The Determinants of the Recent Fertility Decline in Russia

Olesya Fomenko
University of North Carolina at Chapel Hill
Department of Economics
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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 per woman of reproductive age) to significantly below the 'safety zone' in 2000 (1.20). Such a low fertility rate is accompanied by the highest death rate among all countries with at least moderate development. These trends are reflected in projected 30% decline in Russian population by 2053 (World Bank report 2005). During the past couple decades, Russia, as well as most transition economies of Central and Eastern Europe, has experienced many drastic in areas of education, labor markets, public services, etc; many aspects of which have established connections with the reproductive choices of women within the framework of current fertility theory. 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 micro-economic analysis. Further research with an application of rich longitudinal data, such as the Russia Longitudinal Monitoring Survey (1994-2006), will allow for greater flexibility in the empirical formulation of the life-cycle fertility model and, therefore, for more accurate conclusions. In this paper, I estimate a comprehensive model of female life-cycle behavior, which accounts explicitly for interdependence of annual reproductive choices, educational, employment, and marriage decisions as well as earnings outcomes and controls for the individual- and community-level heterogeneity, using the Russia Longitudinal Monitoring Survey (1994-2006). 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.

1. Introduction

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 per woman of reproductive age) to significantly below the 'safety zone' in 1995 (see Table 1.1) [1]. The first drop in fertility took place in early 70'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). 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. Another substantial drop in the number of children born to a typical woman over her lifetime occurred around 1995, when the TFR decreased from 1.89 in 1990 to 1.34 in 1995 and then to 1.20 in 2000. Similar trends can be observed for 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 one with the lowest (see Sobotka, 2004). After 2000, one can notice a slight increase in the total lifetime number of births, reflecting recent growing prosperity, but it is far from rebounding to its pre-1995 level.

Such a low fertility rate is of significant concern for Russia, especially in a situation when it is accompanied by the highest death rate among all countries with at least moderate development. Moreover, according to a World Bank report, if current fertility and mortality trends persist, the Russian population is projected to decline below 100 million by 2053, from its 2003 level of 143 million (World Bank 2005). In addition to the record population declines, the currently low fertility rate will result in the rapid aging of the society, which is commonly associated with the wide array of negative consequences. Among the adverse impacts on the economy with the aging population, the most frequently stated are 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.

[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 a case of low fertility rate exceeding 1.5, the total population size can be sustainable with the help of appropriate migration policies.

The Russian government defines the current birth rate as one of the most critical problems, which is reflected in the policy measures enacted since January 1st, 2007. Under this plan, women receive monthly child allowances during the first 18 months in the amount equivalent to 60 US dollars for the first child and $120 for the second child (compared to average monthly income of $300). Also, mothers are able to stay at home for the first 18 months with 40% wage compensation up to $250 per child. 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 be used for improvements in housing conditions and/or educational needs of their children. This law introduces sizable financial incentives for having children and will impose substantial social cost. As Becker 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" (Becker, 2006). If the Russian program proves to be successful, we might see more countries putting forward their own programs to encourage women to have more children.

One of the potential explanations for such a decline in fertility rates for women across all age groups and, especially in the 20-24 age interval, is the continuously growing number of students in universities and technical colleges in response to the increasing demand for high-skilled labor in a changing economic environment (Klasen and Luanov, 2006 and Hotz et al., 1997). According to Figure 1.2, the number of university students per 10,000 people almost tripled from 1950 to 2005, with a particularly steep increase (163%) between 1995 and 2000, whereas the number of students-in-training for low-skilled work has experienced a permanent decline since 1970. The number of students in technical colleges has been climbing since its drop in 1995. 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). Moreover, high-skilled occupations are associated with a longer time span of and higher intensity of human capital accumulation both in school and on the job and, therefore, have a higher degree of interference with childbearing decisions. The fertility literature supplies some evidence in support of a direct relationship between career-achievement aspirations and waiting time until

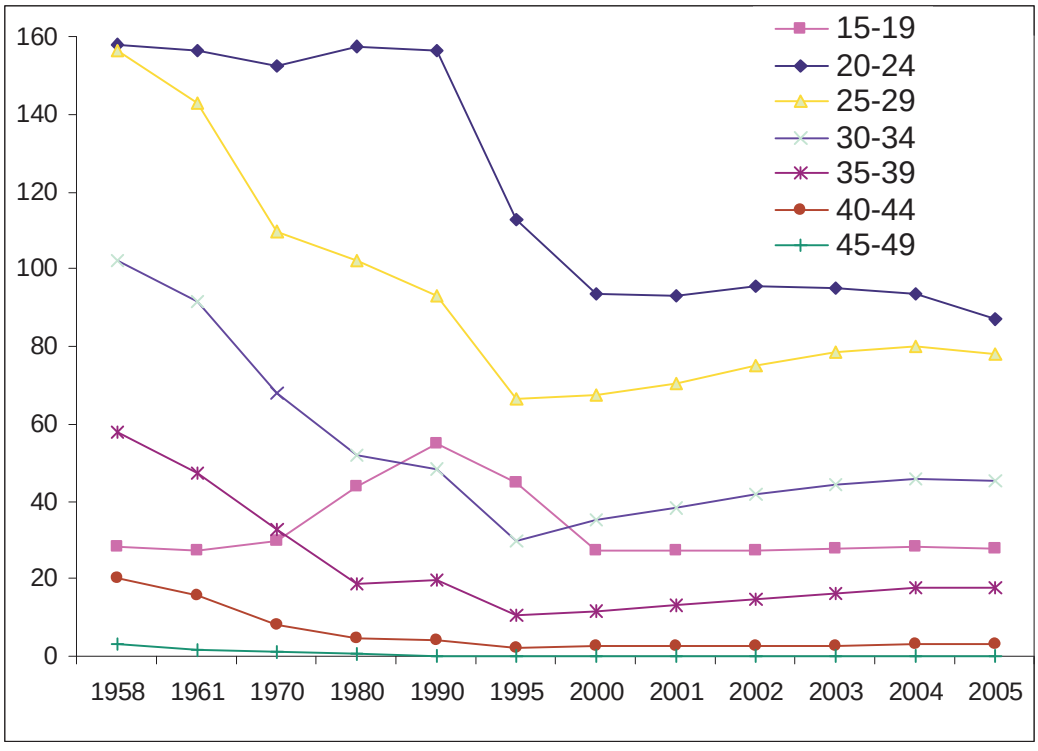
the first birth (Moffitt, 1984; Rindfuss et al., 2007 and Gustafsson, 2001). Traditionally, education is also expected to have a negative impact on the completed fertility through the substitution effect. Since children are considered to be time-intensive goods, if the wage is positively related to education, 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. Also, the negative effect of increased educational attainment on childbearing can be reinforced by a decline in 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).

The introduction of the market system changed the entire wage distribution and variability of non-labor income. Wages are no longer paid according to a centrally defined grid, but instead are allowed to be determined by market forces. 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 income and substitution effects of women's earnings (see Arroyo and Zhang, 1997). Higher wages contribute to a higher opportunity cost of woman's time as well as larger income available for childbearing and rearing. Evaluation of the labor and non-labor income effects on fertility will provide predictions for the effectiveness of the child-support allowances, wage compensations, and one-time birth payments.

The transition period in Russia before 2000 can be characterized by substantial volatility in real GDP, high inflation, and a fall in both labor force participation and employment that can be contributing factors to the sharp decline in fertility during these years. Also during this period between 1995 and 2000, the Russian economy experienced a high rate of inflation, contributing to an overall environment of economic instability. After 2000, real GDP started growing at a rate of around 5-7% a year corresponding to a period of a slow increase in the fertility rate. Therefore, one can notice a direct relationship between the stability of real GDP growth and the birth rate.

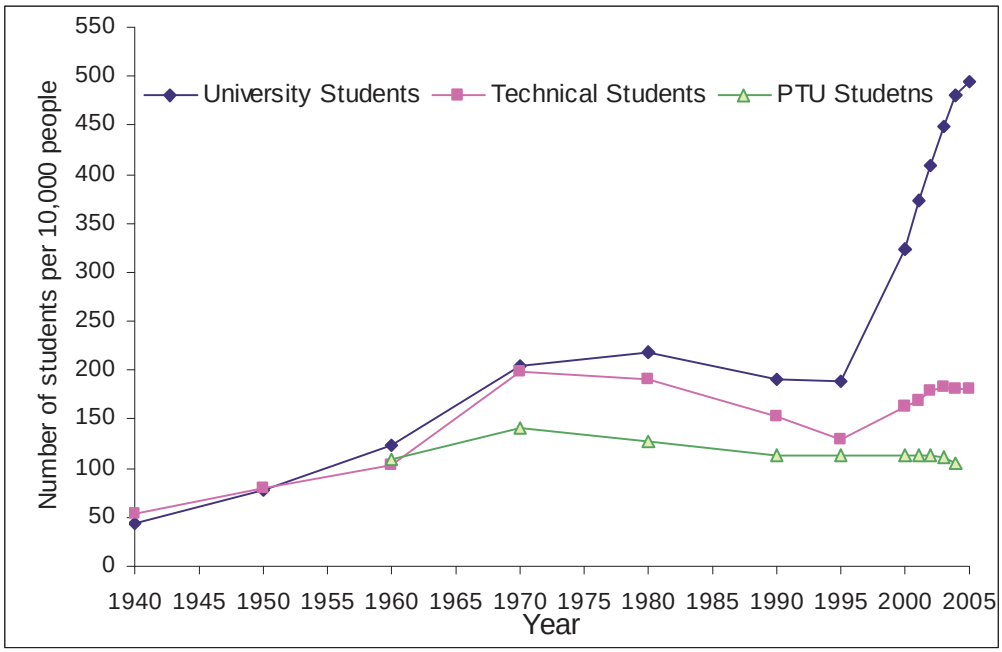
Figure 1.3 shows a substantial decline in both labor force participation and the employment rate over the period of falling fertility rates (1990-2000). After 2001, labor force participation stabilized at about the 81% level, and the employment rate started rising for both males and females, coinciding with a period of slight improvement in the fertility rate. Therefore, the fertility decline might be partly attributed to a temporal increase in the consumption-smoothing incentives in a highly volatile economic environment (see Hotz et al., 1997). Russia has experienced many drastic changes during the past couple decades; many aspects of which have established connections with the reproductive choices of women within the framework of current fertility theory. In this context, my analysis will provide insights into what factors are responsible for the recent fertility decline in Russia and what are the most effective pathways to alleviate the low fertility crises – whether it is reduction in the incompatibility of schooling/ working and childrearing, subsidizing financial costs of having children, or providing a more stable economic environment.

Figure 1.1 Number of Births per 1,000 Women Aged 15-49 across 5-year Age Categories



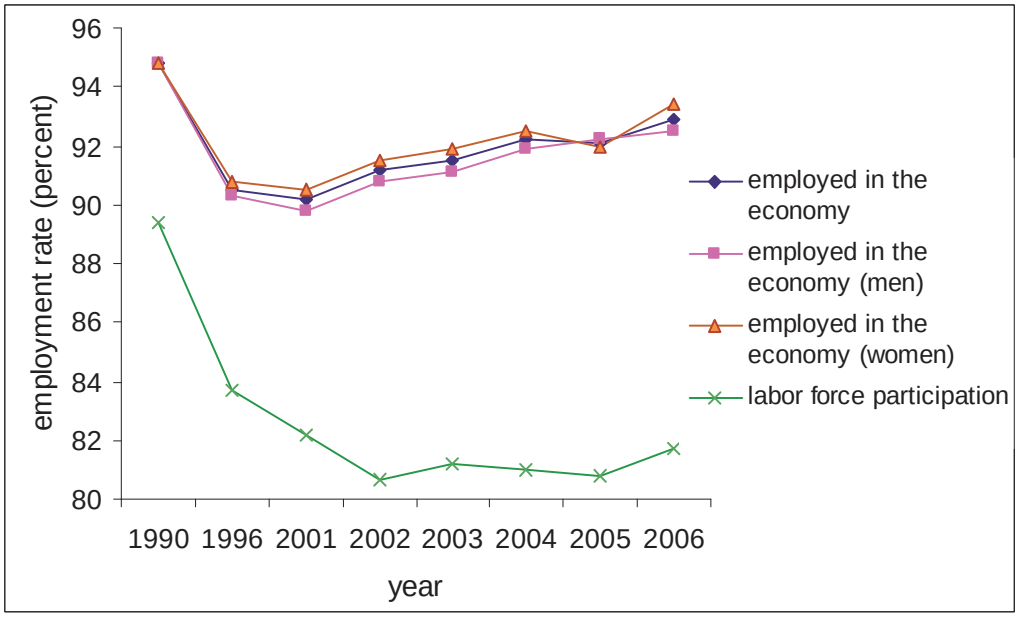
Data Source: Federal State Statistics Service Database.

Figure 1.2 Number of Students by Education Category



Data Source: Federal State Statistics Service Database

Figure 1.3 Employment Statistics



Data Source: Federal State Statistics Service Database

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 micro-economic 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. 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., reduction of child-care subsidies and allowances). His static empirical model is estimated on microeconomic cross-sectional data for 1984 and 1993 for both countries and restricted to married women between 20-38 years old. The total fertility demand during the Communist regime[2] is estimated using a linear regression model, using potential wages of men and women as well as the mothers' age profile and an indicator of a job change as demand determinants. His findings show that the demand parameters are significantly different across years and countries. The estimated effects of the parameters of interest support standard predictions such as: (1) an increase in women's wages brings a decline in the number of children with a wage elasticity of 0.81, and (2) an increase in family income encourages fertility with an income elasticity of 0.39. According to probit estimates of the determinants of the recent births, 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, such as education, employment history, housing ownership, and place of residence; and belief variables, on the timing of the births and early exiting from childbearing for the first two parities. To model a birth process, Klasen and Luanov (2006) use a more flexible continuous time multistate hazard

[2] The total demand for children during the Communist regime is specified as the total number of children above 3 years old in a family. The intention of such definition of the total demand is to isolate the reproductive decisions of the Communist era from those of the transition period.

model[3], allowing for the dependence of the timing of each birth on the fertility history, partially, by incorporating unobserved individual heterogeneity. In their estimations, they study the Family and Fertility Survey of 1998, a cross-sectional data set, with detailed information on fertility histories. The analyzed sample is restricted to women between the ages of 16 and 44 with completed education and divided into three cohorts, so that 16-26 year olds in 1998 are included in the first cohort, women aged 27-35 in the second cohort, and 36-44 year olds in the third cohort[4]. The timing of the data suggests that only the youngest cohort was influenced solely by the transition process in the forming of their fertility behavior.

The effect of education on the age at the first two births is estimated based on time-invariant measures of acquired education at the survey date. By doing so, they ignore interrelationship and potential simultaneity of these 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 education attainment. For instance, getting a bachelor-equivalent degree increases waiting time before the first birth by 1.1 years more for the youngest cohort (associated with the transition) relative to the older cohorts (the socialist period), and getting a master's degree will raise this difference in waiting time to 1.7 years. The impact of education on postponement of the first birth is also reinforced by a phenomenon specific to the transition – an exit from childbearing after the first birth driven by education accumulation. 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 unearned income. Also, their empirical model is constrained by an assumption of invariability of individual observed characteristics. Overall, the existing studies on the countries in the transition provide some background the importance of different factors in 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 on issues relevant to countries in

[3] Heckman and Walker (1987, 1990a,b) first introduced this type of multistate dynamic hazard models to the fertility literature.

[4] Restricting sample to women with completed education might result in the sample selectivity problem since the timing and spacing of births decisions might be correlated with education attainment choices.

transition is an estimation of a more comprehensive model of female life-cycle behavior, which accounts explicitly for 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.

The existing life-cycle literature attempts to explain 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 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. They refer to the scarcity of data sources that combine earnings information and birth histories as being a major reason for this gap in the fertility literature. 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 data. The wage and income effects flip signs across different parities and appear to be weaker than in Heckman and Walker (1990). Tasiran's findings are not supportive of those obtained by Heckman and Walker (1990), which leaves room for further analysis.

Rindfuss et al. (2007) add to the literature by analyzing the effect of the availability of high-quality and affordable child care as well as women's educational attainment on the timing of the first birth in Norway. They estimate a fixed-effects model to control for the placement endogeneity problems and selective migration. The authors hypothesize that institutional

[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.

changes (e.g., greater availability of child-care facilities) took place to accommodate 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 child care has a strong pronatalist effect on women of all ages; in particular, increasing in child care capacity from 0 to 75% improves the probability of childbearing for 15-19 year olds from 0.024 to 0.069, for 20-24 year olds from 0.049 to 0.11, and for 25-29 year olds from 0.104 to 0.140. They find that woman's enrollment and education attainment have significant negative effects on the timing of the first birth, the size of which declines with her 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 woman's education rather than its effect through different channels such as labor force participation, wages and marital outcomes.

Rindfuss et al. (2008) extend the analysis of the child care availability effects in Norway to include not only the timing of first birth but also the timing of subsequent births up to the fifth parity. 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). According to their simulation results, 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. Their findings also indicate that the wider availability of high–quality day care has a different effect depending on birth parity because of information acquired with exposure. Overall, this paper shows that expansion of affordable, worker-friendly and high-quality child-care availability will increase the total fertility rate substantially and, in the case of Norway, up to the replacement level. In this study, Rindfuss et al. (2007) also demonstrated the importance of controlling for unobserved heterogeneity and municipality fixed effects since simulations of the model without these controls provide results contradicting theoretical expectations.

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, 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. They demonstrate that not controlling for unobserved heterogeneity and the endogeneity of education will result in significantly biased coefficient estimates for policy variables by the underestimating influence of family planning efforts and overestimating the effect of 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). The improvement in family planning reduces completed fertility by one child per woman, delays marriage for almost a year, influences women to marry higher educated men, and encourages women to stay longer in schools with the last effect being three times stronger than that of an improved student-teacher ratio of the magnitude evidenced between 1970 to 1993. On the other hand, the described improvement in student-teacher ratio has almost no impact on completed fertility and age at marriage. Angeles, Guilkey, and Mroz (1998 and 2005b) also find that reproductive choices are sensitive to the introduction of different family planning programs. They demonstrate that treatment of educational attainment as exogenous results in a negative estimated relationship between additional education and fertility. In particular, in Peru, women with 10 years of education compared to women with no education delay the onset of their motherhood on average by about 3 years (from 20.77 to 23.85) and have substantially less conceptions (from 5.19 to 2.64). Angeles, Guilkey, and Mroz (1998 and 2005a,b) do not control for labor market outcomes of women; therefore, their education estimates are partially capturing wage and employment effects.

3. Theoretical model:

My model builds on the application of the standard neoclassical model of consumer demand for reproductive decisions introduced by Becker (1960) that considers fertility outcomes as parents' demand for the lifetime number of children. The theoretical model is specified to explain the sequence of the mother's educational, labor, and marital choices and their impact on fertility outcomes. Therefore, women are followed from age 14, when they are about to graduate from mandatory incomplete secondary school and are starting to plan their future careers, including further education. At the same age, a woman is assumed to enter her fecundity period since, and her annual life choices are traced throughout her primary fertility years until age 35. Pursuit of an additional year of schooling positively influences future wages of the woman, but

competes for time with working and non-market activities, including motherhood, via the time constraint[6]. The choice of work hours affects income available for adult- and children-related consumption through the budget constraint and influences her future earnings through experience accumulation and job tenure. Hence, both additional education and greater labor market attachment improve a woman's future wages 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. 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 adult and child-related goods and services (C_{it}), including formal child care, and from her leisure or non-market activities (L_{it}). The woman derives additional utility from her marital status (M_{it}) and her husband's characteristics if she is married at time t. Her husband's characteristics are assumed to be exogenous. The mother also obtains utility from her children (N_{it}) and additional utility from newborns ($n_{i,t-1}$). The individual per-period utility also depends on time-varying schooling and employment specific taste shifter ($\mu_{it}^{h,s}$), on an unobserved time-invariant preference parameter (θ_i), reflecting her family size preferences and career-related ambitions, 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 presence of a newborn:

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

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

and

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

Such 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 marginal utility of consumption of the market-purchased goods and services:

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

and

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

Every period, the 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 control their fertility perfectly and costlessly. Hence, the number of children at any period is defined as follows:

$$N_{it} = \sum_{t=0}^{t-1} n_t .$$

In making her decision to have children, the woman faces a time constraint, where she allocates 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 kids and the presence of a newborn in the family through the contemporaneous utility function. Overall, having children, especially under 1 year old, leaves less time for work and school and, moreover, increases disutility from work and school with every child.

The woman's wage are an increasing function of her acquired education (S_{it}), accumulated job tenure (τ_{it}), and work experience (E_{it}). Then, her labor income in period t is $w(S_{it}, \tau_{it}, E_{it}) H_{i,t}$. Acquired education up to time t counts years of schooling and is dynamically defined as follows:

$$S_{it} = \begin{cases} S_{i,t-1} + 1 & if\ s_{i,t-1} = 1 \\ S_{i,t-1} & otherwise \end{cases}.$$

Non-earned income, $I_{it}(M_{it}, s_{it})$, depends on the woman's marital status and any stipend received as a student. In addition to being determined by individual employment decisions over the lifetime and current marital and educational states, 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, hers and her family members' payments structure, etc.). Hence, total expenditure on annual adult and children-related consumption is financed from the woman's labor income, and non-earned income of the same year, and depends on realization of the income shock[7]:

$$w(S_{it}, \tau_{it}, E_{it}, H_{i,t-1}) H_{it} + I_{it}(M_{it}, s_{it}) + \varepsilon_{it} = C_{it}.$$

This per-period budget constraint assumes that capital markets are perfectly imperfect – no lending or borrowing is permitted.

[7] Since tuition cost is zero in most public educational institutions, the monetary cost of attending school is ignored.

According to the budget constraint, mothers incur 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 the purchased goods consumed when children are present in the family. Overall, having children potentially reduces contemporaneous mother's earned income through the time constraint, by decreasing available time for work, and the magnitude of the respective earnings loss is determined by current wages. In addition to the immediate effect of high demand for mother's time, childrearing reduces woman's earned income for the coming years by possibly suppressing education 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 enters the woman's contemporaneous utility[8]. Every period the woman faces a probability of being married in this period, and it is formulated by the following function:

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

where M_{it} is an indicator of marital status, and it takes on value 1 if the woman is married and 0 otherwise. The probability of being married at time t is expected to be higher if the woman was married in the period before and if she has children (N_{it}) or a newborn from ($n_{i,t-1}$) 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 socio-demographic characteristics (D_{it}) of her community (e.g., ratio of men to women[9]).

The timing of the woman's choices is summarized in the following paragraph. At the beginning of each period, the woman learns her marital status (M_{it}) along with her husband's

[8] 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 the parenthood within marriage is facilitated by pooling the financial resources of the spouses. Moreover, male's and female's financial contribution capacity for childrearing is modeled as a main criterion for matching by Weiss and Willis (1985), Willis (1995), and Lam (1988).

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

characteristics if she is married and the realization of the time-varying taste shifters summarized in a vector, $\mu_{it}^{h,s}$. The information known to the woman at the beginning of period t can be summarized in the following vector:

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

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}). Therefore, 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 these constraints in the utility function, at the last fertile period T, the present value of lifetime utility associated with fertility decision $n_{it} \in \{0, 1\}$, 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:

$$V_{iT}^{n_{iT}}(Z_{iT}, H_{iT}, s_{iT}, \varepsilon_{iT}) = U\Big\{w(S_{iT}, \tau_{iT}, E_{iT}, H_{i,T-1})H_{iT} + I_{iT}(M_{iT}, s_{iT}) + \varepsilon_{iT}, \bar{T} - H_{iT}, N_{iT},$$
$$n_{iT-1}, M_{iT}, \mu_{iT}^{h,s}, \theta_i, D_{iT}\Big\} + \beta \sum_{M_{i,T+1}=0}^{1} \Pr(M_{i,T+1} \mid M_{iT}, S_{i,T+1}, N_{iT+1}, n_{iT,} w_{i,T+1}, \theta_i, D_{iT+1}) W(Z_{i,T+1})$$

where $W(Z_{i,T+1})$ is the total expected utility at time T associated with the infertile period of the woman's life that is determined by complete fertility among the other state variables known at time T+1. β is a discount factor.

After learning the income shock, the woman's decision to conceive a child at time T for any employment and schooling choices comes from the following utility maximization exercise[10]:

$$V_{iT}^{n^*_{iT}}(Z_{iT}, H_{iT}, s_{iT}, \varepsilon_{iT}) = \max\left\{V_{iT}^{n_{iT}=0}(Z_{iT}, H_{iT}, s_{iT}, \varepsilon_{iT}), V_{iT}^{n_{iT}=1}(Z_{iT}, H_{iT}, s_{iT}, \varepsilon_{iT})\right\},$$

[10] In the theoretical model, the woman is not restricted by availability of educational institutions, which is not true for some communities. Such accessibility constraints are exploited in the empirical specification for identification purposes.

where n_{iT}^{*} denotes optimal conception decision.

This woman is making her optimal schooling and work-hours choices in uncertainty regarding her future real income (ε_{it}). Hence, her maximum expected lifetime utility at the beginning of period T can be expressed as:

$$G_{iT}(Z_{iT}) = \max_{H_{iT}, s_{iT}} E_{\varepsilon_{iT}} \left\{ V_{iT}^{n^{*}_{iT}}(Z_{iT}, H_{iT}, s_{iT}, \varepsilon_{iT}) \right\}.$$

Then, the total life-cycle utility at T, expected at the end of T-1, is

$$\sum_{M_{i,T}=0}^{1} \Pr(M_{i,T} \mid M_{i,T-1}, S_{iT}, N_{iT}, \theta_i, D_i, n_{i,T-1,} w_{iT}) \, E_{\mu_{iT}} G_{i,T}(Z_{iT}).$$

The expectation operator refers to the uncertainty regarding future realizations of the period-specific preference parameters, contained in Z_{iT}.

The lifetime value of making a fertility choice, n_{it}, conditional on a particular employment and schooling alternatives and real income shock in period t= T-1 is:

$$V_{i,T-1}^{n_{it}}(Z_{i,T-1}, H_{i,T-1}, s_{,iT-1}, \varepsilon_{i,T-1}) = U\Big\{ w(S_{i,T-1}, \tau_{i,T-1}, E_{i,T-1}, H_{i,T-2}) H_{i,T-1} + I_{i,T-1}(M_{i,T-1}, s_{i,T-1}) + \varepsilon_{i,T-1},$$
$$\bar{T} - H_{i,T-1}, N_{i,T-1}, n_{i,T-2}, M_{i,T-1}, \mu_{i,T-1}, \theta_i, D_{i,T-1} \Big\}$$
$$+ \beta E_{\mu_{iT}} \sum_{M_{i,T}=0}^{1} \Pr(M_{iT} \mid M_{i,T-1}, S_{i,T}, N_{iT}, \theta_i, D_{iT}, n_{i,T,} w_{i,T}) \, G_{i,T}(Z_{i,T})$$

where β is a discount factor. In choosing her optimal hours of work, schooling and fertility alternatives at time t for any t less or equal to T-1, the woman follows the same steps formulated for T.

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

In the empirical model, I simultaneously estimate the determinants of fertility, woman's education, hours of work, wages, and marital outcomes, by applying a maximum likelihood method with correction for individual- and community-level heterogeneity. This empirical specification allows the examination of the direct impact of all modeled choices and policy variables on fertility outcomes as well as their indirect effect through various pathways described in the theoretical model. Moreover, this joint estimation framework addresses the endogeneity problem, which arises from the dependence of the life-cycle individual choices on the unobserved permanent preference parameter, as it is shown in the theoretical formulation. Further discussion of the endogeneity concerns is presented in the specification of the equations.

4.1. Fertility Equations

The timing of conception leading to the first and second live births is specified separately by a discrete time hazard model for women during their primary fecundity years between 14 and 35:

$$\ln\left[\frac{\Pr(n_{ijtk}=1 \mid n_{i,j,t-1,k}=0)}{\Pr(n_{ijtk}=0 \mid n_{i,j,t-1,k}=0)}\right] = X_{ijtk}\alpha_k + G_{ijk}\beta_k + P_{jt}\gamma_k + \lambda_{ik} + \omega_{jk},$$

where X_{ijtk} *contains* $w_{ijt}, H_{ijt}, N_{ijt}, S_{ijt}, s_{ijt}, I_{ijt}, M_{ijt}$, *and* D_{ijt}.

The dependent variable n_{ijtk} takes on value 1 if a woman i from community j conceives k^{th} child at time (age) t. The conception probability at every period is defined by observed time-varying and time-invariant individual characteristics (X_{ijtk} and G_{ijk}, respectively), and time-varying community observables (P_{jt}). 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_{ik}) and community (ω_{jk}) factors which are unobserved by the researcher. The first is intended to capture such personal characteristics as an individual specific taste for family and children, career ambitions, and the degree of fecundity. The latter parameter embodies local beliefs regarding family size and local values defining the socially accepted role of a woman in the community.

The vector X_{ijtk} contains exogenous and endogenous time-varying individual and household variables. X_{ijtk} controls for the following exogenous individual and household characteristics: the women's age and her husband's age, husband's education, employment status, ethnicity (or nationality), type of her and her husband's employer, her expectations regarding the household's future economic wellbeing, and her husband's employment perspectives[11], the household's ownership of the housing and its area per adult, the number of all adults and retired adults residing in the household, and an index representing economic wellbeing of the household[12]. G_{ijk} includes the woman's ethnicity and geographic indicators.

Endogenous covariates included in X_{ijtk} are potential wages, tenure, marital status, non-earned income, school enrollment status, acquired education, employment status and hours of work. The source of the endogeneity of the above variables is in the role of unobserved personal characteristics (λ_{ik}) in shaping all of the woman's fertility-related outcomes. In particular, 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. 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.

P_{jt} captures time-varying economic and infrastructural development of the community, by including such exogenous variables as an index summarizing the availability and quality of municipal services and presence of different types of preschool establishments in the household's population center. The regional controls contain female unemployment rate, proportion of workers loosing their jobs, real monetary annual income and monthly wage growth, gross domestic per capita product, and capacity of pre-school education facilities.

Since labor earnings are not available for unemployed women, potential wages are predicted for all women to capture shadow prices of their time. They are predicted based on

[11] Perception variables will not be included in main specification. Even though only variables representing household level expectations and husband's work perspectives are chosen, they still might introduce endogeneity bias.

[12] This index summarizes the household's ownership of basic home appliances (e.g. washer and refrigerator) and access to municipal services such as central hot water and heating.

computed parameters of a joint estimation of actual wage, labor force participation, and education equations. The education equation is included in 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[13]. Following the theoretical model, the wage function is given by:

$$w_{ijt} = \alpha_0 + \alpha_1 S_{it} + \alpha_2 \tau_{it} + \alpha_3 \tau^2{}_{it} + \alpha_4 E_{it} + \alpha_5 E^2{}_{it} + \alpha_6 1 \cdot \{H_{i,t-1} = 0\} + P^w_{jt} \gamma^w + \lambda^w_i + \omega^w_j$$

P^w_{jt} includes identification variables: an index of local prices (based on food prices reported in the RLMS), average real monthly earnings in the region, regional unemployment rate (or female unemployment), and percentage of population with income below subsistence level. Type of the settlement, the region of residence as well as annual real income growth and regional GDP per capita enter the wage equation.

The term λ^w_i represents permanent individual factors, such as her unobserved career-oriented ambitions, which influence the woman's wage and correlate with individual level unobservable factors from the employment and education equations. The wage equation also contains a community-specific time-invariant error term, ω^w_j, that has an effect on the earnings of women in the community and is allowed to correlate with similar terms attributed to the employment and educational outcomes.

4.2. Education Equation

The education equation addresses the endogeneity concern of the school attendance variable in the fertility equation and the potential endogeneity of acquired education in all of the estimated processes. 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

[13] 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 incompleteness 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.

decisions. 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:

$$\ln\left[\frac{\Pr(s_{ijt}=1\mid s_{i,j,t-1})}{\Pr(s_{ijt}=0\mid s_{i,j,t-1})}\right]=X_{ijt}^{S}\alpha^{S}+G_{ij}^{S}\beta^{S}+P_{jt}^{S}\gamma^{S}+\lambda_{i}^{S}+\omega_{j}^{S},$$

where X_{ijt}^{S} *contains* $N_{ijt}, n_{i,j,t-1}, S_{ijt}, s_{i,j,t-1}, I_{ijt}, M_{ijt}$, *and* $D_{ijt\,ijt}$.

The vector X_{ijt}^{S} includes exogenous and endogenous time-varying personal characteristics. Endogenous covariates in X_{ijt}^{S} are the woman's marital status, non-earned income, her previous year's education status, total educational attainment, and number of children born (defined by the conception equation). The potential endogeneity of the above variables comes from the correlation of individual and community levels between unobserved characteristics from the respective equations and λ_{i}^{S} *and* ω_{j}^{S}. Permanent individual characteristics, G_{ij}^{S}, include the woman's ethnicity, region of the residency, and settlement type.

P_{jt}^{S} contains identification variables, which explain education continuation but have no explanatory power for the woman's decision to have a child. These exclusion restrictions are the availability of high schools (private or public) in the woman's community, presence of a public library, delivery of local and regional newspapers in the population center, ratio of current year college and technical school graduates to adult population in the region and the proportion of employed in the region according to their degree. The vector of time-varying community characteristics also includes real monetary income growth, and gross domestic per capita product.

4.3. 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 personal variables:

$$\ln\left[\frac{\Pr(M_{ijt}=1\mid M_{i,j,t-1})}{\Pr(M_{ijt}=0\mid M_{i,j,t-1})}\right]=X^{M}_{i,j,t-1}\alpha^{M}+G^{M}_{j}\beta^{M}+P^{M}_{jt}\gamma^{M}+\lambda^{M}_{i}+\omega^{M}_{j},$$

where X^{M}_{ijt} *contains* $w_{ijt}, N_{ijt}, n_{i,j,t-1}, S_{ijt}, s_{i,j,t-1}, M_{i,j,t-1}$, *and* D_{ijt}.

The lagged variables reflect dependence of the probability of the marital status in every period t on the state variables known at the beginning of time t including previous decisions. All modeled choices are made after learning this period's marital status. The vector $X^{M}_{i,j,t-1}$ contains exogenous and endogenous time-varying individual and household variables lagged one year. Endogenous covariates included in $X^{M}_{i,j,t-1}$ are the woman's past year school enrollment, highest educational degree obtained, current potential wage, her marital and employment states in the previous period and the number of children ever born as well as her fertility decision in the previous period. λ^{M}_{i} *and* ω^{M}_{j} are individual and community characteristics unobserved by researchers that are most likely correlated with personal outcomes included in the equation.

Regional identification variables, included in P^{M}_{jt}, are the number of marriages and divorces in the region adjusted to the total regional population above 16 and the ratio of women to men (for 16 plus year olds).

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

4.4. Hours of Work

Estimation of the hours of work equation casts light on an additional pathway through which major life-cycle choices and policy variables can have an impact on fertility outcomes for women. Also, the inclusion of the hours of work equation controls for the potential endogeneity of woman's labor supply in the fertility equation.

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

$$H_{ijt}=X^{H}_{ijt}\alpha^{H}+G^{H}_{ij}\beta^{H}+P^{H}_{ij}\gamma^{H}+\lambda^{H}_{i}+\omega^{H}_{j}+\eta_{ijt},$$

where X^{H}_{ijt} *contains* $w_{ijt}, N_{ijt}, n_{i,j,t-1}, S_{ijt}, I_{ijt}, M_{ijt}$, *and* D_{ijt}.

η_{ijt} is a time varying individual specific error term following a normal distribution with mean 0 and variance $\sigma_{\eta..}$ Endogenous variables in X_{ijt}^{H} are the woman's marital status, potential wage, non-earned income, completed education, and number of children as well as presence of a newborn. X_{ijt}^{H} contains exogenous covariates such as the woman's age, her husband's ethnicity (or nationality), education, and employment status. G_{ij}^{H} includes woman's ethnicity and geographical identifiers.

Possible identifiers for the hours of work equation are local availability and regional capacity of formal child-care conditional on having kids of pre-school age. Also, regional per-capita GDP and real income growth enter this equation.

4.5. Labor Force Participation Equation

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. It also addresses the potential endogeneity of employment status in the fertility and marriage equations.

The woman's labor force participation decision at every year (age) t during the surveyed years is specified as follows:

$$\ln\left[\frac{\Pr(H_{ijt} > 0)}{\Pr(H_{ijt} = 0)}\right] = X_{ijt}^{L}\alpha^{L} + G_{ij}^{L}\beta^{L} + P_{ij}^{L}\gamma^{L} + \lambda_{i}^{L} + \omega_{j}^{L},$$

where X_{ijt}^{L} *contains* $n_{i,j,t-1}, N_{ijt}, S_{ijt}, \tau_{ijt}, I_{ijt}, M_{ijt}$, *and* D_{ijt}.

The vector X_{ijt}^{L} contains exogenous and endogenous time-varying individual and household variables. Endogenous covariates included in X_{ijt}^{L} are marital status, non-earned income, highest education acquired, tenure and the number of the children ever born and the woman's fertility decision in the previous period.

X_{ijt}^{L} controls for the following exogenous individual characteristics: her age, ownership of the housing and its area per adult, and her husband's ethnicity, education, and employment status

as well as type of his employer, and expectations about his future employment[14]. G_{ij}^{L} includes the woman's ethnicity and geographical identifiers.

Possible identifiers for the labor force participation equation contained in P_{ij}^{L} are presence of a state employment agency in the population center and its functions, the regional unemployment rate, local availability and regional capacity of formal child-care interacted with having kids of the pre-school age, per capita amount of investments in capital in the region, and regional real output of the following sectors: services, industry, and agriculture. Also, regional real GDP per-capita and real income growth enter this equation.

For years prior to RLMS coverage or before reaching 18 years old[15], information on some variables is not recoverable.[16] Fertility, education, and marital equations will be modeled on a modified set of observables for those years.

4.6. Likelihood Function Specification

All individual and community specific unobservables are assumed to correlate across all equations, following an unknown joint distribution. In order to avoid making assumptions regarding the actual distribution of the unobserved factors such as an assumption of normality, the distribution is 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

$$\pi_I(b) = \Pr(\lambda_{i1} = \lambda_{1b}, \lambda_{i2} = \lambda_{2b}, \lambda_i^s = \lambda_{3b}, \lambda_i^M = \lambda_{4b}, \lambda_i^H = \lambda_{5b}, \lambda_i^L = \lambda_{6b},$$
$$\lambda_{i1}^{'} = \lambda_{7b}, \lambda_{i2}^{'} = \lambda_{8b}, \lambda_i^{'s} = \lambda_{9b}, \lambda_i^{'M} = \lambda_{10b}),$$

[14] Perception variables will not be included in main specification. Even though only variables representing household level expectations and husband's work perspectives are chosen, they still might introduce endogeneity bias.

[15] Before reaching age of 18, individuals often choose not to participate in the adult section of the survey, and, therefore, information on many key variables is not collected for them.

[16] For the years before participation in the RLMS, the dependent variable in the marriage equation is divided into three categories such as 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.

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 (or initial condition equations).

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

$$\pi_J(q) = \Pr(\omega_{j1} = \omega_{1k}, \omega_{j2} = \omega_{2k}, \omega_j^s = \lambda_{3k}, \omega_j^M = \omega_{4k}, \omega_j^H = \omega_{5k}, \omega_j^L = \omega_{6k},$$
$$\omega_{j1}^{'} = \omega_{7k}, \omega_{j2}^{'} = \omega_{8k}, \omega_j^{'s} = \lambda_{9k}, \omega_j^{'M} = \omega_{10k}),$$

for q=1, 2,…, Q.[17]

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

$$L_{ij}(\lambda_{ik}, \omega_{jk}, \lambda_i^s, \omega_j^s, \lambda_i^M, \omega_j^M, \lambda_i^H, \omega_j^H, \lambda_i^L, \omega_j^L, \lambda_{ik}^{'}, \omega_{jk}^{'}, \lambda_i^{'s}, \omega_j^{'s}, \lambda_i^{'M}, \omega_j^{'M}) =$$
$$\prod_{t=14}^{A_i} \prod_{k=1}^{2} \left[\Pr(n_{ijtk} = 1 \mid n_{i,j,t-1,k} = 0, \lambda_{ik}^{'}, \omega_{jk}^{'})^{n_{ijtk}} [1 - \Pr(n_{ijtk} = 1 \mid n_{i,j,t-1,k} = 0, \lambda_i^{'}, \omega_j^{'})]^{1-n_{ijtk}}\right]$$
$$\Pr(s_{ijt} = 1 \mid \lambda_i^{'s}, \omega_j^{'s})^{s_{ijt}} [1 - \Pr(s_{ijt} = 1 \mid \lambda_i^{'s}, \omega_j^{'s})]^{1-s_{ijt}} \Pr(M_{ijt} = 1 \mid \lambda_i^{'M}, \omega_j^{'M})^{M_{ijt}} [1 - \Pr(M_{ijt} = 1 \mid \lambda_i^{'M}, \omega_j^{'M})]^{1-M_{ijt}}$$
$$\prod_{t=A_i}^{E_i} \prod_{k=1}^{2} \left[\Pr(n_{ijtk} = 1 \mid n_{i,j,t-1,k} = 0, \lambda_{ik}, \omega_{jk})^{n_{ijtk}} [1 - \Pr(n_{ijtk} = 1 \mid n_{i,j,t-1,k} = 0, \lambda_i, \omega_j)]^{1-n_{ijtk}}\right]$$
$$\Pr(s_{ijt} = 1 \mid \lambda_i^s, \omega_j^s)^{s_{ijt}} [1 - \Pr(s_{ijt} = 1 \mid \lambda_i^s, \omega_j^s)]^{1-s_{ijt}} \Pr(M_{ijt} = 1 \mid \lambda_i^M, \omega_j^M)^{M_{ijt}} [1 - \Pr(M_{ijt} = 1 \mid \lambda_i^M, \omega_j^M)]^{1-M_{ijt}}$$
$$\Pr(H_{ijt} > 0 \mid \lambda_i^L, \omega_j^L) 1 \cdot \{H_{ijt} > 0\} [1 - \Pr(H_{ijt} > 0 \mid \lambda_i^L, \omega_j^L) 1 \cdot \{H_{ijt} \le 0\}] \frac{1}{\sigma_\eta} \Phi(\eta_{ijt} \mid \lambda_i^H, \omega_j^H)$$

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}.

[17] $\omega^{'}$ 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

$$L_{ij}(\omega_j, \omega_j^s, \omega_j^M, \omega_j^H, \omega_j^L) = \sum_{b=1}^{B} \pi_I(b) L_{ij}(\lambda_{1b}, \omega_{j1}, \lambda_{2b}, \omega_{j2}, \lambda_{3b}, \omega_j^s, \lambda_{4b}, \omega_j^M, \lambda_{5b}, \omega_j^H, \lambda_{6b}, \omega_j^L, \lambda_{7b}, \omega_{j1}^{'}, \lambda_{8b}, \omega_{j2}^{'}, \lambda_{9b}, \omega_j^{'s}, \lambda_{10b}, \omega_j^{'M}),$$

The unconditional likelihood function for all women over all communities is

$$L = \prod_{j=1}^{240} \sum_{q=1}^{Q} \pi_j(q) \prod_{i=1}^{N} L_{ij}(\omega_{1q}, \omega_{2q}^s, \omega_{3q}, \omega_{4q}, \omega_{5q}, \omega_{6q}, \omega_{7q}^s, \omega_{8q}, \omega_{9q}, \omega_{10q}),$$

where N is the total number of women and 240 is the total number of communities.

5. Data

This study is conducted using the Russia Longitudinal Monitoring Survey (RLMS), which is a series of nationally representative surveys collected fourteen times since 1992. The RLMS is designed to study the impact of reforms on the wellbeing of households and individuals, which makes it appropriate for studying the effects of reforms on fertility and the fertility related choices of the women. 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. The initial sample consisted of 6,333 households (16,623 individuals), out of which 5,473 households (or 14,282 individuals) participated in the last survey of Phase I. This paper analyzes data collected in the Phase II, covering Round V (1994) to Round XIV (2005/06) and ranging from 3,750 households with 8,342 adults and 2,123 children (Round VII) to 4,715 households with 10,670 adults and 1,981

children (Round XII). The choice of the Phase II is dictated by its longer time span, improved quality of sampling procedure[18] and inclusion of the community questionnaire.

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, are grouped into 38 strata according to geographical characteristics and level of urbanization. Three of them, Moscow city, Moscow Oblast, and St. Petersburg city, are self-representing strata and selected with certainty. The remaining 35 primary sampling units (PSU's) are non-self-representing[19] regions drawn from 35 equal-sized strata with probability proportional to its population size. Secondary sample units[20] (SSU) within every PSU are randomly selected such that the proportion of the rural to urban population is preserved. In the last stage of sampling, ten households are drawn from the ordered list of all households in each SSU, by selecting randomly the first household and choosing the rest of the households, using a equidistance principle. The total number of households in the sample representing each PSU is approximately equal with an average of 108 households. The RLMS is a household-based survey, which covers a substantial number of households including all individuals within the sampled households. 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 out 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.

5.1. Sample Description

The sample for this study is restricted to women between the ages of 18 and 35 in 1994-2005. Since the primary focus of my 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. Also, individuals who have not participated in three or more consecutive rounds of the survey are right censored[21]. 45 women have unrecoverable missing information on some key variables and, therefore, are dropped from the study. Table 5.1 summarizes response characteristics of the

[18] The number of the sampled clusters is almost doubled in Phase II.
[19] It represents not only itself but the entire stratum.
[20] In rural areas, SSU is represented by a village and, in urban areas, SSU is defined by the boundaries of the census districts.
[21] If individuals do not respond to either last one (246 women) or last two (477 women) rounds of the survey, they are included in the right censored category.

women. 4006 women age 18-35 with one or fewer children participated at least in one out of ten rounds of the survey, resulting in 13,340 woman-year observations. Summary statistics of the key characteristics of these 13,340 observations is presented in Table 5.2, showing that the average age of the women in the sample is 25 years old. On average, these women are married 59% of the time and employed in 60% of the periods. According to Table 5.1, out of 4006 individuals in the sample, 309 women have at least one single non-response, and 81 also have missed two consecutive rounds of the survey at least once. In addition, 1825 women have not participated in three or more consecutive years of the study, or the last one or two rounds. The observations falling under the last category are right-censored immediately before missing three consecutive rounds. 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.

Table 5.1 Sample Description

	1st and 2nd birth parities
No. of woman-year observations	13340
No. of individuals:	4006
- single round missing	309
- two consecutive rounds missing	81
- right censored:	
o Total	1825
o Missed two last rounds	477
o Missed the last round	246

Table 5.2 Summary Statistics - Pooled sample

Variables	Mean	
Age	25.06	(4.86)
Married	0.59	(0.49)
Student currently	0.18	(0.38)
Employed	0.60	(0.49)
No. of observations	13340	

5.2. Variable Descriptions

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. The dependent variable in the main equation of interest – 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[22], 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 including questions specifically targeting the last 30 days time period. 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 and to keep 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 5.4, during 1994-2004, a total of 14,775 woman-year observations belong to a group at risk of pregnancy at age 18-35 with their first child, and 5664 of them are attributed to the years being in the survey[23]. Similar numbers for the second-child pregnancy are 8447 and 6164, respectively. A total of 539 conception events leading to the first-child birth happened during years of participation in the survey and 54% fewer conceptions of the second child (290 conceptions) occurred.

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

[23] For women, who entered the survey in later rounds, the conception round is computed based on birth date records in the later rounds. Missing interview dates for this group of women are imputed by using mean of the sampled dates for the respective round.

Table 5.4 Sample Characteristics (Conceptions).

No. of observations with imputations						No. of observations without imputations				
	Birth parities			Conceptions		Birth parities			Conceptions	
Year	1st	2nd	Total	1st	2nd	1st	2nd	Total	1st	2nd
1994	2024	943	2967	120	20	486	547	1051	40	20
1995	1920	902	2822	114	21	501	538	967	41	21
1996	1861	902	2763	220	47	502	571	1001	75	47
1998	1876	926	2802	215	49	511	614	1067	66	49
2000	1793	961	2754	125	20	601	654	1202	66	20
2001	1668	979	2647	115	30	723	756	1424	68	30
2002	1441	977	2418	108	30	754	801	1499	69	30
2003	1220	958	2178	88	35	787	834	1570	63	35
2004	972	899	1871	62	38	799	849	1574	51	38
Total	14775	8447	23222	1167	290	5664	6164	11828	539	290

The key individual-level explanatory variables in my analysis are age, marital status, education, and employment. The entire sample is divided into four age categories, identified by four dummy variables with the youngest group being the reference. The marital status indicator records whether a woman is currently in a registered or unregistered marriage[24]. 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. 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. If the woman changes her marital status, after her marriage information has been missing for two periods, then she is assigned a new marital status after the first missing period[25].

[24] This distinction between types of marriages is not recorded in the study before 1998.
[25] 1471 women have unrecoverable marital information for some years after their 14th birthday and prior to their surveyed years.

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 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[26]. Moreover, the RLMS records information on duration of enrollment in the educational institutions and on graduation year, broken down by their type[27]. Using the standard primary school enrollment age, 7 years old, as 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 outside of the surveyed years. When 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.

The RLMS contains an extensive section on employment, which yields the following set of work-related variables: employment status and history, hours of work, earnings information, and ownership categories of the primary employer. 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 work measured in days, total employment duration, and an indicator recording whether the woman ever worked or not[28]. In addition to the above described employment characteristics, duration of unemployment as well as duration of schooling are used for backdating employment status and 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 (see Appendix B for more details). For

[26] Degrees are stated in the order of advancement.
[27] 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.
[28] For V-VIII rounds, records of total years of employment are available only for currently unemployed.

non-response years, for which employment status is recovered as being employed, hours of work are computed as an average of two surrounding rounds.

Earnings data contains information on after-tax monetary wages paid in the last 30 days by the primary employers and on a more appropriate measure of earnings – average monthly after-tax wages, based on the last 12 months payments[29]. Moreover, the latter measure 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 (see Appendix Table B2 for more details)[30] . 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 using total family monetary income in the last 30 days[31] 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 at least in one period. These missing values are predicted using OLS estimates of household income reported in the Appendix Table B3. All monetary values are adjusted for inflation using monthly CPI with 1995 as a base year. Employing enterprises are classified as being foreign if owned or co-owned by foreigners or governmental if owned or co-owned by government and not co-owned by foreigners. To recover the firm's ownership type for missing rounds, the firms are assumed not to change their types.

[29] 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.
[30] Other explanatory variables used in OLS estimation of average wage predictor are second degree age polynomial, geographical identifiers, education, settlement type, and marital status.
[31] Missing total income was constructed based on information available on payments from a primary or additional place of work in the form of money or goods, on any kind of pensions, stipends, alimony, and rental and interest income.

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[32].

Among household-level characteristics included in the analysis are the number of all and only retired adults residing in the dwelling, living space in meters per adult, family ownership of their dwelling and some appliances as well as their access to public utilities (e.g., central heating or water supply). In the case of missing information on the above variables, a gradual transition is assumed[33]. If values are missing for the first or last periods of the participation in the survey, such values are imputed by a response in the closest reported period. 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.

Also, regional time-series data on 32 subdivisions, collected by the Federal State Statistics Service (Goskomstat), are merged with the RLMS, employing regional identifiers. In my analysis, I use information on the regional unemployment rate, regional capacity of formal child-care, number of marriages and divorces in the region adjusted to the total regional population above 16 and ratio of women to men (for 16 plus year olds), proportion of employed in the region, by their degree, real monetary income growth, gross domestic product per capita, average real monthly earnings in the region, percentage of population with income below subsistence level, product per capita amount of investments in capital in the region, and regional real output of the following sectors: services, industry, and agriculture, etc. These additional variables provide for identification of the empirical model and embody some policy instruments.

5.3. Descriptive Statistics Analysis

Tables 5.5a through 5.8d display descriptive statistics for 1995, 2000 and 2004[34] on the variables included in the model for two different samples: a broadly defined sample of all women in the age group from 18 to 35 and the sample restricted to women with fewer than two

[32] 341 women are identified as married but have missing spousal information in some years. In the empirical section, an indicator of missing at least one key spousal variable in a given year is incorporated in estimations.
[33] For instance, if family ownership information is missing for two periods and, in the last period, they reported not having a refrigerator and, in the first period, they reappear, they report on possessing one, then 0 value is assigned to the first missing period and 1 to the second
[34] The choice of years to be presented in the Tables is purely defined by the intent to keep equal time intervals.

children. The tables labeled with letters b, c, and d present comparison between women who decide to conceive a baby in a particular year and those who do not. Table 5.5a shows some noticeable changes in fertility behavior among Russian women. Women of age 18-35 have decreasing numbers of kids starting at 0.95 per woman in 1995 and falling to 0.77 over 9 years with the interval between the births of the first and second children is increasing from 3.46 years in 1995 to 4.68 years in 2004, which is consistent with the previously stated nation-wide statistics. Also, Tables 5.5b-d report a substantial decline in the proportion of women conceiving their first child at age18-20 by 29% from 49% level to 35% during only 5 years since 1995, whereas the proportion of women having their first child between age 26 and 30 rises by 50% during the same period.

Even though, on average, the number of children declines significantly, the fraction of women being married drops only slightly from 0.68 to 0.63[35], while a more sizable 20 percent increase in the proportion of women belonging to the category of never married is observed. However, marriages are more than twice as common among women who are planning to have their first child than among those who choose to postpone their fertility. However, such disparity in marriage rates declines in 2004. Overall, marriage is not perceived to be a necessary condition to have children: only 67-81% of women planning onset of motherhood are married. No significant changes in the total and retired number of adults as well as in dwelling area and ownership take place across nine years. The educational attainment indicators exemplify the overall trend for pursuing more education: the fraction of women for whom a high school diploma is the highest degree drops over nine years and the number of women with some and completed college education increases by 70% and 10%, respectively, during the same time spanAs reported in Table 5.5a, all real income variables exhibit a fall in 2000 relative to the 1995 level, at least partially reflecting the aftermath of the 1998 financial crisis, and show full recovery with sizable growth by 2004 (e.g., about 30% growth in household income and 80% rise in wages since 1995). It is also interesting to note that, even though husbands' real wages follow the same trend as women's wages, the magnitude of their wage growth is substantially smaller – 52%, comparing to 80% for women over nine years. The employment rate among women is fairly stable across years, whereas the work week becomes longer. In particular, from 1995 to 2000, it extends on average by three hours. Among other changes in labor-related

[35] This drop might be mitigated by the more explicit inclusion in the category of married in the later years those who are living together but not registered.

characteristics, which can be attributed to the introduction of a more dynamic market system, are declines in tenure by ten months and in government employment by 26 percent across nine years. Comparison of these employment statistics between women, who make their fertility decision in favor of having a child and those who decide against it, yields evidence that currently employed woman are more likely to decide on having a child, both their first and second child (reported in Tables 5.5b-d). However, in all except for the after crises years, their employment is less intense in terms of work hours, and, for the second birth interval, this difference reaches five hours per week. Mothers-to-be are observed to have greater non-earned income, which is, in almost all years, supplemented by above average wages for women just entering motherhood. In 1995 and 2000, women expecting their second child demonstrate significantly lower earnings potential than their counterparts'.

In rural areas, proportionally larger number of women decide to have a child, but the disparity in frequencies of second conceptions among women residing in rural settlements versus urban are drastically greater. Moreover, women, expecting their second child, live, on average, in less developed communities. One of the distinctive features of transitioning from the centrally planned economy to the market-oriented one is a reduction of publicly provided services and increasing supplementation of them by the private providers. In particular, provision of public nurseries and preschools has experienced a decline in the number of population centers serviced: in 1995, 73% and 96% of women lived in population centers where public nurseries and preschools, respectively, were offered and these numbers fell to 65% and 89%, respectively until 2000. Notice that the provision of public preschool services exhibits some improvement after 2000. The given types of formal child-care are increasingly supplemented by private sector providers, whose coverage rose by 35% for nursery offerings and 52% for preschool services. Surprisingly, the women expecting a child reside in communities with a lower supply of nurseries and preschools, both public and private.

Overall, the summary statistics comparison demonstrates the existence of major differences between different fertility groups as they are captured by the key explanatory variables.

Table 5.5a Sample Statistics (all birth parities) - Individual and Family Characteristics

	1995		2000		2004	
Variables	Mean		Mean		Mean	
Age	26.60	(5.31)	26.02	(5.09)	26.21	(5.10)
Age categories: 18-20	0.16	(0.37)	0.17	(0.38)	0.17	(0.38)
21-25	0.28	(0.45)	0.31	(0.46)	0.30	(0.46)
26-30	0.26	(0.44)	0.28	(0.45)	0.27	(0.45)
31-35	0.30	(0.46)	0.24	(0.43)	0.25	(0.44)
Married	0.68	(0.47)	0.68	(0.47)	0.63	(0.48)
Never married	0.24	(0.43)	0.27	(0.44)	0.29	(0.45)
No. of kids	0.95	(0.93)	0.83	(0.84)	0.77	(0.82)
Age of 1st child	5.33	(5.24)	5.71	(5.18)	6.87	(4.78)
Age of 2nd child	3.70	(5.49)	4.07	(5.31)	5.26	(4.46)
Interval between two births	3.46	(3.42)	4.35	(3.77)	4.68	(3.76)
Retired adults present	0.25	(0.43)	0.21	(0.41)	0.21	(0.41)
Adults	2.65	(1.07)	2.63	(1.13)	2.71	(1.28)
Retired adults	0.32	(0.61)	0.27	(0.57)	0.27	(0.57)
Own dwelling	0.86	(0.35)	0.83	(0.38)	0.83	(0.37)
Living space per adult	13.97	(6.91)	14.33	(7.63)	13.93	(7.38)
Index of wellbeing	6.72	(2.14)	6.65	(2.20)	7.07	(2.16)
Education:						
Student currently	0.12	(0.33)	0.17	(0.38)	0.13	(0.33)
High school diploma	0.35	(0.48)	0.35	(0.48)	0.32	(0.47)
Some college	0.07	(0.25)	0.09	(0.29)	0.12	(0.32)
Technical/medical school	0.36	(0.48)	0.34	(0.48)	0.31	(0.46)
College degree	0.19	(0.39)	0.18	(0.38)	0.21	(0.41)
Employment and income:						
Other income	849	(1649)	608	(836)	1,106	(1716)
Ever worked	0.85	(0.36)	0.83	(0.38)	0.84	(0.36)
Employed	0.63	(0.48)	0.59	(0.49)	0.64	(0.48)
Primary work hours	41.77	(14.64)	44.18	(16.41)	44.17	(16.36)
Earnings	1.45	(1.07)	1.28	(1.24)	2.60	(2.31)
Tenure	53.43	(51.80)	46.35	(47.32)	43.05	(44.98)
Gov. employer	0.75	(0.43)	0.70	(0.46)	0.56	(0.50)
Foreign employer	0.05	(0.21)	0.04	(0.19)	0.04	(0.19)
No. of observations	1,483		1,596		1,973	

Table 5.5b Sample Statistics - Individual and Family Characteristics, 1995

	1st Birth Interval				2nd Birth Interval			
Conception Occurred	Yes		No		Yes		No	
Variables	Mean		Mean		Mean		Mean	
Age	21.68	(3.50)	23.08	(4.67)	25.43	(4.33)	26.68	(4.57)
Age categories: 18-20	0.49	(0.51)	0.38	(0.48)	0.14	(0.36)	0.09	(0.28)
21-25	0.37	(0.49)	0.37	(0.48)	0.38	(0.50)	0.37	(0.48)
26-30	0.12	(0.33)	0.14	(0.35)	0.33	(0.48)	0.30	(0.46)
31-35	0.02	(0.16)	0.11	(0.31)	0.14	(0.36)	0.25	(0.43)
Married	0.78	(0.42)	0.30	(0.46)	0.81	(0.40)	0.79	(0.41)
Never married	0.24	(0.43)	0.66	(0.48)	0.14	(0.36)	0.08	(0.26)
Retired adults present	0.17	(0.38)	0.28	(0.45)	0.62	(0.50)	0.27	(0.44)
Adults	2.95	(0.95)	2.98	(1.11)	3.33	(1.28)	2.56	(1.08)
Retired adults	0.27	(0.63)	0.36	(0.63)	0.95	(0.86)	0.35	(0.64)
Age of the 1st child					3.97	(2.34)	5.08	(3.76)
Own dwelling	0.95	(0.22)	0.88	(0.32)	0.81	(0.40)	0.84	(0.37)
Living space per adult	11.73	(4.56)	12.72	(6.03)	12.15	(4.65)	13.23	(6.59)
Index of wellbeing	6.95	(1.84)	7.07	(2.12)	6.14	(2.39)	6.86	(2.02)
Education:								
Student currently	0.10	(0.30)	0.31	(0.46)	0.05	(0.22)	0.05	(0.21)
High school diploma	0.44	(0.50)	0.34	(0.47)	0.33	(0.48)	0.29	(0.45)
Some college	0.05	(0.22)	0.16	(0.36)	0.10	(0.30)	0.03	(0.17)
Technical/medical school	0.34	(0.48)	0.29	(0.45)	0.33	(0.48)	0.43	(0.50)
College degree	0.15	(0.36)	0.17	(0.38)	0.19	(0.40)	0.22	(0.41)
Employment and income:								
Other income	896	(906)	992	(1993)	909	(1149)	800	(1320)
Ever worked	0.78	(0.42)	0.72	(0.45)	0.86	(0.36)	0.89	(0.31)
Employed	0.68	(0.47)	0.51	(0.50)	0.67	(0.48)	0.68	(0.47)
Primary work hours	41.11	(16.12)	42.76	(15.33)	38.57	(11.34)	41.57	(14.10)
Earnings	1.75	(1.56)	1.56	(1.14)	0.80	(0.42)	1.43	(1.06)
Tenure	26.83	(22.77)	34.01	(40.50)	64.74	(45.39)	50.80	(45.39)
Gov. employer	0.61	(0.50)	0.69	(0.46)	0.79	(0.43)	0.79	(0.40)
Foreign employer	0.18	(0.39)	0.06	(0.23)	0.00	(0.00)	0.05	(0.21)
No. of observations	41		460		21		517	

Table 5.6a Sample Statistics (all parities) - Community Characteristics

	1995		2000		2004	
Variables	Mean		Mean		Mean	
Region:						
Northern and North Werstern	0.08	(0.27)	0.08	(0.27)	0.07	(0.26)
Cental and Central Black-Earth	0.16	(0.37)	0.17	(0.38)	0.16	(0.37)
Volga-Vyastski and Volga Basin	0.16	(0.37)	0.18	(0.38)	0.16	(0.37)
North Caucasian	0.15	(0.36)	0.15	(0.36)	0.14	(0.34)
Ural	0.15	(0.35)	0.15	(0.36)	0.15	(0.36)
Western Siberian	0.11	(0.31)	0.11	(0.31)	0.08	(0.28)
Eastern Siberian and Far Eastern	0.10	(0.30)	0.11	(0.32)	0.10	(0.31)
Settlement of urban type	0.06	(0.23)	0.07	(0.25)	0.06	(0.23)
Rural	0.22	(0.41)	0.26	(0.44)	0.24	(0.43)
Index of wellbeing	7.38	(2.24)	7.31	(2.29)	7.55	(2.28)
Public nursery	0.73	(0.44)	0.65	(0.48)	0.64	(0.48)
Private nursery	0.17	(0.37)	0.22	(0.41)	0.23	(0.42)
Public preschool	0.96	(0.20)	0.89	(0.31)	0.93	(0.26)
Private preschool	0.21	(0.41)	0.27	(0.45)	0.32	(0.47)
Public incomplete sec. school	0.64	(0.48)	0.60	(0.49)	0.46	(0.50)
Public complete sec. school	0.95	(0.21)	0.93	(0.25)	0.93	(0.25)
Private schools	0.37	(0.48)	0.34	(0.47)	0.33	(0.47)
Public high school	0.61	(0.49)	0.58	(0.49)	0.62	(0.49)
Private high school	0.23	(0.42)	0.26	(0.44)	0.30	(0.46)
Library	0.97	(0.17)	0.95	(0.21)	0.96	(0.20)
Local daily newspaper	0.90	(0.31)	0.91	(0.28)	0.93	(0.26)
Regional daily newspaper	0.67	(0.47)	0.77	(0.42)	0.70	(0.46)
Employment agency	0.80	(0.40)	0.77	(0.42)	0.77	(0.42)
training services	0.94	(0.23)	0.96	(0.20)	0.96	(0.20)

Table 5.6b Sample Statistics - Community Characteristics, 1995

	1st Birth Interval				2nd Birth Interval			
Conception Occurred	Yes		No		Yes		No	
Variables	Mean		Mean		Mean		Mean	
Region:								
Northern and North Werstern	0.12	(0.33)	0.06	(0.24)	0.10	(0.30)	0.09	(0.28)
Cental and Central Black-Earth	0.17	(0.38)	0.18	(0.39)	0.10	(0.30)	0.17	(0.37)
Volga-Vyastski and Volga Basin	0.15	(0.36)	0.14	(0.35)	0.24	(0.44)	0.17	(0.37)
North Caucasian	0.17	(0.38)	0.13	(0.34)	0.29	(0.46)	0.12	(0.33)
Ural	0.10	(0.30)	0.14	(0.35)	0.14	(0.36)	0.15	(0.36)
Western Siberian	0.10	(0.30)	0.09	(0.29)	0.10	(0.30)	0.12	(0.32)
Eastern Siberian and Far Eastern	0.12	(0.33)	0.12	(0.32)	0.00	(0.00)	0.09	(0.29)
Settlement of urban type	0.02	(0.16)	0.04	(0.19)	0.14	(0.36)	0.05	(0.22)
Rural	0.10	(0.30)	0.15	(0.36)	0.38	(0.50)	0.17	(0.38)
Index of wellbeing	7.67	(1.98)	7.72	(2.22)	6.83	(2.46)	7.55	(2.12)
Public nursery	0.79	(0.41)	0.78	(0.41)	0.67	(0.48)	0.77	(0.42)
Private nursery	0.13	(0.34)	0.21	(0.41)	0.14	(0.36)	0.17	(0.37)
Public preschool	0.97	(0.16)	0.97	(0.18)	0.90	(0.30)	0.96	(0.20)
Private preschool	0.21	(0.41)	0.29	(0.46)	0.19	(0.40)	0.20	(0.40)
Public incomplete sec. school	0.77	(0.43)	0.69	(0.46)	0.76	(0.44)	0.66	(0.48)
Public complete sec. school	0.97	(0.16)	0.96	(0.19)	0.86	(0.36)	0.95	(0.21)
Private schools	0.44	(0.50)	0.46	(0.50)	0.14	(0.36)	0.40	(0.49)
Public high school	0.67	(0.48)	0.70	(0.46)	0.38	(0.50)	0.64	(0.48)
Private high school	0.21	(0.41)	0.28	(0.45)	0.14	(0.36)	0.25	(0.43)
Library	1.00	(0.00)	0.98	(0.14)	0.95	(0.22)	0.97	(0.16)
Local daily newspaper	0.95	(0.22)	0.93	(0.26)	0.81	(0.40)	0.92	(0.27)
Regional daily newspaper	0.74	(0.44)	0.71	(0.46)	0.62	(0.50)	0.72	(0.45)
Employment agency	0.90	(0.31)	0.85	(0.36)	0.71	(0.46)	0.84	(0.37)
training services	0.97	(0.17)	0.96	(0.19)	0.87	(0.35)	0.96	(0.19)

Table 5.8a Sample Statistics (all parities) - Husband's characteristics

	1995		2000		2004	
Variables	Mean		Mean		Mean	
Age	30.55	(5.93)	30.09	(5.78)	30.59	(5.84)
Student currently	0.05	(0.21)	0.04	(0.21)	0.03	(0.17)
High school diploma	0.50	(0.50)	0.51	(0.50)	0.47	(0.50)
Some college	0.04	(0.20)	0.04	(0.19)	0.06	(0.24)
Technical/medical school	0.21	(0.41)	0.22	(0.41)	0.20	(0.40)
College degree	0.22	(0.41)	0.18	(0.39)	0.21	(0.41)
Employed	0.78	(0.41)	0.74	(0.44)	0.80	(0.40)
Primary work hours	45.93	(14.68)	48.41	(15.95)	49.14	(16.21)
Earnings	2.68	(2.04)	2.41	(3.46)	4.08	(4.00)
Gov. employer	0.66	(0.47)	0.58	(0.49)	0.48	(0.50)
Foreign employer	0.06	(0.23)	0.06	(0.24)	0.05	(0.22)
Finding a new job like current:						
certain	0.39	(0.49)	0.43	(0.50)	0.50	(0.50)
both yes and no	0.16	(0.37)	0.20	(0.40)	0.20	(0.40)
absolutely not	0.45	(0.50)	0.37	(0.48)	0.30	(0.46)
Concern about job loss:						
very concerned	0.31	(0.46)	0.29	(0.45)	0.20	(0.40)
both yes and no	0.37	(0.48)	0.37	(0.48)	0.42	(0.49)
not concerned	0.32	(0.47)	0.34	(0.48)	0.38	(0.49)
No. of observations	943		995		1,140	

6. Results

This section presents and evaluates estimates of the nine-equation system modeled jointly with controls for community and individual heterogeneity. This method allows for a correction for the potential endogeneity of the previous or contemporaneous life-cycle fertility, educational, marital, and employment choices as well as for individual and community specific permanent effects. The distributions of the unobserved individual- and community-level factors are estimated jointly with the rest of the model's parameters by using flexible semi-parametric discrete factor method. Their underlying distribution is approximated using discrete distribution with four points of support for community heterogeneity and nine points for individual heterogeneity that adds 121 parameters and improves the log-likelihood function values by 15,612 (see Table 6.1). For such increase in the log-likelihood values, the Likelihood-Ratio test yields p-value of basically zero, indicating strong significance of the heterogeneity parameters. The estimated probabilities of each point of support are presented in Table 6.1. Two additional specification tests are performed to asses 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 equations, in which their insignificance can be rejected with zero p-value (Table 6.2).

Table 6.1	Value of the Loglikelihood Function	No. of Parameters
Heterogeneity corrected model	-84205.60	599
Simple Logit model	-92011.67	478
Gain from heterogeneity correction	15612.14	121
Estimated heterogeneity distributions:		
Community-Level Probability Weights		
point 1	0.248	
point 2	0.195	
point 3	0.434	
point 4	0.124	
Individual-Level Probability Weights		
point 1	0.114	
point 2	0.162	
point 3	0.117	
point 4	0.126	
point 5	0.036	
point 6	0.130	
point 7	0.126	
point 8	0.079	
point 9	0.108	

Table 6.2 Results of the Likelihood Ratio Tests

Null hypothesis:	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 6.4-5 present estimated parameters of annual first and second conception outcomes, respectively, following two alternative techniques. The first column in both tables contains estimates of the preferred, random-effects, model with correction for endogeneity and heterogeneity, whereas the second one shows estimates of simple logit model, relying on assumption of independence. Inspection of the estimates 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 precisely estimated 18-20 age coefficient as a normalization factor. Ignoring endogeneity and heterogeneity problems leads to an upward bias of education and downward bias of marriage effects on the onset of fertility. Relative to incomplete high school education, college degree has the most sizable and significant pronatalist impact in both procedures, but its magnitude is estimated to be almost 50% larger using independence assumption. As expected, being a student has a discouraging effect on entering motherhood, which gains its significance and becomes twice as powerful in the preferred model. Tenure has a positive and significant effect on annual probability of having a first child and is stable across specifications. According to the preferred model, employment and non-earned income increase annual conception probability, whereas hours of work and earnings have the opposite impact on fertility. However, these estimates have relatively large standard errors and are not stable across two models. Also after controlling for community heterogeneity, regional child-care capacity, fertility rate and average earned income lose their significance and magnitude.

Unlike in the first conception event, women with incomplete secondary education are most likely to conceive a second child, followed by women with some college education. Mothers with high school or technical degrees have the lowest yearly probability of conception. The logit specification underestimates the negative impact of acquiring education with the effect of college degree being twice as small. The simple model also exhibits a downward bias in the

impact of marriage.[36] Controlling for community specific permanent effects leads to a gain in significance for such regional factors as capacity of preschool facilities, inflation, and average earnings. In the preferred second conception model as compared to the first one, non-labor income and employment status estimates switch their signs to negative, but remain insignificant. Also, women married to more educated and employed husbands are more likely to expect a second child. The above comparison of the findings coming from two alternative specifications suggests that ignoring of the endogeneity of the fertility- related life-cycle choices as well as permanent heterogeneity biases the simple logit estimates. The estimates for the remaining seven equations can be found in the Appendix.

Table 6.3 Estimated coefficients for the first conception equation

	Random effects model		Simple logit model	
Variables	Coef.	Std. Err.	Coef.	Std. Err.
18-20	1.599	(0.501)	1.482	(0.480)
21-25	1.366	(0.461)	1.284	(0.443)
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	-0.041	(0.030)	-0.038	(0.037)
Own dwelling	0.212	(0.137)	0.229	(0.140)
Husband's 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)
Slavic	0.269	(0.181)	0.297	(0.201)
Urban	0.018	(0.197)	-0.037	(0.218)
Urban type	0.002	(0.271)	-0.159	(0.286)

[36] The coefficients of the annual probability of the second conception can be compared directly since in the case of their normalization by asset index, an accurately estimated parameter, the coefficients relative size would remain practically unchanged.

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)
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)
Uneployment 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)
Income below min	-0.006	(0.008)	-0.003	(0.008)
Technical grads empl	0.104	(0.023)	0.097	(0.025)
College grads empl	0.055	(0.020)	0.051	(0.020)
Hs grads empl	0.077	(0.020)	0.075	(0.021)
College grads	-0.066	(0.033)	-0.075	(0.029)
Tech. grads	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				
Community: point 1	0.000	-- normalized		
point 2	0.202	(0.195)		
point 3	-0.278	(0.135)		
point 4	-0.840	(0.289)		
Individual:point 1	0.000	-- normalized		
point 2	0.252	(0.267)		
point 3	-0.147	(0.272)		
point 4	-1.695	(0.308)		
point 5	-0.205	(0.360)		
point 6	-0.753	(0.263)		
point 7	-1.237	(0.290)		
point 8	-1.152	(0.391)		
point 9	-2.338	(0.358)		

Table 6.4 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	-0.087	(0.036)	-0.084	(0.033)
Kids (<3 yrs old)	-1.357	(0.443)	-1.345	(0.444)
Kids (3 and 8 yrs 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)
Own dwelling	-0.074	(0.157)	-0.082	(0.148)
Husband's 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)
Slavic	-0.440	(0.196)	-0.358	(0.243)
Community variables:				
Urban	-0.029	(0.220)	-0.082	(0.188)
Urban type	0.078	(0.308)	-0.114	(0.251)
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)
High school	-0.395	(0.362)	-0.423	(0.321)
Library	0.306	(0.367)	0.302	(0.344)
Regional:				
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 agr.sector	-0.334	(0.306)	-0.321	(0.329)
GDP in ind.sector	-0.014	(0.004)	-0.016	(0.005)
Uneployment 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 empl	0.065	(0.028)	0.063	(0.033)
College grads empl	0.012	(0.021)	0.011	(0.023)
Hs grads empl	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				
Community: point 1	0.000	-- normalized		
point 2	0.075	(0.241)		

point 3	-0.369	(0.172)
point 4	-0.029	(0.269)
Individual:point 1	0.000	-- normalized
point 2	0.315	(0.339)
point 3	0.544	(0.285)
point 4	-0.627	(0.378)
point 5	-0.520	(0.449)
point 6	-0.440	(0.275)
point 7	-0.100	(0.312)
point 8	-0.242	(0.406)
point 9	-0.899	(0.472)

7. Simulation Results

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

To answer these concerns, the life-cycle simulations are performed, by tracing 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 a 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 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. Such decision regarding her educational pathway is guided by the prevalence of the respective educational pursuit. 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, husband's age is generated by a random draw from a normal distribution with mean and variance of the observed sample of husbands 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. Univariate simulations are performed by assigning one of the exogenous or

endogenous covariates a particular value with subsequent simulation of her life-cycle choices. Table 7.1 assesses performance of the life-cycle simulation to fit the observed process. Taking into account the standard deviation of the sample statistics, the simulated statistics is very close to the actual one.

Table 7.1 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

The following figures 7.1-2 compare the life-time effects of college, high school, and incomplete high school degrees and their attainment on the likelihood of the first and second conception at different ages. High school graduates are 54% and 16% more likely to start motherhood before their 20's than college graduates and high school dropouts, respectively. By early 20's, difference between high school graduates and dropouts almost closes and college graduates take a lead in occurrence of the first births. Mothers with high school diplomas are also associated with the highest probability of having a second birth before they reach age 25 with the 60% lead over college graduates at ages 14-20 (15% over high school dropouts) that goes down to 20% at ages 21-25. The difference almost disappears when women reach their late 20's. Overall, mothers with high school diplomas have a second child 20% more frequently.

Figure 7.1

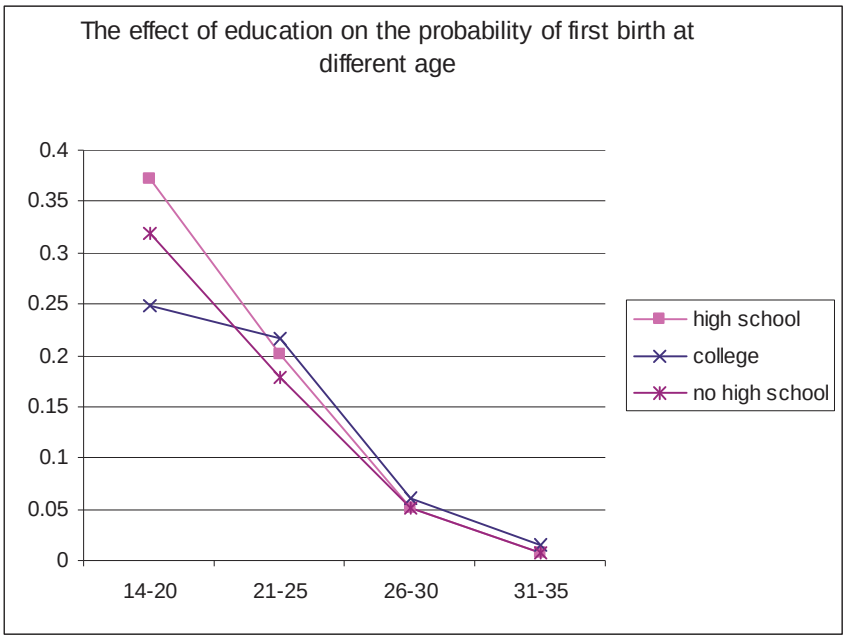
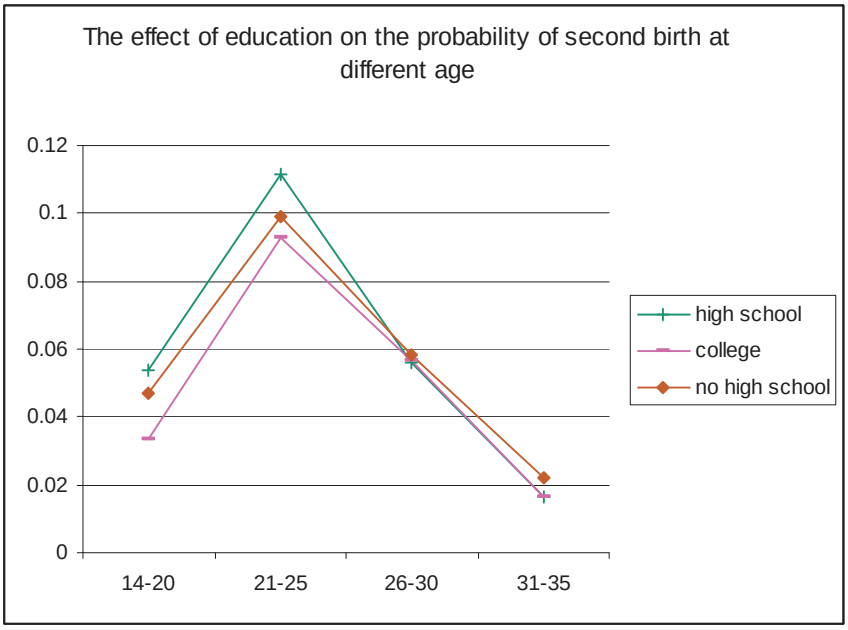


Figure 7.2



Also, comparison of the simulated frequencies of the conception events by age categories across two models is presented for the survey years in figures 7.3-4. Figure 7.3 demonstrates that logit model underestimates the long-term effect of incomplete high school degree on likelihood of having a first child, especially before early 20's. Surprisingly, the effect of college degree is very similar across two models except for teen years. According to figure 7.4, the simulated

effects of college degree on the likelihood of the second conception are significantly upward biased particularly for women in their 20's. Similar conclusions are applicable to mothers with incomplete high school degrees.

Figure 7.3

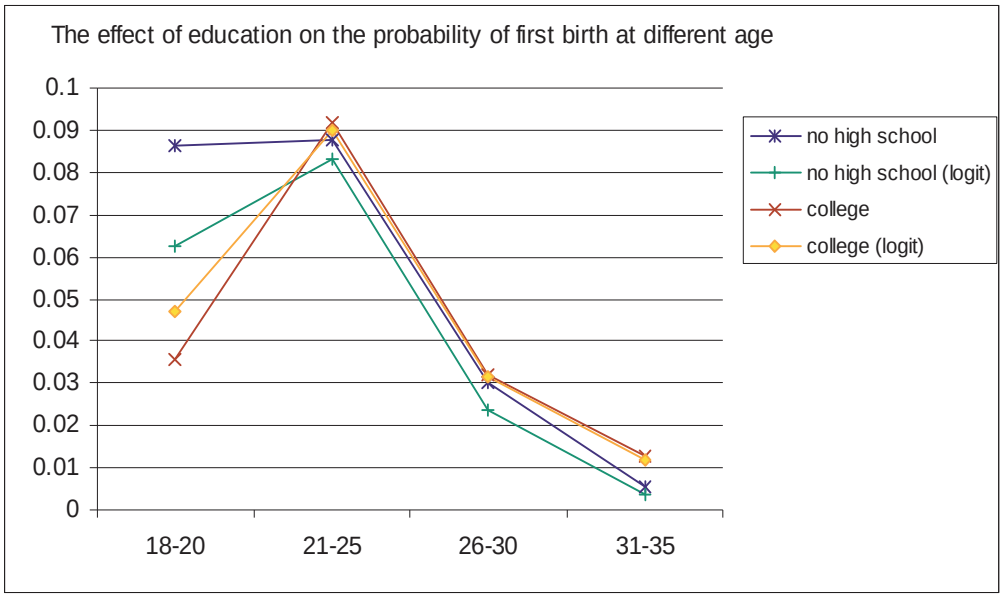


Figure 7.4

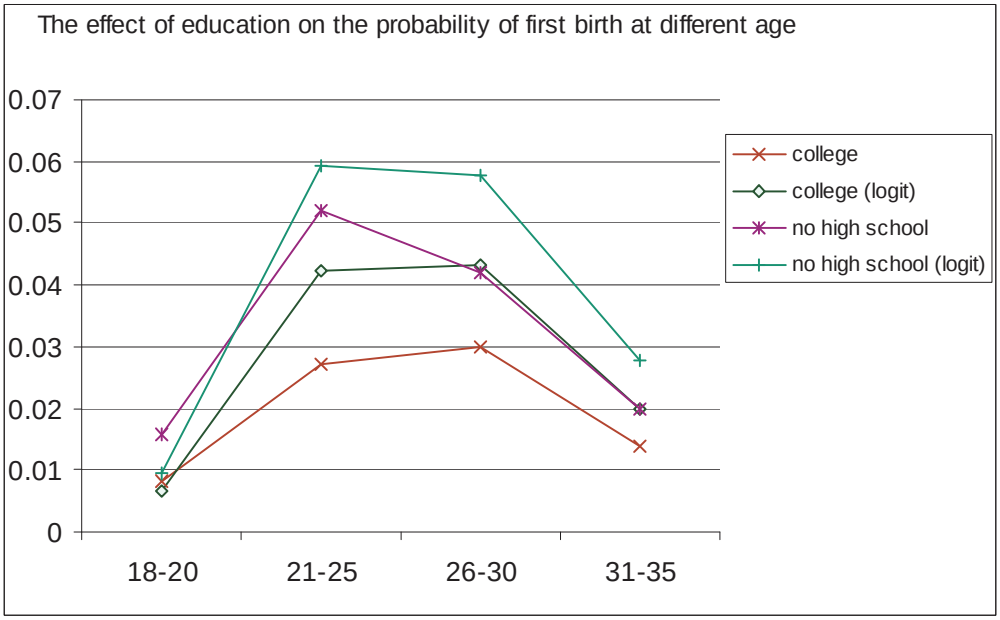


Figure 7.5 captures the effect of marriage on first birth probability. Overall, married women are more likely to have a first child than never married women; in particular, 10 times

more likely in their teens and 7 times more likely in early 20's. This disparity is falling to 5 times when women reach their 30's. Marital status also has a substantial pronatalist impact on the second birth, being the strongest for women in their 20's (see Figure 7.6). The simulated logit probabilities significantly overestimate the impact of marriage status on decision to have a second child and underestimates its impact on onset of motherhood.

Figure 7.5

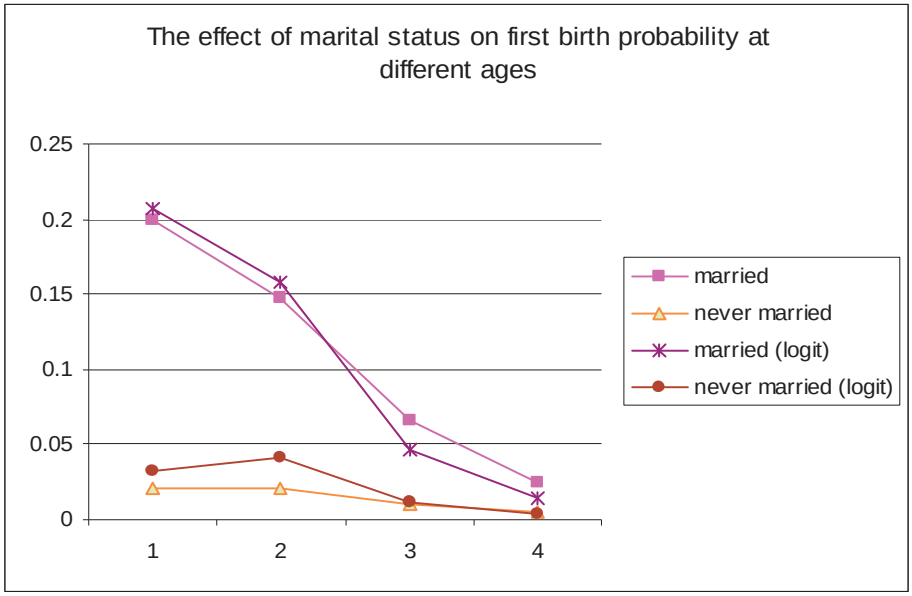
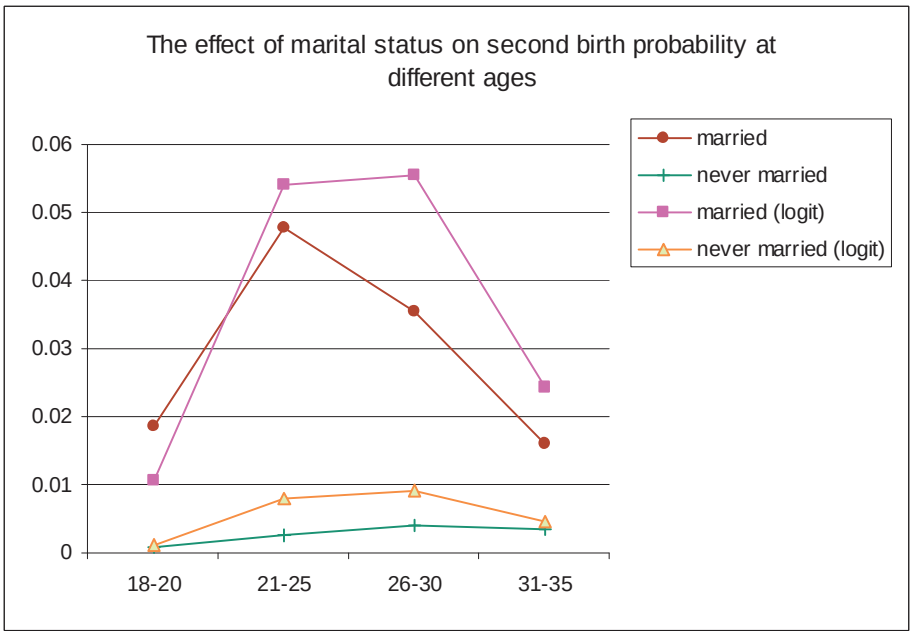


Figure 7.6



Economic environment of the 90'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 coming back up to 84% level in 1998. Also, real wages fluctuated significantly, experiencing 50% fall in 1998 and more than doubling by 2002. To isolate the effect of these economic changes, I perform simulation of six economic environments defined by different inflation rates and regional earned income changes.

Figure 7.7

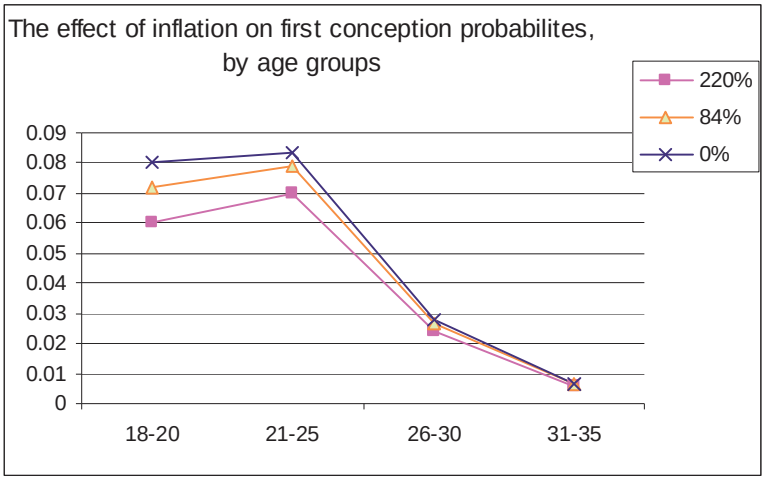
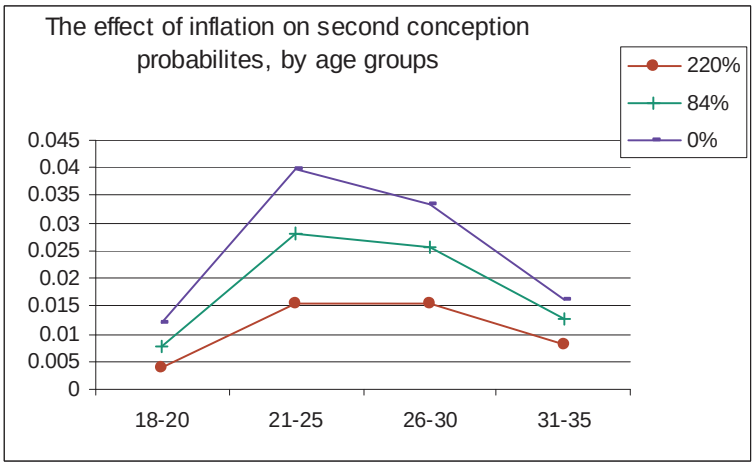


Figure 7.8

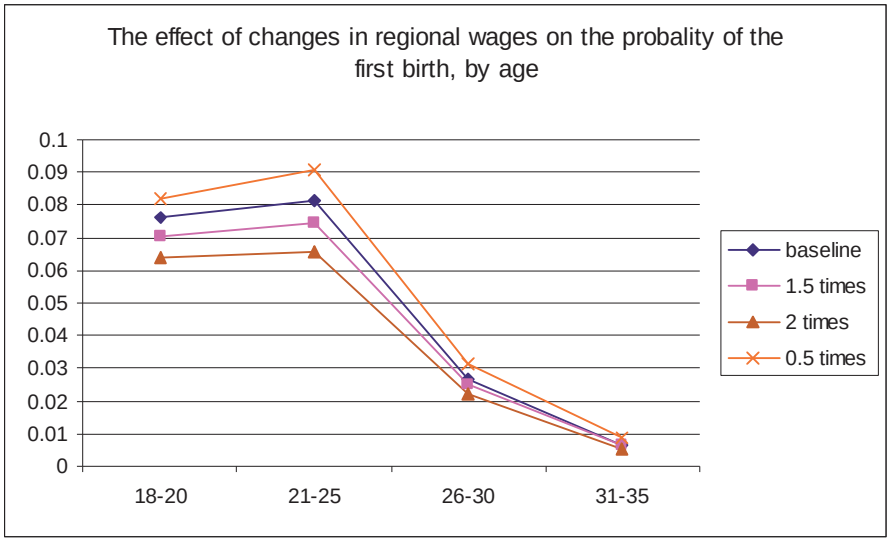


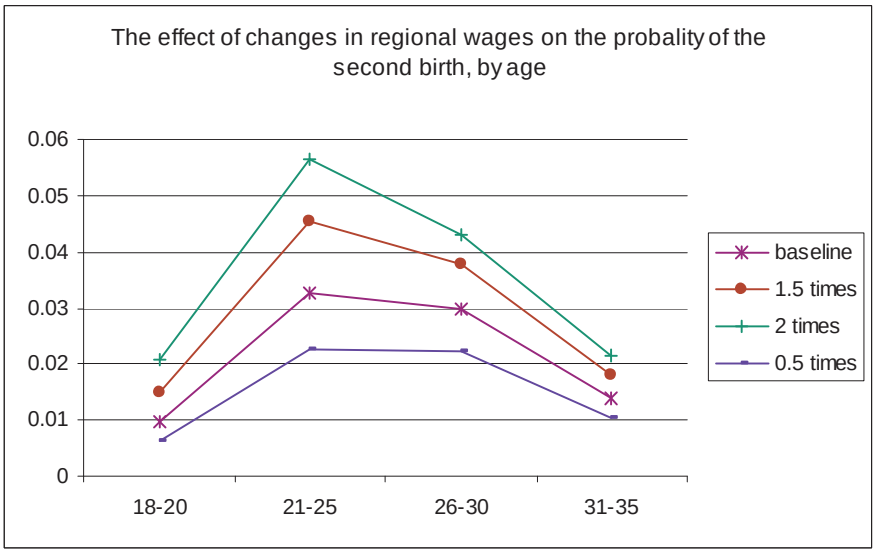
	Inflation (relative to the previous year)							
Variable	baseline		220%		84%		0%	
Annual probabilities								
1st conception	0.114	(0.026)	0.093	(0.029)	0.109	(0.026)	0.121	(0.028)
2nd conception	0.042	(0.017)	0.021	(0.011)	0.038	(0.015)	0.054	(0.022)
student	0.190	(0.006)	0.275	(0.020)	0.207	(0.007)	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)
Duration in years								
schooling	0.521	(0.019)	0.789	(0.064)	0.576	(0.022)	0.468	(0.021)
marriage	1.740	(0.054)	1.528	(0.083)	1.694	(0.053)	1.772	(0.065)
tenure	1.776	(0.127)	1.327	(0.140)	1.671	(0.125)	1.877	(0.125)
employment	1.626	(0.095)	1.339	(0.111)	1.560	(0.096)	1.674	(0.097)

Note: Standard deviations are given in parentheses

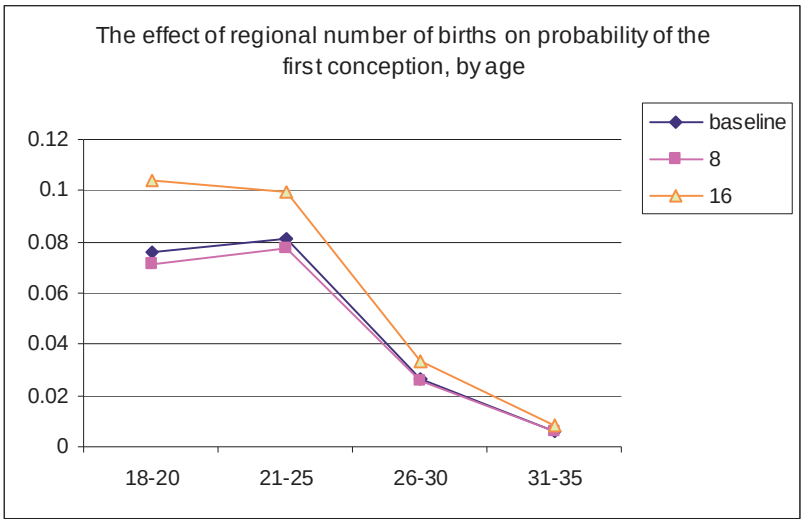
	Average regional wage changes							
Variable	baseline		1.5 times incease		2 times incease		0.5 time increase	
Annual probabilities								
1st conception	0.114	(0.026)	0.105	(0.026)	0.092	(0.027)	0.133	(0.032)
2nd conception	0.042	(0.017)	0.064	(0.025)	0.089	(0.036)	0.027	(0.013)
student	0.190	(0.006)	0.168	(0.013)	0.148	(0.020)	0.216	(0.013)
employment	0.518	(0.028)	0.487	(0.032)	0.456	(0.039)	0.547	(0.030)
marriage	0.561	(0.009)	0.583	(0.014)	0.595	(0.024)	0.529	(0.017)
Duration in years								
schooling	0.521	(0.019)	0.457	(0.034)	0.403	(0.053)	0.593	(0.036)
marriage	1.740	(0.054)	1.754	(0.070)	1.744	(0.096)	1.692	(0.065)
tenure	1.776	(0.127)	2.159	(0.173)	1.988	(0.208)	2.510	(0.173)
employment	1.626	(0.095)	1.504	(0.105)	1.387	(0.125)	1.738	(0.099)

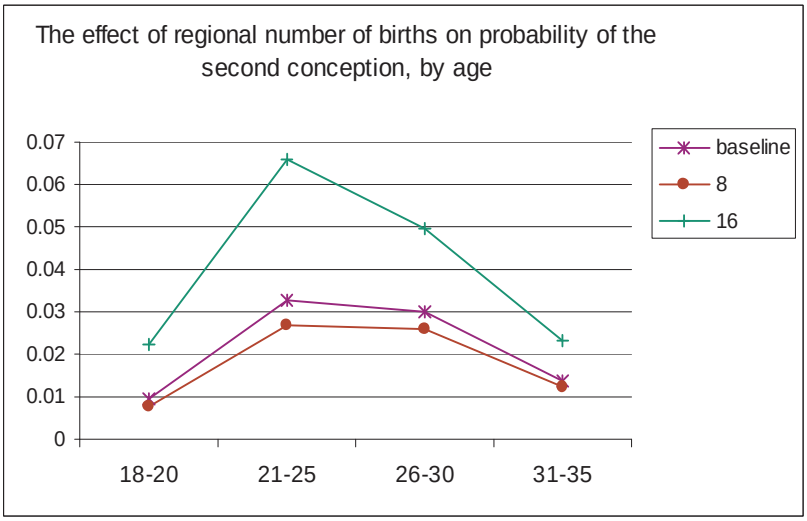
Note: Standard deviations are given in parentheses


The effect of changes in regional wages on the probality of the first birth, by age
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
18-20
21-25
26-30
31-35
baseline
1.5 times
2 times
0.5 times


The effect of changes in regional wages on the probality of the second birth, by age
0.06
0.05
0.04
0.03
0.02
0.01
0
18-20
21-25
26-30
31-35
baseline
1.5 times
2 times
0.5 times

The following figures graph the effect of low and high fertility environments on individual fertility choices.





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Appendix A: Attrition Analysis

Table 5.3 provides information regarding reasons for leaving the study (missing at least three consecutive rounds). This information is collected for the censored individuals with some household members still participating in the survey, totaling 495 women out of 1825 right censored observations. 75 (or15.15%) of them continue to reside in the sampled dwellings, 73.33 percent have moved out to a new dwelling, 5.66 percent has formed a new sub-household in the original dwelling units and 5 women died.

Table 5.3 Summary of Provided Reasons for Leaving the Survey
(Right Censored Observations)

	1st and 2nd birth parities	
	Freq.	Percent
Reasons:		
Present	75	15.15
Changed Address	363	73.33
Sub HH	28	5.66
Died	5	1.01
Other	18	3.64
Don't Know	6	1.21
Total	495	100

Women leaving this study for reasons related to the fertility choices, which are not controlled for in the empirical model, might bias estimation results. To address such attrition-related concerns, I first analyze one subgroup of women who are known to have moved out from their original dwelling. I test whether changes in their marital or educational statuses are sufficient explanations for their relocation. If this hypothesis proves to be true, then attrition of this segment of the censored observations will not bias my estimates since educational, marital, and fertility choices are included in the model. The attrition bias due to the remaining right-censored observations is addressed in the empirical estimation by inclusion of the attrition equation, modeling the decision to exit the RLMS.

Table A3 displays test results of the hypothesis that women move out from their original household either to pursue advanced education or because of changes in their marital status. Proportions of women age 18 to 35, who have either gotten divorced, married, or become a student between two consecutive rounds, are computed for two samples. The first sample contains only women present in two consecutive surveys, and the second one also includes women leaving the survey in the second round for any reasons. When calculating the total proportion of the women changing their marital or educational status based on the latter sample, women who have moved out from their original dwelling are assumed to have done so for one of the tested reasons. Therefore, they are included in the total number of women who have gotten divorced, married, or become a student between two consecutive rounds. According to the table, the total proportions of women making these decisions are similar for the two samples for the same years; hence, one can conclude that the hypothesis holds true.

Table A3 Attrition Analysis for Women of 18-35 Years Old before the Birth of their Second Child

	Women present in two consecutive survey rounds					Extended sample (inc. right-censored obs. in second round)		
Year*	N	Got divorced	Got married	Became a student	Total	Total**	N	Address changes
1994	673	0.040	0.058	0.003	0.101	0.098	1014	0.030
1995	678	0.032	0.056	0.012	0.100	0.107	940	0.031
1996	624	0.040	0.099	0.010	0.149	0.145	970	0.044
1998	719	0.061	0.094	0.014	0.169	0.163	1027	0.035
2000	956	0.036	0.066	0.004	0.106	0.122	1173	0.034
2001	1137	0.034	0.056	0.011	0.102	0.111	1387	0.027
2002	1216	0.033	0.062	0.011	0.105	0.116	1454	0.027
Total	6003						7965	

*Last two rounds are not included since the censoring rule is different for them, which leads to overestimation of the right-censored sample size.
** In the computation of the total proportions, women who have changed their addresses are assumed to do so because of the changes in their marital or educational states.

Appendix B: Imputation of work-related variables and household income

Table B1 shows OLS estimates used for imputation of usual hours of work for women and men based on work hours for the last 30 days. The sample used for this estimation is limited to women aged 18-35, who work between 5 and 100 hours per week. Usual hours of work information is not recorded for 1994 (Round V), so the sample excludes observations from 1994. The following table also reports similar estimates on a sample of 18-60 year old men working from 5 to 100 hours a week.

Table B1 reports OLS estimates used for predictions of missing real average wages for women and men. Both regressions are estimated for years starting form 1998 that is dictated by unavailability of average wages data prior to 1998. Extreme outliers are excluded form estimations.

Table B1. OLS Estimates for Usual Hours

	Women (18-35 year olds)		Men (18-60 year olds)	
	Coefficient	t-statistics	Coefficient	t-statistics
Last month work hours	0.480	37.42	0.348	54.23
Year:				
1995	0.234	0.4	0.091	0.31
1996	-0.361	-0.63	-	-
1998	-	-	0.374	1.21
2000	1.039	1.82	0.913	2.93
2001	1.466	2.57	1.635	5.47
2002	0.770	1.44	1.070	3.63
2003	1.129	2.11	1.060	3.62
2004	1.516	2.94	1.402	4.96
2005	2.075	3.99	1.228	4.37
Age	0.620	1.92	0.068	1.43
Age2	-0.013	-2.3	-0.001	-2.32
Northern and North Werstern	1.365	2.25	2.523	7.32
Cental and Central Black-Earth	-0.315	-0.71	-0.028	-0.11
Volga-Vyastski and Volga Basin	-0.837	-1.84	-0.578	-2.23
North Caucasian	-0.665	-1.31	1.000	3.41
Ural	-0.116	-0.25	-0.571	-2.24
Western Siberian	-0.699	-1.34	0.805	2.61
Eastern Siberian and Far Eastern	-0.208	-0.38	0.574	1.86
Settlement of urban type	-1.491	-2.91	-1.066	-3.11
Rural	-4.099	-12.05	-2.348	-13.03
Married	-0.416	-1.58	1.073	5.33
High school diploma	-0.288	-0.28	-0.223	-0.71
Technical/medical school	-2.008	-1.98	-0.194	-0.58

(Table B1. OLS Estimates for Usual Hours, continued)

Some college	-2.711	-2.43	-0.122	-0.23
College degree	-5.632	-5.54	-1.603	-4.84
Constant	20.248	4.54	28.537	30.6
No. of observations	7178		16483	
R-squared	0.29		0.23	

Table B2 reports OLS estimates used for predictions of missing real average wages for women and men. Both regressions are estimated for years starting form 1998 that is dictated by unavailability of average wages data prior to 1998. Extreme outliers are excluded from the estimations.

Table B2. OLS Estimates for Real Average Wages

	Women (18-35 year olds)		Men (18-60 year olds)	
	Coefficient	t-statistics	Coefficient	t-statistics
Last month real wages	0.603	45.15	0.603	66.08
Year:				
1998	0.072	2.46	-	-
2000	-	-	-0.076	-3.83
2001	0.104	4.02	-0.020	-1.01
2002	0.197	7.76	0.063	3.29
2003	0.234	9.52	0.118	6.14
2004	0.295	11.84	0.168	8.73
2005	0.327	13.15	0.188	9.85
Age	0.014	0.81	0.009	3.02
Age2	0.000	-0.54	0.000	-3.81
Northern and North Werstern	0.019	0.64	0.110	5.22
Cental and Central Black-Earth	-0.176	-7.58	-0.159	-12.43
Volga-Vyastski and Volga Basin	-0.296	-11.99	-0.257	-18.09
North Caucasian	-0.237	-8.28	-0.224	-13.29
Ural	-0.217	-8.85	-0.140	-11.03
Western Siberian	-0.170	-5.64	-0.148	-7.88
Eastern Siberian and Far Eastern	-0.141	-5.3	-0.034	-1.98
Settlement of urban type	-0.056	-2.36	-0.076	-4.24
Rural	-0.184	-9.31	-0.262	-17.79
Married	-0.006	-0.47	0.086	7.19
High school diploma	0.014	0.24	0.074	2.97
Technical/medical school	0.074	1.33	0.096	3.72
Some college	0.072	1.22	0.064	2.04
College degree	0.163	2.9	0.160	6.22
Constant	1.955	8.3	2.278	30.07
No. of observations	5409		11580	
R-squared	0.70		0.71	

Table B3. OLS Estimates for Household Income – Women (18-35 year olds)

Year:	Coefficient	t-statistics
1994	0.196	5.7
1995	-0.009	-0.24
1996	-	-
1998	-0.457	-12.64
2000	-0.140	-4.06
2001	0.031	0.96
2002	0.197	6.13
2003	0.278	8.71
2004	0.438	13.97
2005	0.545	17.37
Age	0.014	0.9
Age2	0.000	-0.84
Northern and North Werstern	-0.094	-3.05
Cental and Central Black-Earth	-0.392	-16.57
Volga-Vyastski and Volga Basin	-0.628	-25.99
North Caucasian	-0.376	-13.19
Ural	-0.439	-18.66
Western Siberian	-0.442	-14.26
Eastern Siberian and Far Eastern	-0.395	-13.92
Settlement of urban type	-0.107	-3.36
Rural	-0.395	-17.89
Married	0.129	7.02
High school diploma	0.209	5.5
Technical/medical school	0.376	9.83
Some college	0.486	11.9
College degree	0.588	14.79
Own dwelling	0.074	3.79
No. of female adults	0.191	13.87
No. of male adults	0.309	23.36
No. of retired female adults	0.122	7.92
No. of retired male adults	0.276	12.02
Own washer	0.152	7.89
Central heating	0.100	3.92
Central cold water	0.132	5.17
Central hot water	0.186	9.35
Living space per adult	0.005	4.41
Constant	5.158	24.99
No. of observations	15515	
R-squared	0.34	