type of earnings information recorded in those years – money wages paid in the last 30 days. After 1998, when a more complete measure of work compensation becomes available, only 7-8% of working women do not report their earnings. To account for missing wage information in the estimation of potential wages, I subdivide the sample of women in three categories: unemployed, employed with reported wages, and employed with missing wages. Therefore, the employment equation is specified not as a simple logit, but as a multinomial logit.

[16] According to the labor-supply theory, a person chooses employment over unemployment if her reservation wage is below the offered wage (or market wage), where the reservation wage represents earnings at which this person is indifferent between being employed and unemployed. Individual- and household-level variables summarizing the cost of employment and alternative income sources (e.g., marital status, non-earned income, husband's characteristics, number of children, dwelling ownership, etc.) define the reservation wage and, therefore, the employment decision. On the other hand, offered wages are determined by a person's productive skills; therefore, individual characteristics capturing cost of employment and alternative income sources are excluded from the wage equation.

4.2. Education, Employment, and Hours of Work Equations

In this section, I specify joint schooling (*S*), employment (*L*) and hours of work (*H*) decisions. These joint decisions are influenced by a set of individual and household exogenous covariates (D_{ijt})[17], a vector of endogenous state variables (Z_{ijt}), and time-varying community and regional characteristics (P_{jt}^{S}, P_{jt}^{L} and P_{jt}^{H}, respectively). P_{jt}^{S} and P_{jt}^{L} contain the same set of characteristics including information captured in vector P_{jt}^{M}.

As it is described in the theoretical model, at age 14 the woman completes her mandatory schooling and starts planning her future career via human capital accumulation. For women of age 14 and above, the education decision of whether or not to pursue additional schooling in the current year is described by the following logistic form:

$$\ln\left[\frac{\Pr(s_{ijt}=1)\,|\,\lambda^{S},\omega^{S}}{\Pr(s_{ijt}=0)\,|\,\lambda^{S},\omega^{S}}\right]=D_{ijt}\alpha^{S}+Z_{ijt}\beta^{S}+P_{jt}^{S}\gamma^{S}+\lambda^{S}+\omega^{S}.$$

The schooling decision is influenced by such endogenous covariates (Z_{ijt}) as the total number of children born to the woman and the presence of a newborn in the family, the woman's total educational attainment, the woman's marital status, and her non-earned income.

The log odds of the woman being employed ($H_{ijt}>0$) relative to being unemployed ($H_{ijt}=0$) at every year (age) *t* during the surveyed years is specified as follows:

$$\ln\left[\frac{\Pr(H_{ijt}>0)\,|\,\lambda^{L},\omega^{L}}{\Pr(H_{ijt}=0)\,|\,\lambda^{L},\omega^{L}}\right]=D_{ijt}\alpha^{L}+Z_{ijt}\beta^{L}+P_{jt}^{L}\gamma^{L}+\lambda^{L}+\omega^{L}.$$

Endogenous covariates included in Z_{ijt} are the number of children ever born and the woman's fertility decision in the previous period, highest education acquired, her marital status, and non-earned income. The employment equation is included to correct for sample selection bias in the hours of work equation, which is estimated only for the working sub-sample of women. The source of this bias stems from the potential divergence between the working sub-sample of women and their counterparts with respect to unobserved characteristics, such as family preferences or motivation. The employment equation also addresses the potential endogeneity of employment status in the fertility and marriage equations.

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[17] Individual and household exogenous covariates overlap across equations with husbands' characteristics being excluded from the educational equation since only a small proportion of married women is observed to be still in school.

Work supply intensity is measured by weekly hours and formulated by:

$$H_{ijt} = D_{ijt}\alpha^{H} + Z_{ijt}\beta^{H} + P_{ij}^{H}\gamma^{H} + \lambda^{H} + \omega^{H} + \eta_{ijt}^{H}.$$

η_{ijt} is a serially-uncorrelated error term following a normal distribution with mean 0 and variance σ_{η}. The employment intensity decision depends on the following personal outcomes (Z_{ijt}):number of children in the household, the previous period reproductive decision, the woman's completed education, her potential wage, non-earned income, and the woman's marital status. The vector P_{jt}^{H} shares the set of regional and community parameters with P_{jt}^{L} from the employment equation, excluding employment agency indicator, divorce and marriage rates, and male to female ratio.

4.3. Fertility Equations

Having allocated her time and money for the current period, the woman decides whether or not to have a child in the next period. During the woman's primary fecundity years between 14 and 35, the timing of conception leading to the first and second live births is specified separately by a discrete time hazard model:

$$\ln\left[\frac{\Pr(n_{ijtk} = 1 \mid N_{ijt} = k-1, \lambda_k^N, \omega_k^N)}{\Pr(n_{ijtk} = 0 \mid N_{ijt} = k-1, \lambda_k^N, \omega_k^N)}\right] = s_{ijt}\psi_k + H_{ijt}\phi_k + D_{ijt}\alpha_k^N + Z_{ijt}\beta_k^N + P_{jt}^N\gamma_k^N + \lambda_k^N + \omega_k^N \quad . \quad k=1, 2.$$

The dependent variable n_{ijtk} takes on a value of 1 if a woman *i* from community *j* conceives a k^{th} child at time (age) *t* or 0, otherwise. The conception probability at every period is defined by observed individual characteristics (D_{ijt} and Z_{ijt}, respectively), and time-varying community observables (P_{jt}^{N}). The set of P_{jt}^{N} covariates overlaps with the vectors P_{jt}^{M}, P_{jt}^{S}, P_{jt}^{L} and P_{jt}^{H}. However, some regional and community parameters have only an indirect effect on fertility behavior through other endogenous choices. Among these variables are regional marriage and divorce rates, unemployment rates for different educational groups, and the presence of an unemployment agency in the population center. The effects of all personal- and community-level characteristics are allowed to vary with parity. Also, the probability of conceiving a child is influenced throughout fertility years by permanent personal (λ_k^N) and community (ω_k^N) factors which are unobserved by the researcher.

The decision to give birth in the next period is influenced by all endogenous outcomes associated with the current period (s_{ijt}, H_{ijt}), including employment status, hours of work and tenure, and histories (Z_{ijt}) such as school enrollment status and acquired education, potential wage, marital status, and non-earned income. The source of the endogeneity of the above variables is in the role of unobserved personal characteristics (λ_k^N) in shaping all of the woman's fertility-related outcomes. Because of the correlation between these variables and the permanent preference parameter, estimation of the fertility equation independently will yield biased and inconsistent results. For these reasons, all described choices are estimated jointly and unobserved personal and community factors are assumed to correlate across equations. In order to avoid making assumptions regarding the actual distribution of the unobserved factors such as an assumption of normality, the error term distributions are approximated using a semi-parametric discrete factor method (Heckman and Singer, 1994; Mroz and Guilkey, 1995 and Mroz, 1999). The likelihood function specification can be found in the Appendix.

For years prior to the Russia Longitudinal Monitoring Survey coverage or before reaching 18 years old, information on some variables is not recoverable. Fertility, education, and marital equations will be modeled on a modified set of observables for those years.[18] Also, for the years before the woman's participation in the survey the timing of first and second conceptions is specified in a single equation and estimated on a larger sample including all women in their primary fecundity years regardless of their fertility history upon entering the study. The purpose of this specification is to avoid sample selection bias associated with the sample definition dependence on the previous reproductive choices since the analyzed sample is limited to women entering the survey with less than two children.

5. Data

The empirical model is estimated using the Russia Longitudinal Monitoring Survey (RLMS), which is a nationally representative longitudinal survey collected sixteen times since 1992.[19] The RLMS is designed to study the impact of reforms on the wellbeing of households and individuals. The RLMS is a household-based survey, which covers a substantial number of

[18] For the years before participation in the RLMS, the dependent variable in the marriage equation is divided into three categories: married, not married, and missing marital status. Such a definition of marital status is determined by failure to recover marital status for these years: 1471 women have missing marital information for at least one period.

[19] The Russia Longitudinal Monitoring Survey has been organized and coordinated by Dr. Barry M. Popkin, Fellow of the Carolina Population Center at the University of North Carolina at Chapel Hill.

households including all individuals within the sampled households.[20] This longitudinal data set is especially valuable for studying fertility since it links detailed individual income, educational, employment and marital information with fertility histories, household, and community characteristics. Data have been collected in two phases on entirely different samples. This paper analyzes data collected in Phase II, covering Round V (1994) to Round XIV (2005/06), and includes 3,750 to 4,715 households with 8,342-10,670 adults.[21] This survey employs a multi-stage clustering design, which enables one to capture the great ethnic heterogeneity of the Russian population and the substantial socio-economic diversity of the country's vast territory. After excluding some remote areas, 1,850 regions, where 95.6% of the population resides, participate in the sampling procedure.

5.1. Sample Construction

The sample for this study is restricted to women between the ages of 18 and 35 in 1994-2005. Since the primary focus of the analysis is on the timing of the first two conceptions, the sample of women is additionally limited to years of life before they have their second child. 45 women have unrecoverable missing information on some key variables and, therefore, are dropped from the study. 4006 women aged 18-35 with one or fewer children participated in at least one out of ten rounds of the survey, resulting in 13,340 woman-year observations (see Table 5.1). Also, 1,825 individuals who have not participated in at least three consecutive rounds or in the last one are right censored.[22] Missing information for non-response rounds is either recovered based on information provided in the later rounds or imputed, employing techniques discussed later in this section. Women leaving this study for reasons related to the fertility choices, which are not controlled for in the empirical model, might bias estimation results. The attrition bias due to the right-censored observations is addressed in the empirical estimation by inclusion of the attrition equation, modeling the decision to exit the RLMS.

[20] Original dwellings are visited every round with three attempts to interview all adult-members, even if the household had refused to participate during previous rounds, or if it is known that the household moved to a new dwelling. Also, if the originally selected household or some members of it change their address, they are followed to a new dwelling.

[21] The choice of Phase II is dictated by its longer time span, improved quality of sampling procedure and inclusion of the community questionnaire.

[22] If individuals do not respond to either the last one (246 women) or last two (477 women) rounds of the survey, they are included in the right censored category. Out of 4006 individuals in the sample, 309 women have at least one single non-response, and 81 have missed two consecutive rounds of the survey at least once.

Table 5.1 Summary Composition

Variables	Mean
No. of individuals:	4006
Woman-year observations:	13345
-at risk with 1st conception	6407
-at risk with 2nd conception	6947
No. of first conceptions	596
No. of second conceptions	327

5.2. Variable Description

The RLMS contains detailed information on the timing of every individual's birth in the sampled households, including children. Linking mothers with their children within the household allows the construction of conception histories for each woman since age 14. The dependent variable in the fertility equation indicates whether a conception leading to a live birth took place in a given year. The conception event is associated with a particular survey year if the respective birth occurred not earlier than one month after the interview date and not later than a month after the next interview. Since the time interval between two consecutive interviews ranges from 9 to 15 months,[23] this rule results in the conception date falling in the interval 8 months before the interview or 7 months after the interview. In addition to retrospective questions, the RLMS poses questions to capture changes since the last interview. Therefore, it is critical in the definition of the conception event to separate the child's birth date and the conception round. By doing so, individual and family characteristics, recorded in the interview, embody the environment in which the decision to have a child was made rather than reflecting adjustments on the part of the woman and her family associated with the recent or upcoming birth of the child. On the other hand, the interview date of the conception round is restricted to be relevant to the corresponding conception decision. As summarized in Table 5.1, during years of participation in the survey, a total of 6407 woman-year observations belong to a group at risk of pregnancy at age 18-35 with their first child, and 6947 with their second child. A total of 596 conception events leading to the first-child birth happened during surveyed years and 45% fewer conceptions of the second child (327 conceptions) occurred.

[23]The interval between interviews reached 54 months for round VII and VIII.

The key individual-level explanatory variables in the analysis are age, marital status, education, employment, and labor and non-labor income. The construction of these variables, including imputation rules for non-response years and a detailed description of the backdating of marital and educational variables to age 14, are presented in Appendix B. The structure of the survey allows for identification of spouses within the household and linking husbands' characteristics to their wives. Hence, age, employment and education characteristics of the husbands are also included in the analysis, employing the same guidelines to define corresponding explanatory variables.

Among household-level characteristics included in the analysis are the number of retired adults residing in the dwelling, family ownership of their dwelling and some appliances, as well as their access to public utilities (e.g., central heating or water supply). These family-related factors are intended to capture availability of informal child-care, the family's overall economic wellbeing, and existence of any living space constraints. The latter was shown to play a significant role in fertility planning in the previous literature on fertility in transition economies. Table 5.2 summarizes descriptive statistics for the discussed variables for all women in the sample and offers a comparison between them and those women who decide to conceive their first child and second child.

Regional time-series data on 32 subdivisions, collected by the Federal State Statistics Service (Goskomstat), are merged with the RLMS, employing regional identifiers. The full list of variables along with their definitions is presented in Appendix B, Table B5.3. These regional indicators capture the socio-economic circumstances (including the impacts of government policies) in which women make their reproductive decisions. These socio-economic indicators demonstrate high volatility across studied years. In addition to the substantial heterogeneity of the country's vast territory, the socio-economic changes do not manifest themselves to the same degree in all regions, so there is an additional variation in those indicators across different regions. In particular, the 1998 financial crisis did not bring the same impact to all corners of Russia: inflation in 1998 relative to the previous year ranged between 60.4% and 106%. Average earnings dropped only 5% in some regions, but plummeted by 20% in others, and real GDP experienced growth of up to 6.4% in some areas and declined by 17% in others. Such substantial differentiation in regional indicators both across years and regions provides needed variation in the socio-economic environment to estimate the effects of the regional factors on fertility behavior more accurately and allows for simulation of a wide spectrum of circumstances.

Table 5.2: Descriptive Statistics

Variables	All women		1st conception		2nd conception	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Age 18-20	0.21	(0.41)	0.33	(0.47)	0.07	(0.26)
Age 21-25	0.36	(0.48)	0.47	(0.50)	0.33	(0.47)
Age 26-30	0.25	(0.44)	0.16	(0.37)	0.41	(0.49)
Age 31-35	0.18	(0.38)	0.04	(0.18)	0.19	(0.39)
Married	0.59	(0.49)	0.77	(0.42)	0.91	(0.28)
1st child < 3 years	0.16	(0.37)	0.00	(0.00)	0.23	(0.42)
1st child 3 - 8 years old	0.21	(0.41)	0.00	(0.00)	0.53	(0.50)
Student	0.18	(0.38)	0.19	(0.40)	0.05	(0.22)
High school	0.32	(0.47)	0.35	(0.48)	0.34	(0.47)
Technical/medical school	0.32	(0.47)	0.32	(0.47)	0.33	(0.47)
Some college	0.11	(0.32)	0.09	(0.28)	0.05	(0.21)
College degree	0.20	(0.40)	0.21	(0.40)	0.22	(0.41)
Employed	0.59	(0.49)	0.62	(0.49)	0.67	(0.47)
Hours of work	44.03	(15.82)	43.95	(15.52)	43.29	(16.14)
Earnings	2.04	(2.04)	1.94	(1.85)	1.79	(1.49)
Tenure	2.03	(3.23)	1.51	(2.23)	2.69	(3.39)
Slavic	0.88	(0.33)	0.88	(0.32)	0.84	(0.37)
European (excl.slavic)	0.01	(0.09)	0.01	(0.07)	0.01	(0.11)
Non-earned income	0.92	(1.69)	0.98	(1.93)	0.74	(0.98)
Own dwelling	0.84	(0.37)	0.83	(0.38)	0.81	(0.39)
Retired adults present	0.23	(0.42)	0.22	(0.41)	0.21	(0.41)
Index of assets	7.03	(2.11)	6.87	(2.12)	6.36	(2.32)
Husband's characteristics:						
Age	28.94	(5.60)	25.40	(4.33)	29.36	(5.12)
High school diploma	0.20	(0.40)	0.18	(0.39)	0.18	(0.39)
Technical/medical school	0.47	(0.50)	0.47	(0.50)	0.48	(0.50)
Some college	0.06	(0.24)	0.08	(0.28)	0.04	(0.20)
College degree	0.21	(0.41)	0.19	(0.39)	0.23	(0.42)
Work hours	36.36	(24.52)	33.81	(24.88)	33.19	(23.55)
Employed	0.76	(0.43)	0.72	(0.45)	0.72	(0.45)
Community characteristics:						
Urban	0.73	(0.44)	0.71	(0.45)	0.61	(0.49)
Settlement of urban type	0.06	(0.23)	0.05	(0.22)	0.05	(0.23)
Rural	0.21	(0.41)	0.24	(0.43)	0.33	(0.47)
Public nursery	0.65	(0.48)	0.65	(0.48)	0.57	(0.50)
Public preschool	0.86	(0.35)	0.87	(0.34)	0.85	(0.36)
Middle school	0.53	(0.50)	0.54	(0.50)	0.50	(0.50)
High school	0.37	(0.48)	0.36	(0.48)	0.30	(0.46)
Library	0.88	(0.32)	0.90	(0.30)	0.91	(0.29)
Employment agency	0.74	(0.44)	0.75	(0.44)	0.69	(0.46)
Sample size	13,345		595		329	

6. Results

This section presents and evaluates the estimates of the nine-equation system modeled jointly with controls for community and individual heterogeneity. The distributions of the unobserved individual- and community-level factors are estimated jointly with the rest of the model's parameters by using the flexible semi-parametric discrete factor method. Their underlying distribution is approximated using discrete distributions with four points of support for community heterogeneity and nine points for individual heterogeneity that add 121 parameters and improve the log-likelihood function value by 15,612 (see Table 6.1). For such an increase in the log-likelihood value, the Likelihood-Ratio test yields P-value of approaching zero, indicating strong significance of the heterogeneity parameters. The estimated probabilities of each point of support and respective heterogeneity coefficients are presented in Table 6.1.

Table 6.1: Estimation Summary	Value of the Loglikelihood Function	Number of Parameters
Heterogeneity corrected model	-84205.60	599
Simple Logit model	-92011.67	478
Gain from heterogeneity correction	15612.14	121

Estimated heterogeneity distributions	Weights	Unobserved heterogeneity effects											
Community		1st Conception		2nd Conception		Marriage		Schooling		Employment		Work Hours	
Point 1	0.25	0.00		0.00		0.00		0.00		0.00		0.00	
Point 2	0.19	0.20	(0.20)	0.07	(0.24)	-0.02	(0.17)	0.39	(0.22)	0.19	(0.14)	4.51	(0.77)
Point 3	0.43	-0.28	(0.14)	-0.37	(0.17)	0.45	(0.12)	0.47	(0.13)	-0.59	(0.08)	0.17	(0.46)
Point 4	0.12	-0.84	(0.29)	-0.03	(0.27)	1.56	(0.21)	-1.04	(0.28)	0.93	(0.18)	-6.19	(0.93)
Individual													
Point 1	0.11	0.00		0.00		0.00		0.00		0.00		0.00	
Point 2	0.16	0.25	(0.27)	0.31	(0.34)	-3.63	(0.19)	-2.36	(0.21)	3.56	(0.19)	0.97	(1.36)
Point 3	0.12	-0.15	(0.27)	0.54	(0.29)	-2.02	(0.21)	0.51	(0.25)	2.28	(0.18)	-0.41	(1.43)
Point 4	0.13	-1.69	(0.31)	-0.63	(0.38)	3.28	(0.36)	-0.89	(0.27)	1.96	(0.21)	0.62	(1.51)
Point 5	0.04	-0.21	(0.36)	-0.52	(0.45)	-0.64	(0.21)	-1.85	(0.26)	3.64	(0.22)	39.57	(1.49)
Point 6	0.13	-0.75	(0.26)	-0.44	(0.27)	1.71	(0.23)	-0.06	(0.24)	3.05	(0.15)	1.52	(1.43)
Point 7	0.13	-1.24	(0.29)	-0.10	(0.31)	1.09	(0.21)	-5.29	(0.34)	4.85	(0.21)	0.09	(1.34)
Point 8	0.08	-1.15	(0.39)	-0.24	(0.41)	-0.61	(0.30)	-2.69	(0.28)	2.14	(0.24)	2.06	(1.80)
Point 9	0.11	-2.34	(0.36)	-0.90	(0.47)	3.77	(0.44)	-2.39	(0.29)	3.15	(0.26)	-0.28	(1.51)

6.1. Identification

Endogenous choices are identified by time-varying exogenous community and regional variables which have only indirect effects on fertility choices via the respective endogenous outcomes. In particular, the presence of an employment agency in the population center directly influences employment and education decisions, but impacts fertility outcomes only through altering educational and employment decisions. Other identification variables are unemployment rates for different education attainments, interaction between the availability of nursery and preschool facilities and having children of the corresponding age, cohabitation with a retired adult interacted with having children of the preschool age,[24] marriage and divorce rates, and female to male ratio. Two specification tests are performed to assess joint significance of all identification variables first in the conception equations, proving their joint insignificance with P-value of 0.26, and then in all the rest of the equations, in which their insignificance can be rejected with zero P-value (Table 6.2). Also, the dynamic structure of the model provides additional identification since the previous-period values of exogenous time-varying variables impact the current period endogenous outcomes indirectly through the previous-period values of the latter (Bhargava, 1991). Moreover, the non-linearity property of the model is shown in Mroz (1999) to be sufficient for its identification.

Table 6.2: Results of the Likelihood Ratio Tests

Null hypotheses:	Statistics	Degrees of freedom	p-value
All heterogeneity parameters are jointly insignificant	15612.14	121	0
Identification variables are jointly insignificant in fertility equations	24.52	21	0.26
Identification variables are jointly insignificant in marriage, education, and employment equations	357.85	40	0

6.1. Fertility Equations

Tables 6.2 and 6.3 present estimated parameters of annual first and second conception outcomes, respectively, for two alternative estimation techniques. The first column in both tables contains estimates for the preferred random-effects model with correction for endogeneity and heterogeneity, whereas the second one shows estimates from a simple logit model, relying on the assumption of error term independence.

[24] Indicators of the availability of nursery and preschool facilities in the population center and cohabitation with a retired adult are included only in the fertility equations as controls for child-care costs and alternatives. However, their interactions with the presence of a child of the relevant age are included in all of the endogenous equations to control for accommodation of the mother's child-care needs.

Table 6.2: Estimated Coefficients for the First Conception Equation

	Random Effects Model		Simple Logit Model	
Variables	Coef.	Std. Err.	Coef.	Std. Err.
Age 18-20	1.599	(0.501)	1.482	(0.480)
Age 21-25	1.366	(0.461)	1.284	(0.443)
Age 26-30	1.116	(0.426)	1.022	(0.404)
Technical school	-0.297	(0.344)	0.326	(0.271)
High school	0.069	(0.315)	0.334	(0.291)
Some college	-0.361	(0.361)	-0.158	(0.316)
College	1.319	(0.599)	1.817	(0.559)
College*18-20	-2.708	(1.000)	-2.582	(1.159)
College*21-25	-1.565	(0.488)	-1.437	(0.524)
College*26-30	-1.386	(0.519)	-1.158	(0.504)
Married	4.132	(0.515)	3.184	(0.356)
Student	-0.493	(0.168)	-0.255	(0.174)
Other income	0.012	(0.027)	-0.002	(0.025)
Earnings	-0.068	(0.159)	-0.078	(0.123)
Employed	0.200	(0.237)	-0.091	(0.220)
Tenure	0.099	(0.027)	0.087	(0.026)
Work hours	-0.004	(0.004)	0.001	(0.004)
Retired adult	0.091	(0.121)	0.092	(0.126)
Index of assets	-0.041	(0.030)	-0.038	(0.037)
Slavic	0.269	(0.181)	0.297	(0.201)
European (excl.slavic)	1.328	(0.951)	0.999	(0.682)
Urban	0.018	(0.197)	-0.037	(0.218)
Settlement of urban type	0.002	(0.271)	-0.159	(0.286)
Own dwelling	0.212	(0.137)	0.229	(0.140)
Husband characteristics:				
Age	-0.051	(0.016)	-0.054	(0.013)
Technical school	-0.047	(0.294)	0.091	(0.273)
High school	0.285	(0.269)	0.324	(0.246)
Some college	0.095	(0.338)	0.075	(0.244)
College	0.274	(0.303)	0.425	(0.260)
Work hours	0.002	(0.005)	0.002	(0.004)
Employed	0.211	(0.263)	0.145	(0.247)
Community variables:				
Nursery	-0.205	(0.139)	-0.218	(0.133)
Preschool	-0.140	(0.272)	-0.097	(0.224)
Capacity	0.002	(0.007)	0.012	(0.005)
Middle school	0.136	(0.128)	0.121	(0.144)
High school	-0.472	(0.312)	-0.533	(0.332)
Library	0.246	(0.330)	0.294	(0.315)
Regional variables:				
Average wage	-0.185	(0.112)	-0.289	(0.110)
Wage growth	0.118	(0.052)	0.128	(0.050)
Wage growth over 2yrs	-0.009	(0.004)	-0.009	(0.003)
Real GDP	0.004	(0.005)	0.007	(0.005)
Real GDP growth	-0.015	(0.012)	-0.019	(0.012)
GDP growth over 2 yrs	0.004	(0.008)	0.007	(0.007)
Unemployment rate	0.001	(0.018)	-0.005	(0.016)
Fertility rate	0.100	(0.065)	0.138	(0.071)
Inflation	0.057	(0.150)	-0.028	(0.142)

Table 6.2 (Continued)	-0.066	(0.033)	-0.075	(0.029)
Technical grads employment	0.104	(0.023)	0.097	(0.025)
College grads employment	0.055	(0.020)	0.051	(0.020)
Hs grads employment	0.077	(0.020)	0.075	(0.021)
College graduates	-0.066	(0.033)	-0.075	(0.029)
Tech. graduates	0.006	(0.047)	0.043	(0.049)
Cohort 1	-1.362	(0.496)	-0.948	(0.440)
Cohort 2	-0.609	(0.312)	-0.270	(0.289)
Cohort 3	-0.205	(0.180)	0.050	(0.177)
Constant	-12.535	(1.513)	-13.584	(2.176)
Unobserved heterogeneity effect		Yes		No

Table 6.3: Estimated coefficients for the second conception equation

	Random Effects Model		Simple Logit Model	
Variables	Coef.	Std. Err.	Coef.	Std. Err.
18-20	0.447	(0.508)	0.479	(0.453)
21-25	0.058	(0.345)	0.105	(0.309)
26-30	0.234	(0.237)	0.246	(0.213)
Technical school	-0.690	(0.365)	-0.520	(0.294)
High school	-0.739	(0.329)	-0.605	(0.282)
Some college	-0.410	(0.445)	-0.301	(0.352)
College	-0.610	(0.440)	-0.293	(0.329)
Index of assets	-0.087	(0.036)	-0.084	(0.033)
1st child < 3 years	-1.357	(0.443)	-1.345	(0.444)
1st child 3 - 8 years old	-0.545	(0.435)	-0.550	(0.429)
Married	2.104	(0.600)	1.689	(0.635)
Student	-0.024	(0.300)	-0.028	(0.290)
Other income	-0.056	(0.057)	-0.058	(0.050)
Earnings	-0.213	(0.207)	-0.245	(0.162)
Employed	-0.032	(0.281)	0.056	(0.235)
Tenure	0.014	(0.020)	0.012	(0.018)
Work hours	0.004	(0.005)	0.001	(0.004)
Retired adult	0.189	(0.154)	0.179	(0.142)
Slavic	-0.440	(0.196)	-0.358	(0.243)
European (excl.slavic)	-0.393	(0.611)	-0.226	(0.594)
Urban	-0.029	(0.220)	-0.082	(0.188)
Settlement of urban type	0.078	(0.308)	-0.114	(0.251)
Own dwelling	-0.074	(0.157)	-0.082	(0.148)
Husband's characteristics:				
Age	-0.022	(0.016)	-0.021	(0.019)
Technical school	0.369	(0.350)	0.360	(0.300)
High school	0.222	(0.314)	0.224	(0.252)
Some college	0.341	(0.451)	0.269	(0.415)
College	0.599	(0.358)	0.541	(0.295)
Work hours	-0.009	(0.005)	-0.009	(0.005)
Employed	0.209	(0.279)	0.127	(0.266)
Community variables:				
Nursery	-0.032	(0.156)	-0.023	(0.153)
Preschool	-0.048	(0.283)	-0.018	(0.287)
Capacity	-0.025	(0.011)	-0.014	(0.009)
Capacity*<8 yrs old kids	0.015	(0.008)	0.015	(0.007)
Middle school	-0.031	(0.150)	-0.072	(0.153)

Table 6.3 (Continued)				
High school	-0.395	(0.362)	-0.423	(0.321)
Library	0.306	(0.367)	0.302	(0.344)
Regional variables:				
Average wage	0.400	(0.162)	0.401	(0.144)
Wage growth	-0.060	(0.069)	-0.054	(0.084)
Wage growth over 2yrs	-0.0083	(0.0043)	-0.0081	(0.0044)
Real GDP growth	-0.004	(0.006)	-0.003	(0.005)
GDP in agricultural sector	-0.334	(0.306)	-0.321	(0.329)
GDP in industrial sector	-0.014	(0.004)	-0.016	(0.005)
Unemployment rate	0.010	(0.021)	0.018	(0.021)
Fertility rate	0.149	(0.068)	0.125	(0.057)
Inflation	-0.468	(0.212)	-0.446	(0.254)
Technical grads employment	0.065	(0.028)	0.063	(0.033)
College grads employment	0.012	(0.021)	0.011	(0.023)
Hs grads employment	0.037	(0.024)	0.046	(0.031)
Cohort 1	0.158	(0.554)	0.331	(0.418)
Cohort 2	0.190	(0.434)	0.325	(0.342)
Cohort 3	0.283	(0.322)	0.406	(0.243)
Constant	-6.391	(1.844)	-7.297	(2.909)
Unobserved heterogeneity effect		Yes		No

Inspection of the estimates for the first and second parities from the two models reveals divergence in the effects of most endogenous variables even after adjusting for arbitrary normalization, by comparing ratios of the effects (employing the precisely estimated age 18-20 coefficient for the first birth interval and the index coefficient for the second interval as normalization factors).[25] Ignoring endogeneity and heterogeneity problems leads to downward bias of the marriage effect on the fertility rates. As expected, being a student has a discouraging effect on reproductive decisions, and it gains significance and becomes twice as powerful in the preferred model for the first conception. Tenure has a positive and significant effect on the annual probability of having a first child and is stable across specifications. More detailed comparison of the predictions derived from the two models is presented in the simulation section; direct interpretation of the effects of most covariates of interest is complicated by the presence of their interaction terms or related variables. Also, after controlling for community heterogeneity in the first conception equation, the effects of regional child-care capacity, fertility rate and average earned income decrease in magnitude and lose significance. In the second fertility equation, incorporating community-specific permanent effects leads to a gain in

[25] Quantitative direct comparison between two models is complicated by the differing structure of their logistic error terms, which in the case of the simple logit model also includes the heterogeneity parameter. Since the logit model imposes an error term variance of $\pi^2/3$, by arbitrary normalizing of estimated coefficients, only ratios of the estimates can be used for comparison across models.

significance for such regional factors as capacity of preschool facilities, inflation, and average earnings. The estimates for the remaining seven equations can be found in Appendix C.

6.2. Simulation Results

The discussion of the estimated coefficients is incomplete for it presents only the immediate effects of the fertility-altering determinants, ignoring their indirect impact through the contemporaneous marital, employment, and educational endogenous decisions and the long-term aspect of the analyzed choices. Also, this model contains interaction terms as well as categorical variables, for which interpretation is not straightforward based on logit coefficients.

To answer these concerns, life-cycle simulations are performed by tracing all estimated women's choices back from age 14 following the timing guidelines described in the theoretical model. Starting at age 14, using estimated parameters, including mass points, and the woman's exogenous characteristics, I simulate all of her endogenous choices for every year of her life until she either leaves the survey or gives birth to a second child. First, the computed annual probabilities, including conception, schooling, marriage, and employment probabilities, are compared to a corresponding random draw from a uniform distribution with endpoints zero and one, to assign a particular value to her endogenous choices. Then, all time-varying variables related to these decisions are updated accordingly. When the woman completes her high school studies, she chooses between attending college or technical school, conditional on her selecting to acquire additional education. She is assigned a particular educational pathway according to the prevalence of the respective educational pursuit in the observed population of women with high school diplomas. Since only women observed to be married have the husband's characteristics recorded, I generate these characteristics, based on observed sample statistics, separately for women in different age categories. For example, the husband's age is generated by a random draw from a normal distribution with mean and variance of the observed sample of men married to women in a particular age category. The endogenous outcomes are then averaged over the sample of women. This process is replicated 250 times to calculate standard errors of predictions, by perturbing the structural parameters according to the estimated covariance matrix assuming multivariate normality. Univariate simulations are performed by assigning one of the exogenous or endogenous covariates a particular value with subsequent simulation of life-cycle conception, educational, employment, and marital choices. All simulated summaries presented in this section isolate the probabilities of the first and second parity transitions for years of participation in the survey since many covariates of interest, both individual and regional, are available only for those years. Table 6.4 assesses the performance of the life-cycle simulation to fit the observed process. Taking into account the standard deviation of the sample statistics, the simulated statistics are very close to the actual statistics.

Table 6.4: Distribution of life-cycle conception probabilities by age groups

		Baseline		Actual	
First parity	14-20	0.317	(0.018)	0.281	(0.450)
	21-25	0.195	(0.013)	0.234	(0.423)
	26-30	0.054	(0.005)	0.060	(0.238)
	31-35	0.009	(0.002)	0.011	(0.106)
Second parity	14-20	0.044	(0.005)	0.035	(0.184)
	21-25	0.099	(0.012)	0.111	(0.315)
	26-30	0.055	(0.008)	0.071	(0.257)
	31-35	0.016	(0.005)	0.022	(0.147)
Total number of conceptions:					
		0.791	(0.048)	0.821	(0.753)
Life-cycle education attainment:					
Years in school after 14		5.169	(0.044)	5.490	(2.208)
High school		0.320	(0.009)	0.324	(0.468)
Technical school		0.294	(0.007)	0.286	(0.452)
Some college		0.092	(0.002)	0.104	(0.306)
College		0.238	(0.004)	0.208	(0.406)

Note: Standard deviations are given in parentheses

Based on the previous discussion, schooling as an individual choice has a strong effect on reproductive decisions since it influences the shadow price of the woman's time. On the other hand, nation-wide attainment of college degree almost tripled over the decade since 1994, in response to the emerging modern sector with its greater demand for highly skilled labor. Therefore, the trend toward a more educated labor force has at least two dimensions. Firstly, it captures the pace of introduction of the new market system or the development of the region, and secondly, it reflects changes in the personal structure of incentives.[26] The following Figure 6.1 compares the long-term effects of college, high school, and incomplete high school degrees and

[26] Higher levels of education in the transition economy became more attractive, compared to the communist period, because of higher returns to education both in terms of a wage premium (particularly through employment in the emerging foreign/modern sector) and insurance against unemployment (Klasen and Luanov, 2006 and Kantrova, 2003).

their attainment on the likelihood of the first and second conception at different ages.[27] The negative effect of attainment of college education on the onset of motherhood is only observed for women before their 20's during the schooling years. In particular, high school graduates are 170% and 11% more likely to start motherhood before age 21 than college graduates and high school dropouts, respectively. By the early 20's, the difference between high school graduates and dropouts almost closes, and college graduates take the lead in occurrence of the first births, which goes up to 207% in the early 30's. However, college graduates never catch up with high school graduates with respect to frequency of first births; the overall probability for college degree holders is 60% smaller. University educated mothers demonstrate the lowest frequency of second births, whereas mothers with incomplete high school diplomas are associated with the highest simulated probability of a second conception for all age categories; the latter (relative to the former) have twice as large of a probability before reaching age 25 and almost 1.5 times afterwards. Comparison of the timing of having a child for various educational degrees, conditional on having a child, shows that acquisition of advanced degree not only reduces total fertility but also delays substantially entrance to motherhood before age 21 (see Figure 6.2).[28] The age structure of the second conceptions is only slightly influenced by education with some fertility shift from teen years to the late 20's. Therefore, the advanced education pursuit interferes with the mother role of women; however, as can be seen from Figure 6.3, increasing the number of college graduates employed in the economy has a pronatalist effect on both parity transitions. In particular, when the proportion of college graduates employed in the regional economy increases from the lowest observed level, 0.11, to the highest, 0.44, for all surveyed years, the likelihood of the first and second conceptions improves by 77% and by 41%, respectively.[29] The emergence of the modern sector creates an environment encouraging fertility, but acquiring a college degree is not combinable with early childbearing and, moreover, creates disincentives for women to have children even after completing their education due to the increased opportunity cost of child-raising associated with higher human capital.

[27] In the education simulations, I follow the timeline presented in the theoretical model. In doing so, the woman is assigned college degree not immediately after reaching age 14, but after she completes her high school requirements and four years of college education.
[28] These findings find support in conclusions made by Klasen and Luanov (2006) and Sobotka (2001) in their analysis of Czech Republic.
[29] The relative effect of more educated labor force on the likelihood of the first conception is particularly strong for the youngest and oldest categories of women, more than 90% improvement in fertility probabilities. For the second parity, it is the strongest for the youngest group (61% increase) and is fading with age down to 23% improvement.

Figure 6.1: The Effect of Education on the Probability of First (Left Panel) and Second (Right Panel) Births at Different Ages

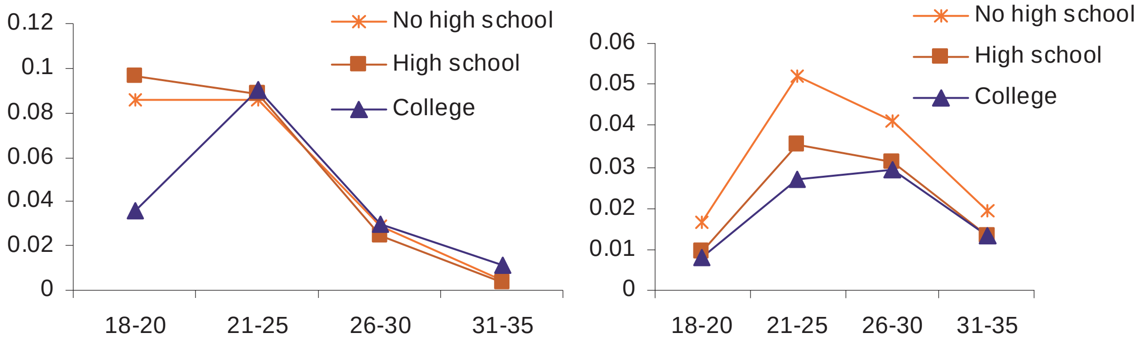


Figure 6.2: Effect of Education on Timing of First (Left Panel) and Second (Right Panel) Births Conditional on their Realizations

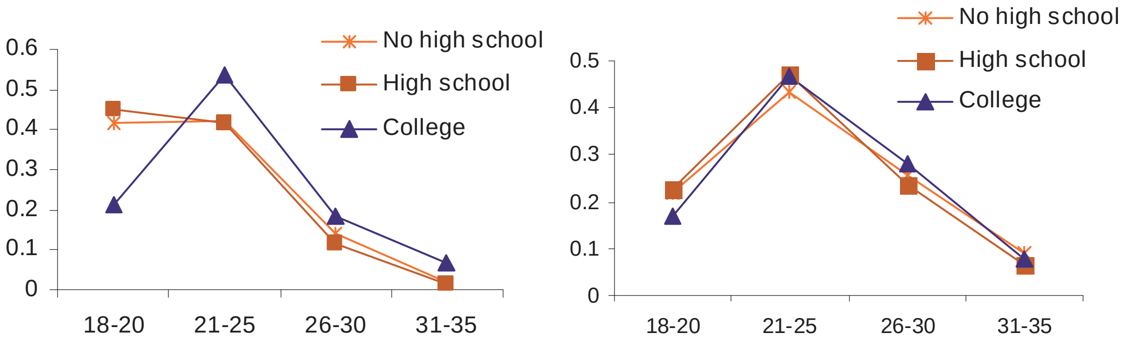
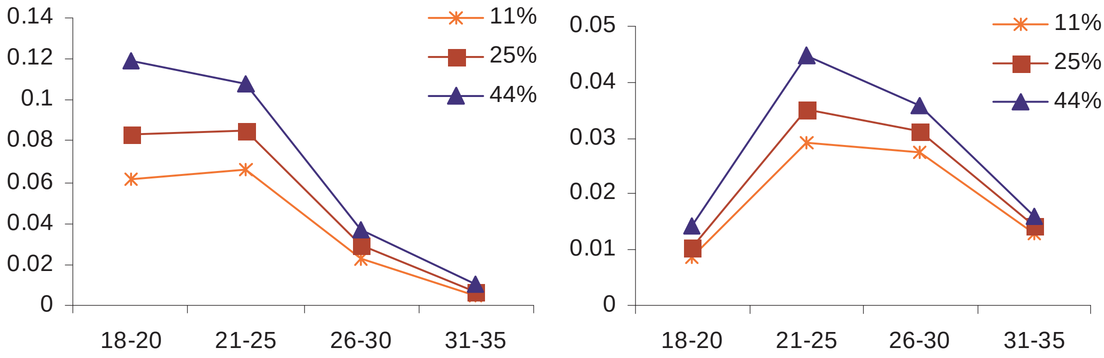
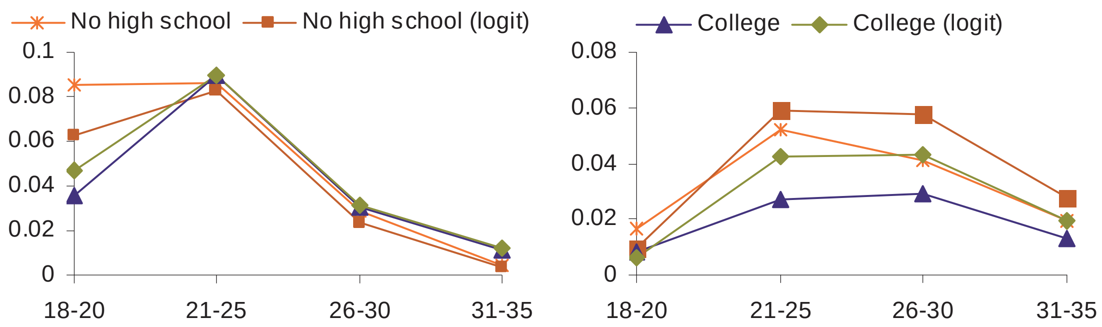


Figure 6.3: The Effect of Regional Employment Rate of College Graduates on the Probability of First (Left Panel) and Second (Right Panel) Births, by Age Groups



Also, a comparison of the simulated frequencies of the conception events by age categories across the two models is presented in Figure 6.4. As can be seen in Figure 6.4, the results with endogeneity controls and without them are significantly different for the first and second birth intervals, and t-test suggests that the respective probabilities of conception at different ages are statistically different even at 1% level of significance.[30] According to the total probabilities of the first and second conceptions during the survey years, ignoring endogeneity and heterogeneity substantially biases down the negative effect of a college degree relative to an incomplete high school education.[31] It appears that the importance of human capital accumulation is so prevalent that women who have an unobserved inclination toward high fertility curtail it in favor of advanced education, which, in turn, increases opportunity cost of childbearing in excess of the cost estimated by the simple logit model. As a result, women exhibiting family-oriented preferences find themselves acquiring higher education and reevaluating their fertility, but they still have a greater probability of choosing in favor of having a child than their counterparts than is observed in the biased down logit estimates.

Figure 6.4: The Effect of Education on the Probability of First (Left Panel) and Second (Right Panel) Births at Different Ages

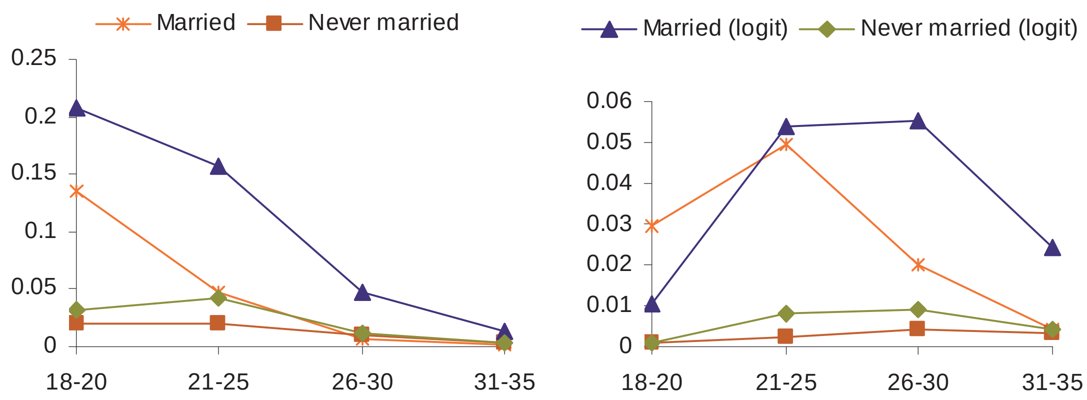


According to Figure 6.5 (right panel), the effect of marriage on the first birth probability varies greatly with age; in particular, married women are 6.8 times more likely to have their first born child in their teens and 2.5 times more likely in their early 20's. Interestingly, this disparity is reversed when women reach age 26: never married women have a 1.28 times higher likelihood to start a family than their counterparts. Hence, marital status shifts the timing of the onset of motherhood toward younger years. Marital status has an even more substantial pronatalist impact on the second birth. Its relative size is the strongest for women in their 20's (increasing 38 times

[30] Even though the effect of a college degree is visually very similar across the two models except for the teen years when the negative effect of education (or college years) is underestimated, the difference in the simulated probabilities is still significantly different at all ages with a P-value approaching zero.
[31] According to the preferred model , the first conception probability for the surveyed years declines by 0.038 from 0.204 level in response to obtaining college degree versus incomplete secondary education, as opposed to decline in conception probability only by 0.008 in the logit specification.

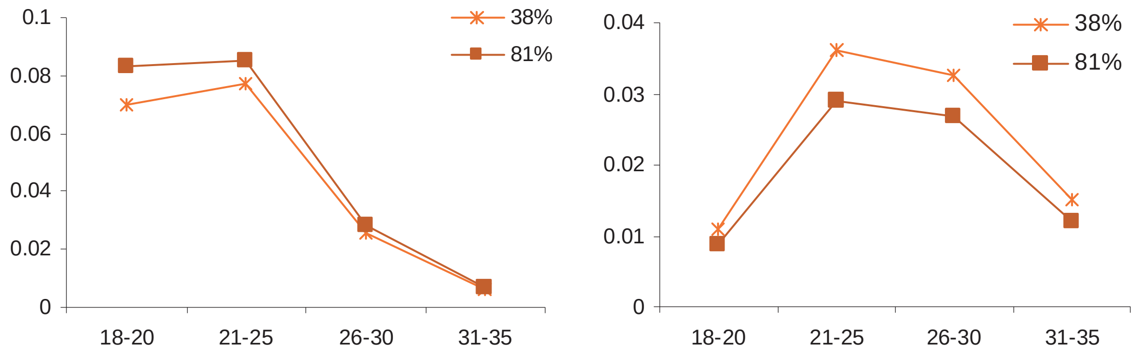
the frequency of conception events) and falling to 1.38 times for the oldest category (see Figure 6.5). The simulated logit probabilities provide significantly different estimates of the marriage effect: all of the age-specific probabilities are statistically different at the 1% significance level. Overall, marital status is estimated to play a more substantial role in reproductive decision making if unobserved individual characteristics are not accounted for; if individual heterogeneity is modeled, being married in all periods verses never being married increases the first conception occurrence by 0.14 and by 0.33 points if not. The respective numbers for the second conception are 0.093 and 0.122. A potential explanation for this divergence in the results is that the logit specification essentially compares fertility rates of those who have entered marriage to those women who have decided against it, ignoring that some women made their nuptial decision based on fertility-related unobserved preferences.

Figure 6.5: The Effect of Marriage on the Probability of First (Right Panel) and Second (Left Panel) Births at Different Ages



In the literature, the transition period is widely associated with the reduced availability and quality of public services, including formal child-care. Two levels of child-care capacity, 38% (the lowest observed) and 81% (the highest observed across regions) are simulated to be available throughout participation in the survey. Increased child-care availability leads to earlier childbearing and higher first conception fertility (see Figure 6.6). As expected, improved child-care capacity has a stronger impact on younger women (a 20% increase in the conception probability for the 18-20 year olds) since it coincides with a period of more intense human capital accumulation both in school and on the job. These findings are consistent with Rindfuss et al. (2007). The effect of day care capacity reverses for the second birth interval and becomes negative. One possible explanation could be that high accessibility of child care facilitates an early transition to motherhood without sacrificing the mother's career aspirations, but it does not provide her with sufficiently favorable conditions to resolve the time conflict between her established career demands and a two-child family. For low child-care accessibility, motherhood interferes substantially with the woman's career, which is captured in low first conception rates as well as in a relatively low opportunity cost during the second birth interval if a woman decides to have a first born. Interestingly, women seem to rely more on informal child-care availability, captured by the presence of a retired adult in the family, when making their decision regarding having a second child.[32]

Figure 6.6: The Simulated Effects of Low and High Capacity of Child Care Facilities on the Probability of First (Left Panel) and Second (Right Panel) Births at Different Ages

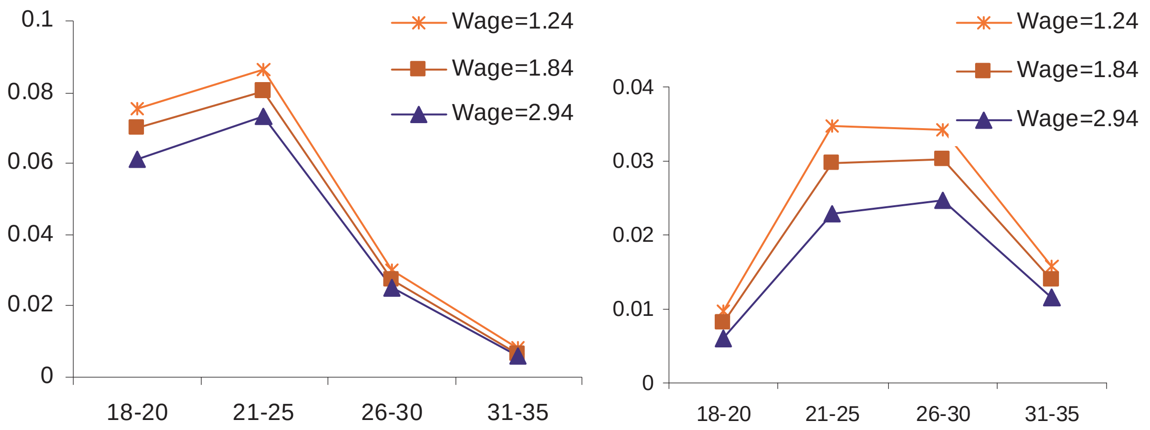


To assess the effect of potential wages on fertility transitions, women's hourly earnings are fixed at three levels, 1.84, 1.24, and 2.94 rubles, representing sample averages before, during and after the 1998 crisis. A reduction in both parities' fertility rates as wages grow, proves that the substitution effect of women's wages is more powerful than the income effect (see Figure 6.7). In particular, when women's earnings improve from the crisis level to 2.94 rubles, 135% growth, women reduce their willingness to have a first child by 17% and a second child by 31%.[33] According to simulations of 25%, 50%, 100%, and -50% changes in hourly earnings of women, the wage elasticity of the annual fertility probability is found to vary between -0.14 and -0.17 for the first conception and between -0.27 and -0.42 for the second one. Therefore, the negative wage effect is stronger for the second transition rate.

[32] If a retired adult is residing in the same household, a woman is 9% more likely to have a second child.

[33] All related fertility probabilities are precisely estimated with boot-strapped standard errors ranging between 0.00010 and 0.00016.

Figure 6.7: The Simulated Effects of Regional Real Wages on the Probability of First (Left Panel) and Second (Right Panel) Births at Different Ages



Most child allowance programs in Russia operate through supplementing non-earned income, which motivates simulation of a one-time payment in the amount of $10,220, enacted in January 2007. According to the expected probabilities, this substantial financial contribution to the family income leads to only a small 5.6% increase in first conception occurrences that is mostly attributed to growth in teenage pregnancies (a 10% increase). Moreover, it has a small negative impact on second transition rates, reducing the overall probability by 6.6%. Sizable financial subsidies do not appear to be an effective way to encourage fertility, especially for the second birth. I also conducted simulations of income changes by 25%, 50%, 100% and -50%, yielding income elasticities of annual probabilities of 0.006 and -0.034 for the first and second parities, respectively.

Analysis of reproductive decisions cannot be complete without consideration of the socio-economic environment in which these decisions are made, especially taking into account the volatility of the Russian economy during the transition period. The economic environment of the 1990's, as it was described in the introduction, can be characterized by high inflation reaching 220% with respect to the previous year in 1994 and 84% in 1998. Also, real wages fluctuated significantly, experiencing a 32% fall during 1998-99 and more than doubling by 2004. To isolate the effect of these economic changes, I perform a simulation of six economic environments defined by different regional inflation rates and monthly earned income. Higher average wages create better earnings opportunities for women, which translates to low transition rates to motherhood (with a regional wage elasticity of annual transition rate of -0.23); however, conditional on having a first child, the likelihood of having a second one is improving greatly in the high income regions (with a 1.07 regional wage elasticity of annual transition rate). Younger mothers are particularly responsive to the regional real income changes; in particular, a 50% rise in wages leads to a 54% increase in frequencies of having a second child before age 21 and 38% increase for women in their early 20's (see Table 6.5). Also, as a result of such a rise in real income, annual probabilities of continuing education and employment experience a relative decline by 11% and 6%, respectively, whereas the probability of being married demonstrates an increase by 4% with respect to the baseline case. Moreover, based on the estimated earnings growth impact, a 21% growth in real wages over 2 years, representing a modest growth for Russia at the turn of this century, as compared to 0% growth scenario over the studied period, leads to an 11% relative decline in the total number of births, with a 9% decrease in the number of first parity transitions and a 14% decrease in second (see Table 6.5).[34] On the other hand, the 1998 crisis level of slowdown in economic activities is expected to result in 18% more births and earlier childbearing.

Table 6.5	The Effect of Average Regional Wage Changes							
Variable	baseline		0.5 time		1.5 times		2 times	
Annual probabilities								
1st conception	0.114	(0.026)	0.210	(0.038)	0.174	(0.034)	0.154	(0.037)
2nd conception	0.042	(0.017)	0.060	(0.023)	0.114	(0.033)	0.138	(0.039)
Student	0.190	(0.006)	0.216	(0.013)	0.168	(0.013)	0.149	(0.021)
Employment	0.518	(0.028)	0.548	(0.030)	0.488	(0.032)	0.457	(0.039)
Marriage	0.561	(0.009)	0.529	(0.017)	0.583	(0.014)	0.594	(0.024)
	The Effect of Economic Growth over 2 Year Period							
Annual probabilities	-33%		0%		21%		45%	
1st conception	0.232	(0.039)	0.202	(0.034)	0.183	(0.033)	0.163	(0.033)
2nd conception	0.116	(0.036)	0.093	(0.029)	0.080	(0.026)	0.068	(0.024)
Student	0.192	(0.012)	0.191	(0.007)	0.190	(0.007)	0.189	(0.010)
Employment	0.515	(0.028)	0.517	(0.028)	0.518	(0.028)	0.520	(0.028)
Marriage	0.565	(0.009)	0.562	(0.009)	0.560	(0.009)	0.558	(0.009)
	The Effect of Inflation Rates (relative to the previous year)							
Annual probabilities	baseline		220%		84%		0%	
1st conception	0.114	(0.026)	0.093	(0.029)	0.109	(0.026)	0.121	(0.028)
2nd conception	0.042	(0.017)	0.021	(0.011)	0.038	(0.015)	0.054	(0.022)
Student	0.190	(0.006)	0.275	(0.020)	0.207	(0.007)	0.172	(0.007)
Employment	0.518	(0.028)	0.413	(0.033)	0.498	(0.028)	0.549	(0.028)
Marriage	0.561	(0.009)	0.477	(0.023)	0.545	(0.010)	0.586	(0.010)

Note: Standard errors are given in parentheses

[34] The growth rate over two years reached 45% in 2000 and did not fall below 22% over the next 5 years.

High inflation rates bring uncertainty to economic wellbeing and reduce the real value of earnings. As shown in Table 6.5, inflation is predicted to have a sizable negative influence on fertility. If birth rates are compared for the economy with 84% inflation (1998 crisis level) against the 0% inflation case, women appear to reduce the total number of children they have by 14%, the number of first-borns by 7% and the number of second children by 27%. The decrease in fertility rates is observed for all ages with an overall delay in the timing of the births. The direct effect of high inflation is reinforced by an increased annual probability of schooling (20% increase) and decreased probability of marriage (by 7%) and employment (by 9%). I also observe a substantial positive peer effect which is particularly strong for the second parity, a relatively small positive effect of regional unemployment on the second transition rate, and a positive effect of tenure accumulation.

7. Conclusion

This paper offers a comprehensive analysis of the determinants of low fertility in Russia. It disentangles complex pathways through which life-cycle personal choices exert themselves on fertility behavior. This study also analyzes the extent to which socio-demographic circumstances, including fertility policies, shape reproductive decisions both directly and through other related choices. My findings demonstrate that the recent increased demand for highly-skilled labor by the emerging modern sector influences fertility outcomes through two pathways: individual human capital accumulation and regional college graduates representation in the employed population, capturing the pace of the transition to the new market system. As expected, attainment of a college degree interferes with the maternal role of women, resulting in delayed childbearing and lower overall fertility; however, an increasing proportion of college graduates employed in the economy has a pronatalist effect on both parity transitions. Hence, the emergence of the modern sector creates an environment encouraging fertility, but pursuit of a college degree is not combinable with early childbearing and, moreover, creates disincentives to have children even after completing education because of the increased opportunity cost of child-raising associated with higher human capital. Also, simulations of the effects of individual choices, such as educational attainment and marital outcome, underline the importance of modeling unobserved individual- and community-specific parameters. Ignoring endogeneity of fertility-related individual choices significantly reduced the negative effect of a college degree relative to an incomplete secondary education. In addition, the simple logit estimation overestimates the willingness or ability of married women to have children, as compared to never-married women.

The increasing shadow value of female time, as it is measured by potential earnings, is estimated to have a significant negative effect on fertility, with the wage elasticity of the annual fertility probability ranging between -0.14 and -0.42 for the first conception and between -0.27 and -0.42 for the second one. It appears that the substitution effect of female earnings is estimated to be more powerful than the income effect, and its effect is stronger for the second birth. Moreover, higher regional wages create better earnings opportunities for women, reinforcing the negative maternal wage effect on the transition to motherhood (regional wage elasticity of the annual birth probability of -0.23). However, conditional on having a first child, high income regions create a pronatalist environment with estimated regional income elasticity of annual transition rate of 1.07. My findings also indicate that current fertility policy, operating through supplementing non-earned income of mothers, is not able to generate the desired effect. Even a sizable one-time payment of $10,220 (enacted in 2007) produces only a 5.6% increase in the first conception occurrences and reduces the number of second births by 6.6%.

As discussed above, high inflation was a significant factor in defining the Russian economic environment during the 1990's and in bringing great uncertainty regarding individual economic wellbeing. As expected, in highly uncertain economic circumstances, women significantly reduce their fertility. The direct negative effect of high inflation is reinforced by its indirect impact through greater school attendance, lower marriage and employment probabilities.

Overall, my findings show that fertility-stimulating efforts should be directed away from the supplementation of non-labor income, as it is conducted now, but toward the improvement of macro-stabilization policies and the reconciliation of the incompatibility of the career demands of the market system with the requirements of motherhood.

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Appendix A: Likelihood Function Specification

In order to avoid making assumptions regarding the actual distribution of the unobserved factors such as an assumption of normality, the error term distributions are approximated using a semi-parametric discrete factor method (Heckman and Singer, 1994; Mroz and Guilkey, 1995 and Mroz, 1999). The joint distribution of the individual unobserved terms for a woman *i* is given by

$$\pi_I(b) = \Pr(\lambda_1^N = \lambda_{1b}^N, \lambda_2^N = \lambda_{2b}, \lambda^s = \lambda_b^S, \lambda^M = \lambda_b^M, \lambda^H = \lambda_b^H, \lambda^L = \lambda_b^L,$$
$$\lambda_1^{'N} = \lambda_b^{'N}, \lambda^{'S} = \lambda_b^{'S}, \lambda^{'M_1} = \lambda_{b,}^{'M_1} \lambda^{'M_2} = \lambda_b^{'M_2}),$$

for b=1, 2,…, B, where B is the number of mass points. $\lambda^{'}$ denotes unobserved terms associated with the corresponding modified equations for years prior to the survey period.

Then, the distribution of the permanent community unobservable with Q points of support is

$$\pi_J(q) = \Pr(\omega_1^N = \omega_{1q}^N, \omega_2^N = \omega_{2q}^N, \omega^S = \omega_q^S, \omega^M = \omega_q, \omega^H = \omega_q^H, \omega^L = \omega_q^L,$$
$$\omega^{N'} = \omega_q^{`N}, \omega^{'S} = \omega_q^{`S}, \omega^{'M_1} = \omega_q^{`M_1}, \omega^{'M_2} = \omega_q^{`M_2}),$$

for q=1, 2,…, Q.[37]

The parameters of the above distributions are estimated along with the other unknown parameters of the model using a maximum likelihood procedure. Omitting the observed explanatory variables for notational simplicity, the contribution of woman *i* from community *j* to the likelihood function, conditional on the individual and community heterogeneity errors, is

$$L_{ij}(\lambda_b, \omega_q) = \prod_{t=14}^{A_i} \prod_{k=1}^{2} \left[\Pr(n_{ijtk} = 1 \mid \lambda_b^{'N}, \omega_q^{'N})^{n_{ijtk}} [1 - \Pr(n_{ijtk} = 1 \mid \lambda_b^{'N}, \omega_q^{'N})]^{1-n_{ijtk}}\right]$$
$$\Pr(s_{ijt} = 1 \mid \lambda_b^{'S}, \omega_q^{'S})^{s_{ijt}} [1 - \Pr(s_{ijt} = 1 \mid \lambda_b^{'S}, \omega_q^{'S})]^{1-s_{ijt}} \prod_{m=0}^{2} \Pr(M_{ijt} = m \mid \lambda_b^{'M_m}, \omega_q^{'M_m}) 1[M_{ijt} = m]$$
$$\prod_{t=A_i}^{E_i} \prod_{k=1}^{2} \left[\Pr(n_{ijtk} = 1 \mid N_{ijt} = k-1, \lambda_{kb}^N, \omega_{kq}^N)^{n_{ijtk}} [1 - \Pr(n_{ijtk} = 1 \mid N_{ijt} = k-1, \lambda_{kb}^N, \omega_{kq}^N)]^{1-n_{ijtk}}\right]$$
$$\Pr(s_{ijt} = 1 \mid \lambda_b^S, \omega_q^S)^{s_{ijt}} [1 - \Pr(s_{ijt} = 1 \mid \lambda_b^S, \omega_q^S)]^{1-s_{ijt}} \Pr(M_{ijt} = 1 \mid \lambda_b^M, \omega_q^M)^{M_{ijt}} [1 - \Pr(M_{ijt} = 1 \mid \lambda_b^M, \omega_q^M)]^{1-M_{ijt}}$$
$$\Pr(H_{ijt} > 0 \mid \lambda_b^L, \omega_q^L) 1 \cdot \{H_{ijt} > 0\} [1 - \Pr(H_{ijt} > 0 \mid \lambda_b^L, \omega_q^L) 1 \cdot \{H_{ijt} \le 0\}] \frac{1}{\sigma_\eta} \Phi(\eta_{ijt} \mid \lambda_b^H, \omega_q^H)$$

where

A_i = *max*{18, age of woman *i* at the first surveyed year},

E_i= *min*{35, age of woman *i* at the last response year}.

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[37] $\omega^{'}$ denotes unobserved community parameters associated with the corresponding modified equations for years prior to the survey period (or initial condition equations).

Φ denotes a standard normal cumulative function with standard deviation σ_η.

The individual likelihood function unconditional on the personal unobserved parameters, but still conditional on the community heterogeneity terms is

$$L_{ij}(\omega_q, \pi_I) = \sum_{b=1}^{B} \pi_I(b) L_{ij}(\lambda_b, \omega_q)$$

The unconditional likelihood function for all women over all communities is

$$L_{ij}(\pi_{I,} \pi_J) = \prod_{j=1}^{J} \sum_{q=1}^{Q} \pi_J(q) \prod_{i=1}^{N} L_{ij}(\omega_q, \pi_I),$$

where N is the total number of women and J is the total number of communities (J=154).

Appendix B: Variables Construction

The entire sample is divided into four age categories, identified by four dummy variables. The average age of the women in the sample is 25 years old. The marital status indicator records whether a woman is currently in a registered or unregistered marriage.[38] As part of the adult questionnaire, the RLMS also collects information on whether an adult was ever married, which is supplemented in rounds X and XII, by the female sexual history questionnaire, containing data on age at first marriage and duration of the current marriage. These variables constitute all available information for backdating marital status to age 14. If information on marital status is missing for up to two periods and not recoverable using the previously described variables, then a woman is assumed to stay married (divorced) if she is married (divorced) a year before and after. In the case of changing marital status during her one-period absence from the survey, I assume that her transition to the new marital status took place in the missing period. On average, these women are married 59% of the time.

Next, two types of education dummies are defined. The first one identifies the current educational status and takes on a value of one if the individual reports being a student in a particular survey year. Also, a set of five dummies defines the highest completed degree: mandatory incomplete secondary school degree (8-9 years), high school degree (10-12 years), some college attended, but not completed, technical, medical, or pedagogical school diploma, and college degree[39]. Moreover, the RLMS records information on the duration of enrollment in

[38] This distinction between types of marriages is not recorded in the study before 1998.
[39] Degrees are stated in the order of advancement.

the educational institutions and on graduation year, broken down by their type.[40] Using the standard primary school enrollment age, 7 years old, as the starting age of schooling, and assuming that schooling at all institutions is an uninterrupted process, all education variables can be reconstructed for non-response years and before the surveyed years. When the duration of enrollment is missing, it is imputed by the average duration of attendance at the respective school type. In cases of unknown graduation date, the assumption of continuity of education is applied. 18% of person-round observations are in school.

The RLMS contains an extensive section on employment, which yields the following set of work-related variables: employment status and history, hours of work, and earnings information. A woman is considered to be employed if she either works positive hours or is on maternity leave without interruption of her employment. Employment history variables contain information on tenure at the current primary job measured in days, total employment duration, and an indicator recording whether the woman ever worked or not.[41] In addition to the above described employment characteristics, duration of unemployment as well as duration of schooling are used for imputation of missing variables. For employment information recovery, schooling and working are assumed to be not combinable, which is supported by the data: only one woman is observed to work while studying in 1995, this number increases to 7 for 1996 and 1998 and drops again to two female working students in 2000. When tenure information is not reported, years of uninterrupted employment is assumed to constitute tenure at the current job. The hours of work variable measures usual hours spent working at the primary job per week. In cases of missing usual hours, including 1994 (Round V) when this variable is not recorded, hours of work are predicted based on reported hours for the last 30 days.[42] For non-response years, for which employment status is recovered as being employed, hours of work are computed as an average of two surrounding rounds.

The earnings data contain information on after-tax monetary wages paid in the last 30 days by the primary employer and on a more appropriate measure of earnings – average monthly after-tax wages – based on the last 12 months' payments.[43] Moreover, the latter measure

[40] Information on enrollment is not collected in Round V and records on graduation dates from all educational institutions become available starting in Round IX. Records regarding ever studying in a particular school type are collected for all rounds.

[41] For V-VIII rounds, records of total years of employment are available only for those currently unemployed.

[42] Other explanatory variables used in OLS estimation of usual hours of work predictor are second degree age polynomial, education, marital status, geographical identifiers, settlement type, and year dummies.

[43] If a person has been employed with the current employer for less than 12 months, average monthly wage is computed based on the time with this employer.

summarizes monthly earnings regardless of whether they were paid on time or not, and it is not restricted to monetary payments. During the transition period, payments in goods as well as arrearage of wages became prevalent in Russia. According to the sample statistics, goods are received as payments for work by 3-10% of women getting any compensation for their work in the last 30 days. Moreover, payments in kind were the only compensation for some of these women in a particular month. An even greater proportion of people faced delayed payments: 35% of working age women report owed earnings by the primary employer in 1994, and this number peaks at 62.8% in 1998 with a subsequent decline to 12.6 % in 2004. Unfortunately, information on the preferred measure of earnings, average wages, is not collected for the first three rounds. Instead, it is predicted based on monetary and in kind earnings in the last 30 days.[44] For non-response rounds, average wages are approximated by the means of two neighboring values if they are non-missing.

A measure of non-earned income is constructed as the difference between total family monetary income in the last 30 days, including payments from a primary or additional place of work in the form of money or goods, any kind of pensions, stipends, alimony, rental and interest income, and total personal earnings from all jobs in the form of money or goods over the same period of time. Missing non-earned income for up to two periods is imputed by the averages of two neighboring values, still leaving 290 families with missing household income information in at least one period. These missing values are predicted using OLS estimates of household income as a function of a second degree age polynomial, education, marital status, household composition, dwelling and appliances ownership, geographical identifiers, settlement type, and year dummies. All monetary values are adjusted for inflation using monthly CPI with 1995 as a base year.

All geographical locations are classified as belonging to one of the three settlement types: urban, settlement of urban type, and rural. Regional identifiers are used to group all sampled sites into 8 aggregated regions such as Metropolitan areas (Moscow and St. Petersburg), Northern and North Western, Ural, Western Siberian, North Caucasian, etc. The RLMS also records information on the availability of formal nursery and pre-school child care facilities and the presence of middle and high schools in a particular population center.[45]

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[44] Other explanatory variables used in OLS estimation of average wage predictor are second degree age polynomial, education, marital status, geographical identifiers, settlement type, and year dummies.

[45] 437 individuals are missing pre-school formal child-care information as well as all other characteristics of their population center. In the empirical work, an indicator, identifying these population centers, is included.

Table B5.3: Definitions and Descriptive Statistics of Regional Variables

Variable	Description	Mean	Std. Dev.
Average wage	Average monthly real wage	2.84	(1.60)
Wage growth	Real wage growth, this year's wage as a percentage of last year's wage	103.65	(16.43)
Wage growth over 2 years	Real wage growth, this year's wage as a percentage of before-last year's wage	106.58	(27.20)
Real GDP	Real GDP per capita	41.72	(27.67)
GDP in agricultural sector	Real per-capita GDP in agricultural sector	0.22	(0.26)
GDP in industrial sector	Real per-capita GDP in industrial sector	35.07	(44.90)
Real GDP growth	Real GDP per capita as percentage of last year's GDP	100.01	(11.00)
Real GDP growth over 2 yrs	Real GDP per capita as percentage of before-last year's GDP	99.09	(19.55)
Unemployment rate	Unemployment rate, percent	9.79	(3.66)
Fertility rate	Number of newborns per 1000 people for a year	9.19	(1.42)
Inflation	CPI inflation, year-on-year price change, percent	0.46	(0.59)
Income belowe minimum	Population below minimum income as percentage of total population	27.52	(10.33)
Technical grads employment	Employment ratio (relative to total employed) of technical and medical school graduates	30.47	(4.22)
College grads employment	Employment ratio (relative to total employed) of college graduates	20.34	(6.07)
HS grads employment	Employment ratio (relative to total employed) of high school graduates	36.20	(6.38)
College graduates	College graduates per 1000 of population	5.04	(3.22)
Tech graduates	Technical and medical school graduates per 1000 of population	5.11	(1.39)
Capacity	Number of 1-6 year-olds in pre-school as a percentage of total	57.70	(9.51)
Divorce rate	Divorces per 1000 of adult (16+) population	5.64	(1.42)
Marriage rate	Marriages per 1000 of adult population	8.51	(1.14)
Female/male ratio	Ratio of adult women to men	1.20	(0.06)
College grads unemployment	Unemployed college graduates as a percentage of total unemployed	10.58	(5.36)
Technical grads unempl.	Unemployed technical and medical school graduates as a percentage of total unemployed	26.00	(5.37)
HS grads unemployment	Unemployed high school graduates as a percentage of total unemployed	47.57	(7.11)
City college	Number of college students in a closest metropolitan area, in 1000s	19.77	(23.32)
City technical	Number of technical and medical school students in a closest metropolitan area, in 1000s	6.35	(7.18)

Appendix C: Estimation Results

Table C6.6: Estimated Coefficients for the Marriage, Education, Employment and Work Hours Equations

	Marriage		Education		Employment		Work Hours	
Variables	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
18-20	-0.849	(0.227)	1.358	(0.313)	-1.529	(0.161)	-2.472	(0.945)
21-25	0.102	(0.179)	0.204	(0.277)	-0.437	(0.128)	-0.136	(0.701)
26-30	0.288	(0.131)	-0.157	(0.240)	-0.140	(0.096)	0.664	(0.533)
Technical school	0.760	(0.235)	-0.540	(0.244)	1.391	(0.168)	-4.838	(1.230)
High school	0.505	(0.223)	0.181	(0.232)	0.190	(0.155)	-2.099	(1.159)
Some college	-0.023	(0.247)	2.996	(0.252)	-0.631	(0.175)	-5.185	(1.335)
College	1.106	(0.278)	-1.650	(0.280)	1.827	(0.188)	-9.371	(1.368)
Index of assets	0.029	(0.022)	0.048	(0.025)	0.111	(0.015)		
No.kids	1.965	(0.284)	-0.600	(0.362)	0.317	(0.229)	-3.075	(1.025)
1st child < 3 years	1.541	(0.294)	-0.657	(0.369)	-0.773	(0.228)	0.455	(1.054)
1st child 3 - 8 years old	0.592	(0.352)	-0.682	(0.513)	-0.668	(0.258)	-1.675	(1.260)
Married			-0.595	(0.135)	0.231	(0.264)	-1.248	(1.276)
Student (*t-1*)	-0.407	(0.103)						
Other income			0.020	(0.022)	-0.067	(0.015)	0.121	(0.098)
Earnings	-0.272	(0.124)					0.415	(0.514)
Employed	0.108	(0.095)						
Tenure	-0.020	(0.013)						
Retired adult	-0.368	(0.120)			-0.209	(0.083)		
Own dwelling	-0.663	(0.100)	0.168	(0.115)	-0.220	(0.070)	-0.513	(0.414)
Slavic	0.485	(0.136)	-0.073	(0.151)	0.551	(0.100)	2.013	(0.578)
European (excl.slavic)	0.356	(0.386)	0.637	(0.457)	0.400	(0.281)	-0.770	(1.086)
Husband's characteristics:								
Age					-0.012	(0.007)	0.074	(0.036)
Technical degree					-0.132	(0.179)	0.261	(0.861)
High school					0.073	(0.162)	0.177	(0.792)
Some college					0.023	(0.211)	-1.083	(1.145)
College					-0.048	(0.182)	-1.410	(0.876)
Work hours					-0.004	(0.002)	0.053	(0.015)
Employed					0.502	(0.140)	-3.506	(0.902)
Community variables:								
Urban	0.081	(0.152)	-0.036	(0.215)	-0.218	(0.135)	2.334	(0.675)
Settlement of urban type	-0.607	(0.208)	-0.392	(0.250)	-0.271	(0.161)	0.594	(0.894)
Nursery* child < 3 years	-0.987	(0.101)	0.142	(0.108)	-0.116	(0.071)	-0.230	(0.462)
Preschool*child < 8 yrs	-0.867	(0.242)	0.053	(0.420)	0.326	(0.168)	3.009	(0.903)
Capacity* child < 8 years	0.013	(0.005)	0.007	(0.006)	0.002	(0.004)	-0.007	(0.017)
Retired adult*child<8 yrs	-0.326	(0.162)	0.567	(0.169)	0.092	(0.117)	-0.377	(0.513)
Middle school	-0.037	(0.085)	-0.041	(0.101)	0.155	(0.063)	0.504	(0.396)
High school	0.647	(0.222)	0.390	(0.311)	-0.137	(0.194)	-1.135	(0.932)
Library	0.325	(0.231)	0.578	(0.339)	0.053	(0.183)	0.945	(0.974)
Employment agency			0.380	(0.212)	0.136	(0.150)		
Regional variables:								
Average wage	0.282	(0.106)	-0.213	(0.095)	-0.136	(0.060)	1.255	(0.453)
Wage growth	-0.083	(0.034)	0.074	(0.041)	-0.112	(0.024)	0.648	(0.174)
Wage growth over 2yrs			-0.001	(0.003)			0.001	(0.011)
Real GDP	0.001	(0.003)	0.004	(0.004)	0.012	(0.003)	-0.042	(0.015)
GDP growth			-0.004	(0.010)	-0.006	(0.004)	0.005	(0.038)
GDP growth over 2yrs	0.009	(0.005)	0.003	(0.006)			0.065	(0.025)

Table C6.6 (Continued)								
GDP in agr.sector	-0.262	(0.153)	-0.606	(0.196)	0.058	(0.119)	0.044	(0.769)
GDP in ind.sector	-0.007	(0.002)	0.000	(0.003)	0.003	(0.001)	-0.009	(0.008)
Unemployment rate	0.003	(0.014)	0.067	(0.016)	-0.035	(0.010)	-0.081	(0.062)
Fertility rate	-0.006	(0.047)	0.031	(0.061)	-0.078	(0.039)	-0.243	(0.220)
Inflation	-0.503	(0.120)	0.577	(0.124)	-0.483	(0.079)	3.392	(0.496)
Divorce rate	0.066	(0.043)	0.325	(0.053)	0.153	(0.033)		
Marriage rate	-0.042	(0.060)	-0.302	(0.072)	-0.105	(0.045)		
Female/male ratio	2.820	(1.205)	1.155	(1.374)	0.784	(0.969)		
Income below minimum	0.007	(0.006)	-0.002	(0.007)	-0.004	(0.004)	-0.093	(0.025)
College grads unempl.			0.035	(0.015)	-0.022	(0.009)	-0.050	(0.054)
Technical grads unempl.			0.031	(0.010)	-0.009	(0.006)	-0.094	(0.038)
HS grads unempl			0.016	(0.010)	-0.006	(0.006)	-0.046	(0.040)
Technical grads empl.	-0.069	(0.019)	-0.033	(0.023)	-0.006	(0.015)	-0.127	(0.094)
College grads empl.	-0.052	(0.015)	-0.045	(0.021)	-0.006	(0.013)	-0.137	(0.082)
HS grads empl.	-0.058	(0.018)	-0.065	(0.021)	0.019	(0.014)	-0.176	(0.087)
College graduates			-0.061	(0.028)	0.024	(0.017)	-0.010	(0.095)
Tech. graduates			-0.028	(0.039)	0.066	(0.026)	-0.500	(0.152)
Cohort 1	-0.447	(0.164)						
Cohort 2	-0.347	(0.203)	1.263	(0.267)	-0.141	(0.115)	-0.335	(0.583)
Cohort 3	-1.418	(0.283)	1.811	(0.310)	0.048	(0.139)	-0.867	(0.713)
Cohort 4			2.388	(0.386)	-0.108	(0.194)	0.411	(1.003)
Constant	-0.031	(1.923)	-2.298	(2.484)	-1.504	(1.610)	54.729	(7.958)
Unobserved heterogeneity effect		Yes		Yes		Yes		Yes

Table C6.7 Estimated Coefficients for the Marriage, Education, and Fertility Equations (for Before the Surveyed Years)

	Marriage				Education		Fertility	
	Married		Status Missing					
Variables	Coef.	Std.Err.	Coef.	Std.Err.	Coef.	Std.Err.	Coef.	Std.Err.
Age 14-15	-2.450	(0.314)	4.618	(0.437)	6.659	(0.331)	-1.085	(0.224)
Age 16-17	-0.769	(0.266)	-0.531	(0.418)	4.037	(0.277)	0.626	(0.168)
Age 18-20	0.607	(0.244)	1.771	(0.351)	1.565	(0.250)	1.107	(0.142)
Age 21-25	0.672	(0.226)	0.775	(0.316)	0.330	(0.229)	0.934	(0.128)
Age 26-30	0.178	(0.220)	0.189	(0.305)	-0.084	(0.218)	0.492	(0.125)
Technical school	0.786	(0.111)	0.658	(0.225)	-5.291	(0.150)	0.428	(0.097)
High school	0.581	(0.092)	0.829	(0.202)	-3.288	(0.124)	0.400	(0.084)
Some college	0.052	(0.122)	0.224	(0.269)	0.812	(0.151)	0.145	(0.105)
College	0.865	(0.149)	0.857	(0.275)	-6.810	(0.192)	0.450	(0.112)
Slavic	0.286	(0.087)	0.074	(0.149)	0.288	(0.103)	-0.108	(0.059)
European (excl.slavic)	0.373	(0.269)	0.713	(0.428)	0.723	(0.392)	-0.051	(0.187)
Conception (*t-1*)	0.937	(0.181)	1.687	(0.235)	0.194	(0.103)	-	-
No.kids	1.183	(0.128)	0.426	(0.173)	-1.034	(0.082)	-	-
Married missing	-3.098	(0.244)	-12.931	(0.288)	0.728	(0.095)	-1.037	(0.074)
Married (*t-1*)	4.529	(0.111)	7.662	(0.202)	-0.371	(0.080)	2.339	(0.072)
Student	-	-			-	-	-0.313	(0.065)
Student (*t-1*)	0.000	(0.000)	0.001	(0.000)	-	-	-	-
Community:								
Urban	-0.200	(0.075)	0.546	(0.134)	1.027	(0.111)	-0.291	(0.054)
Settlement of urban type	-0.185	(0.126)	0.173	(0.233)	0.305	(0.179)	-0.205	(0.091)

Table C6.7 (Continued)								
Metropolitan areas	-0.678	(0.144)	-0.305	(0.217)	0.085	(0.171)	-0.044	(0.101)
Northern and N Werstern	-0.013	(0.147)	-1.159	(0.231)	0.681	(0.178)	0.048	(0.103)
Central and Central Black-Earth	-0.214	(0.134)	-0.984	(0.225)	-0.232	(0.161)	0.032	(0.096)
Volga-Vyastski and Volga Basin	-0.248	(0.106)	-0.551	(0.178)	0.180	(0.163)	-0.025	(0.079)
North Caucasian	-0.114	(0.125)	-1.196	(0.207)	0.949	(0.159)	0.103	(0.087)
Ural	-0.090	(0.113)	-0.764	(0.181)	0.101	(0.164)	0.131	(0.080)
Western Siberian	-0.216	(0.113)	-0.226	(0.177)	0.062	(0.134)	0.098	(0.079)
Year 1980-84	0.298	(0.114)	-0.222	(0.149)	-0.324	(0.109)	0.551	(0.121)
Year 1985-89	0.402	(0.125)	-0.757	(0.194)	-0.695	(0.129)	0.794	(0.123)
Year 1990-94	0.289	(0.159)	-1.652	(0.251)	-1.470	(0.169)	0.328	(0.139)
Year 1995-96	0.378	(0.194)	-1.842	(0.331)	-1.636	(0.209)	0.440	(0.162)
Year 1998-00	0.666	(0.219)	-2.325	(0.393)	-1.175	(0.238)	0.367	(0.181)
Year 2001-04	0.247	(0.262)	-2.295	(0.479)	-1.290	(0.272)	-0.175	(0.209)
Regional:								
City college	0.005	(0.005)	-0.026	(0.009)	0.000	(0.005)	-0.002	(0.004)
City technical	-0.019	(0.019)	0.120	(0.032)	0.048	(0.019)	0.007	(0.015)
Constant	0.476	(0.407)	6.400	(0.612)	-0.727	(0.430)	-3.885	(0.244)
Cohort 2	-0.282	(0.101)	0.680	(0.152)	0.998	(0.122)	0.136	(0.069)
Cohort 3	-0.238	(0.136)	0.202	(0.205)	1.636	(0.151)	0.437	(0.094)
Cohort 4	-0.665	(0.228)	-1.740	(0.411)	0.629	(0.241)	0.673	(0.170)
Unobserved heterogeneity effect								
Community: Point 1	0.000		0.000		0.000		0.000	
Point 2	0.056	(0.113)	-1.293	(0.226)	0.830	(0.234)	-0.021	(0.081)
Point 3	0.096	(0.090)	-1.173	(0.126)	0.744	(0.101)	-0.111	(0.057)
Point 4	0.413	(0.152)	-0.149	(0.272)	-0.072	(0.196)	-0.032	(0.110)
Individual: Point 1	0.000		0.000		0.000		0.000	
Point 2	-1.696	(0.134)	1.030	(0.299)	-0.157	(0.241)	0.150	(0.118)
Point 3	-0.623	(0.132)	1.229	(0.301)	4.666	(0.233)	0.263	(0.130)
Point 4	-22.60	(1.000)	7.592	(0.445)	1.800	(0.225)	0.243	(0.123)
Point 5	-0.377	(0.174)	0.743	(0.367)	0.774	(0.259)	0.348	(0.156)
Point 6	0.192	(0.119)	-0.996	(0.337)	2.418	(0.185)	-0.347	(0.121)
Point 7	0.286	(0.123)	-1.409	(0.337)	-1.165	(0.252)	-0.433	(0.117)
Point 8	-0.140	(0.164)	1.214	(0.334)	-5.396	(0.220)	0.420	(0.147)
Point 9	2.419	(0.283)	5.846	(0.391)	-1.914	(0.247)	0.190	(0.124)