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WHAT ACCOUNTS FOR THE EMERGENCE OF MALTHUSIAN FERTILITY IN TRANSITION ECONOMIES? *

MAJA B. MICEVSKA

Center for Development Research

University of Bonn

AND

PAUL J. ZAK

Claremont Graduate University

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* **Correspondence to:** Maja Micevska, Center for Development Research, University of Bonn, Walter-Flex-Str. 3, 53113 Bonn, Germany or micevska@uni-bonn.de.

Abstract

The transition to market-oriented economies in Central and Eastern Europe and the former Soviet Union in the 1990s, like the Great Depression in the U.S. and Germany in the 1930s, generated sharp declines in real incomes and a corresponding drop in fertility. This is contrary to the robust negative relationship between income and fertility that has been extensively documented. This paper presents a theoretical model that explains the positive relationship between fertility and income. The model predicts that: *i)* the perceived level of subsistence consumption fundamentally determines whether fertility and income are positively or negatively related; *ii)* once incomes decline below a threshold, declining labor income causes fertility to fall; and *iii)* rising income inequality has a negative impact on fertility rates. Empirical tests using both aggregate and microeconomic data provide strong support for the predictions of the model. Our empirics predict that the perceived subsistence level is a statistically significant determinant of fertility and that the average country in our sample will remain in a Mathusian fertility regime for twenty more years.

Keywords: Fertility, Subsistence Consumption, Transition.

JEL Classification: **J13** Fertility**; P20** Transitional Economies; **I31** Basic Needs.

1 INTRODUCTION

The link between birth rates and economic conditions has intrigued economists since the beginning of systematic economic analysis. Malthus contended that fertility would rise as incomes increase and vice versa, influencing the predictions of nineteenth-century economists. Counter to Malthus' prediction, during the past 150 years fertility generally fell rather than rose as incomes grew. Empirical evidence on the inverse relationship between fertility and income per capita has been extensively documented in the literature (e.g., Tamura, 1988; Barro, 1991; Feng, Kugler & Zak, 2000). Much of the recent literature on fertility and economic growth has modeled the transition *from* the "Malthusian" stage where there is a positive relationship between income and population growth, *to* the "modern" stage characterized by an inverse relationship between income and fertility (e.g., Becker et al., 1990; Kremer, 1993; Galor & Weil, 1996; Dahan & Tsiddon, 1998).

In the wake of the collapse of the communist block, Malthusian fertility has reemerged in Eastern and Central Europe and the countries of the former Soviet Union. Indeed, the transition by communist countries to market-oriented economies in the 1990s, like the Great Depression in the U.S. and Germany in the 1930s, generated sharp declines in real incomes and corresponding drops in fertility rates. This paper reconciles the existing models of fertility with the positive relationship between income and fertility observed in the former communist countries. It does this by analyzing the impact of individuals' perceived subsistence level of consumption on economic and fertility choices. In addition to an explanation for the dramatic fall in fertility following the transition, this paper sheds new light on the mechanisms linking income inequality and fertility.

Some scholars have suggested that the fall in fertility in transition countries is unrelated to the economic factors. According to these views, all or most of the recent decrease in fertility is the result of a shift toward Western-style reproductive behaviors (Conrad, et al., 1996), attitudes toward family and work (Maxwell, 1998), or the removal of pronatalist politics of the 1980s (Zakharov & Ivanova, 1996). However, these explanations have little support in the data, as shown by the more rapid than average decline in fertility rates among older women especially in the former Soviet Union, by the frequent increases in the share of first births in total births, and by the results of recent surveys on factors influencing women's childbearing decisions. For instance, in a 1999 survey in Russia, 97 percent of the women interviewed cited a lack of money as a major barrier to having another child, 15 percent said inadequate housing was the main cause, while 8 percent cited the confidence in regaining their jobs after childbirth (*The New York Times*, 2000).[1]

This paper presents an equilibrium model in which individuals consume, save and make fertility choices, in the tradition of Becker (1960), Razin & Ben-Zion (1975), and Becker & Barro (1988). To derive nonergodic behavior from an otherwise standard intertemporal fertility model, a subsistence level of consumption is introduced. The model is thus related to the work by Azariadis (1996) and Jones (2000). This paper, however, extends these studies in three primary ways. First, we derive rather than assume a structural break that produces a demographic transition, i.e., a threshold below which

[1] For additional surveys with similar findings, see Haub (1994).

fertility declines as incomes fall. Second, we characterize the relationship between fertility and the *distribution* of income taking into account subsistence consumption. We show that this produces a nonmonotone relationship between inequality and fertility. And third, we subject the model's implications to a battery of empirical tests which we show support the model's predictions.

Indeed, the model has three primary testable predictions: *i*) the perceived level of subsistence consumption fundamentally determines whether fertility and income are positively or negatively related; *ii*) once incomes decline below an identified threshold, declining labor income causes fertility to fall; and *iii*) rising income inequality has a negative impact on fertility rates. These results are quite intuitive. If incomes fall sufficiently relative to subsistence levels of consumption, children become less affordable and aggregate births decrease.[2] Furthermore, higher income variance associated with increased downward income mobility makes meeting subsistence consumption less likely, resulting in a decreased willingness to have children. Thus, though changes in income inequality have long been recognized as important correlates of economic growth, this paper explores an unexamined relationship between income inequality and fertility choices in times of economic depression.[3]

The model's predictions are tested in two ways. The first uses aggregate cross-section time-series data from 1979 to 1999 for 23 transition countries. The data set includes six regions (Central Europe, the Balkans, the Baltic states, the Slavic states of the former Soviet Union, the Transcaucasian states, and Central Asia) that display

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[2] Jones (2000) calls this the subsistence effect.

[3] For a thorough discussion of the relationship between income inequality and economic growth, see Galor & Zeira (1993), McGregor (1995), Perotti (1996), Owen & Weil (1997), Barro (2000).

considerable variation, thus reducing the risk of spurious results or weak inferences. The second empirical test of the model utilizes microeconomic data from the Russian Longitudinal Monitoring Survey. One of the empirical contributions of the paper is the estimation of the income threshold that determines whether fertility and income are positively or negatively related. This threshold is fundamentally determined by the perceived subsistence level of consumption that, interestingly, shows evidence of changing over time (Milanovic & Jovanovic, 1999).

The rest of this paper is organized as follows. Section 2 briefly reviews the remarkable decline in birth rates and real incomes in the former communist countries during the period of transition. In Section 3, we present an overlapping generations model with endogenous fertility. Section 4 derives implications from the model, while Section 5 empirically tests the implications of the model. Section 6 concludes by reviewing our primary findings.

2 THE POST-COMMUNIST "GREAT DEPRESSION" AND THE DEMOGRAPHIC RESPONSE

Although experiences varied from country to country, the transition from communism generally featured a sharp fall in real incomes, associated in many countries with a rise in unemployment and inflation. In a number of countries these developments caused widespread poverty and disintegration of the comprehensive social programs developed by the former regimes. It is therefore not surprising that the transition has profoundly affected, in many different ways, the lives and behavior of the hundreds of millions of people. One of the ways people reacted to the palpable worsening of material circumstances was reflected in a precipitous drop in fertility rates.

Table 1. Total Fertility Rate (TFR) and Crude Birth Rate (CBR)

Country	TFR		CBR		% change in	
	1989/90	1997/8	1989/90	1997/8	TFR	CBR
Central Europe	*1.88*	*1.30*	*13.34*	*9.68*	*-30.85*	*-27.44*
Czech Republic	1.89	1.16	12.70	8.80	-38.62	-30.71
Hungary	1.84	1.33	12.10	9.70	-27.72	-19.83
Poland	2.08	1.40	14.90	10.30	-32.69	-30.87
Slovak Republic	2.09	1.38	15.20	10.70	-33.97	-29.61
Slovenia	1.52	1.23	11.80	8.90	-19.08	-24.58
Balkans	*2.09*	*1.63*	*16.19*	*12.32*	*-22.01*	*-23.90*
Albania	3.03	2.46	24.90	18.32	-18.81	-26.43
Bosnia-Herzegovina	1.70	1.60	14.20	13.04	-5.88	-8.17
Bulgaria	1.90	1.09	12.60	7.70	-42.63	-38.89
Croatia	1.63	1.45	11.80	10.50	-11.04	-11.02
Macedonia	2.09	1.75	18.80	14.80	-16.27	-21.28
Romania	2.20	1.32	16.10	10.60	-40.00	-34.16
Yugoslavia	2.08	1.74	14.90	11.30	-16.35	-24.16
Baltic states	*2.09*	*1.22*	*15.13*	*8.73*	*-41.63*	*-42.30*
Estonia	2.21	1.21	15.50	8.50	-45.25	-45.16
Latvia	2.05	1.09	14.60	7.60	-46.83	-47.95
Lithuania	2.00	1.36	15.30	10.10	-32.00	-33.99
Slavic states and Moldova	*2.13*	*1.34*	*15.45*	*8.95*	*-37.09*	*-42.07*
Belarus	2.03	1.23	15.00	8.80	-39.41	-41.33
Moldova	2.50	1.60	18.90	9.70	-36.00	-48.68
The Russian Federation	2.01	1.23	14.60	8.60	-38.81	-41.10
Ukraine	1.99	1.30	13.30	8.70	-34.67	-34.59
Transcaucasian states	*2.54*	*1.53*	*22.10*	*11.90*	*-39.76*	*-46.15*
Armenia	2.62	1.30	22.90	10.50	-50.38	-54.15
Azerbaijan	2.80	2.00	26.40	16.40	-28.57	-37.88
Georgia	2.21	1.29	17.00	8.80	-41.63	-48.24
Central Asia	*4.10*	*2.79*	*32.16*	*20.28*	*-31.95*	*-36.94*
Kazakhstan	2.82	2.00	23.00	14.30	-29.08	-37.83
Kyrgyz Republic	3.88	2.79	30.40	22.00	-28.09	-27.63
Tajikistan	5.23	3.40	38.80	21.40	-34.99	-44.85
Turkmenistan	4.40	2.92	34.90	20.30	-33.64	-41.83
Uzbekistan	4.18	2.82	33.70	23.40	-32.54	-30.56
All transition countries	*2.48*	*1.68*	*19.05*	*12.36*	*-32.26*	*-35.12*
EU countries	*1.64*	*1.54*	*12.43*	*11.14*	*-6.10*	*-10.38*

Source: World Development Indicators 2000.

Table 1 illustrates the change in fertility for 27 transition countries since the beginning of the transition. The *total fertility rate* (the number of births per woman) and *crude birth rate* (the number of births per 1,000 people) both decreased sharply in every country. The average crude birth rate declined from 19.05 to 12.36, a drop of approximately 35 percent. Central Europe and the Balkans have registered relatively smaller declines in fertility; their crude birth rates decreased, on average, by 28 and 24 percent, respectively. The decline was greater in Central Asia, even greater in the Slavic states, Moldova and the Baltics, and the greatest in the Transcaucasian states (a 46 percent decline). The dispersion of fertility rates among transition economies also declined, indicating decreased differences among countries.

The contrast with European Union (EU) countries, where the crude birth rate fell by 10 percent during the same period, puts the fertility decline within a broader European context. As Table 1 shows, the fertility decline in the transition countries was three to four times as large as the decline recorded in the EU countries during the same period. *A fortiori*, the largest reductions in fertility rates among EU countries recorded in the 1970s and 1980s is unmatched by the deep fertility declines for the transition countries during the 1990s.[4] Before the fall of communism, average fertility in every regional grouping of countries in Table 1 exceeded the EU average, while a decade later fertility in every group except the Central Asian republics (which have had traditionally high fertility rates) was approximately the same level or lower than the EU average. In particular, before the transition the vast majority of the transition countries had fertility rates of around two children per woman. Among the EU countries in 1989, only two countries – Ireland and Sweden – had total fertility rates higher than two, with the lowest rates observed at that time in Italy and Spain of less than 1.4. In 1997/98, all the transition

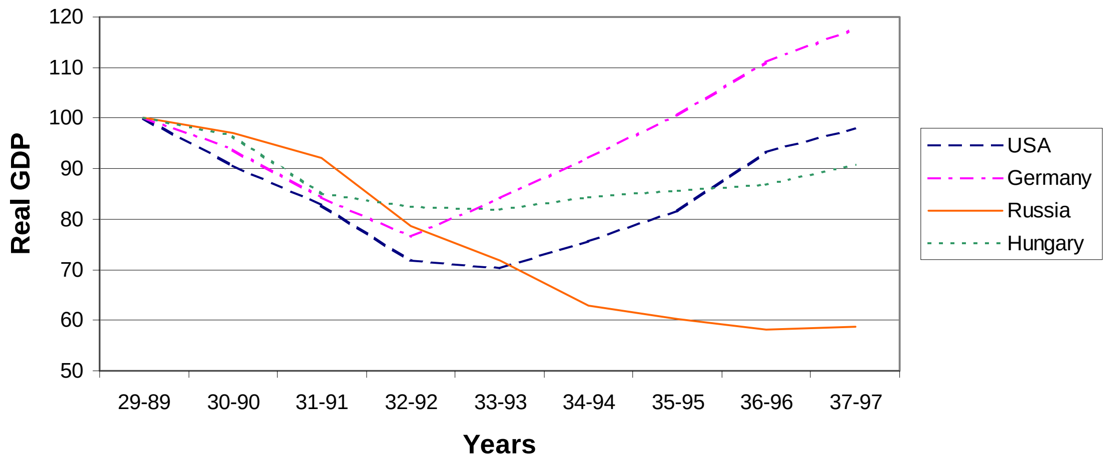
[4] For an extensive discussion of fertility declines in transition countries as compared to those in the EU in the 1970s and 1980s, see Macura (1996).

countries – with the exception of the Central Asian countries, Azerbaijan and Albania – had total fertility rates below two, with most countries well below two.

The depth of the post-communist depression is further illustrated by comparing it to the 1929-33 Great Depression. Figure 1 shows real GDP for Russia and Hungary during 1989-97, using 1989 as a base year, and real GDP for the United States and Germany during 1929-37, using 1929 as a base year. The decline in output was initially steeper in Hungary, Germany, and the U.S. than in Russia. Yet, while the first three countries experienced a large initial drop in output and then began to grow after three to four years, Russia has experienced a continuing deep depression. Russian GDP fell monotonically throughout the sample period, and in 1997 was 42 percent below its 1989 level. The depression in Hungary, though deeper than that in Russia during the first two years, was not as severe or long-lived. The Hungarian trough, reached in 1993, was approximately 18 percent below the 1989 level. Since 1993, Hungary has grown consistently and, by 1997 Hungarian GDP was only 9 percent below its 1989 level.

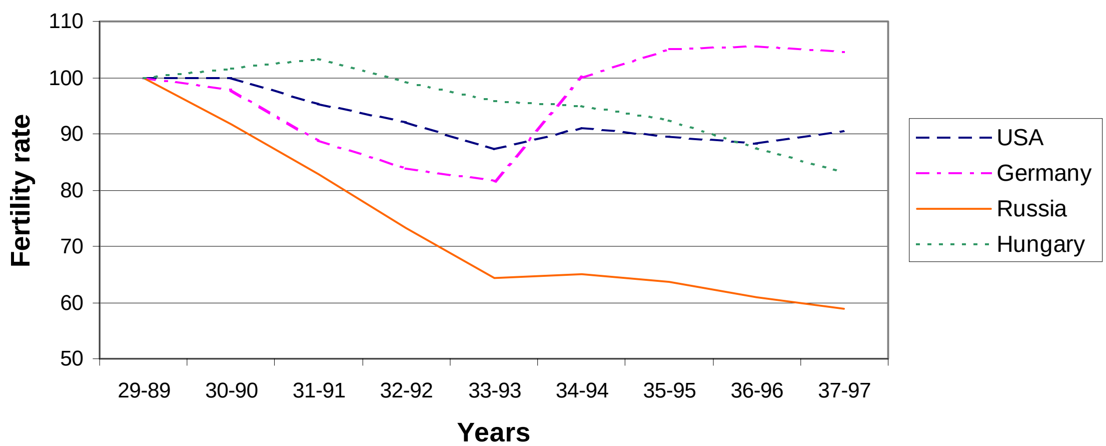
The behavioral patterns of fertility during the Great Depression and the post-communist transition are also analogs. As shown in Figure 2, each of the four countries experienced a decline in fertility rates following economic deterioration. Germany and the United States reached their lowest fertility rates in 1933. Births increased rapidly in 1934 in Germany, with fertility in that year exceeding its initial 1929 level. In the U.S., fertility started increasing in 1934 and slowly approached its 1929 level during the 1930s. Out of the four countries, Russia experienced the most severe fertility reduction, mirroring the decline in its GDP. In 1997 the fertility rate in Russia was 41 percent below its base level.

Figure 1. Real GDP in the USA and Germany (1929-37); and in Russia and Hungary (1989-97)



Note: 1929 = 100 for the U.S. and Germany; 1989 = 100 for Russia and Hungary.
Source: For the U.S. and Germany: Liesner (1989, Table US.2 and Table G.2). For Russia and Hungary: World Development Indicators, GDP at market prices (constant 1995 US$).

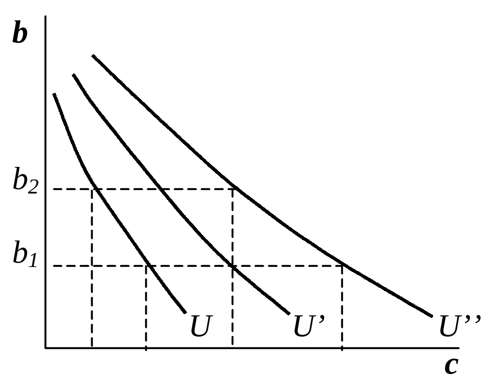
Figure 2. Fertility Rate in the USA and Germany (1929-37); and in Russia and Hungary (1989-97)



Note: 1929 = 100 for the USA and Germany; 1989 = 100 for Russia and Hungary.
Source: For the USA: Statistical Abstract of the United States (1944-45). For Germany: Mitchell (1992). For Russia and Hungary: World Development Indicators, Fertility rate, crude (per 1,000 people).

While the data may be subject to measurement error, the figures clearly illustrate that massive income declines produce a different effect on fertility than do gradual income variations. Unfavorable shocks seemingly jar an economy into a Malthusian state where fertility declines follow drops in income. The key assumption in the model developed in the next section is that there is a switch in domination between the substitution and income effects of a change in income on fertility depending on the level of income. Specifically, the substitution effect (child-rearing requires time away from work) normally dominates the income effect (children are more affordable) à la Becker (1991). However, if income falls sufficiently relative to the subsistence level of consumption, the income effect dominates the substitution effect and the willingness to have children falls. This is shown in the indifference map in Figure 3 where households become less willing to trade consumption for children as they become poorer within a critical range.[5] In particular, when income is sufficiently low relative to the subsistence level of consumption, a household with utility level *U* is less willing to give up consumption in order to increase births from b_1 to b_2 than is the wealthier household at utility *U''*.

Figure 3. Indifference map near subsistence consumption



Note: **b** is births, **c** is consumption.

[5] For a formal derivation of this critical range, see equation (5).

Both the Great Depression and the transition of the former communist countries featured an increased proportion of those living in poverty, including those that were traditionally situated in the middle class. For example, Milanovic & Jovanovic (1999) show that in Russia between 1993-96 the percentage of the population who (subjectively) considered themselves poor was extremely high, 60-90 percent, and varied over time. Even according to the "objective" criterion of the official poverty line, the proportion of the poor increased from 25-60 percent during the same period. Because of the impoverishment of the middle class, income inequality rose sharply post transition.[6] Therefore, the analysis that follows characterizes the effects of changes in both the level and distribution of income on fertility.

3 THE MODEL

Agents in this model live three periods in overlapping generations, and are heterogeneous in their human capital and in the perceived level of subsistence consumption. The first period of an agent's life is childhood, the second is young adulthood, and the third is old age. By assumption, parents choose their children's consumption, and therefore children do not receive utility from consuming goods. In the second period of life, agents supply labor inelastically to firms, choose family size, and save for old age. Reproduction is limited to the second period of life and, for simplicity,

[6] For empirical evidence of increased income inequality during the post-communist transition, see Kakwani (1996) and Milanovic (1998).

children are produced by parthenogenesis (asexual reproduction).[7] We also abstract from the spacing of children by assuming that parents have all of their children at the beginning of adulthood. In old age, agents are retired and consume from the principal and interest on their savings. Agents die at the end of the third period of their lives.

3.1 THE CONSUMER'S PROBLEM

It is convenient to specify the model in units per effective worker so that human capital enters the model in a tractable way. Let us identify an agent by the superscript $i \in \Re^+$. Young adults use current labor income wh^i (the economy-wide average wage w times type i's human capital h^i) to fund consumption c_1^i, to raise children at cost e^i per child, and to save a^i for old age. Define c_2^i as old-age consumption which is financed by the principal and interest on savings, Ra^i, where $R \equiv 1 + r - \delta$ is one plus the net interest rate ($r - \delta$), with $\delta \in [0,1]$ the depreciation rate on physical capital. Preferences are defined over youthful consumption c_1^i, old-age consumption c_2^i, and the number of children b^i.[8]

When utility is logarithmic, the lifetime utility maximization problem for agent i born at time t - 1 is

[7] Parthenogenesis simplifies the intergenerational transmissions of human capital and allows us to avoid the issue of marriage matching; on marriage matching, see Zak & Park (in press) and Burdett & Coles (1997).
[8] Note that the model does not assume that parents are altruistic toward their children. The incorporation of altruism would complicate but not substantially change the analysis (see Zak, 2000).

$$\max_{c_1^i, c_2^i, b^i} (1-\beta)\ln\left(c_{1,t}^i - x_{1,t}^i\right) + \beta \ln\left(c_{2,t+1}^i - x_{2,t+1}^i\right) + \gamma \ln\left(b_t^i\right) \tag{1}$$

subject to

$$c_{1,t}^i = w_t h_t^i - e_t^i b_t^i - a_{t+1}^i$$

$$c_{2,t+1}^i = R_{t+1} a_{t+1}^i$$

$$c_{1,t}^i \geq x_{1,t}^i \quad \forall t$$

$$c_{2,t+1}^i \geq x_{2,t+1}^i \quad \forall t$$

$$b_t^i \geq \bar{b} > 0$$

where $\beta \in (0,1)$ is the patience parameter, $\gamma > 0$ is the weight on the preference for children, and $\left(x_{1,t}^i, x_{2,t+1}^i\right)$ are the perceived subsistence consumption levels for young and old adults. The budget constraints in (1) relate to the two periods of adulthood.[9] Lastly, $\bar{b} > 0$ is the minimum number of children in each family.[10]

The rearing of children is a time intensive activity (Birdsall, 1988). Rather than include a "time spent with children" choice for parents, we simplify the model by assuming that higher wages induce a substitution effect away from fertility by raising the cost of children nonlinearly, though with an upper bound. As a result, the cost of children is parameterized as a convex function of labor income,

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[9] Perceived levels of subsistence consumption are primarily affected by an individual's past consumption and by comparison with the consumption of others. The factors that influence the formation of perceived subsistence levels are outside the scope of this paper. For a discussion of comparison utility in an endogenous growth model, see Carroll, Overland & Weil (1997).

[10] The constraint that $b_t^i \geq \bar{b} > 0$ is necessary for well-defined asymptotic behavior of the system but is not crucial to the analysis.

$$e_t^i = \begin{cases} D\left(w_t h_t^i\right)^{\rho} & \text{for } w_t h_t^i < \kappa \\ D_1 w_t h_t^i & \text{for } w_t h_t^i \geq \kappa \end{cases} \tag{2}$$

for $0 < D < 1 \big/ \left(\left(w_t h_t^i\right)^{\rho-1} \bar{b}\right) \forall i,t$, $D_1 \equiv \gamma \big/ \left((1+\gamma)\bar{b}\right)$ and $D_2 \equiv x_{1,t}^i + x_{2,t+1}^i \big/ R_{t+1} \ \forall i,t$. The parameter $\rho > 1$ is the constant elasticity of the cost of children with respect to the labor income.[11]

Setting aside integer constraints associated with the choice of family size and ignoring altogether complications like infant mortality, twins, and the like, the optimal choices made by a type *i* agent at time *t* for savings and the number of children are

$$a_{t+1}^{i*} = \frac{\beta}{1+\gamma}\left(w_t h_t^i - x_{1,t}^i\right) + \frac{1-\beta+\gamma}{1+\gamma} x_{2,t+1}^i \big/ R_{t+1} \tag{3}$$

$$b_t^{i*} = Max\left\{\frac{\gamma}{1+\gamma} \frac{w_t h_t^i - x_{1,t}^i - x_{2,t+1}^i \big/ R_{t+1}}{D\left(w_t h_t^i\right)^{\rho}}, \bar{b}\right\} \tag{4}$$

subject to the restriction $w_t h_t^i > x_{1,t}^i + x_{2,t+1}^i \big/ R_{t+1}$.

Optimal savings, (3), is increasing in income, decreasing in the preference for children parameter, γ, and increasing in the patience parameter, β. As expected, optimal savings is negatively related to current perceived subsistence consumption, $x_{1,t}^i$, and

[11] The bifurcated cost of children parameterization is the result of the lower bound on fertility, $\bar{b}$, and is designed so that the model's equilibrium conditions are continuous at $b_t = \bar{b}$. The critical value of labor income, κ, where the cost of children increases linearly in labor income is implicitly defined by $D_1 w_t h_t^i - D\left(w_t h_t^i\right)^{\rho} = D_1 D_2 \ \forall i,t$. It is straightforward to show that for any $\rho > 1$ there is $w_t h_t^i > 0$ for which κ is unique.

positively related to the discounted value of future perceived subsistence consumption, $x^i_{2,t+1} / R_{t+1}$. The optimal number of children (4), which will be the focus of the analysis in the following sections, increases as the preference for children rises and falls as the perceived subsistence consumption levels increase.[12]

5 IMPLICATIONS OF THE MODEL

Lemma 1 defines the threshold for a positive relationship between fertility and income.

Lemma 1. *The optimal number of children is increasing in labor income if*

$$w_t\, h^i_t < \overline{w_t\, h^i_t} \equiv \frac{\rho}{\rho - 1}\left(x^i_{1,t} + x^i_{2,t+1} \big/ R_{t+1}\right) \qquad (5)$$

This lemma demonstrates that if labor income declines sufficiently relative to the current and discounted future subsistence levels of consumption, children become less affordable and fertility decreases. To wit, when income drops sufficiently, the income effect on fertility dominates the substitution effect, reducing the birth rates.

Note that since $\rho > 1$, the Malthusian threshold $\overline{w_t\, h^i_t}$ is above the sum of the perceived subsistence consumption levels. As expected, the threshold $\overline{w_t\, h^i_t}$ is positively

[12] Appendix A.1 specifies the equilibrium conditions for this model.

related to the perceived levels of subsistence consumption. In addition, the threshold is declining in the elasticity of the cost of children with respect to labor income, ρ.[13] For example, in countries with pro-natalist policies ρ might be lower and thus the Malthusian threshold, $\overline{w_t h_t^i}$, higher. In this case, a smaller decline in income would induce a fertility reduction. One characteristic of the former communist countries was a generally pro-children stance as reflected in relatively cheap facilities for childcare, universal health care and education, and a heavy emphasis on family allowances.[14] This suggests that the cost-of-children elasticity ρ was relatively low, resulting in a high Mathusian threshold $\overline{w_t h_t^i}$. Accordingly, with a high ρ at the outset of the transition, even moderate declines in incomes would have been sufficient to generate reductions in fertility.

The optimal number of children, as given by equation (4), is a continuous function of labor income. Lemma 1 shows that births increase in labor income at low levels of income (below $\overline{wh^i}$). It is straightforward to show that births decrease at an increasing rate when income is at intermediate levels (between $\overline{wh^i}$ and $\overline{\overline{wh^i}}$), and then decrease at a decreasing rate at high levels of income (above $\overline{\overline{wh^i}}$).[15] This pattern is depicted in Figure 4.[16]

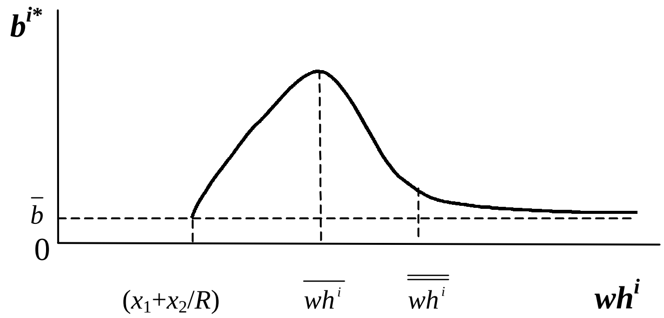
[13] Note that ρ is constant from individual's point of view, but it could vary across countries.

[14] For extensive discussion of family social services during both the former regimes and the transition period, see Milanovic (1998).

[15] $\overline{\overline{wh^i}} \equiv \frac{\rho+1}{\rho-1}\left(x_1^i + x_2^i / R\right)$.

[16] Kremer (1993) assumes an almost identical pattern for population growth versus income. Jones (2000) supposes the same pattern to characterize the relationship between fertility and productivity.

Figure 4. Fertility Versus Income



The model also permits a characterization of the relationship between the number of births and the distribution of labor income. Theorem 1 demonstrates that, for an economy with a significant fraction of the population with incomes below the Malthusian threshold $\overline{wh^i}$, rising inequality negatively impacts fertility. To derive this result, we use the notion of a mean preserving spread (Rothschild & Stiglitz, 1970) in which one distribution is constructed from another by moving mass from the middle of the distribution to the tails, keeping the mean constant and increasing the variance.[17] Let μ be an appropriately defined measure defined over young adult agents. Then we have

Theorem 1. *If* $\int_0^{\overline{wh^i}} d\mu \geq \int_{\overline{\overline{wh^i}}}^{\infty} d\mu$ *, i.e., if there are a greater mass of low income than high income agents, then a simple mean preserving spread of the distribution of labor income decreases the aggregate number of births as long as the spread distribution also satisfies this inequality.*[18]

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[17] The assumption of constant mean is not crucial to the analysis. Assuming a decreasing mean (since labor income decreases during economic depressions) strengthens the result.
[18] Proof is provided in Appendix A.2.

The intuition for this result is straightforward: during an economic depression, the proportion of agents with income below the Malthusian threshold increases and children become less affordable. As long as there are not too many high income agents (i.e. non-Malthusians), rising inequality produces a larger proportion of poor individuals who behave as Malthus predicted. Note that this theorem does not depend on the minimum number of births being $\bar{b}$, but follows from the aggregation of fertilty choices with varying domination of income and substitution effects.

4 EMPIRICAL EVIDENCE

The model produces three empirically testable predictions for fertility in times of economic depression. First, declining labor income causes fertility to fall. Second, since the condition in Theorem 1 is likely to be satisfied for all post-transition countries, increases in income inequality also have contributed to fertility declines. Third, higher perceived levels of subsistence consumption have a negative impact on fertility rates.

The first two predictions are tested using cross-section time-series data for 23 transition countries from 1979 to 1999.[19] The third prediction is directly tested using microeconomic data from the Russian Longitudinal Monitoring Survey (RLMS).[20]

[19] This is the largest number of transition countries for which we have been able to assemble data on variables in the model. Out of 27 transition countries, four countries (Bosnia-Herzegovina, Tajikistan, Turkmenistan and Yugoslavia) were excluded from our empirical analyses because of missing or unreliable data.

[20] The RLMS is supervised by the Carolina Population Center at the University of North Carolina at Chapel Hill. The first phase started in 1992 with around 6,300 households. The second phase started in 1994 with

Individual-level data avoids the endogeneity issues that plague the fertility-income association in aggregate data. Most importantly, this dataset allows us to *directly* test the impact of perceived levels of subsistence consumption on fertility choices.

5.2 FERTILITY IN TRANSITION COUNTRIES: CROSS-COUNTRY EVIDENCE

We use both common measures of fertility in our studies, the crude birth rate (CBR) and the total fertility rate (TFR), as a robustness check. Wages – a factor that determines labor income – are proxied by real GDP per capita since, by equation (A3), they are directly proportional to each other. As in Barro (1991), school enrollment rates are used as proxies for human capital, the other factor that determines labor income in the model. In particular, we use gross secondary school enrollment rates measuring the number of students enrolled in the designated grade levels relative to the total population of the corresponding age group. Except in three transition countries (Hungary, Poland and Slovenia), secondary school enrollment plummeted after 1990, with the largest decline (more than 50 percent) recorded in Albania. The birth rate, real GDP per capita, and secondary school enrollment data are all taken from the World Bank (*World Development Indicators*, 2001).

Income inequality is typically measured by the Gini coefficients in the Deininger-Squire dataset. However, this dataset does not contain full time-series data for most transition countries. A major improvement in measuring income inequality in the countries under study is the UNICEF/ICDC TransMONEE project on monitoring social

almost 4,000 households. The data has been collected a total of 9 times. For a detailed description of the RLMS dataset, see http://www.cpc.unc.edu/projects/rlms/rlms_home.html.

conditions and public policy in Central and Eastern Europe and the former Soviet Union.[21] The measure of income inequality used in our analysis is taken from the TransMONEE data on Gini coefficients of monthly earnings that span from 1989 to 1997 for 15 transition countries.

Finally, the transition from communism to market economies was accompanied, in most countries, by a dramatic increase in democratization and political liberalization. To control for this effect, we include a measure of civil liberties from the Polity IV dataset.[22]

Table 2. Fertility: Transition Countries, 1979-99

	(1)	(2)[1)]	(3)	(4)[1)]
Dependent variable	CBR		TFR	
Real GDP per capita	.0039*** (.0005)	.0025*** (.0008)	.0005*** (6.18E-05)	.0003*** (.0001)
Real GDP per capita squared	-2.56E-07*** (4.35E-08)	-1.61E-07*** (4.89E-08)	-3.29E-08*** (5.04E-09)	-1.79E-08*** (6.64E-09)
Secondary school enrollment	.1687*** (.0565)	-.2589 (.3284)	.0170** (.0083)	-.0470 (.0562)
Secondary school enrollment squared	-.0007** (.0003)	.0015 (.0020)	-7.11E-05* (4.19E-05)	.0003 (.0003)
Gini		-15.235*** (3.124)		-2.238*** (.4876)
Polity indices	-.0326 (.0214)	-.0485*** (.0301)	-.0081** (.0034)	-.0023 (.0054)
Adjusted R^2	.84	.95	.76	.93
Number of observations	183	74	172	74

Notes: White heteroskedasticity-consistent standard errors in parentheses.
Coefficients for country dummies are not shown to conserve space.
* = significant at 10 percent; ** = significant at 5 percent; *** = significant at 1 percent.
1) Data span from 1989-97 for 15 countries.

[21] See, http://eurochild.gla.ac.uk/Documents/monee.
[22] We use the "polity index" from the Polity IV dataset. Source: http://www.bsos.umd.edu/cidcm/polity.

Table 2 reports the results of using the FGLS procedure with country fixed effects (Greene, 2000).[23] All independent variables are lagged one period to instrument the variables the theory identifies as jointly endogenous with births, as well as to capture dynamic changes in the underlying structure. To account for the nonlinear relationship between births and labor income shown in Figure 4, squares of the proxies for wages and human capital are included in the regressions.[24]

Regressions (1) and (3) test the quadratic relationship between fertility and labor income, controlling for increased democratization. The linear coefficients on real GDP per capita and secondary school enrollment carry the expected positive signs and are significant at better than 1%. Importantly, the significant negative coefficients on the squared terms capture the model's prediction of a positive relationship between fertility and income which attenuates as income moves above the Malthusian threshold.

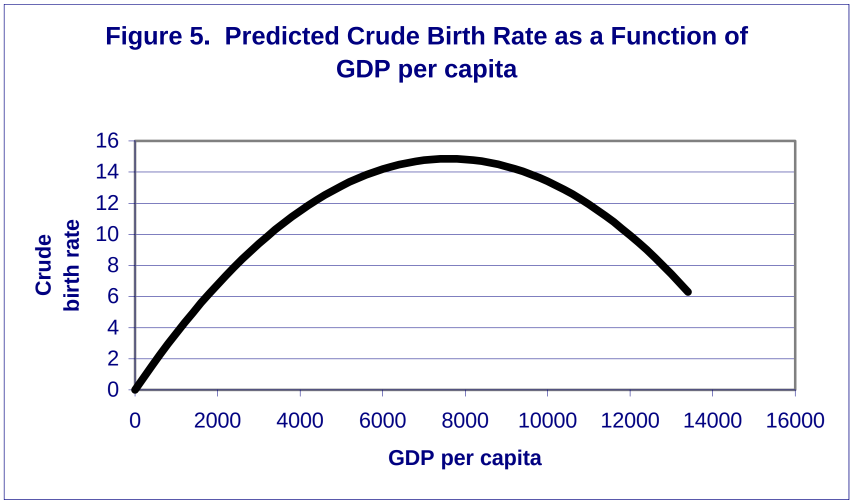
Figure 5 illustrates the nonlinear effect of income on fertility using the estimated coefficients from regression (1). It shows that the (average) Malthusian threshold for the countries in the sample is approximately $7,600 GDP per capita (constant 1995 US$). At this threshold, the maximal CBR is 14.85.[25] Note that in 1999 the average GDP per capita in constant 1995 US$ for the 23 transition countries was approximately $2,500 and the average CBR was 11.54. Thus, per capita incomes will have to increase, on average, more than 200% before the transition countries exit the Malthusian fertility stage. To wit, even if the transition countries are able to grow at 5% per year (real per capita), the model

[23] The *F*-test for the presence of fixed effects rejected the null hypothesis that the intercept parameters for all countries are equal.

[24] The relationship between fertility and income when income is less than $\overline{\overline{wh^i}}$ can be approximated by a quadratic function. This is the domain relevant for our analysis.

[25] The maximal TFR at the threshold is 1.90.

predicts that the average country in our sample will remain in a Malthusian fertility regime for the next twenty years.



Regressions (2) and (4) add the GINI variable measuring income inequality to the base equations. As predicted by Theorem 1, increasing inequality has a negative and significant impact on fertility. However, once the effects of income inequality have been controlled for, the coefficients on secondary school enrollment are no longer significant. This suggests that inequality and school enrollment may have the same source of variation. Nevertheless, the coefficient estimates on GDP per capita are consistently statistically significant and robustly impact fertility in each regression.

Throughout regressions (1) to (4) the coefficient on the civil liberty control variables carry negative, though sometimes insignificant, sign. This finding is consistent with Feng, Kugler & Zak (2001) who show that civil liberties have a negative and significant impact on fertility in a panel of 109 countries from 1960-1990.

Taken as a whole, the empirical results support the first two predictions of the theory (a Malthusian threshold and the role of inequality). Next, we turn to testing the third prediction, the direct role of perceived subsistence levels on fertility choices.

5.2 FERTILITY AND HARDSHIP: MICROECONOMIC EVIDENCE FROM RUSSIA

In this section we use the 1998/99 RLMS data as the basis for our empirical work rather than aggregated national data. This data set, which includes complete survey responses from approximately 8,700 individuals (of which almost 5,000 are women), provides information that can be used to estimate the effect of the perceived subsistence level on fertility choices directly.

The dependent variable, fertility, is based on a question in the RLMS on willingness to have a (another) child for women between 18 and 50 years of age who appeared to be fertile and have less than two children.[26] The dependent variable takes the value of 1 if a woman wants to have (another) child and 0 otherwise. We develop a standard probit regression model in which fertility is a function of income and the perceived poverty minimum as a proxy for perceived subsistence consumption.[27] To account for economies of size within the household, both income and the perceived poverty level are calculated per equivalent adult using a single-parameter equivalence of 0.5.[28] In addition, we augment equation (4) with a set of variables capturing expectations

[26] The respondent's ability to become pregnant is based on a positive responses to the question, *"Do you have a menstrual cycle now?"*, including women who gave a negative answer but whose menstrual cycle stopped because of current pregnancy.
[27] Appendix A.3 provides description and summary statistics of the variables used in the empirical analysis.
[28] We also estimated the model using household per capita income and the perceived per person poverty minimum (i.e. when the equivalence parameter is unity). The estimated coefficients on these variables remained significant and carried the predicted signs.

of future economic status and satisfaction with one's life at the present. Finally, we control for a number of individual characteristics, including age, education, marital and employment status, and religiousness that may account for variations across individuals in income and perceived subsistence level of consumption in equation (4).

Table 3. Probit Regression Results for Russia

Dependent variable: 1 if wants (another) child, 0 otherwise			
Independent variables	(1)	(2)	(3)
Income per equivalent adult (thousands of rubles)	.2808*** (.0734)	.2542*** (.0813)	.2687*** (.0868)
Income per equivalent adult squared (thousands of rubles)	-.0145** (.0622)	-.0151** (.0066)	-.0149** (.0069)
Perceived poverty minimum per equivalent adult (thousands of rubles)	-.4441*** (.1490)	-.4002** (.1560)	-.2552* (.1551)
Future expectations		.1858*** (.0527)	.0746 (.0597)
Current satisfaction with life		.0723 (.0535)	.0265 (.0588)
Age			.1989** (.0912)
Age squared			-.0044*** (.0015)
Education			.0026 (.0212)
Married			-.1645 (.1162)
Employed			.0103 (.1280)
Religiousness			.0213 (.0568)
Constant	-.3481*** (.0834)	-.9678*** (.1664)	-2.4273* (1.4189)
Likelihood ratio statistic	24.72***	44.25***	168.99***
McFadden R-squared	.02	.05	.20
Number of observations	744	632	625

Notes: Coefficient estimates are presented with their corresponding QML (Huber/White) heteroskedasticity-consistent standard errors.
Three stars indicate significance at 1%, two at 5% and one star indicates significance at 10%.

Table 3 presents results of three probit regressions estimating the augmented fertility equation (4). Regression (1) includes only income per equivalent adult, its square, and the perceived poverty level per equivalent adult. As predicted by the theory, fertility has a quadratic relationship with income, initially increasing, and then decreasing. Also, as expected, the higher the perceived poverty line the less likely that a woman will want to have a (another) child. Indeed, the estimated coefficient on the perceived poverty level is not only statistically significant, but quantitatively important, being about 50% larger (in absolute value) than the estimated coefficient on income itself.

Regression (2) adds an additional set of control variables measuring subjective evaluations of present and future economic conditions to regression (1). As expected, having positive prospects for the future has positive and significant effect on fertility. On the other hand, evaluating one's present situation in positive light does not significantly influence the willingness of a woman to have a (another) child. The estimated coefficients on the income terms and perceived poverty level all retain their predicted signs and high levels of significance with the inclusion of these additional variables.

In regression (3), we include several demographic variables that may influence fertility choices. The relationship between fertility and age of the woman is quadratic, with the willingness to have children increasing until age 23 (the average age of women at childbearing in 1998), and then decreasing. When age is included in the regression, however, the effect of the perceived poverty level is considerably reduced and only marginally significant. While education and employment status have the expected positive signs, these coefficients are statistically insignificant. Likewise, being married does not have a statistically significant effect on the willingness to have children. A possible explanation for this is the inclusion in the analysis of relatively young women (starting at age 18) who may anticipate getting married later.[29] Finally, religiousness has insignificant effect on fertility which should not be surprising since most of the women interviewed were raised under the former communist regime that disallowed the practice of religion.[30]

Throughout regression (1) through (3) the coefficients on income per equivalent adult and income per equivalent adult squared are consistently significant and carry the expected signs. The point estimates in regression (3) indicate fertility and income are positively related (holding constant the other variables) when income per equivalent adult is less than Rs. 9,000. The mean income per equivalent adult for the 3,830 interviewed households is Rs. 838 (the median income per equivalent adult is only Rs. 570).[31] In fact, only 11 households in the sample have income per equivalent adult higher than Rs. 9,000. This suggests that the majority of Russian households are in the Malthusian fertility state where there is a positive relationship between income and fertility. It is important to note that the coefficient estimates on the income variables are extremely robust to different specifications.[32]

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[29] However, when we performed the same analysis including only women between 23 and 50 years of age, the effect of marital status on fertility remained insignificant.

[30] Interestingly, there was no appreciable difference in the willingness of Muslim women to answer questions about abortion, pregnancy history and other sensitive sections of the survey.

[31] By running the regression with household per capita income and perceived per person poverty level as independent variables we get a Malthusian threshold of Rs. 4,200. The mean household per capita income for the 3,830 households is Rs. 526.

[32] We ran regressions including other control variables (fear of job loss, ability to purchase necessities, economic rank on a 9-step scale, etc.) and the coefficients on *income per equivalent adult* and *income per equivalent adult squared* always remained statistically significant and carried the expected signs.

6 CONCLUSION

The inverse relationship between income and fertility is a well-established result in the economic literature. Standard models typically predict that income reductions should increase, not decrease, fertility. The transition of post-communist countries in Eastern and Central Europe and the former Soviet Union shows that this “standard” result does not always hold. We demonstrated that if a standard fertility model is modified to allow for perceived subsistence consumption, the model can generate income-to-fertility causality that is substantially similar to that observed in the data.

The model predicts that a reduction in labor income below an identified Malthusian threshold reduces the desire to have children. Thus, in times of economic crises, fertility falls. Thomas Malthus understood the effect of poverty on fertility, writing in 1798 that

> *But as from the laws of our nature some check to population must exist, it is better that it should be checked from a foresight of the difficulties attending a family and the fear of dependent poverty than that it should be encouraged, only to be repressed afterwards by want and sickness.*

The theory additionally predicts that increases in income inequality and perceived subsistence consumption levels decrease the aggregate number of births. For a sample of 23 transition countries, we find strong empirical support for these propositions.

Is taking into account perceived subsistence consumption an appealing explanation for drastic declines in fertility in times of economic disruption? It might be possible to explain this behavior in transition countries through some different factor or factors, without considering the effects of income or perceived subsistence consumption. Nevertheless, because the model provides such a good explanation of the data, it is unclear why one would want to abandon the explanatory power of per capita income and perceived subsistence for an alternative explanation.

APPENDIX

This appendix defines a competitive equilibrium for the model, provides proofs, and presents description of variables used in the empirical analysis.

A.1 FIRMS AND EQUILIBRIUM

We close the model by specifying the problem faced by firms and then defining a competitive equilibrium. In every period the economy produces a single homogenous good, using physical capital and efficiency units of labor in the production process. Assume that there are many firms operating in a competitive environment and that agents of all human capital types are necessary to produce output. Let K_t be the aggregate physical capital, μ be an appropriately defined measure over working agents, $N_t \equiv \int_0^\infty d\mu_{t_t}$ is the mass of working agents, and $H_t \equiv \int_0^\infty h_t^i d\mu_t$ is aggregate human capital, i.e., the quantity of efficiency units of labor employed in production at time t.

The profit maximization problem for a representative firm at time t is

$$\max_{K,H} Y_t - r_t K_t - w_t H_t \tag{A1}$$

where r_t is the cost of financing capital investments and w_t is the wage rate per efficiency unit of labor at time t. Let the production function be Cobb-Douglas

$$Y_t = K_t^{\alpha} H_t^{1-\alpha} \tag{A2}$$

for α ∈ (0, 1). Solving for the firm's profit maximizing condition using (A1) and (A2), shows that the labor income paid to a type *i* agent is the marginal product of type *i* labor,

$$w_t h_t^i = (1-\alpha) K_t^{\alpha} H_t^{-\alpha} h_t^i \tag{A3}$$

and the rate of return on capital is its marginal product,

$$r_t = \alpha K_t^{\alpha-1} H_t^{1-\alpha} . \tag{A4}$$

There are three markets in this model: goods, labor (all types), and capital. The capital market clears when, for some value of R_{t+1},

$$K_{t+1} = \int_0^{\infty} a_{t+1}^{i*} d\mu_t \tag{A5}$$

where a^{i*} is given by (3). The working population at time t+1 is aggregate births B_t at time t,

$$N_{t+1} = B_t \equiv \int_0^{\infty} b_t^{i*} d\mu_t \tag{A6}$$

where b^{i*} is given by (4).

A *competitive equilibrium* for the model above is a set of prices $\{w_t, R_{t+1}\}_{t=0}^{\infty}$, such that given

i) initial conditions for the distribution of physical capital, $\int_0^{\infty} a_0^i d\mu = K_0 > 0$, and human capital, $\int_0^{\infty} h_0^{\infty} d\mu = H_0 > 0$;

ii) a law of motion for physical capital (A5);

iii) description of the evolution of the subsistence consumption levels $(x_{1,t}^i, x_{2,t+1}^i)$;

consumers maximize lifetime utility by solving (1), firms maximize profits by solving (A1), and prices clear all markets.

A.2 PROOFS

The proof of Theorem 1 follows Rothshild & Stiglitz (1970). Other proofs are omitted to save space, but are available from the authors upon request.

Proof. [Theorem 1] Let *F* be the nondegenerate distribution of labor income at a particular point in time for a given level of capital stock, *K*, and let *G* be a distribution derived from *F* via a simple mean preserving spread (MPS). By Lemma 1, for incomes below the threshold $\overline{wh^i}$, the desired number of children increases monotonically in labor income wh^i, and is concave. Increasing the mass of agents with incomes less than $\overline{wh^i}$ reduces fertility, since, by Rothschild & Stiglitz (1970), $\int_0^{\overline{wh^i}} b^i dF < \int_0^{\overline{wh^i}} b^i dG$.

Similarly, increasing the mass of agents with incomes above $\overline{wh^i}$ raises fertility. However, as long as $\int_0^{\overline{wh^i}} d\mu \geq \int_{\overline{wh^i}}^{\infty} d\mu$, the concavity of $b(wh^i)$ for labor incomes below $\overline{wh^i}$ dominates the increase in fertility for agents with incomes above $\overline{wh^i}$. That is, the decrease in fertility by relatively poor agents after an MPS exceeds the increase in fertility by relatively wealthy agents ′

A.3 VARIABLE DESCRIPTION AND SUMMARY STATISTICS

Variable	Description/RLMS Question	Mean
Willingness to have (another) child	1 if the woman wants (another) child, 0 otherwise	0.40 (0.49)
Household income	Household income in rubles	1927.37 (3198)
Household per capita income	Household income divided by the number of household members	630.07 (1048.6)
Income per equivalent adult	Household income divided by the number of household members raised to the power of 0.5	1083.51 (1788.8)
Perceived poverty minimum per equivalent adult	Perceived family poverty level divided by the number of household members raised to the power of 0.5 / "What amount of money would signify that your family is below the poverty level?"	438.49 (399.40)
Future expectations	(1 = will live much worse, … 5 = will live much better) / "Do you think that in the next 12 months you and your family will live better than today?"	2.51 (1.07)
Current satisfaction with life	(1 = not at all satisfied, … 5 = fully satisfied) / "To what extent are you satisfied with your life in general at present time?"	2.13 (1.03)
Age	Age in years	31.63 (8.16)
Education	Years of education completed	10.90 (2.66)
Married	1 if married, 0 otherwise	0.61 (0.49)
Employed	1 if employed, 0 otherwise	0.71 (0.46)
Religiousness	1 = atheist, … 5 = believer	3.77 (0.99)

Notes: Standard deviations in parentheses.
The sample includes responses from women between 18 and 50 years of age who appeared to be fertile and had less than two children.

Source: The 1998/99 round of the RLMS dataset

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