Trends in socioeconomic inequalities in the health of newborns in the Czech Republic between 1990 and 2007 [1]

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Abstract

This paper explores the impact of post-socialist transformation of the Czech society upon the health of newborns from different socioeconomic groups. We use six different measures of child health – various constructs based on birth weight, length of gestation, and vitality – as dependent variables and mother's educational attainment as the key predictor. We use birth certificate data about all singleton births in 1990, 1992, 1994, 1996, 1998, 2000, 2002, 2004 and 2007 (N=912,591). We estimate random-intercept multi-level models and report observed trends in health inequality by maternal education. We consistently and persistently observe large gaps in health between children born to mothers with elementary education on the one hand and all other children on the other hand. While trends are not entirely congruent across all measures of child health, we find more evidence of growing inequality than of declining or stable inequality. Inequality grew mostly in the 1990s and then stabilized or even declined. We offer two tentative explanations for observed growth in inequality: selective adjustment hypothesis and selective childlessness hypothesis.

Keywords: Central Europe, family, health inequality, post-socialist transformation

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1. Introduction: socioeconomic transformation and population health

Many former socialist countries witnessed marked and prolonged worsening of population health after 1989. While many scholars expected that population health would improve once the oppressive and mis-functional political system and inefficient command economy were dismantled, a mortality crisis took place instead. Russia is its most often cited manifestation. According to available data, life expectancy at birth, which had been declining slowly since the second half of 1980s, fell from 64 to 58 in men and from 74 to 71 in women in Russia between 1991 and 1994 [Meslé 2004]. Levels of morality and life expectancy were still worse for men in 2007 than in the beginning of 1990s [Federal State Statistics Service].

Post-socialist development of population health – in Russia and elsewhere – is often attributed to accompanying social and economic changes. Socioeconomic standing, work conditions, marital status, character of a person's social network or even character of a community where people live are often mentioned as predecessors of individual's health (for thorough explanations see, for instance, [Bartley, Blane, and Smith 1998; Blaxter 1991; Cockerham 2007; Grigoriev et al. 2010; Marmot 2004]). Since social, economic, geographic, and demographic structures changed markedly during post-socialism, their transformations were frequently seen as culprits of worsening population health. For instance, Adeyi et al. [1997] and Grigoriev et al. [2010] see possible causes of health worsening in the decrease of real incomes, greater exposure to stress (connected for instance to job insecurity, unemployment, growing income inequality, weakening family stability) and stress-related behavior (including upsurge in alcohol consumption), weak regulation of environmental risks, or deteriorating health care (see also [Chen et al. 1996; Cockerham 1997; Marmot and Bobak 2000; Stuckler, King, and McKee 2009]).

While the Czech Republic (and other formerly socialist Central European countries) also experienced a period of deteriorating mortality and morbidity at the beginning of the 1990s, it was only a short-lived phenomenon followed by a rapid – and rather unprecedented – improvement of many indices of population health [Blažek and Dzúrová 2000]. For instance gross infant mortality rate increased from 10.0 to 10.8 between 1989 and 1990 and then experienced a fourfold decrease. Its 2008 level (2.8 deaths per 1000 live births) ranks the Czech Republic among the ten countries with the lowest infant mortality in the world [United Nations 2010; see also Koupilová et al. 2000].

Yet, another important indicator of child health – mean birth weight – recorded a less positive development in the Czech Republic. While newly born children weighed on average 3308 grams in 1989, mean birth weight dropped to 3276 grams in 1991. Later mean birth weight experienced a continuous improvement until 1999, when it peaked at 3339 grams, only to fall again to 3293 grams by 2008, i.e. below the 1989 level [Czech Statistical Office 2008, 2009]! Similarly the proportion of pre-term deliveries – i.e. births before the 38th week of pregnancy – remained stable until 2002, oscillating between 7.7 % and 8.8 %, and then increased to 10.5 % in 2007 (see Table 1).[2]

[2] The proportion of newborns with low birth weight – another often employed indicator of child health – has risen considerably after 1989. There were 7.2 % of newborns with low birth weight in 2008 as compared to 5.5 % such newborns in 1990 [Czech Statistical Office 2008, 2009]. The rising number of multiple births, which is caused by more intensive use of assisted reproduction technology in the last years, explains this trend. The share of multiple births among all births has grown from 0.9 % to 2.0 % between 1990 and 2008 [Czech Statistical Office 2008, 2009]. The proportion of low birth weight newborns remains at the 5% level among singleton births (see Table 1).

2. Health inequality during post-socialism

The post-socialist health crisis (and the subsequent health improvements) did not affect all groups of adults in the same fashion. The rise of mortality occurred mostly among the population in productive age (20-59 years) and impacted men more than women, widening the gender gap that was present before the regime change [Cornia and Paniccià 2000: 13]. Socioeconomic health gap, which existed in the socialist countries despite their egalitarian ideology [Shkolnikov et al. 1998; Sobotík and Rychtaříková 1992], grew as well after 1989 [Shkolnikov et al. 1998] as the negative consequences of societal transformation affected disproportionately the less educated people.

In addition, also disparities in mortality by marital status, migrant status, or ethnic origin increased in the post-socialist states, impacting negatively people who live in incomplete families, illegal migrants, or ethnic minorities [Cornia and Paniccià 2000: 16-28; Pikhart, Drbohlav, Dzurova 2010]. People in the Czech Republic witnessed the same changes as individuals in other transforming societies. Particularly people in the productive age and young families were most strongly impacted [Blažek and Dzúrová 2000].

We have seen that pregnancy and birth outcomes witnessed an improvement by some indices (and a worsening by other) in the Czech Republic (see above). It is possible that some social groups did not follow the same path of development and stayed behind, while others improved their situation disproportionately. Interestingly, however, socioeconomic inequality in birth and pregnancy outcomes has not been researched very often in post-socialist societies (including the Czech Republic) over the last two decades. Carlson et al. [1999] used data from the Czech birth register and showed that the higher the education of the mother, the lower the risk of fetal loss (i.e. abortion or still birth). Infant mortality has been highly stratified by maternal education both during socialism and post-socialism [Rychtaříková and Demko 2001]. Bobák et al. [2000] investigated the stratification of infant death from external causes and document that infants and children of better educated mothers faced less risk of dying in any form of accident. Social inequalities in infant health were confirmed also in other post-socialist countries, for instance former East Germany or Estonia [Koupil et al. 2006; Raum et al. 2001]. According to the findings of Koupilová et al. [2006], the educational gap in infant mortality has been even widening in Estonia.

To the best of our knowledge, there is only one published paper that has explicitly addressed the issue of trend in the socioeconomic inequality of health among infants in the Czech Republic after 1989. Koupilová et al. [1998] inquired into the effect of maternal education on a birth weight, pre-term delivery, and infant mortality in 1989-1991 and 1994-1996 using data on all live singleton births, which were obtained from a population register. That data showed an increase in the effect of the mother's education on birth weight (measured in grams) and on the odds of pre-term delivery in OLS or logistic regression models.

Changes in the association between parental social standing and the health of their children may have far reaching stratification consequences. Socioeconomic standing of parents, to a certain degree, translates into the health of their children (e.g. [Gortmaker and Wise 1997; Kramer et al. 2000; Wise 2003]) and child health then affects their adult socioeconomic statuses. A number of scholars have documented the consequences of poor birth and pregnancy outcomes for socioeconomic statuses later in life (e.g. [Conley and Bennet 2002; Conley, Strully, and Bennett 2003; Spencer and Law 2007]). Hence growing socioeconomic inequality in child health may transform the entire process of intergenerational status inheritance. The social problem it poses is twofold. Rise in child health inequalities represents a major immediate threat to equity and a significant barrier to future intergenerational social mobility. Any such instance should be monitored and analyzed thoroughly.

This paper investigates trends in socioeconomic inequality in the health of newborns in the Czech Republic between 1990 and 2007. While changes in the SES-health association are of intrinsic interest in any social context, the post-socialist Czech Republic is a particularly attractive case, since the country has experienced unprecedented improvements in population health (e.g. life expectancy at birth grew from 68 to 74 in men and from 75 to 80 in women between 1990 and 2008 – [Czech Statistical Office 2010]) and significant increases in economic and social inequality in many areas. Yet, our understanding of inequality in child health and its changes in this particular context is somewhat limited.

3. Changes in social structure that may have affected birth and pregnancy outcomes

Koupilová et al. [1998] offer a number of somewhat speculative explanations for rising disparities in infant health that they observed in the Czech Republic in the first half of the 1990s. However, their main argument emphasizes that growing inequality in birth outcomes truly reflects a divergence of living standards between less educated and better educated mothers. The authors maintain that declining real incomes and reductions in social security benefits have made the less educated comparatively more vulnerable to socioeconomic risks and exacerbated existing differences. The rhetoric adopted by Koupilová et al. [1998] then implies that social security reforms undertaken by the Czech government in the 1990s contributed significantly to the growing inequality in infant health. They also point to the increasingly socially stratified prevalence of smoking among pregnant women. Furthermore, the authors stress the transformation of the Czech health care system in the first half of the 1990s. These and other possible sources of growing socioeconomic inequality in pregnancy and birth outcomes that escalated during the post-socialist transformation are reviewed in this section.

Following the break-up of the socialist regime the Czech Republic went through a period of economic decline that have negatively impacted especially the lower educated people. Real incomes dropped in the early 1990s and inequality in the distribution of earnings and incomes increased remarkably after 1990 [Večerník 1999, 2001]. There was an increase in intra-generational occupational mobility and a massive exodus of people from the labor market. Employment rates shrank and unemployment – previously practically nonexistent – swelled [Večerník and Matějů 1999]. Employees experienced growing economic returns to education and increasing consistency between education, occupation, and earnings (e.g. [Matějů and Kreidl 2001]). Socioeconomic risks became more stratified by education level and other statuses after 1989. These include the risk of unemployment and long-term unemployment [Frýdmanová et al. 1999; Hamplová and Kreidl 2006; Keune 2003], fear of unemployment [Mareš, Sirovátka, and Vyhlídal 2003], and the risk of material deprivation [Večerník 1999]. Similarly, the odds of downward occupational mobility became more strongly stratified by education and gender [Katrňák et al. 2008]. In addition, poverty rates burgeoned and the nature of poverty itself changed [Mareš and Rabušic 1996]. There is a strong and growing association between the risk of poverty and an individual's human capital.

Social inequalities have also been shaped by social and family policy reforms. Reforms of the 1990s were directed towards less generous and income-tested welfare benefits. Furthermore, state regulation of food prices and the negative taxation of many goods was discontinued in 1991 and was – for a limited period of time – substituted by a direct welfare payment ("*vyrovnávací příspěvek*" in Czech). This payment was universal until 1992 and then continued as a means-tested benefit until 1995. New tax system was introduced in 1993 that established tax benefits for parents and redefined child support ("*přídavky na děti*" in Czech) to depend on the age of the children [Krebs 2005].

Family policy is particularly important for our purpose. While the socialist regime generously and universally supported newlyweds and parents by subsidized loans and allowances, these benefits were discontinued after 1989. Hiršl [2004] tellingly showed that the purchasing power of state support for families with children decreased dramatically after 1989. His “model family” with two average incomes and two children covered 53 % of standardized needs of the children from state benefits (allowances, tax relieves) in 1989, as compared to 15 % in 2002. In addition, child care centers – directly or indirectly subsidized by the state – were disappearing, which lead to a marginalisation of parents on the job market [Hašková, Uhde 2009]. Particularly lone parents faced increasingly challenging labor market conditions as a consequence. Numerous changes in family policy introduced in the 2000s expanded the choice-set available to parents, but frequent changes prevented family policy from offering stable and safe conditions for parents and their children [Kocourková 2008].

Health inequalities were perhaps also influenced by the transformation of the Czech health care system in the first half of the 1990s. The reform assumed (and encouraged) a more active role of patients in seeking and utilizing health care. It institutionalized the principle of the free choice of general practitioner (GP), as opposed to the previous system that bureaucratically assigned people to GPs based on their place of employment or residence. Moreover, the economics of health care changed too. The total share of GDP spent on the health care system increased sharply in the first half of 1990s from the level below 5 % to 7 % (in 1995) and then stabilized on this level [Bryndová et al. 2009]. Private health care centers were established and all medical establishments – public as well as private – were forced to increase productivity with the newly introduced fee-for-service reimbursement system. This resulted in a widespread commercionalisation of the approach of the health-care system to its clients (see e.g. [Hasmanová Marhánková and Hrešanová 2008]). Overall, these changes emphasized individual agency and responsibility and might have made socioeconomic status a more salient factor in seeking and utilizing health care on the side of (potential) patients and also in care provision on the side of health care establishments and their personnel [Habicht et al. 2009]. As a result, these changes might have led to an increasing social gradient in pregnancy and birth outcomes [Koupilová et al. 1998].

To summarize, we believe that the growing overall exposure to risk and uncertainty, more stratified experience with various risk factors, increasing socioeconomic inequality, and institutional and policy reforms might have led to growth in the socioeconomic stratification of pregnancy and birth outcomes during the post-socialist transformation. Bobak et al. [2000] argue that the adverse health consequences of post-socialist transformation were caused by psychosocial factors that work both directly and indirectly through health-related behavior. They see the origins of the psychosocial influences in work conditions, harmful life events and everyday difficulties, social networks (marriage, friendship), job security or the perceived amount of control a person have over his/her life. The above described trends in social structure of Czech society suggest that these risks were unequally distributed.

4. Main research focus and analytic strategy

We argue that post-socialist socioeconomic transformation might have affected sources and patterns of social (dis)advantage in child health. Yet, it might have transformed the mechanisms that link parental socioeconomic standing to child health as well. It is rather difficult to clearly identify these causal pathways, since the complexity of the post-socialist social transformation is enormous and concurrence of the changes is far-reaching. Yet another serious complication in such research enterprise is the lack of data that would contain sufficiently detailed information about health status(es) as well as a wide range of potential explanatory and mediating variables.

Therefore, we focus simply on the description of trends in socioeconomic inequality in pregnancy and birth outcomes. We explore the impact of post-socialist transformation upon the health of newborns from different socioeconomic groups. Our goal is to describe the development of socioeconomic disparities in the health of infants born in the Czech Republic since the beginning of 1990s till now and to offer some (tentative) interpretation. We make no effort to disentangle the various (potential) mediating mechanisms and make use of – conceptually and also statistically speaking – *reduced-form models*. We regard these (simplifying) models sufficient to assess whether the socioeconomic stratification of birth and pregnancy outcomes has changed and if (and to what extent) it represents a public policy challenge.

Our analysis extends earlier research in this area (see e.g. [Koupilova et al 1998]) in three different ways. The exemplary paper by Koupilova et al. [1998], while rich in many aspects, has three important limitations. First, it analyzed only a short period at the early stage of post-socialism (until 1996), while we can map trends until 2007, which may give us more leverage to unambiguously identify trends in inequality. Second, earlier research did not control for some relevant variables (e.g. administrative district) and offered therefore potentially biased estimates of the effect of mother's education on child health. Third (and relatedly), previous analyses did not pay attention to the geographic clustering of data and did not capitalize on the analytical options it offers to researchers. Our design acknowledges the clustered data structure and incorporates it directly into our statistical models via multilevel modeling. Hence, our models are a more realistic representation of the actual data structure and represent a better building block for (potential) future analysts, who might be interested in utilizing macro-level explanatory variables and/or capitalizing more fully on the analytical options that multi-level modeling offers.

Our analysis is, then, a replication and extension of earlier research on socioeconomic inequality in child health in the Czech Republic after 1989. Since we use somewhat different data and analytic procedures than have been used in this area so far, we have to explore explicitly if we can replicate results of earlier research using our statistical models. Then, we investigate if identified trends persisted until 2007. Finally, we also assess whether results are consistent across other measures of infant health not utilized before.

5. Data, Variables, and Statistical Method

We use vital statistics data collected by the Czech Statistical Office for the analysis. The database contains data on all births to Czech mothers in given years. The birth certificate records several characteristics of the newborn and his/her parents. The information about the newborn includes – among other things – sex, vitality, birth weight, length of gestation, parity, along with the date of delivery. Recorded parental characteristic refer mostly to the mother – her age, marital status, education level, and region (administrative district) of her permanent residence.[3] The birth certificate also inquires about the husband's characteristics (age, education etc.) in married mothers. However, it failed to record any information pertaining to cohabiting and other fathers until 2007.[4]

In 2006, when we purchased the first segment of the data (years 1992, 1994, 1996, 1998, 2000, 2002, 2004), Czech Statistical Office only had the birth certificate database in a

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[3] "Permanent residence" is an administrative term referring to the place where a person is registered to vote, pay taxes, etc. It is not always necessarily a person's current residence. We only use data on the district (county) of permanent residence. There are – to our knowledge – no data on how frequently the "permanent" and current addresses differ and how often each is located in a different administrative district.

[4] The data collection practice was changed as of January 1, 2007 and since the birth certificate also routinely collects information on fathers regardless of the mother's marital status. We do not use any information on fathers in this particular analysis.

machine-readable format covering all years back to 1992. Furthermore, the primary database was not available to researchers, who instead could only obtain extracts in the form of multi-way tables. This did not represent an insurmountable analytic problem, since most of the variables are nominal or ordinal. Later we gained access to complete birth databases for years 1990 and 2007 and extended the original dataset. Because we obtained the data on two different occasions and in two different formats, we had to make some measurement compromises to harmonize all records into one database (see Appendix A for full details on the harmonization of birth weight data).

We analyze data on all singleton[5] births in 1990, 1992, 1994, 1996, 1998, 2000, 2002, 2004, and 2007. There were 912,752 such births in these years. We faced only minor problems with missing data. Mother's education was not recorded in 173 cases. Twelve of these missing observations (two in 1996, three in 2000, two in 2002, two in 2004, and three in 2007) occurred in mothers aged 17 years or less. Hence, these mothers could only have completed elementary education before giving birth. Therefore, these missing values were re-coded into elementary education. The remaining 161 cases were deleted.[6] There were no missing values in other variables. Thus we have 912,591 singleton births to study inequality in stillbirth. Other analyses are carried out on live births, i.e. using 909,803 cases.

We use six different dependent variables in our analyses: vitality, length of gestation, and four variables based on birth weight (percentage distributions of our dependent variables

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[5] Multiple pregnancies more often result in adverse outcomes (i.e. preterm birth, low or very low birth weight). Therefore we decided to exclude them from the analysis which is a rather common practice (cf., for instance [Koupilová et al. 1998, 2000, 2006; Raum et al. 2001]).

[6] We have carried out a logistic regression to find out if missing values can be predicted on the basis of other variables in the analysis. We estimated a set of models with all our dependent and independent variables as the predictors of missingness of mother's education. Only district turned out to predict missingness in any significant way.

are presented in Table 1). *Vitality* is a dichotomous variable contrasting still (0) vs. live (1) births. Czech Statistical Office uses a variant of the WHO definition of live birth based on observed signs of life[7]. We see in Table 1 that the share of still births declined fairly rapidly from 0.39 % (in 1990) to 0.30 % (in 1994), then it bounced around somewhat to continue declining after 1998 until its present (2007) level of 0.26 %.

Length of gestation is measured in weeks between mother's last menstrual period and childbirth. We use this information as a dichotomous variable of preterm (37 weeks and less) vs. term birth. Table 1 shows that the proportion of preterm born newborns in singletons was rather stable until 2002. Between 1990 and 2002 the share of preterm born singletons ranged from 7.7 to 8.8 percent without a discernible trend. However it grew to 10.5 % by 2007.

Birth weight is measured and recorded in grams on the birth certificate. We use it both as a *continuous variable* and in dichotomized versions. We use three different birth weight thresholds for the dichotomization. First, we contrast *low birth weight* (2499 grams or less) vs. other (2500 grams or more) birth weight. Second, we contrast *very low birth weight* (1499 grams or less) vs. other birth weight. Finally, we contrast *high birth weight* (3500 grams or more) vs. other. Low and very low birth weight indicate a health disadvantage while high birth weight means an advantageous health condition. According to Spencer [2003: 5-8], who reviewed findings from several European and American studies, children born with the weight between 3500 and 4500 grams have the lowest infant mortality. Rychtaříková [1999] identified weight interval between 3500 and 3999 grams as showing the best survival chances in Czech infants.

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[7] Live birth is (and has been during the whole study period) defined as "*expulsion or extraction of the fetus from the mother's body if the infant shows any sign of life and his/her birth weight is a) higher than 1000 g or b) lower than 1000 g and the infant survives 24 hours. Otherwise the birth is considered as still birth. The marks of life are breath, beat of the heart, pulsation of the umbilical cord or movement of voluntary muscles, whether or not the umbilical cord has been cut or the placenta is attached*" [Ministry of Health Care].

Table 1 presents data on the distribution of categories of birth weight over time, which show little change. For instance, the share of children with low birth weight remains fairly constant across the entire period of observation, ranging from a minimum of 4.3 % in 1998 to a maximum of 5.2 % in 2007. Similarly, there is not much trend in the relative incidence of other categories.

The main explanatory variable is *mother's education*. It is an ordinal variable distinguishing four levels of schooling: elementary, lower secondary (vocational), higher secondary (complete secondary), and tertiary. Education is measured at the time of the woman's delivery, so some mothers may not have completed their education at that time. We also utilize a number of control variables that are known to influence birth and pregnancy outcomes (cf. for instance [Spencer 2003; Koupil et al. 2006; Rychtaříková 1999]): *age of the mother* (split into the following categories: under 17 years, 18-19, 20-24 years, 25-29 years, 30-34 year, 35+ years), *parity* (with four categories: 1, 2, 3, 4+), the *sex* of the infant (male vs. female), *marital status* (never married, married, widowed, and divorced). Our multi-level statistical models use *district* as a clustering (second-level) variable (district has 78 distinct categories).[8] The distribution of cases across the categories of independent variables is presented in Table 2.[9]

We estimate the models for each *year* (1990, 1992, 1994, 1996, 1998, 2000, 2002, 2004, and 2007) to inspect trends in the estimated effect of mother's education. We estimated two models for each of the dependent variables – the baseline model only with mother's education as an explanatory variable and the extended model with the whole set of controls. We used

[8] The system of administrative districts has undergone some reforms during the period under observation. We use district definitions valid as of 2007 in the analysis. Data collected before the reforms were modified and each birth was assigned to the district where it would have belonged after the reform.

[9] We do not report distribution of cases by district for space reasons.

random-intercept models to account for the clustered data structure.[10] For the continuous dependent variable, the two models can be formally written as:

Baseline model (without controls):

$$Y_{ij} = \beta_{0j} + \beta_1 * Ed2 + \beta_2 * Ed3 + \beta_3 * Ed4 + e_{ij} \qquad \text{(Eq. 1)}$$

Extended model (with controls) is then:

$$Y_{ij} = \beta_{0j} + \beta_1 * Ed2_i + \beta_2 * Ed3_i + \beta_3 * Ed4_i + \sum_{k=1}^{K} \beta_k * X_{ki} + e_{ij} \qquad \text{(Eq. 2)}$$

In these equations, Y_{ij} denotes birth weight (in grams) in the i^{th} infant in district j, *Ed2* is the indicator variable for vocational education, *Ed3* indicates complete secondary education, and *Ed4* is the indicator for university education. Also, β_{0j} is a random intercept and e_{ij} is the prediction error. Finally, $\beta_1, \beta_2, \beta_3$ are expected differences in birth weight between, respectively, vocational, complete secondary, and university education and the reference category of education (elementary education). In Equation 2, X_{ki} is a vector of K control variables and β_k are their estimated effects.

We estimate each model separately for each year, for which we have the data. We use estimated coefficients $\beta_1, \beta_2, \beta_3$ from both the baseline and extended models as indicators of the extent of inequality in birth weight in each year.[11] By comparing these coefficients across years, we can observe increasing, stable, or declining inequality. We visualize estimated

[10] In an ancillary analysis (not reported here) we also entered district as fixed-effects into the analysis. Results were not different substantively.

[11] We chose to parameterize the effects of education this way, since a preliminary analysis revealed that the largest gap in child health by maternal education is between mothers with elementary education on the one hand and mothers with all other levels of education on the other hand.

coefficients in a series of graphs to capture possible trends. Furthermore, we report the precise values of all estimated βs in Appendix B.

Both baseline and extended models can analogously be rewritten for dichotomous dependent variables (see e.g. [Hox 2002: Ch. 6; Raudenbush, Bryk 2002: 294-309]) and estimated coefficients can be utilized in a similar fashion to describe trends in socioeconomic inequality in the log odds of still birth, preterm birth, or very low, low, and high birth weight.[12]

6. Results

Figure 1 shows the expected difference in average birth weight in grams between infants born to mothers with lower secondary, higher secondary, and tertiary education compared to the reference category of elementary education. Infants born to mothers with lower secondary education were, on average, by 129 grams heavier in 1990 than infants born to mothers with elementary education. The contrast between university educated mothers and elementary educated mothers was 186 g in the same year. The disparities grew until 1996 and later stabilized at the level of 178 – 188 grams (elementary vs. lower secondary education) and 236 – 240 grams (elementary vs. university educated mothers) with no clear trend. By 2007, the elementary education disadvantage fell to 168 grams, 197 grams, and 213 grams compared to lower secondary, higher secondary, and university education, respectively. Gross educational disparities were thus larger in 2007 than in 1990. When control variables were added to the model, inequalities in birth weight were attenuated (see the right panel of Figure

[12] We report only the estimated effects of mother's education. We report neither the effects of other variables in the analysis, nor other characteristics of our multi-level models (i.e. variance components), since these are of little substantive interests. Similarly, we refrain from comparing the baseline and extended models statistically, because we have population data and statistical inference is therefore of limited value. We have employed STATA 11 MP's commands "`xtreg`" and "`xtlogit`" to obtain all estimates presented in this paper.

1), yet the basic pattern persisted. We again observe a rise in educational disparities peaking in 2004 and a decrease in the last year. Again, net education gap was larger in 2007 than in 1990. In sum, the disparity in mean birth weight by mother's education increased after 1990. However, the rise did not continue after the mid-2000s and currently there seems to be some evidence of a reversal. When controlling for additional variables, the increase in the 1990s is less intense, yet it is still quite manifest. We again observe an indication of attenuating inequality between 2004 and 2007. Despite this last data point, there is more inequality in birth weight in the late 2000s than there was in the early 1990s.

Figure 2 presents beta coefficients for models with binary indicator of low birth weight as the dependent variable. The interpretation of these coefficients is not as intuitive as the difference in grams in the previous analysis, since the figure pictures differences in the expected log odds. Again we see that the biggest gap is between elementary and any higher education of the mother. According to the baseline model, the disparities increased in the first half of 1990s and then lessened steadily even below their initial size. When control variables are added, the trend is much less clear. It appears that the effects of lower secondary education and of university education grew overall, while the effect of higher secondary education stayed the same.

Figure 3 shows trend in the effect of maternal education on the log odds of very low birth weight. Lines in the figure are not very smooth due to the low absolute numbers of newborns in this weight category. The baseline model documents overall reduced educational disparities between 1990 and 2007. They seem to weaken after 1998, until which point they were rather stable. In contrast, the extended model shows the opposite pattern. Despite the oscillatory character of the lines, a trend towards more inequality is recognizable. The disparity increased from -0.43 to -0.48 when we consider elementary vs. lower secondary education of the mother. The contrast between children born to mothers with elementary and mothers with university education rose from -0.68 to -1.00. The net effect of maternal education on the probability of very low birth weight has thus strengthened since 1990.

Figure 4 presents results of the analysis of high vs. other birth weight. The gross disparities between infants born to mothers with elementary and higher levels of education sharply increased between 1990 and 1998. The contrast between elementary and lower secondary education rose from 0.38 to 0.64, and disparity with tertiary education increased from 0.56 to 0. 83. This high level of differences persisted until 2004 and then dropped to 0.58 for elementary vs. lower secondary education of the mother and to 0.70 for the contrast between elementary and university maternal education. The resulting level was, however, higher than the initial disparities. Similarly, the net education effects (see the right panel in Figure 4) were larger in 2007 than in 1990.

Now we focus on another proxy for a newborn's health condition, the length of pregnancy. The results are shown in Figure 5. Both the net and gross education disparities in the log odds of preterm birth were stable in the 1990s and weakened significantly after 1998. This trend is rather robust when we consider the baseline model. The contrast between elementary and lower secondary education decreased from -0.62 to -0.41 and the difference between elementary and tertiary education decreased from -0.83 to -0.58. However, the net improvement is much more modest. Thus, most of the decrease in inequality in preterm birth is explained away by the control variables.

Finally, we proceed to the analysis of how mother's education influences vitality of the fetus. These results are presented in Figure 6. Again, we see that – as in the case of very low birth weight – the low number of cases of interest (i.e. stillbirths) makes the lines bounce around rather strongly. Nevertheless, we observe a quite noteworthy trend. There clearly is more inequality in the vitality of the fetus in the second half of the 2000s than there was in the early 1990s. This is the case when we consider both the gross and net effects of maternal education.

7. Summary and Concluding Discussion

We have explored trends in socioeconomic inequality in birth and pregnancy outcomes in the Czech Republic between 1990 and 2007. We have utilized six different dependent variables – all generally widely agreed upon to be reasonable approximations of child health and future life chances (four measures of birth weight, vitality, and length of gestation). We employed mother's education as a proxy for socioeconomic status of the family, to which the child was conceived and born. We have limited our analysis to singleton births. Since we used hierarchical linear models to account for the clustered data structure, we believe that our analysis offers a more credible evidence of trends than earlier papers have supplied.

Maternal education seems to stratify pregnancy and birth outcomes fairly strongly. Interestingly, the most salient gap in health is between mothers with elementary education and all other mothers. This major stratification division played out disregarding the specific outcome variable and persisted through the period under study. We trust that both sociologists and demographers shall pay more attention to the least educated mothers, their (non-) decisions to conceive a child and the circumstances of their pregnancy and subsequent life situation. While inequality in child health by maternal education is typically partially explained away by other variables (most notably age and marital status), the net effect of education is still remarkably salient. Factors related directly to educational attainment (most notably the amount of economic resources) appear to be responsible for observed levels of inequality. Nevertheless, changing age patterns of fertility and marriage market behavior of women can also make an important contribution to our understanding of the changing patterns of child health stratification. Another variables that may play an important role in shaping the inequality (and that was not included in our analysis) are migrant status od ethnic minority origin. Bobák et al. [2005], for example, observed substantial disparities in birth outcomes beween Roma and non-Roma newborns which, although largely explained by maternal education, persisted after controlling for other predictors.

We saw that inequality in the various birth weight measures increased. The increase occurred mostly in the in the 1990s and this trend did not continue to the 2000s. There even seems to be an indication of declining inequality by the end of the 2000s. Yet, this reversal is indicated mostly by data points at the very end of our time series. Therefore, caution shall be executed before a strong generalization statement is made in this regard. While these tendencies surface in all measures based on child birth weight, the described tendency is most pronounced in the analysis of birth weight measured as a continuous variable and in the most advantageous weight category of 3500 and more grams. This suggests that the socioeconomic transformation impacted most significantly on the health of infants from the least privileged social group in the way that they became less likely to be born in the most advantageous weight category, while the relative risk of the most adverse outcomes did not increase for them.

Inequalities in still birth and pre-maturity display somewhat inconsistent trends. Stratification of the odds of premature delivery showed some reduction (or no trends). Inequality in the vitality of the fetus became perhaps more strongly linked to mother's education. Yet, this last result is – more than any other piece of empirical evidence in this paper – the least robust of all, since the number of stillbirths is extremely low.

Our results conform only partly to the findings of Koupilová et al. [1998] who studied education differences in birth weight, preterm birth, and infant death from 1989 till 1996. Similarly to these authors, we found rising educational differences in birth weight, however, the growing disparity in length of pregnancy was not confirmed in our analysis. We have no explanation as to why our results do not replicate earlier analyses more precisely.

Overall, we have seen more evidence of growing inequality in birth and pregnancy outcomes than of declining stratification. The growth in inequality occurred in the first half of the 1990s in most cases. Therefore we tentatively link this trend to the costs of the early stage of the societal transition after 1989, when the amount of stress and uncertainty related to new social and economic phenomena spread throughout society. We are unsure why inequality stabilized towards the late 1990s. Perhaps some process of psychological adjustment took place in the 1990 that made eventually all people less vulnerable to stressors as they began to understand the new situation and became resistant to stress. We hypothesize that socio-economically advantaged individuals made the adjustment faster and individuals with less resources adjusted at a slower pace. This *selective adjustment hypothesis* would explain why inequality increased initially and then stabilized at a new level.

It is also possible that the (potentially) most vulnerable women within each education group might have increasingly opted to be childless. Vulnerability, we believe, may not relate directly to economic resources, but may reflect the level of social support, for instance, that differs within social strata. Women across education levels may differ in their cognitive abilities to assess their social situations and the life chances of their children. As long as more educated women are faster in understanding and acting upon the new social situation, this learning and decision-making process could also lead to increasing and then stabilizing inequality levels. We call this alternative explanation *selective childlessness.* Selective childlessness could operate through two distinct mechanisms – selective reproduction planning and selective abortion. There is some evidence showing that indeed *selective reproduction planning* increased in the Czech Republic in the 1990s. Little is known on the selectivity of abortion.

Hašková [2009: 97-101] showed, for instance, that Czech women and men with different socioeconomic status consider different factors when deciding about having children. Respondents with higher education and higher income (personal as well as household income) pay more attention to what Hašková calls situational reasons while those with low education and income more adhere to desire-for-a-child factor. The situational factor, preferred by the higher socioeconomic groups, includes regards to partnership and health and work conditions of both potential parents. By timing childbirth according to these conditions (i.e. most probably delaying it after the stressful transition period in 1990s), high-status families may have avoided potential health risks for their children more effectively than low-status families. Thus women who gave births in 1990s (and especially early 1990s) may have selectively more recruited from those who either considered their situation optimal for having children or who just wanted to have children without deliberating their situation properly. This could result in health advantage of children born to the former group of mothers and risk for children from the latter group and thus in rise of inequality.

Our understanding of how social standing influences pregnancy and birth outcomes is still limited. Measuring family background only with maternal education offers an incomplete picture of the resources that families have to bring up a healthy child as it misses the influence of a father's contribution to the social standing of a family (c.f.[Rychtaříková 2001]). Moreover, family arrangement may play an important role in influencing the health of children (c.f. [Bird et al. 2000]) beside and in interaction with parental statuses. Hence we suggest that the observed increase in socioeconomic inequality in the health of newborns shall be considered as a starting point to a more thorough research of family-background health consequences for children.

8. References

Adeyi, Olusoji, Gnanaraj Chellaraj, Ellen Goldstein, Alexander Preker, and Dena Ringold. 1997. "Health status during the transition in Central and Eastern Europe: development in reverse?." *Health Policy and Planning* 12: 132.

Bartley, Mel, David Blane, and George D. Smith. 1998. *The sociology of health inequalities*. Wiley-Blackwell.

Bird, Sheryl Thorburn, Anjani Chandra, Trude Bennet, S. Marie Harvey. 2000. „Beyond Marital Status: Relationship Type and Duration and the Risk of Low birth Weight." *Family Planning Perspectives* 32 (6): 281-287.

Blaxter, Mildred 1991. "Fifty years on--Inequalities in Health." *Population Studies* 69-94.

Blažek, Jiří and Dagmar Dzúrová. 2000. "The decline of mortality in the Czech Republic during the transition: a counterfactual case study." Pp. 303–327 in *The mortality crisis in transitional economies*, edited by Giovanni Andréa Cornia and Renato Paniccià. Oxford University Press.

Bobák, Martin, Hynek Pikhart, and Ilona Koupilová. 2000. "Maternal socioeconomic characteristics and infant mortality from injuries in the Czech Republic 1989-92." *Injury Prevention* 6: 195-198.

Bobak, M., J. Dejmek, I. Solansky, and R. J. Sram. 2005. "Unfavourable birth outcomes of the Roma women in the Czech Republic and the potential explanations: a population-based study." *BMC Public Health* 5:106.

Bryndová, Lucie, Kateřina Pavloková, Tomáš Roubal, Martina Rokosová, and Matthew Gaskins. 2009. “Czech Republic: Health System Review.”*Health Systems in transition* 11 (1): 1-122. (http://www.euro.who.int/__data/assets/pdf_file/0010/97633/E92968.pdf), visited on 26-7-2010.

Carlson, Elwood, Jan M. Hoem, and Jitka Rychtaříková. 1999. “Trajectories of fetal loss in the Czech Republic.” *Demography* 36: 327-337.

Chen, Lincoln C, Friederike Wittgenstein, and Elizabeth McKeon. 1996. “The upsurge of mortality in Russia: causes and policy implications.” *Population and Development Review* 22:517–530.

Cockerham, William C. 2007. *Social causes of health and disease*. Polity Press.

Conley, Dalton, Neil G. Bennet. 2002. „Birth Weight and Income: Interactions Across Generations.“ *Journal of Health and Social Behavior* 42: 450-465.

Conley, D., K. W Strully, and N. G Bennett. 2003. *The starting gate: birth weight and life chances*. Univ of California Pr.

Cockerham, William C. 1997. “The Social Determinants of the Decline of Life Expectancy in Russia and Eastern Europe: A Lifestyle Explanation.” *Journal of Health and Social Behavior* 38: 117-130.

Cornia, Giovanni. A. and Renato Paniccià (eds.) 2000. *The mortality crisis in transitional economies*. Oxford University Press, USA.

Czech Statistical office. 2008. Czech Demographic Handbook 2007. (http://www.czso.cz/csu/2008edicniplan.nsf/engpubl/4032-08-2007), visited on 26-7-2010.

Czech Statistical Office. 2010. *ČR od roku 1989 v číslech* (Czech Republic since 1989 in numbers). (http://www.czso.cz/csu/redakce.nsf/i/cr_od_roku_1989#01), visited on 26-7-2010.

Czech Statistical office. 2009. Demographic Yearbook of the Czech Republic 2008. (http://www.czso.cz/csu/2009edicniplan.nsf/engpubl/4019-09-2008), visited on 26-7-2010.

Federal State Statistics Service. Russia in Figures. (http://www.gks.ru/bgd/regl/b09_12/IssWWW.exe/stg/d01/05-08.htm), visited on 8-7-2010

Frýdmanová, Marie, Kamil Janáček, Petr Mareš, and Tomáš Sirovátka. 1999. "Labour Market and Human Resources." Pp. 21-43 in *Ten Years of Rebuilding Capitalism. Czech Society After 1989*, edited by Petr Matějů and Jiří Večerník. Praha: Academia.

Gortmaker, Steven L., and Paul H. Wise. 1997. "The first injustice: Socioeconomic disparities, health services technology, and infant mortality." *Annual Review of Sociology* 23: 147-170.

Grigoriev, P. et al. n.d. "Mortality in Belarus, Lithuania, and Russia: Divergence in Recent Trends and Possible Explanations." *European Journal of Population/Revue européenne de Démographie* 26: 1–30.

Habicht, Jarno, Raul-Allan Kiivet, Triin Habicht, and Anton E. Kunst. 2009. "Social

Inequalities in the Use of Health Care Services after 8 years of Health Care Reforms – a Comparative Study of the Baltic Counties." *International Journal of Public Health* 54: 250-259.

Hamplová, Dana, and Martin Kreidl. 2006. "Globalization and men's occupational mobility in the Czech republic in the 1990's." Pp. 275- 302 in *Globalization, Uncertainty and Men's Careers: An International Comparison*, edited by Hans-Peter Blossfeld and H. Hofmeister. Cheltenham: Edward Elgar Press.

Hasmanová Marhánková, Jaroslava, and Ema Hrešanová. 2008. "Nové trendy v českém porodnictví a sociální nerovnosti mezi rodičkami." (New Trends in the Czech Birthing System and Emerging Social Inequalities among Birthing Women) *Sociologický časopis/Czech Sociological Review* 44: 87-111.

Hašková, Hana. 2009. *Fenomén bezdětnosti*. (The Phenomenon of Childlesness) Praha: Sociologické nakladatelství.

Hašková, Hana, and Zuzana Uhde, eds. 2009. *Women and Social Citizenship in Czech Society: Continuity and Change*. Praha: Institute of Sociology, Academy of Sciences of the Czech Republic.

Hiršl, Miroslav. 2004. "Příspěvky Českého státu rodinám na náklady spojené s výchovou dětí." (Contributions Provided by the Czech State to Families Raising Children) *Demografie* 46: 166-176.

Hox, Joop. 2002. *Multilevel Analysis. Techniques and Applications.* Mahwah: Lawrence Erlbaum Associates.

Katrňák, Tomáš, Martin Kreidl, Václa Kulhavý, and Tomáš Sirovátka. 2008. "Factors influencing the position of young people on the labour market and changes in mobility chances in the Czech Republic." TransEurope Working Paper 3/2008. Otto-Friedrich-University Bamberg, Bamberg. (http://www.transeurope-project.org/UserFiles/File/Papers/TransEurope_WP3_Katrnak_et_al.pdf), visited on 26-7-2010.

Keune, Maarten. "Capitalist divergence and labour market flexibility in the Czech Republic and Hungary: a comparative analysis of standard and non-standard employment." *Czech Sociological Review* 39: 607–624.

Kocourková, Jiřina. 2008. "Současný baby-boom v České republice a rodinná politika." (The Current 'Baby boom' in the Czech Republic and Family Policy) *Demografie* 50: 240-249.

Koupil, Ilona, Kaja Rahu, Mati Rahu, Helle Karro, and Denny Vagero. 2006. "Major improvements, but persisting inequalities in infant survival in Estonia 1992-2002." *The European Journal of Public Health* 17: 8.

Koupilová, Ilona., Martin Bobák, Jan Holčík, Hynek Pikhart, and David A. Leon. 1998. "Increasing social variation in birth outcomes in the Czech Republic after 1989." *American Journal of Public Health* 88: 1343-1347.

Koupilová, Ilona, Kaja Rahu, M. Rahu, Helle Karro, and David A. Leon. 2000. "Social determinants of birthweight and length of gestation in Estonia during the transition to democracy." *International journal of epidemiology* 29: 118-124.

Kramer, Michael S., Louise Séguin, John Lydon, and Lise Goulet. 2000. "Socio-economic disparities in pregnancy outcome: why do the poor fare so poorly?" *Paediatric and*

Perinatal Epidemiology 14: 194–210.

Krebs, Vojtěch. 2005. *Sociální politika* (Social policy). Praha: Aspi

Mareš, Petr, and Ladislav Rabušic. 1996. "K měření subjektivní chudoby v české společnosti." (Subjective Perception of Poverty in the Czech Republic) *Sociologický časopis* 32: 297–315.

Mareš, Petr, Tomáš Sirovátka, and Jiří Vyhlídal. 2003. "Dlouhodobě nezaměstnaní–životní situace a strategie." (The Long-term Unemployed – Living Conditions and Strategies) *Sociologický časopis/Czech Sociological Review* 39: 37–54.

Marmot, Michael. 2004. *Status syndrome: how your social standing directly affects your health and life expectancy*. Bloomsbury & Henry Holt, 2004.

Marmot, Michael, and Martin Bobak. 2000. "Psychosocial and Biological Mechanisms behind the Recent Mortality Crisis in Central and Eastern Europe." Pp. 127-148 in *The mortality crisis in transitional economies*, edited by Giovanni Andréa Cornia and Renato Paniccià. Oxford University Press.

Matějů, Petr, and Martin Kreidl. 2001. "Rebuilding Status Consistency in a Post-Communist Society. The Czech Republic 1991-1997." *Innovation* 14: 17–34.

Meslé, France. 2004. "Mortality in Central and Eastern Europe." *Demographic Research* Special 2: 45-70.

Ministry of Health Care. The Ministry of Health Care Code nr. 11/1998

Pikhart, Hynek. Drbohlav Dusan, and Dagmar Dzurová. 2010. "The Self-Reported Health of Legal and Illegal/Irregular Immigrants in the Czech Republic." *International Journal of*

Public Health: on-line first.

Raudenbush, Stehen W., and Anthony S. Bryk. 2002. *Hierarchical Linear Models. Applications and Data Analysis Methods.* Thousand Oaks, London, New Delhi: SAGE.

Raum, Elke, Birgit Arabin, Martin Schlaud, Ulla Walter, and Friedrich W. Schwartz. 2001. “The impact of maternal education on intrauterine growth: a comparison of former West and East Germany.” *International Journal of Epidemiology* 30: 81-87.

Rychtaříková, Jitka. 1999. “Sociální a biologické faktory kojenecké úmrtnosti.” (Social and Biological Factors of Infant Mortality) *Demografie* 41: 95-104.

Rychtaříková, Jitka. 2001. “Do maternal and paternal characteristics perform similar roles in adverse pregnancy outcome and infant survival?.” *Acta Universitatis Carolinae: Geographica* 36: 77–94.

Rychtaříková, Jitka, and George J. Demko. 2001. “Inequalities in Infant Survival: An Analysis of Czech Linked Records.” *European Journal of Population/Revue européenne de Démographie* 17: 323–342.

Shkolnikov, Vladimir M., David A. Leon, Sergey Adamets, Eugeniy Andreev, and Alexander Deev. 1998. “Educational level and adult mortality in Russia: An analysis of routine data 1979 to 1994.” *Social Science & Medicine* 47: 357-369.

Sobotík, Zdeněk., and Jitka Rychtaříková. 1992. “Úmrtnost a vzdělání v České republice.” (Mortality and Education in the Czech Republic) *Demografie* 34: 97–104.

Spencer, Nick. 2003. *Weighing the evidence: how is birthweight determined?* Radcliffe Publishing.

Spencer, Nick., and Catherine Law. 2007. “Inequalities in pregnancy and early years and the impact across the life course: progress and future challenges.” *Challenging Health Inequalities: from Acheson to ‘Choosing Health* 69–94.

Stuckler, David, Lawrence King, and Martin McKee. 2009. “Mass privatisation and the post-communist mortality crisis: a cross-national analysis.” *The Lancet* 373: 399-407.

United Nations 2010. *Population and Vital Statistics Report*: Series A. (http://unstats.un.org/unsd/demographic/products/vitstats/seriesa2.htm), visited on 9-7-2010.

Večerník, Jiří. 2001. “Earnings disparities in the Czech Republic: Evidence of the past decade and cross-national comparison.” *Prague Economic Papers* 10: 201-222.

Večerník, Jiří. 1999. “Inequalities in Earnings, Incomes, and Household Wealth.” Pp. 115-136 in *Ten Years of Rebuilding Capitalism*, edited by Jiří Večerník and Petr Matějů. Praha: Academia.

Večerník, Jiří, and Petr Matějů, eds. 1999. *Ten Years of Rebuilding Capitalism. Czech Society 1898-1998*. Praha: Academia.

Wise, Paul H. 2003. “The anatomy of a disparity in infant mortality.” *Annual Review of Public Health* 24: 341-362.

9. Tables and Figures

Table 1. Percentage distribution of dependent variables used in the analysis. Singleton births in the Czech Republic, selected years from 1990 to 2007.

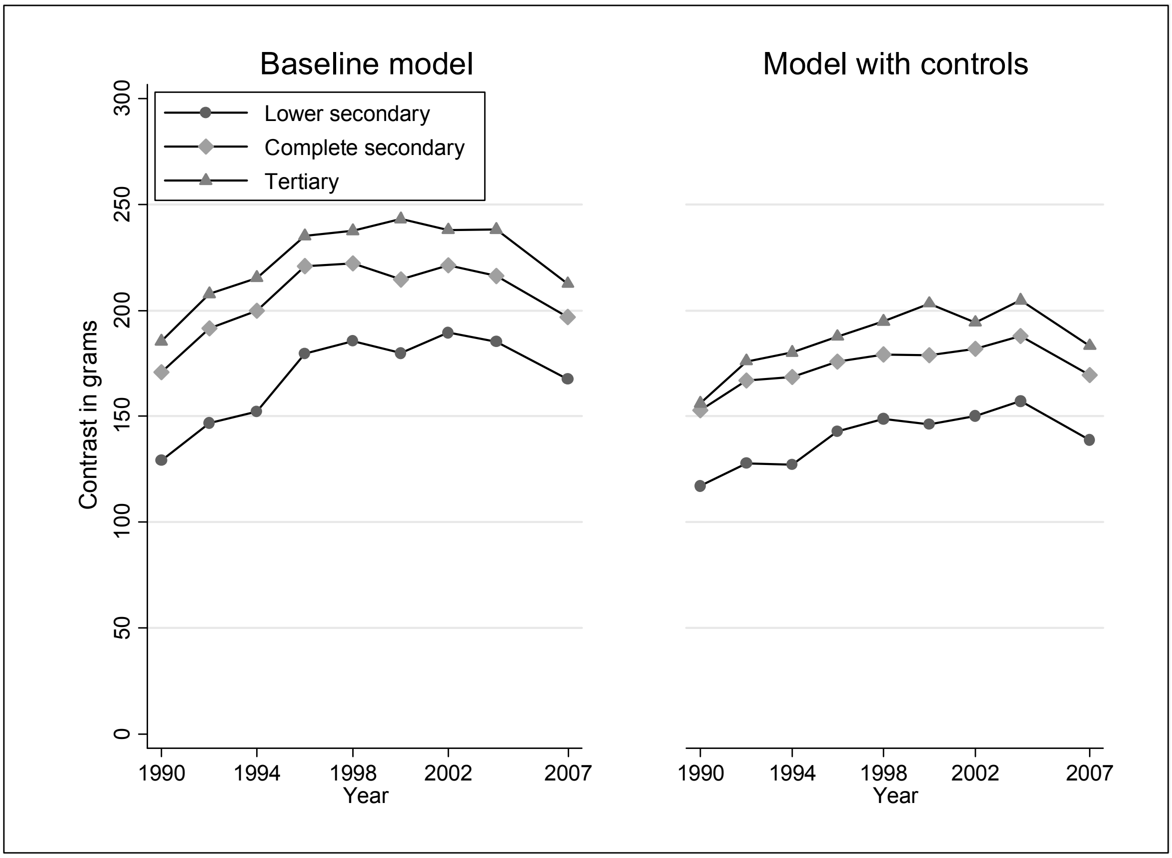
	Year								
	1990	1992	1994	1996	1998	2000	2002	2004	2007
Still births	0.39	0.33	0.30	0.33	0.31	0.27	0.27	0.26	0.26
Total number of births	128,739	119,791	104,876	88,604	87,869	88,363	89,979	94,246	110,124
Birth weight									
1499-	0.6	0.7	0.7	0.7	0.6	0.7	0.7	0.8	0.7
1500-2499	4.1	4.2	4.0	3.7	3.7	3.7	3.9	4.2	4.5
2500-2999	16.9	17.3	16.0	15.1	14.8	14.8	15.4	15.5	16.2
3000-3499	40.4	40.9	40.3	39.1	38.8	39.0	39.1	39.0	40.0
3500+	38.0	37.0	39.1	41.4	42.1	41.8	40.8	40.5	38.6
	100%	100%	100%	100%	100%	100%	100%	100%	100%
Preterm births	7.7	8.8	8.1	8.2	7.9	8.5	8.7	9.5	10.5
Total number of live births	128,243	119,394	104,558	88,315	87,598	88,124	89,737	94,001	109,833

Note: percentage distributions of birth weight and pre-term birth relate to live births only.

Table 2. Percentage distribution of explanatory variables used in the analysis. All singleton births in the Czech Republic, 1990-2007 (N=912,591).

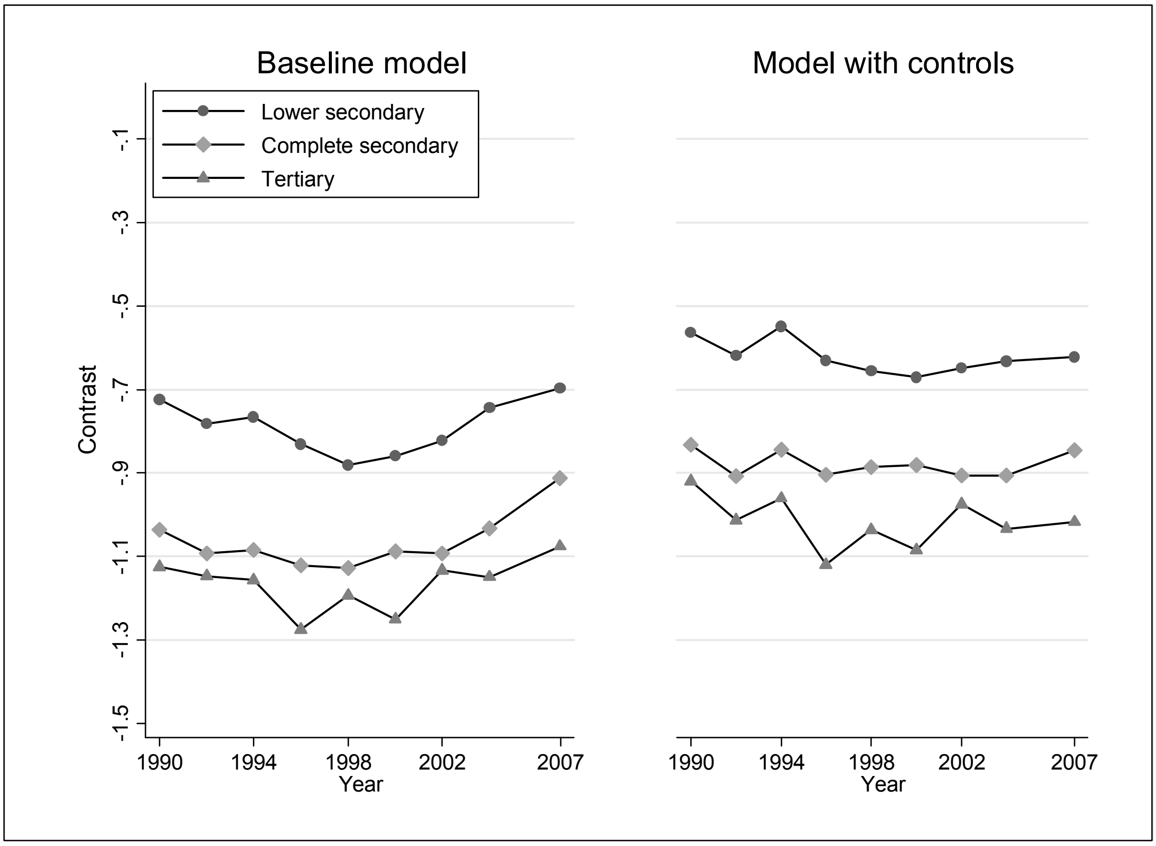
	Year								
	1990	1992	1994	1996	1998	2000	2002	2004	2007
Mother's education									
Elementary	13.8	13.1	13.6	14.0	13.1	12.5	12.5	12.0	11.1
Lower secondary	38.8	41.4	43.1	41.9	40.4	37.7	35.8	32.8	29.5
Complete secondary	38.5	37.3	35.1	35.0	36.7	39.2	40.4	42.0	43.5
Tertiary	8.9	8.2	8.2	9.2	9.8	10.6	11.4	13.2	15.8
	100%	100%	100%	100%	100%	100%	100%	100%	100%
Mother's age									
17-	2.1	2.4	2.0	1.5	1.2	1.0	1.0	1.0	0.8
18-19	12.1	13.9	11.5	7.6	5.7	4.0	3.2	2.8	2.4
20-24	45.0	44.2	44.5	43.4	39.9	32.2	24.7	18.6	14.4
25-29	26.9	26.5	26.9	29.7	34.4	41.1	44.5	44.1	36.8
30-34	9.9	9.1	10.7	13.0	13.8	15.8	19.5	25.3	34.8
35+	4.0	3.9	4.3	4.7	5.1	6.0	7.2	8.1	10.8
	100%	100%	100%	100%	100%	100%	100%	100%	100%
Mother's marital status									
Never married	6.1	7.8	10.7	12.6	14.4	16.8	19.7	24.4	28.3
Married	91.5	89.3	85.4	83.0	80.8	78.0	74.5	69.1	65.1
Divorced	2.2	2.7	3.6	4.2	4.5	4.9	5.5	6.3	6.3
Widowed	0.3	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.3
	100%	100%	100%	100%	100%	100%	100%	100%	100%
Parity									
1	48.3	50.4	48.2	47.1	48.3	48.9	48.9	50.0	47.9
2	37.1	35.7	36.8	38.4	37.8	37.0	36.9	36.2	37.6
3	10.8	10.0	10.5	9.9	9.7	9.7	10.0	9.7	10.6
4+	3.8	3.9	4.5	4.6	4.2	4.3	4.3	4.1	3.9
	100%	100%	100%	100%	100%	100%	100%	100%	100%
Infant's sex									
Female	48.68	48.46	48.63	48.61	48.50	48.15	48.62	48.53	48.92
Total number of births	128,739	119,791	104,876	88,604	87,869	88,363	89,979	94,246	110,124

Figure 1: Estimated effects of lower secondary, higher secondary, and university education of the mother on birth weight. All live singleton births in the Czech Republic in 1990, 1992, 1994, 1996, 1998, 2000, 2002, 2004, 2007. N=909,803.



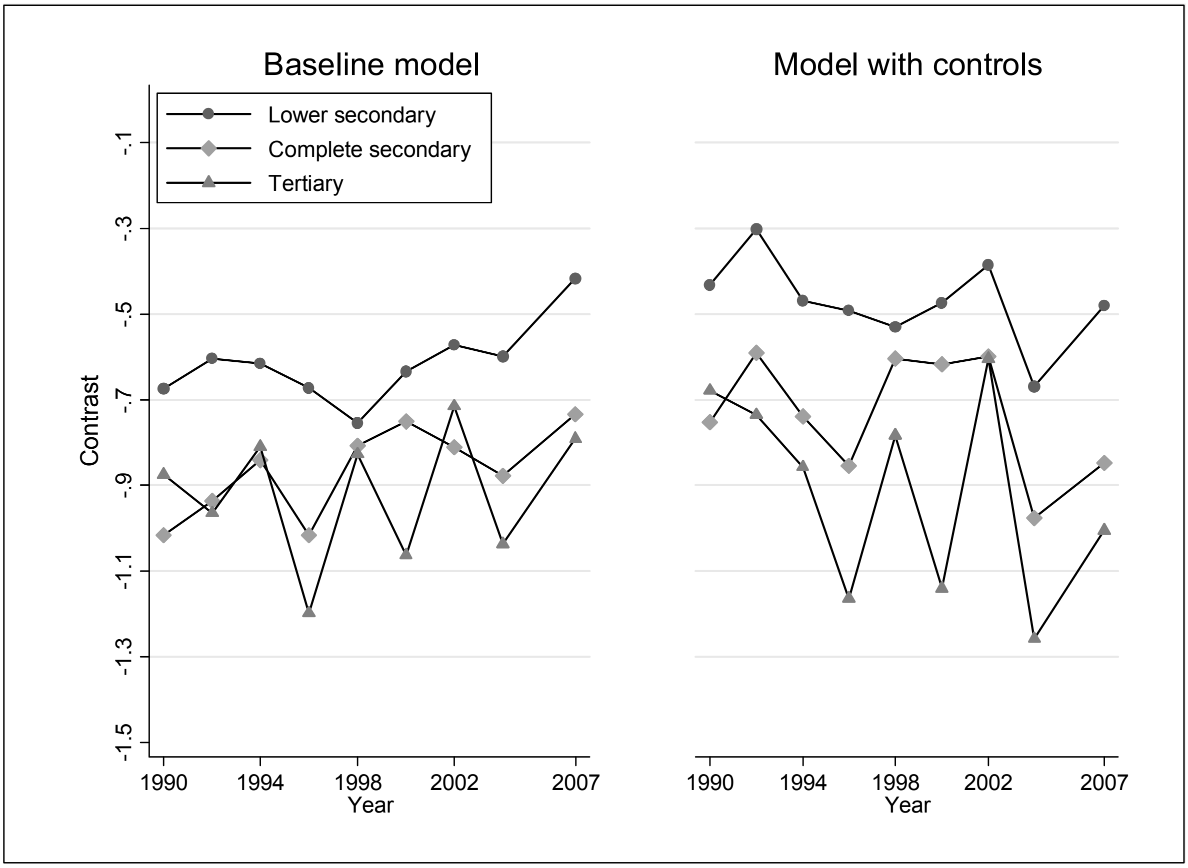
Note: estimates are based on a random-intercept multi-level regression model.

Figure 2: Estimated effects of lower secondary, higher secondary, and university education of the mother on the log odds of low birth weight. All live singleton births in the Czech Republic in 1990, 1992, 1994, 1996, 1998, 2000, 2002, 2004, 2007. N=909,803.



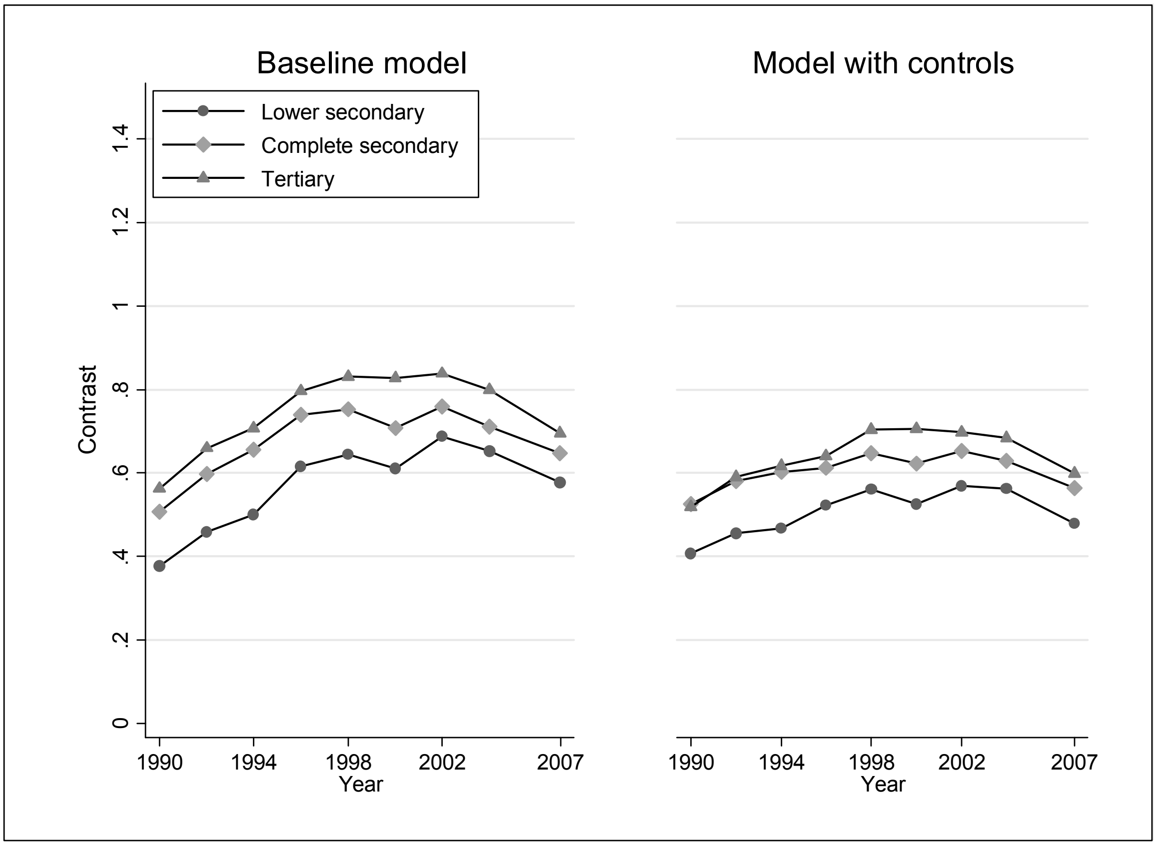
Note: estimates are based on a random-intercept multi-level logistic regression model.

Figure 3: Estimated effects of lower secondary, higher secondary, and university education of the mother on the log odds of very low birth weight. All live singleton births in the Czech Republic in 1990, 1992, 1994, 1996, 1998, 2000, 2002, 2004, 2007. N=909,803



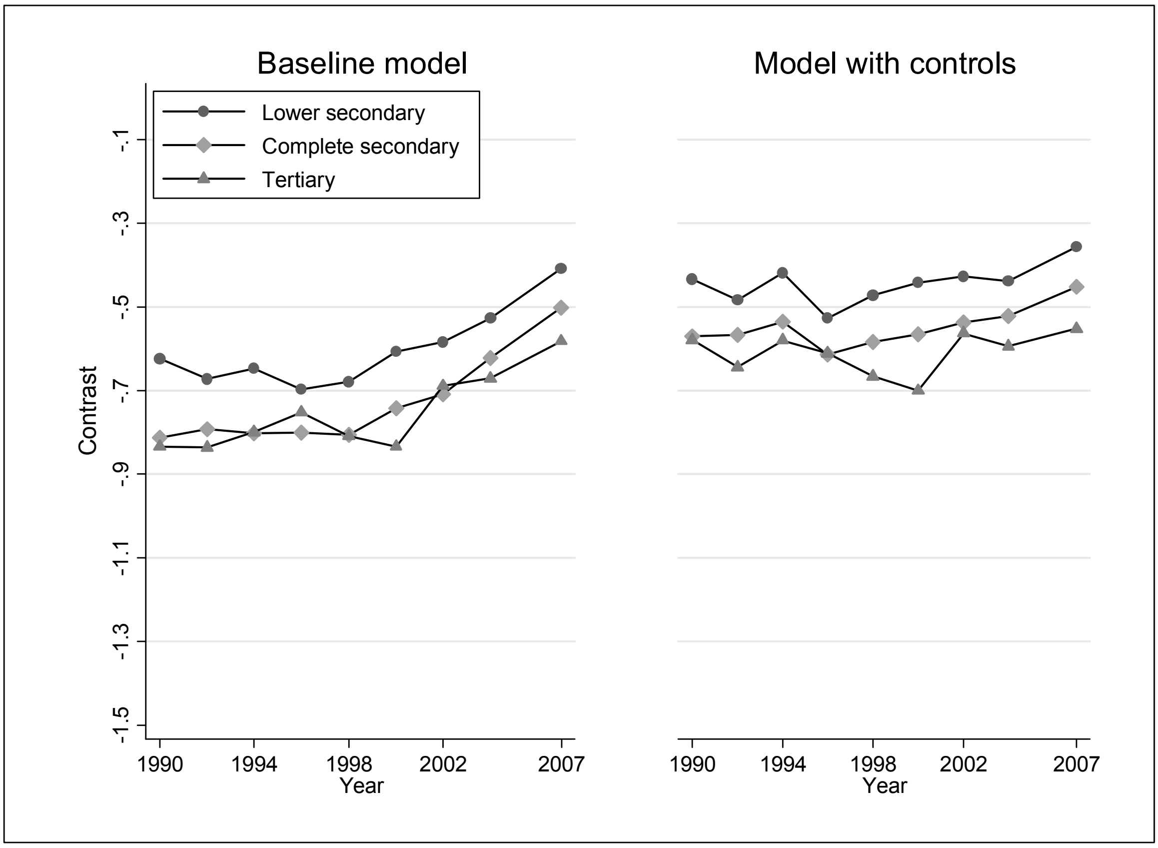
Note: estimates are based on a random-intercept multi-level logistic regression model.

Figure 4: Estimated effects of lower secondary, higher secondary, and university education of the mother on the log odds of high birth weight. All live singleton births in the Czech Republic in 1990, 1992, 1994, 1996, 1998, 2000, 2002, 2004, 2007. N=909,803



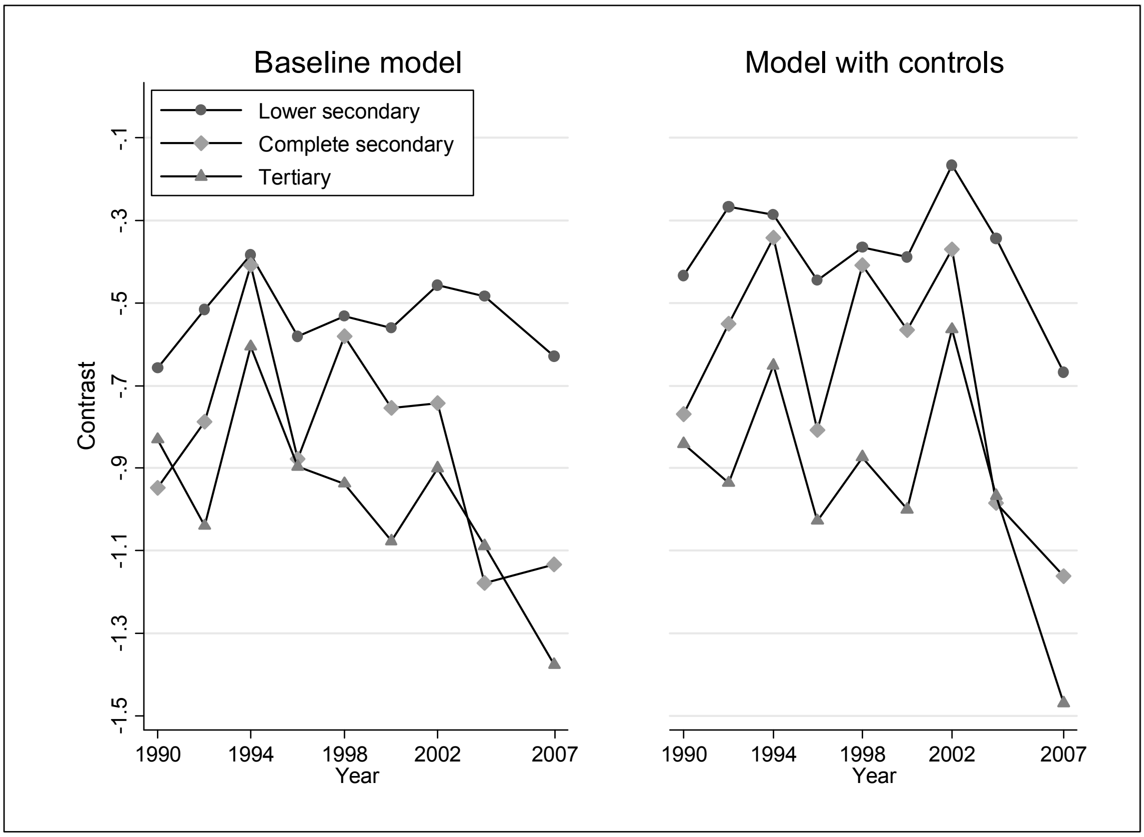
Note: estimates are based on a random-intercept multi-level logistic regression model.

Figure 5: Estimated effects of lower secondary, higher secondary, and university education of the mother on the log odds of pre-term delivery. All live singleton births in the Czech Republic in 1990, 1992, 1994, 1996, 1998, 2000, 2002, 2004, 2007. N=909,803



Note: estimates are based on a random-intercept multi-level logistic regression model.

Figure 6: Estimated effects of lower secondary, higher secondary, and university education of the mother on the log odds of still birth. All singleton births in the Czech Republic in 1990, 1992, 1994, 1996, 1998, 2000, 2002, 2004, 2007. N=912,591



Note: estimates are based on a random-intercept multi-level logistic regression model.

10. Appendix A

Procedures used to convert birth weight intervals to a continuous measurement

We had access to the full birth database for years 1990, 1998, and 2007. We had only multi-way tables for other years (1994, 1996, 2000, 2002, and 2004). The multi-way tables classified cases (individual births) by birth weight interval along with other variables (sex, parity, mother's age, mother's education, marital status, length of gestation, and district). *Birth weight intervals* were (1) less than 1500 grams, (2) 1500-2499 grams, (3) 2500-2999 grams, (4) 3000-3499 grams, and (5) 3500 or more grams. We converted these categories to birth weight measured in grams – i.e. a ratio variable – in the following sequence of steps:

a. We computed mean birth weight for all births in a given birth weight interval using the 1990 data. This resulted in a set of five mean values, one for each birth weight interval.
b. We obtained birth weights interval means for 1998 and 2007 in a similar fashion
c. We used linear extrapolation method to estimate interval means for other years. We used the 1990 and 1998 mean values to estimate interval means in 1992, 1994, and 1996. Similarly, we used the 1998 and 2007 mean values to estimate interval means in 2000, 2002, and 2004.

We end up having only five unique birth weight values in each year. Yet, this is a ratio variable, since it respects the underlying scale (weight in grams) and maintains its key interpretative advantage: we can interpret estimated effects as expected change in birth weight (in grams) produced by a one unit change in an explanatory variable.

Table A1. Calculated values of birth weight in grams for birth weight categories in individual years.

	Year								
	1990	1992	1994	1996	1998	2000	2002	2004	2007
Birth weight category									
-1499	1130.6	1115.0	1099.4	1083.8	1068.2	1078.1	1088.0	1097.9	1112.7
1500-2499	2178.0	2180.1	2182.2	2184.3	2186.3	2188.8	2191.3	2193.8	2197.6
2500-2999	2781.2	2782.7	2784.3	2785.8	2787.4	2788.6	2789.9	2791.1	2793.0
3000-3499	3232.1	3234.5	3236.8	3239.2	3241.6	3242.6	3243.6	3244.7	3246.2
3500+	3798.5	3803.2	3808.0	3812.7	3817.4	3817.2	3817.0	3816.8	3816.6

Appendix B

Table B1. Estimated coefficients of categories of maternal education (elementary education is reference category) for birth weight in grams.

	1990	1992	1994	1996	1998	2000	2002	2004	2007
Baseline model:									
Lower secondary	129.0	149.2	154.0	180.7	185.5	177.7	188.0	184.3	167.6
Complete secondary	170.9	194.6	202.2	222.2	222.1	212.0	219.5	215.2	197.0
Tertiary	185.5	211.4	217.8	236.6	237.7	240.3	236.0	236.9	212.6
Model with controls									
Lower secondary	117.3	129.9	128.6	143.6	148.8	144.5	149.0	156.4	138.8
Complete secondary	153.0	169.5	170.7	176.9	179.3	176.8	180.5	186.9	169.6
Tertiary	156.2	178.9	182.3	188.8	194.9	200.8	192.7	203.7	183.3

Table B2. Estimated coefficients of categories of maternal education (elementary education is reference category) for low vs. other birth weight.

	1990	1992	1994	1996	1998	2000	2002	2004	2007
Baseline model:									
Lower secondary	-0.72	-0.78	-0.77	-0.83	-0.88	-0.86	-0.82	-0.74	-0.70
Complete secondary	-1.04	-1.09	-1.09	-1.12	-1.13	-1.09	-1.09	-1.03	-0.91
Tertiary	-1.12	-1.15	-1.16	-1.28	-1.19	-1.25	-1.13	-1.15	-1.08
Model with controls									
Lower secondary	-0.56	-0.62	-0.55	-0.63	-0.66	-0.67	-0.65	-0.63	-0.62
Complete secondary	-0.83	-0.91	-0.84	-0.90	-0.89	-0.88	-0.91	-0.91	-0.85
Tertiary	-0.92	-1.01	-0.96	-1.12	-1.04	-1.09	-0.98	-1.03	-1.02

Table B3. Estimated coefficients of categories of maternal education (elementary education is reference category) for very low vs. other birth weight.

	1990	1992	1994	1996	1998	2000	2002	2004	2007
Baseline model:									
Lower secondary	-0.67	-0.60	-0.62	-0.67	-0.75	-0.63	-0.57	-0.60	-0.42
Complete secondary	-1.02	-0.94	-0.84	-1.02	-0.81	-0.75	-0.81	-0.88	-0.73
Tertiary	-0.87	-0.96	-0.81	-1.20	-0.83	-1.06	-0.72	-1.04	-0.79
Model with controls									
Lower secondary	-0.43	-0.30	-0.47	-0.49	-0.53	-0.47	-0.39	-0.67	-0.48
Complete secondary	-0.75	-0.59	-0.74	-0.85	-0.60	-0.62	-0.60	-0.98	-0.85
Tertiary	-0.68	-0.74	-0.86	-1.16	-0.78	-1.14	-0.60	-1.26	-1.00

Table B4. Estimated coefficients of categories of maternal education (elementary education is reference category) for high vs. other birth weight.

	1990	1992	1994	1996	1998	2000	2002	2004	2007
Baseline model:									
Lower secondary	0.38	0.46	0.50	0.62	0.64	0.61	0.69	0.65	0.58
Complete secondary	0.51	0.60	0.66	0.74	0.75	0.71	0.76	0.71	0.65
Tertiary	0.56	0.66	0.71	0.80	0.83	0.83	0.84	0.80	0.70
Model with controls									
Lower secondary	0.41	0.45	0.47	0.52	0.56	0.53	0.57	0.56	0.48
Complete secondary	0.53	0.58	0.60	0.61	0.65	0.62	0.65	0.63	0.56
Tertiary	0.52	0.59	0.62	0.64	0.70	0.71	0.70	0.68	0.60

Table B5. Estimated coefficients of categories of maternal education (elementary education is reference category) for preterm vs. term birth.

	1990	1992	1994	1996	1998	2000	2002	2004	2007
Baseline model:									
Lower secondary	-0.62	-0.67	-0.65	-0.70	-0.68	-0.61	-0.58	-0.53	-0.41
Complete secondary	-0.81	-0.79	-0.80	-0.80	-0.81	-0.74	-0.71	-0.62	-0.50
Tertiary	-0.83	-0.84	-0.80	-0.75	-0.81	-0.83	-0.69	-0.67	-0.58
Model with controls									
Lower secondary vs. elementary	-0.43	-0.48	-0.42	-0.53	-0.47	-0.44	-0.43	-0.44	-0.36
Complete secondary vs. elementary	-0.57	-0.57	-0.54	-0.61	-0.58	-0.57	-0.54	-0.52	-0.45
Tertiary vs. elementary	-0.58	-0.64	-0.58	-0.61	-0.67	-0.70	-0.56	-0.59	-0.55

Table B6. Estimated coefficients of categories of maternal education (elementary education is reference category) for vitality.

	1990	1992	1994	1996	1998	2000	2002	2004	2007
Baseline model:									
Lower secondary	-0.66	-0.52	-0.38	-0.58	-0.53	-0.56	-0.46	-0.48	-0.63
Complete secondary	-0.95	-0.79	-0.41	-0.88	-0.58	-0.75	-0.74	-1.18	-1.13
Tertiary	-0.83	-1.04	-0.61	-0.90	-0.94	-1.08	-0.90	-1.09	-1.38
Model with controls									
Lower secondary	-0.43	-0.27	-0.29	-0.45	-0.37	-0.39	-0.17	-0.34	-0.67
Complete secondary	-0.77	-0.55	-0.34	-0.81	-0.41	-0.57	-0.37	-0.98	-1.16
Tertiary	-0.84	-0.94	-0.65	-1.03	-0.87	-1.00	-0.56	-0.97	-1.47