labor&welfareSTATE

Birth weight and family status revisited: evidence from Austrian register data

by

Wolfgang FRIMMEL
Gerald J. PRUCKNER

Working Paper No. 1118

December 2011

Supported by the
Austrian Science Funds

FWF

The Austrian Center for Labor Economics and the Analysis of the Welfare State

JKU Linz
Department of Economics
Altenberger Strasse 69
4040 Linz, Austria
www.labornrn.at

Corresponding author: gerald.pruckner@jku.at
phone +43 (0)70 2468 -8213, -8209 (fax)

Birth weight and family status revisited: evidence from Austrian register data*

WOLFGANG FRIMMEL
University of Linz

GERALD J. PRUCKNER
University of Linz

December 26, 2011

Abstract

In this paper, we study the socio-economic determinants of birth weight with a focus on the mother's family status. We use Austrian birth register data covering all births between 1984 and 2007 and find that a mother's marriage is associated with a higher birth weight of the newborn in a range between 4 and 6 dekagrams. This result remains stable if we control for time-invariant unobserved mother heterogeneity. A divorce around pregnancy results in birth weight 2 to 8 dekagrams lower as compared to that of newborn babies of single mothers. The family status effects in the 2000s are stronger as they were in the 1980s. A quantile regression suggests that family effects are more pronounced at the lower quantiles of the birth weight distribution and diminish at higher percentiles. Finally, in accordance with several instrumental variable (IV) studies, we find that the significantly positive impact of family status on children's health outcomes disappears if we confine our sample to mothers, who are below the age of 22 years. We conclude that social and financial stress may have an important influence on the birth weight of newborns, especially at the lower tail of the birth weight distribution.

JEL Classification: I12, J12, J13, C21
Keywords: Low birth weight, family status, newborn health, fixed-effects estimations

*Corresponding author: Gerald J. Pruckner, Johannes Kepler University of Linz, Department of Economics, Altenberger Straße 69, A-4040 Linz, phone: +43 70 2468 8213, fax: +43 70 2468 8209, email: gerald.pruckner@jku.at. This research was funded by the Austrian Science Foundation (FWF) under the National Research Network "The Austrian Center for Labor Economics and the Analysis of the Welfare State," project no. S10306-G14.

1 Introduction

Birth weights of newborn babies play an important role in several respects. (i) Low birth weight of babies entails high direct treatment cost for newborn care (Lewit et al., 1995; Joyce, 1999; Russell et al., 2007). (ii) Such babies have a higher incidence of infant mortality (McIntire et al., 1999). (iii) There is evidence of negative long-term health and educational effects. Case et al. (2005) emphasize the role of childhood health in determining health, educational attainment, and social status in adulthood. Nutrition in utero can have an effect on one's health in middle age, for example, through a direct impact on coronary heart disease and diabetes (*fetal-origins hypothesis*). Moreover, *life course models* stress the extent to which the effects of childhood illness and deficiencies persist even in adulthood either directly the illness itself, or indirectly, by restricting educational attainment and life chances. Based on data from the UK's National Child Development Study, the authors find that children who have experienced poorer uterine environments and poorer health in childhood have lower educational attainment, poorer health, and lower socio-economic status in adulthood. Black et al. (2007) use a rich administrative dataset from Norway and apply twin techniques. Similarly, the authors find significant effects of birth weight on long-run outcomes such as height, adult IQ, earnings, and education. Berman and Rosenzweig (2004) use Minnesota Twin Registry data of female monozygotic twins and find that the heavier twin continues to be taller and has greater educational attainment. Moreover, she earns higher wages.[1]

The significant and persistent long-term effects of low birth weight on future health stress the relevance and importance of studying the (socio-economic) determinants of birth weights. Identifying the driving forces of newborns' health may help to prevent detrimental health effects later in life and curb future health expenditures. In this paper, we present the results of a regression analysis on the socio-economic determinants of birth weight with a focus on the role of family status. The empirical analysis is based on the Austrian birth register data for the period from 1984 to 2007. We find that the birth weight of newborns is significantly higher for married mothers as compared to single mothers if we

[1] Almond et al. (2005) utilize within-twins variation for U.S. twin pairs. As compared to more conventional previous studies, they find significantly smaller effects of low birth weight on short-term health outcomes such as hospital costs, infant mortality, Apgar scores, and assisted ventilator use after birth.

control for a series of socio-economic mother characteristics and for mother fixed-effects. Divorce of the expectant mother around pregnancy decreases infants' birth weights. The mother's family status has a significant impact over all quantiles of the birth weight distribution, with the quantitative effects being larger at the lower tail of the distribution. Moreover, the importance of potential stress factors during pregnancy, such as emotional instability and financial worries due to one's expected role as a single mother, increases over time. Finally, the influence of marriage and divorce has been found to be higher in the years after 2000 as compared to previous decades.

A series of (theoretical) arguments suggest that marriage has a positive effect on the well-being of children. Some of these arguments also apply to the prenatal period and are therefore relevant for newborns' health. Within the framework of household production models, marriage may increase financial and time resources in a household and thereby affect children's well-being. Moreover, marriage can be expected to change the input combination within a household so that it can be used more effectively. In their model, with children being treated as a collective good by both partners, Weiss and Willis (1985) argue that marriage allows the spouses to monitor and enforce their investment for the collective good through trust and family closeness, and makes it possible for the couple to overcome free-ride incentives. In a similar vein, Ducan et al. (2006) argue that marriage makes monitoring of mutual behavior in a family easier and that children may behave better when someone is regularly watching. Other literature strands stress that marriage improves children's well-being by reducing instability and stress and by providing a wide net of social bonds. Shore and Shore (2009) cite empirical studies that find associations between depression during the second trimester of pregnancy and slower fetal growth. Psychological stress (depression, anxiety) may affect the mother's and the newborn's health directly via neuroendocrine functioning and the immune system or indirectly via maternal behavior such as smoking, drinking, or lack of exercise (Chomitz et al., 1995; Hoffman and Hatch, 2000; Hobel and Culhane, 2003; Eccleston, 2011). Moreover, stress may affect the mother's appetite and caloric intake reducing fetal weight gain.

The happiness literature provides another reason for a positive relation between marriage and birth weight. The birth weight of newborns of a married mother can be expected to be higher because married people are happier than unmarried people (Blanchflower and Oswald, 2004; Alesina et al., 2004). In this context, Chapman and Guven (2010) underline the importance of marriage quality. Happiness might also have an indirect effect on birth weight through marital health, as happiness and health seem to be positively related (Sabatini, 2011). In contrast, the observed negative association between stress and happiness (Schiffrin et al., 2010) provides additional support for the stress argument.

The majority of empirical studies examine the relationship between the marital status of mothers and the weight of newborns and find that the birth weight of newborn babies is, ceteris paribus, significantly higher if the mother is married as compared to an unmarried mother (Luo et al., 2004; Raatikainen et al., 2005; Zeitlin et al., 2002).[2] Several authors evaluate the effects of demographics and prenatal maternal behavior at different quantiles of the birth weight distribution (Abrevaya, 2001; Abrevaya and Dahl, 2008; Koenker and Hallock, 2001; Wehby et al., 2009). In general, quantile regressions show that most factors (including family status, race, education, and prenatal care) have a significantly higher impact at lower quantiles and lower impacts at higher quantiles.

Among other effects, these studies present correlations between marriage and infant health. As a consequence, they fail to account for selectivity. For example, healthier women may have a higher probability to be married and may also give birth to healthier children. Only a few papers are available that convincingly control for selectivity and show the causal effects of marriage on children's well-being. A recent example for an instrument variable (IV) approach is Buckles and Price (2010), who consider the requirement of blood tests for obtaining a marriage license across the U.S. as an instrument for marriage. The IV estimates of the authors confirm the positive ordinary least squares (OLS) effects of marriage on birth weight and gestation period for first-time mothers. For low socio-economic groups (young and less-educated mothers), however, the effect of marriage on infant birth weight is found to be insignificant or even negative. Finlay and Neumark (2009) use incarceration rates for males as an instrument for women's marital behavior. The authors provide evidence that the children of Hispanic mothers, who are most affected by changes in male incarceration rates, may be better off if their mother has never been married. Another IV

[2] In their analysis of single births of nulliparous mothers, Kirchengast et al. (2007) find that newborns of married mothers in Austria were significantly lighter and shorter than those of unmarried mothers.

approach, that utilizes variation in U.S. state laws that regulate the minimum age at which individuals are allowed to get married, is presented by Dahl (2010). Using these marriage laws as an instrument for early marriage, the author estimates that a woman who marries young has a 31 percentage points higher likelihood to live in poverty when she is older.

The results from IV strategies suggest that cross-sectional associations between child outcomes and family structures overstate the true causal impacts, and there is at least some evidence that the finding of beneficial effects for two-parent families is reversed for low socio-economic status groups.[3] However, as Finlay and Neumark (2010, p. 1049) point out, the chosen identification strategies are not always convincing, and very few opportunities exist to exploit reliable exogenous variation in family status.[4] Moreover, the papers that find negative (causal) impacts of marriage on child outcomes refer to very specific underprivileged groups of the population, as they provide local average treatment effects for females whose marriage decision is, for example, influenced by male incarceration percentages or by the presence of blood test requirements to obtain a marriage certificate.

This paper contributes to the literature in several ways: First, extending similar previous studies, we present empirical evidence on determinants of birth weights on the basis of data from a Bismarckian type national health system that provides comprehensive health services to the population, including complementary preventive prenatal health care for pregnant women. An important aim of this contribution is to report whether socio-economic gradients are smaller in national health systems as compared to health systems that require a higher proportion of private payments. Second, the empirical analysis is based on a large sample of observations as we observe all Austrian births during the period between 1984 and 2007 and control for unobserved time-invariant heterogeneity by including mother fixed-effects. Finally, our data cover a time period of 24 years. Therefore, we can study whether the impacts of certain characteristics on birth weight have changed over time.

The remaining paper is organized as follows: Section 2 describes the data and presents the

[3] Using state-level panel data on maternally linked births to control for unobserved heterogeneity, Abrevaya and Dahl (2008) find positive impacts of marriage on birth weight. The results remain significantly positive throughout the range of quantiles and are quite similar in comparison to the cross-section specifications.

[4] For a more detailed discussion of these limitations, both in the context of convincing natural experiments and also in finding reliable instrumental variables for marriage that are unrelated to infant well-being outcomes, see Ribar (2004).

empirical strategy. Section 3 reports the empirical results, and Section 4 summarizes the main findings and concludes the study.

2 Institutional background, data, and estimation strategy

Austria's Bismarckian-type health care system is predominantly funded by employment-based social insurance contributions. Patients hold mandatory health insurance provided by the provincial sickness funds ("Gebietskrankenkassen") that guarantees easily accessible services.[5] For example, the funds offer pregnant women a comprehensive mother-child care program that was introduced in 1974. The program comprises at least five basic prenatal health exams for the expectant mother and her unborn baby.[6] Regular health checks are undertaken by resident gynecologists who are chosen by the mothers. Pregnant women receive the services free of charge, and the doctors are reimbursed by the sickness funds that pay a predetermined honorarium for each health examination. Moreover, there is a strong financial incentive for expectant mothers to participate in this program, as the eligibility for several family (birth) benefits has been linked to the utilization of basic prenatal medical examinations. As a consequence, Austrian social security register data reveal that more than 90 percent of women who give birth underwent the five basic prenatal health checks during the period between 1998 and 2007.

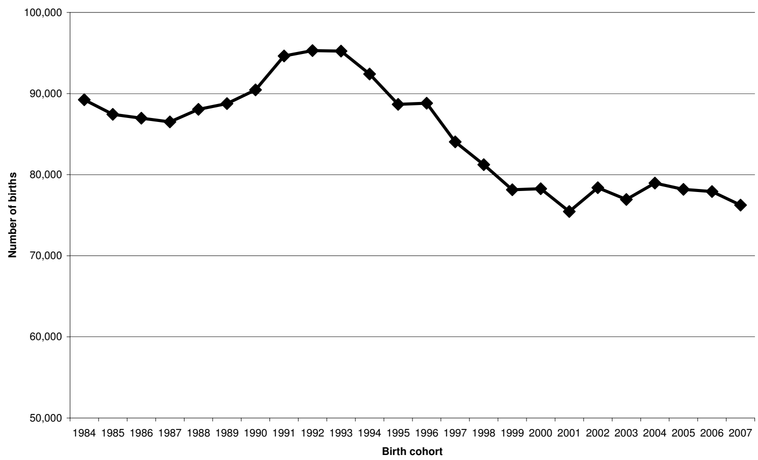
In this study, we use data from the Austrian birth register, covering all 2,036,263 live births between 1984 and 2007. Birth register data include information on the birth date of the child and the parents; legitimacy status of the child; place and method of birth; health outcomes such as birth weight, gestation duration, and Apgar-scores; and maternal socio-economic characteristics like age, education, religion, employment, and citizenship at the time of birth. The data also contain information on the mother's family status and the date of her marriage. Since information on marriages during pregnancy is partly missing in the birth register, we matched the missing information for 207,968 observations from the Austrian marriage register. The variable on divorce around pregnancy – a proxy for

[5]The regional sickness funds comprise approximately 75 percent of the Austrian population, covering all private employees and their additional insureds.

[6]The program also includes five postnatal health examinations of the baby starting at birth up to his/her second year of life.

an incriminating and stressful family life – is matched from the Austrian divorce register.[7]

Figure 1: Number of births per year



As Figure 1 shows, fertility in Austria has declined over time. Since the 1980s, the number of annual births has gone down from roughly 90,000 births per year to less than 80,000. Only at the beginning of the 1990s did fertility slightly increase, most probably as a reaction to the extension of the maternal leave duration in 1990. This development was followed by an even sharper decline in fertility in the late 1990s. However, in the 2000s, the rate of decline slowed down significantly. At the same time, the fraction of children born out of wedlock has increased from less than 10 percent in 1984 to 38 percent of births in 2007 (see Figure 2).

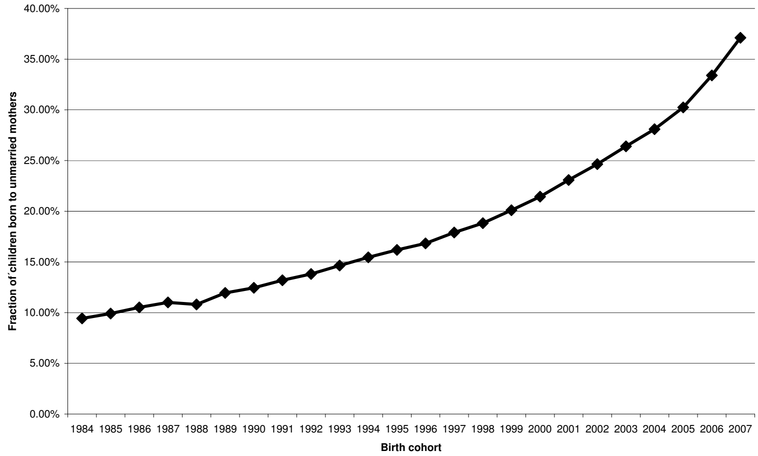
In order to analyze the contribution of the mother's family status on the health of the newborn, we estimate, in the first step, the following OLS model with standard errors clustered by mothers:

$$bw_i = \alpha + \beta_1 fam_i + \beta_2 X_i + \beta_3 bc_i + \beta_4 bo_i + \mu_i, \tag{1}$$

where *bw* represents a newborn's birth weight. The maternal family status at birth is captured by *fam*, and *X*, *bc* and *bo* denote the mother's socio-economic characteristics, dummies for birth cohorts, and birth order, respectively.

[7] We consider divorces 6 months before and 6 months after birth as "around pregnancy". However, we do not have information on the reasons for divorce, for example, whether the parents split up because of the upcoming birth.

Figure 2: Fraction of children born out- of- wedlock, 1984-2007



Obviously, OLS estimates are expected to be biased due to unobserved heterogeneity of the mothers. In order to correct for the time-invariant heterogeneity, the fixed-effects model

$$bw_{ij} = \alpha + \beta_1 fam_{ij} + \beta_2 X_{ij} + \beta_3 bc_{ij} + \beta_4 bo_i + \eta_j + \mu_{ij}, \tag{2}$$

is estimated with mother fixed-effects η_j. The mother fixed-effect controls for genetic endowment and behavioral aspects – such as smoking and drinking — that are constant over time (across births). However, we cannot fully identify a true causal effect of the family status on birth weight, as mothers might change their behavior between two births. Moreover, birth-individual heterogeneity may be introduced by different fathers whose characteristics cannot be observed for children born out of wedlock.[8] Finally, we employ quantile regressions suggested by Koenker and Hallock (2001) to analyze the effect of family status at different points on the birth weight distribution.

Descriptives for newborns' birth weight and socio-economic controls for married and unmarried mothers are depicted in Table 1. In our sample, 81.81 percent of mothers are married, and the birth weight of their newborns is, on average, 9 dekagrams higher as compared to the newborns of unmarried mothers. A similar difference can be observed for the gestation period and the occurrence of premature births, which is two percentage points lower among married mothers.[9] Married and unmarried mothers also differ in sev-

[8] For children born in wedlock, we provide further estimates that control for father characteristics.

[9] Premature birth is defined as either a gestation duration of less than 37 weeks or a birth weight of below 250 dekagram.

eral socio-economic characteristics. Married mothers are, on average, 0.84 years older at the time of birth, they are better educated, and are employed in higher income jobs. In western Austria, the proportion of unmarried mothers is higher as compared to the eastern provinces of Vienna, Burgenland, and Lower Austria. The city versus rural area gradient can also be observed.[10] About 15.8 percent of married mothers have a foreign citizenship. The percentage of foreigners runs down to 8.4 percent for the group of unmarried mothers.

3 Empirical results

This section presents our estimation results. First, we discuss findings on the influence of family status and provide results for further groups of controls (Table 2). For all sets of right-hand-side variables, we compare OLS with mother fixed-effect (FE) specifications and present a separate regression that includes births with a gestation period of more than 36 weeks only. Second, to account for the fact that mother and child characteristics may influence birth weights differently for low- and normal birth-weight infants, we present results of quantile regressions in Table 3. Third, we analyze whether the impacts of the independent variables change over time (Table 4). According to IV papers that provide local average treatment effects for specific groups of mothers (for example, see Buckles and Price, 2010), we extend our fixed-effect analysis for the "marginal" group of mothers who are below 22 years old. We finally present regression results for the alternative outcomes gestation period and the probability of premature birth (Table 5).

Birth weight and family status

Table 2 shows that marriage significantly increases infant birth weight. In the OLS specification, the birth weight of infants born to married mothers is, on average, 5.5 dekagrams more than that of babies born to unmarried mothers. If the mothers are not married at the time of conception, the impact on the birth weight of the infants remains similar, with a highly significant coefficient of 4.9 dekagrams. This means that being married is crucial whereas time of marriage is of minor importance. On the contrary, a mother getting divorced during pregnancy is associated with a reduction in the infant's birth weight by 7.9

[10] The city dummy is equal to 1 if a community has more than 10,000 inhabitants and 0 otherwise.

dekagrams as opposed to babies born to single mothers.[11]

If we control for time-invariant heterogeneity by including mother fixed-effects, the coefficients of the mother's family status remain highly significant, though their quantitative importance decreases somewhat. As can be seen in the FE specification in Table 2, the birth weight of infants born to married mothers is 4.3 dekagrams higher than that of infants born to single mothers. The coefficient for the group of babies whose mothers got married during pregnancy is 4.1 dekagrams. The impact of a divorce during pregnancy is considerably reduced in the fixed-effect model. Infants born to mothers who got divorced during pregnancy have a birth weight that is 2.1 dekagrams lower than that of the base group of newborns of single mothers in the FE variant.

Controls

Newborn boys are significantly heavier than newborn girls, with a weight difference of approximately 14 dekagrams, and twins are lighter by more than one kilogram as compared to single births. The impact of the mother's age is inverse U-shaped in the OLS specification; in the mother FE model, the birth weight of a baby decreases with the age of the mother.

The birth weight of infants increases with the educational qualifications of the mothers. As compared to the base group of mothers who have completed compulsory school, the birth weight of babies increases significantly by 3.7, 6.0, 8.0, and 9.3 dekagrams if the mother has completed apprenticeship, vocational high school, general qualification for university entrance (Matura), or a university degree, respectively. As before, the coefficients decrease in the mother fixed-effect variant. However, with the exception of apprenticeship, they remain significant. Other significant impacts can be found with the respect to the mother's employment status. In the OLS specification, we find significant coefficients for students, retirees, farmers, workers, and employed and self-employed persons as opposed to coefficients for unemployed and not employed persons. However, the impact remains significant only for workers (positive), retirees, and employees (negative) in the mother FE model.

[11] Unfortunately, our data do not allow a separation of single mothers from cohabitating mothers. However, if the stabilizing impacts do not hinge on the existence of a marriage certificate, the negative birth weight effects of having no partner can be expected to be even larger. Luo et al. (2004) find that pregnancy outcomes are worse among mothers living without a partner as compared to mothers in common-law unions and married mothers.

The significant and negative coefficient of the city dummy (mother living in a city) in the OLS model changes to positive at the 90 percent significance level in the FE variant, and the significant negative influence of the western regions disappears in the FE specification. Mothers who are native to Turkey and the Balkans give birth to babies with a significantly lower birth weight as compared to babies born to Austrian mothers in the FE specification. Finally, the birth order is of particular importance. The birth weight of babies increases significantly with the birth order in both specifications with the weight difference between the first-born and second-born baby of 14 dekagrams to a difference of more than 23 dekagrams for the fifth or higher number of births.[12]

As a robustness check, we also present regression results that only include births after a gestation period of at least 36 weeks in columns 5-8 of Table 2. In doing so, we study the role that premature birth plays.[13] The results indicate that the positive and significant influence of the marriage variable still exists. The quantitative effects decrease somewhat. However, the birth weight of infants born to married mothers is still approximately 2.9 dekagrams higher as compared to the weight of babies born to single mothers in the FE model. We conclude from this that the positive emotional and financial impact of a stable partnership is not only reflected by a lower probability of premature birth but, ceteris paribus, also increases the weight of babies born after a "normal" gestation period. The fact that the family status of the mother also has an influence on normal birth-weight babies is supported by the negative and significant impact of whether a mother gets divorced around pregnancy. The signs of the control variables remain almost unchanged as compared to the specification including all births. Only the significantly negative influences of mothers who are either retired or employed as employees disappear. We interpret this as an indication that the two employment statuses favor the probability of a premature birth.[14]

[12]In another specification (not included in the paper), we control for father characteristics that are available for married couples only. We find that a mother's marriage (divorce) during pregnancy increases (decreases) the newborn's birth weight by 0.5 (3.4) dekagrams as compared to the base group of mothers who got married before their pregnancy. Moreover, the father's age and his educational background enter the FE specification significantly positive whereas the birth weight of a newborn is 0.7 dekagrams lower (at the 10 percent level) if father and mother have a different religious denomination. Estimation results are available on request.

[13]In general, gestation length can either serve as a separate outcome (see our Table 5) or as a control in the birth weight regression. Including it as a control introduces a bias that reflects the fact that the variable of interest (birth weight) and the control (gestation duration) are determined at the same time (Angrist and Pischke, 2009). As an alternative, we run a separate regression including term births only (gestation period more than 36 weeks).

[14]For the effect of employment status on the duration of gestation and on the probability of a premature

Quantile regressions

The results presented in Table 2 represent estimates that approximate the conditional mean of birth weights, given certain values of socio-economic characteristics. However, some percentiles of the birth weight distribution may be more affected by the right-hand side variables than others. To answer the question of whether our regressors influence the birth weight differently at different quantiles of the birth weight distribution, we provide quantile regressions in Table 3. The presented parameter estimates reflect the change of infant birth weight in a specified quantile of the outcome variable due to a one-unit change in the independent variable.

Our variables of interest – marriage and divorce – have a significant impact in all quantiles. However, the quantitative effects decrease with the birth weight. The marriage of the mother increases a baby's birth weight by approximately 8.2 dekagrams in the 0.10 quantile whereas the same effect amounts to only 2.4 dekagrams in the 0.90 quantile. The least square models presented in Table 2 clearly underestimate the impact at the lower tail of the birth weight distribution and overestimate the effects at the upper tail. The same applies to the divorce variable. The disparity between single mothers and mothers who get divorced around the time of pregnancy diminishes substantially from the lowest decile (11.8 dekagrams) to the highest (4.1 dekagrams). These results clearly indicate that the positive (negative) influence of marriage (divorce) is of particular importance for lower birth-weight babies.

So far, we have interpreted a higher birth weight as an indicator of better health of the newborn. However, very high birth weights may indicate health problems in the infant. As a consequence, we might expect that "being married" and "getting divorced" change signs for the very highest (unhealthy) birth weights. Our observation of decreasing impacts in the 0.90 quantile that includes birth weights above 435 dekagrams (macrosomia) is compatible with this view.

Although boys are obviously larger than girls, the disparities between the sexes are much smaller at the lower tail of the distribution than at the higher quantiles. Whereas boys are 9.6 dekagrams heavier in the 0.10 quantile, the difference runs up to 16.8 dekagrams

birth, see Table 5.

in the 0.90 quantile. The regression coefficients for age indicate that this effect is more concave at the lower quantiles. In the lowest decile, the birth weight of newborns increases till the mother reaches the age of 20, and decreases thereafter. At the higher quantiles, the "optimal age" of mothers gradually increases and is 23 years at the highest decile. The effect of twin births decreases in absolute numbers from 127 dekagrams in the 0.10 quantile to 99 dekagrams in the 0.90 quantile. The positive impacts of education categories beyond compulsory school also decrease with higher quantiles. Therefore, higher education affects the behavior of pregnant women in particular at the lower tail of the birth weight distribution. Similarly, the strongly negative effect of retired mothers decreases substantially over the birth weight distribution. At the 0.10 quantile, the birth weight effect of retired mothers as compared to the base group is almost 23 dekagrams. This disparity is reduced to 3.8 dekagrams at the highest decile, indicating that health problems of mothers in early retirement have detrimental impacts, particularly at the lower tail of the weight distribution. This result is confirmed by the positive retirement coefficient in the regression of premature births (see Table 5).

The place of a mother's residence in any of the western provinces of Austria remains insignificant in the 0.10 quantile whereas it significantly decreases a baby's birth weight by 2.5 dekagrams in the highest decile. This may also indicate that unhealthy high birth weights (at the top of the distribution) are, ceteris paribus, rare in the western parts of Austria – a fact that is compatible with a distinct gradient in body weights between the west and the east of the country. Other effects that increase over deciles can be found in mothers with different ethnic backgrounds. The impact of birth order along the weight distribution is ambiguous. The positive weight effect of the second birth decreases slightly, the impact of the third birth remains almost unchanged, and the weight gain of subsequent births increases from the lower to the upper tail of the distribution.

Period effects

The estimation results in Table 4 indicate how the impact of the mother's family status changes over time. For this purpose, we estimate three separate regressions (OLS and mother FE) for different decades covered in the Austrian birth register. The most striking result is that the marriage and divorce effects do not decrease or even disappear over the decades. On the contrary, the impact of whether a mother is married increases from the 1980s (3.3 dekagrams) over the 1990s (4.3 dekagrams) until the most recent decade (5.0 dekagrams) in the FE specification. The same pattern can be observed for a marriage during pregnancy. Interestingly enough, the negative impact of a divorce around pregnancy is a recent phenomenon. According to the FE model, this variable becomes significant only in the 2000s. The weight difference of 6.6 dekagrams is not only statistically significant but also quantitatively important.

Marginal marriages

As discussed in the Introduction, we are aware of IV studies that instrument mother's marriage by incarceration rates for males (Finlay and Neumark, 2009), blood test requirements (Buckles and Price, 2010), and by regulation in minimum age at which individuals are allowed to get married (Dahl, 2010). The main conclusion drawn from these studies is that the available cross-sectional evidence between family structure and child outcomes overstates the true causal impacts. However, the presented local average treatment effects solely control for selection into early marriage, as the exogenous variation induced by the chosen instruments affects the very young and poorly educated mothers only. As a consequence, these studies provide high internal validity whereas their external validity is relatively low. In a further robustness check, we also confine our sample to the group of very young mothers. Columns 1-4 in Table 5 report the OLS and FE estimates if we include only mothers who are not more than 21 years old in our sample. According to the aforementioned IV studies, we find that the significant influence of a mother's marriage and divorce on the newborn's birth weight disappears for this restricted sample if we control for time-invariant unobserved heterogeneity of the mothers (FE specification). In comparison to our basic specification in Table 2, the coefficients of most controls remain unchanged. As before, we find a significantly positive birth weight effect for newborn boys and a significantly negative effect for twins. Moreover, the mother's age, whether the mother is employed as a worker or as an employee, and birth order effects remain significant. On the contrary, the previously significant coefficients for the mother's education and her ethnic background disappears. Our robustness check replicates the IV results for the restricted sample of very young mothers. Since we do simultaneously find positive marriage effects for the representative sample, we argue that policy implications based on local average treatment effects cannot be extended to all mothers.

Alternative outcomes: gestation period and premature birth

Table 5 also presents regression results for two alternative outcomes: gestation period and the probability of premature birth. As can be seen from columns 5 to 8, being married increases the gestation period by 0.6 days as compared to the pregnancy duration of single mothers. The effect increases to 0.9 days for mothers who get married during pregnancy. In contrast to the results for the birth weight specifications, the divorce variable remains insignificant in the FE variant. The remaining controls confirm our previous results – gestation period decreases if the mother is over 19 years old, and increases with the mother's education and with birth order. Moreover, the gestation period is substantially shorter for twin births and also decreases if the mother is retired or has a Turkish ethnic background. As compared to newborn girls, the gestation period for boys is significantly less by approximately 0.4 days.

These results are confirmed by estimates of probabilities for premature births. Being married reduces a mother's probability of having a premature delivery by 1.8 percentage points in the linear probability model and by 1.4 percentage points in the FE specification. A divorce increases the same probability by 2.3 percentage points in the OLS variant; however, the effect remains insignificant if we include fixed effects. The probability increases for twins and decreases with maternal education and birth order, whereas other effects are, though significant in some cases, quantitatively not important.

4 Summary and conclusions

In this paper, we present regression results for socio-economic determinants of birth weight for all Austrian births over a period of more than 20 years. We include a series of obviously important characteristics of mothers and also control for time-invariant heterogeneity by mother fixed-effects. As compared to single mothers, we find positive and significant effects on the newborns' birth weight if the mothers got married either before or during pregnancy. Similarly, a newborn's birth weight decreases significantly if the mother gets divorced around the time of pregnancy. We interpret these findings as evidence for the importance of emotional comfort and/or financial security provided for expectant mothers by stable family relations. The results remain stable if we include only births after a gestation period of more than 36 weeks (normal birth-weight babies) in our sample.

"Being married" and "getting divorced" have a significant impact over all quantiles of the birth weight distribution. However, the quantitative effects are substantially larger for the lower than for the higher quantiles. Though it is almost impossible to influence psychological and emotional security by public policy, family transfer measures ought to be designed to alleviate financial pressure on at least single mothers. These measures cannot be expected to only reduce vertical income differences among parents but also to contribute toward improving the initial health status of otherwise underprivileged newborns. Family status effects do not, interestingly, diminish over time. On the contrary, the coefficients are larger in the 2000s as compared to previous decades, indicating that being a single mother is no less stressful today than it was 20 years ago. One possible explanation for this may be that fathers are more capable and willing to take on domestic and family responsibilities at present than they were in the past. Equal pay for women and their increasing social and financial independence over time have not improved the overall perspective of single mothers.

Moreover, according to existing empirical evidence, we find that the birth weight of infants increases with the mother's education and with the birth order. Other significant impacts can be found for the marital employment status and the ethnic background of the mother. Newborn boys are significantly heavier than girls, the birth weight of twins is 100 dekagrams less as compared to single births, and the age of the mother has a negative weight effect on newborns. The father's age and his educational attainment are the only significant father correlates that both have a positive influence on a newborn's birth weight. From the health policy perspective, a clear picture of the most important determinants would allow the introduction of selective measures for particular groups of pregnant women.

Our results fit well into the available empirical evidence, in both qualitative and largely quantitative respects. The most striking difference in our study is that we can neither explicitly control for maternal smoking and drinking during pregnancy, nor for maternal participation in prenatal health care. The Austrian birth register does not provide behavioral information. However, as mentioned earlier, an overwhelming majority of expectant mothers in Austria undergo the five basic prenatal health checks that are offered for free within the mother-child care program, participation in which is a prerequisite for entitling the mother to child care benefits. As a consequence, there is almost no variation in Austrian mothers' utilization of prenatal health exams. Moreover, even though we cannot observe lifestyle-related behavior of mothers, we estimate fixed-effects that control for maternal behavior that does not change over time. Moreover, given the expected correlation between lifestyle and socio-economic status, behavioral effects should be captured at least partly by mother variables such as age, education, and employment status.[15]

The order of magnitude of the marriage coefficients and of controls in our analysis is similar to that in existing studies. However, almost all coefficients are quantitatively slightly lower than those estimated in U.S. data. This result presumably indicates the importance of access to health care services. The utilization of preventive prenatal health services that are free of charge for all expectant mothers in the Austrian national health care system may reduce the extent of socio-economic gradients in birth weight (and probably future children's health) observed in more privately managed health systems.

Finally, from a methodological perspective, more research has to be done on the identification of causal effects of family status on children's health outcomes such as birth weight. The available evidence, based mainly on IV estimates, is not yet convincing. Local average treatment effects that use exogenous variation for the probability of getting married have been presented. Whereas these studies seem to be internally valid, they suffer from inadequate external validity for a broader and more representative group of mothers.

[15]This argument is supported by recent evidence provided by Fertig (2010) who argues that as much as 50 percent of the current association between smoking and birth outcomes can be explained by adverse selection into smoking.

References

Abrevaya, Jason (2001), 'The effects of demographics and maternal behavior on the distribution of birth outcomes', *Empirical Economics* **26**, 247–257.

Abrevaya, Jason and Christian Dahl (2008), 'The Effects of Birth Inputs on Birthweight: Evidence from Quantile Estimation on Panel Data', *Journal of Business and Economic Statistics* **26**(4).

Alesina, Alberto, Rafael Di Tella and Robert MacCulloch (2004), 'Inequality and Happiness: Are Europeans and Americans Different?', *Journal of Public Economics* **88**, 2009–2042.

Almond, Douglas, Kenneth Y. Jay and David S. Lee (2005), 'The Costs of Low Birth Weight', *The Quarterly Journal of Economics* **120**(3), 1031–1083.

Angrist, Joshua D. and Jörn S. Pischke (2009), 'Mostly Harmless Econometrics: An Empiricist's Companion'.

Berman, Jere R. and Mark R. Rosenzweig (2004), 'Returns to Birthweight', *The Review of Economics and Statistics* **86**(2), 586–601.

Black, Sandra E., Paul J. Devereux and Kjell G. Salvanes (2007), 'From the Cradle to the Labor Market? The Effect of Birth Weight on Adult Outcomes', *The Quarterly Journal of Economics* **122**(1), 409–439.

Blanchflower, David G. and Andrew J. Oswald (2004), 'Well-being Over Time in Britain and the U.S.A.', *Journal of Public Economics* **88**, 1359–1386.

Buckles, Kasey and Joseph Price (2010), *Marriage and Infant Health*, Working Paper, Department of Economics, University of Notre Dame.

Case, Anne, Angela Fertig and Christina Paxson (2005), 'The Lasting Impact of Childhood Health and Circumstance', *Journal of Health Economics* **24**(2), 365–389.

Chapman, Bruce and Cahit Guven (2010), 'Marital Status is Misunderstood in Happiness Models', *Working paper, Deakin University Australia, SWP 2010/03* .

Chomitz, Virgina, Lilian W.Y. Cheung and Ellice Lieberman (1995), 'The Role of Lifestyle in Preventing Low Birthweight', *The Future of Children* **5**(1).

Dahl, Gordon (2010), 'Early Teen Marriage and Future Poverty', *Demography* **47**(3), 689–718.

Ducan, Greg, Bessie Wilkerson and Paula England (2006), 'Cleaning up their Act: The Effects of Marriage and Cohabitation on Licit and Illicit Drug Use', *Demography* **43**, 691–710.

Eccleston, Melissa (2011), *In Utero Exposure to Maternal Stress: Effects of 9/11 on Birth and Early Schooling Outcomes in New York City*, Job market paper, Harvard University.

Fertig, Angela R. (2010), 'Selection and the Effect of Prenatal Smoking', *Health Economics* **19**, 209–226.

Finlay, Keith and David Neumark (2009), 'Is Marriage Always Good for Children?', *The Journal of Human Resources* **45**(4).

Hobel, Calvin and Jennifer Culhane (2003), ‘Role of Psychosocial and Nutritional Stress on Poor Pregnancy Outcome’, *Journal of Nutrition* **133**, 1709–1717.

Hoffman, Susie and Maureen Hatch (2000), ‘Depressive Symptomology during Pregnancy: Evidence for an Association with Decreased Fetal Growth in Pregnancies of Lower Sociual Class Women’, *Health Psychology* **19**(6), 535–543.

Joyce, Theodore (1999), ‘Impact of Augmented Prenatal Care on Birth Outcomes of Medicaid Recipients in New York City’, *Journal of Health Economics* **18**, 31–67.

Kirchengast, Sylvia, Michael Mayer and Manfred Voigt (2007), ‘Pregnancy outcome is associated with maternal marital status in Austria – even at the beginning of the 21st century’, *Anthropologischer Anzeiger* **65**(4), 415–426.

Koenker, Roger and Kevin F. Hallock (2001), ‘Quantile Regression’, *Journal of Economic Perspectives* **15**(4), 143–156.

Lewit, Eugene, Linda Baker, Hope Cormann and Patricia Shiono (1995), ‘The Direct Cost of low Birth Weight’, *The Future of Children* **5**(1), 35–56.

Luo, Zhong-Cheng, Russel Wilkins and Michael S. Kramer (2004), ‘Disparities in Pregnancy Outcomes According to Marital and Cohabitation Status’, *Obstetrics & Gynecology* **103**(6), 1300–1307.

McIntire, Donald D., Steven L. Bloom, Brian M. Casey and Kenneth J. Levono (1999), ‘Birth Weight in Relation to Morbidity and Mortality Among Newborn Infants’, *The New England Journal of Medicine* **340**(16), 1234–38.

Raatikainen, Kaisa, Nonna Heiskanen and Seppo Heinonen (2005), ‘Marriage still protects pregnancy’, *British Journal of Obstetrics & Gynaecology* **12**(10), 1411–1416.

Ribar, David (2004), *What do Social Scientists know about the Benefits of Marriage? A Review of Quantitative Methodologies*, IZA Discussion Paper No. 998.

Russell, Rebecca B., Nancy S. Green, Claudia A. Steiner, Susan Meikle, Jennifer L. Howse, Karalee Poschman, Todd Dias, Lisa Potetz, Michael J. Davidoff, Karla Damus and Joann R. Petrini (2007), ‘Cost of Hospitalization for Preterm and Low Birth Weight Infants in the United States’, *Pediatrics* **120**(1), e1–e9.

Sabatini, Fabio (2011), *The Relationship Between Happiness and Health: Evidence from Italy*, MPRA Working paper.

Schiffrin, Holly H., D. Rezendes and S.K. Nelson (2010), ‘Stressed and Happy? Investigating the Relationship Between Happiness and Perceived Stress’, *Journal of Happiness Studies* **11**, 33–39.

Shore, Rima S. and Barbara S. Shore (2009), Kids Count indicator brief – Preventing Low Birthweight, Technical report, Annie E. Casey Foundation, Baltimore, MD.

Wehby, George, Jeffrey Murray, Eduardo Castilla, Jorge Lopez-Camelo and Robert Ohsfeldt (2009), ‘Quantile Effects of Prenatal Care Utilization on Birth Weight in Argentina’, *Health Economics* **18**, 1307–1321.

Weiss, Yoram and Robert J. Willis (1985), ‘Children as Collective Goods and Divorce Settlements’, *Journal of Labor Economics* **3**(3), 268–292.

Zeitlin, Jennifer A., Marie J. Saurel-Cubizolles, Pierre Y. Ancel and the EUROPOP Group (2002), 'Marital status, cohabitation, and the risk of preterm birth in Europe: where births outside marriage are common and uncommon', *Paediatric and Perinatal Epidemiology* **16**, 124–130.

5 Appendix

Table 1: Descriptive statistics

	Married mothers		Unmarried mothers	
	Mean	Std. dev.	Mean	Std.dev.
Dependent variables				
Birth weight (in dekagram)	329.59	(54.44)	320.53	(57.27)
Gestation period (in days)	277.16	(13.17)	276.27	(15.16)
Premature birth	0.075	(0.263)	0.100	(0.300)
Family status				
Married	0.747	(0.435)		
Marriage during pregancy	0.251	(0.437)		
Divorced around pregnancy	0.004	(0.062)		
Sex, age of mother, multiple birth				
Boy	0.513	(0.499)	0.512	(0.499)
Age of mother	26.63	(5.136)	25.79	(5.925)
Multiple birth	0.025	(0.156)	0.023	(0.149)
Religious denomination of mother				
Catholic (Base)	0.768	(0.422)	0.797	(0.401)
Protestant	0.044	(0.205)	0.048	(0.213)
Muslim	0.088	(0.283)	0.021	(0.143)
Other denomination	0.037	(0.189)	0.036	(0.187)
Undenominational	0.063	(0.243)	0.096	(0.295)
Education of mother				
Compulsory school (Base)	0.239	(0.427)	0.237	(0.425)
Apprenticeship	0.350	(0.477)	0.396	(0.489)
High school	0.175	(0.380)	0.150	(0.357)
Matura	0.119	(0.324)	0.113	(0.317)
Academic degree	0.096	(0.294)	0.074	(0.261)
Unknown education	0.021	(0.142)	0.031	(0.173)
Employment of mother				
Unemployed/Housewife (Base)	0.268	(0.441)	0.164	(0.371)
Student	0.011	(0.015)	0.034	(0.181)
Retiree	0.001	(0.023)	0.002	(0.047)
Farmer	0.032	(0.176)	0.010	(0.097)
Worker	0.181	(0.386)	0.227	(0.419)
Employee	0.476	(0.499)	0.515	(0.450)
Self-employed	0.013	(0.113)	0.018	(0.133)
Unknown job	0.021	(0.143)	0.029	(0.169)
Regional variables				
City	0.340	(0.474)	0.382	(0.486)
Western Austria	0.590	(0.492)	0.654	(0.476)
Ethnic background				
Austrian (Base)	0.842	(0.365)	0.916	(0.278)
German/Swiss	0.012	(0.108)	0.013	(0.114)
Balcan States	0.038	(0.192)	0.037	(0.189)
Other states	0.067	(0.250)	0.028	(0.165)
Turkish	0.040	(0.197)	0.006	(0.076)
Number of observations	1,665,923		370,341	

Table 2: Family status and socio-economic determinants of birth weight[a]

	All observations				Gestation duration > 36 weeks			
	OLS		Mother F.E.		OLS		Mother F.E.	
Family Status								
Married	5.459***	(0.124)	4.258***	(0.391)	3.839***	(0.106)	2.820***	(0.333)
Marriage during pregnancy	4.930***	(0.134)	4.099***	(0.410)	3.039***	(0.116)	2.856***	(0.350)
Divorce around pregnancy	-7.946***	(0.733)	-2.059**	(0.901)	-5.608***	(0.604)	-1.785**	(0.754)
Sex, multiple birth and age								
Boy	13.17***	(0.073)	14.21***	(0.085)	14.17***	(0.064)	15.08***	(0.074)
Age of mother	1.171***	(0.066)	-0.453***	(0.142)	0.618***	(0.057)	-0.725***	(0.122)
Age of mother squared	-0.030***	(0.001)	-0.000	(0.002)	-0.016***	(0.001)	0.007***	(0.002)
Twins	-106.2***	(0.360)	-103.8***	(0.547)	-78.27***	(0.288)	-83.23***	(0.471)
Religious denomination of mother (Base: catholic)								
Protestant	-0.443**	(0.209)	-0.130	(0.784)	-0.259	(0.184)	0.290	(0.674)
Muslim	2.647***	(0.263)	2.288*	(1.247)	2.713***	(0.228)	2.920***	(1.025)
Other denomination	-2.494***	(0.286)	-0.627	(0.918)	-1.334***	(0.244)	0.456	(0.772)
Undenominational	-0.331*	(0.176)	-0.468	(0.423)	-0.092	(0.153)	0.255	(0.358)
Education of mother (Base: compulsory school)								
Apprenticeship	3.694***	(0.119)	-0.005	(0.176)	2.849***	(0.104)	0.175	(0.148)
Vocational high school	6.049***	(0.144)	0.480**	(0.214)	4.478***	(0.126)	0.240	(0.181)
Matura	8.011***	(0.164)	1.066***	(0.267)	5.953***	(0.144)	0.431*	(0.227)
Academic degree	9.280***	(0.182)	1.252***	(0.347)	6.680***	(0.160)	0.612**	(0.294)
Unknown education	2.512***	(0.367)	-0.692	(0.465)	2.768***	(0.307)	0.365	(0.384)
Employment of mother (Base: not employed or unemployed)								
Student	3.864***	(0.327)	-0.555	(0.469)	4.098***	(0.283)	0.374	(0.401)
Retiree	-12.72***	(1.601)	-3.752*	(2.062)	-6.017***	(1.309)	-0.117	(1.669)
Farmer	4.492***	(0.258)	0.541	(0.339)	3.689***	(0.231)	0.161	(0.295)
Worker	1.435***	(0.126)	0.594***	(0.158)	1.555***	(0.110)	0.696***	(0.135)
Employee	1.523***	(0.114)	-0.299**	(0.141)	1.631***	(0.100)	-0.065	(0.121)
Self employed	1.482***	(0.349)	0.601	(0.508)	1.430***	(0.304)	0.718*	(0.433)
Unknown job	1.356***	(0.352)	-0.720*	(0.426)	1.579***	(0.299)	-0.362	(0.361)
Regional effects								
City	-2.175***	(0.099)	0.431*	(0.237)	-1.704***	(0.087)	0.478**	(0.204)
Western Austria	-1.276***	(0.095)	-0.281	(0.543)	-1.702***	(0.083)	-0.374	(0.465)
Ethnic background (Base: Austrian)								
German/Swiss	3.928***	(0.388)	-0.853	(1.714)	3.067***	(0.347)	-0.890	(1.458)
Balcan	5.884***	(0.289)	-1.811***	(0.640)	6.484***	(0.248)	-2.388***	(0.535)
Turkish	-0.798**	(0.348)	-3.852***	(0.711)	-0.671**	(0.301)	-4.670***	(0.575)
Other countries	5.896***	(0.202)	0.952*	(0.547)	5.891***	(0.175)	0.176	(0.463)
Birth order								
Second birth	14.26***	(0.083)	14.04***	(0.118)	12.64***	(0.072)	13.29***	(0.103)
Third birth	18.36***	(0.137)	18.62***	(0.217)	16.74***	(0.119)	17.61***	(0.189)
Fourth birth	20.61***	(0.228)	21.84***	(0.336)	19.26***	(0.198)	20.94***	(0.290)
Fifth birth or higher	23.52***	(0.378)	24.60***	(0.519)	22.58***	(0.326)	24.39***	(0.445)
Period dummies	yes		yes		yes		yes	
Constant	295.8***	(0.893)	322.2***	(2.157)	308.4***	(0.763)	330.3***	(1.859)
Observations	2,036,263		2,036,263		1,924,299		1,924,299	
Adjusted R-squared	0.122		0.139		0.088		0.142	
Number of clusters			1,231,570				1,186,860	
Average per cluster			1.653				1.621	

[a] The dependent variable birth weight is measured in dekagram. Robust standard errors clustered by mothers. Standard errors in parentheses. *, ** and *** indicate statistical significance at the 10-percent level, 5-percent level, and 1-percent level, respectively.

Table 3: Family status and socio-economic determinants of birth weight: Quantile Regression[a]

	10%		25%		50%		75%		90%	
Family Status										
Married	8.224***	(0.218)	5.433***	(0.155)	4.199***	(0.116)	3.454***	(0.156)	2.435***	(0.138)
Marriage during pregnancy	7.499***	(0.293)	4.713***	(0.165)	3.469***	(0.107)	2.893***	(0.162)	1.837***	(0.154)
Divorce around pregnancy	-11.76***	(1.317)	-8.599***	(0.711)	-7.484***	(0.746)	-5.113***	(0.653)	-4.146***	(1.302)
Sex, multiple birth and age										
Boy	9.585***	(0.152)	11.95***	(0.072)	13.83***	(0.081)	14.78***	(0.120)	16.78***	(0.141)
Age of mother	2.098***	(0.114)	1.173***	(0.068)	0.695***	(0.069)	0.624***	(0.073)	0.553***	(0.088)
Age of mother squared	-0.055***	(0.002)	-0.031***	(0.001)	-0.019***	(0.001)	-0.016***	(0.001)	-0.012***	(0.002)
Twins	-126.8***	(0.631)	-110.3***	(0.341)	-101.7***	(0.194)	-98.44***	(0.322)	-98.81***	(0.422)
Religious denomination of mother (Base: catholic)										
Protestant	-0.554*	(0.313)	-0.268	(0.223)	-0.388**	(0.162)	-0.282	(0.209)	-0.356	(0.241)
Muslim	3.091***	(0.452)	2.600***	(0.288)	2.611***	(0.229)	2.681***	(0.308)	2.710***	(0.360)
Other denomination	-2.443***	(0.548)	-2.390***	(0.320)	-2.173***	(0.286)	-1.803***	(0.344)	-1.219***	(0.292)
Undenominational	-1.261***	(0.289)	-0.462**	(0.199)	-0.178	(0.211)	-0.055	(0.195)	0.161	(0.254)
Education of mother (Base: compulsory school)										
Apprenticeship	5.984***	(0.175)	4.045***	(0.135)	3.133***	(0.105)	2.351***	(0.101)	1.622***	(0.125)
Vocational high school	9.735***	(0.240)	6.822***	(0.156)	5.004***	(0.109)	3.829***	(0.127)	2.503***	(0.212)
Matura	12.87***	(0.303)	9.005***	(0.240)	6.544***	(0.174)	5.167***	(0.185)	3.676***	(0.246)
Academic degree	15.92***	(0.322)	10.89***	(0.209)	7.563***	(0.138)	5.475***	(0.184)	3.671***	(0.309)
Unknown education	4.151***	(0.693)	3.598***	(0.377)	3.117***	(0.524)	2.226***	(0.483)	1.131**	(0.462)
Employment of mother (Base: not employed or unemployed)										
Student	4.437***	(0.379)	4.783***	(0.410)	4.294***	(0.284)	3.450***	(0.368)	2.992***	(0.454)
Retiree	-22.87***	(2.954)	-15.38***	(1.867)	-10.23***	(1.310)	-7.995***	(1.375)	-3.771**	(1.791)
Farmer	7.366***	(0.402)	5.001***	(0.250)	3.987***	(0.272)	3.094***	(0.221)	2.166***	(0.354)
Worker	0.901***	(0.257)	1.382***	(0.135)	1.625***	(0.149)	1.621***	(0.162)	1.909***	(0.177)
Employee	1.965***	(0.222)	1.821***	(0.125)	1.599***	(0.104)	1.344***	(0.106)	1.287***	(0.183)
Self employed	1.725***	(0.654)	1.811***	(0.451)	1.862***	(0.391)	1.249***	(0.347)	1.188***	(0.427)
Unknown job	1.508***	(0.576)	1.805***	(0.364)	1.374***	(0.527)	1.578***	(0.422)	1.919***	(0.562)
Regional effects										
City	-3.545***	(0.119)	-2.538***	(0.099)	-1.751***	(0.083)	-1.058***	(0.086)	-0.889***	(0.116)
Western Austria	-0.047	(0.127)	-0.836***	(0.104)	-1.508***	(0.066)	-1.955***	(0.113)	-2.455***	(0.110)
Ethnic background (Base: Austrian)										
German/Swiss	4.230***	(0.579)	3.139***	(0.438)	3.820***	(0.370)	3.356***	(0.374)	3.702***	(0.591)
Balcan	3.744***	(0.486)	5.015***	(0.347)	6.482***	(0.278)	6.983***	(0.347)	8.070***	(0.347)
Turkish	5.609***	(0.329)	5.265***	(0.228)	5.716***	(0.158)	6.428***	(0.231)	7.538***	(0.230)
Other countries	0.790	(0.699)	0.191	(0.409)	-1.079***	(0.250)	-1.767***	(0.409)	-1.883***	(0.431)
Birth order										
Second birth	16.25***	(0.137)	13.71***	(0.139)	13.14***	(0.092)	13.31***	(0.136)	13.74***	(0.114)
Third birth	18.83***	(0.246)	17.25***	(0.174)	17.58***	(0.140)	18.18***	(0.131)	19.59***	(0.189)
Fourth birth	19.49***	(0.427)	18.80***	(0.221)	19.86***	(0.204)	21.35***	(0.265)	22.95***	(0.389)
Fifth birth or higher	19.49***	(0.459)	19.84***	(0.247)	22.43***	(0.365)	25.41***	(0.401)	28.67***	(0.484)
Period dummies	yes		yes		yes		yes		yes	
Constant	226.2***	(1.622)	269.5***	(0.904)	305.0***	(0.952)	334.5***	(0.972)	361.8***	(1.197)
Observations	2,036,264		2,036,264		2,036,264		2,036,264		2,036,264	

[a] The dependent variable birth weight is measured in dekagram. Bootstrapped standard errors in parentheses. *, ** and *** indicate statistical significance at the 10-percent level, 5-percent level, and 1-percent level, respectively.

Table 4: Family status and socio-economic determinants of birth weight by decades - Full sample[a]

	1980s				1990s				2000s			
	OLS		Mother F.E.		OLS		Mother F.E.		OLS		Mother F.E.	
Family Status												
Married	7.322***	(0.278)	3.303**	(1.591)	5.559***	(0.188)	4.281***	(0.857)	4.232***	(0.192)	4.955***	(1.183)
Marriage during pregnancy	6.776***	(0.283)	2.730*	(1.623)	4.800***	(0.200)	4.191***	(0.885)	3.609***	(0.229)	4.359***	(1.221)
Divorce around pregnancy	-8.986***	(1.331)	-1.268	(2.423)	-6.295***	(0.999)	-2.337	(1.475)	-9.956***	(1.833)	-6.583**	(3.041)
Sex, multiple birth and age	yes		yes		yes		yes		yes		yes	
Religious denomination of mother	yes		yes		yes		yes		yes		yes	
Education of mother	yes		yes		yes		yes		yes		yes	
Employment of mother	yes		yes		yes		yes		yes		yes	
Regional effects	yes		yes		yes		yes		yes		yes	
Ethnic background	yes		yes		yes		yes		yes		yes	
Birth order	yes		yes		yes		yes		yes		yes	
Period dummies	yes		yes		yes		yes		yes		yes	
Observations	526,952		526,952		888,921		888,921		620,390		620,390	
Adjusted R-squared	0.100		0.120		0.116		0.137		0.147		0.140	
Number of clusters			420,195				630,862				466,886	
Average per cluster			1.254				1.409				1.329	

[a] The dependent variable birth weight is measured in dekagram. Robust standard errors clustered by mothers. Standard errors in parentheses. *, ** and *** indicate statistical significance at the 10-percent level, 5-percent level, and 1-percent level, respectively.

Table 5: Marginal births and alternative outcomes

	Birth weight (marginal births)[a]				Gestation period (full sample)[b]				Premature birth (full sample)[c]			
	OLS		Mother F.E.		OLS		Mother F.E.		OLS		Mother F.E.	
Family Status												
Married	6.651***	(0.277)	2.107	(1.520)	0.579***	(0.032)	0.614***	(0.110)	-0.018***	(0.001)	-0.014***	(0.002)
Marriage during pregnancy	4.500***	(0.237)	1.742	(1.552)	0.928***	(0.034)	0.851***	(0.116)	-0.018***	(0.001)	-0.014***	(0.002)
Divorce around pregnancy	-6.998***	(1.657)	-4.355	(2.713)	-1.101***	(0.198)	-0.169	(0.264)	0.025***	(0.004)	0.001	(0.005)
Sex, multiple birth and age												
Boy	12.41***	(0.165)	13.91***	(0.296)	-0.552***	(0.018)	-0.404***	(0.024)	-0.004***	(0.000)	-0.005***	(0.000)
Age of mother	6.678***	(1.041)	-2.797*	(1.670)	0.395***	(0.017)	0.247***	(0.040)	-0.006***	(0.000)	-0.001	(0.001)
Age of mother squared	-0.166***	(0.028)	0.104**	(0.045)	-0.010***	(0.000)	-0.007***	(0.000)	0.000***	(0.000)	0.000***	(0.000)
Twins	-106.5***	(1.071)	-105.9***	(2.224)	-24.87***	(0.138)	-23.31***	(0.202)	0.580***	(0.003)	0.534***	(0.004)
Religious denomination (Base: catholic)												
Protestant	-0.196	(0.472)	-0.061	(3.157)	-0.171***	(0.050)	-0.429*	(0.224)	0.002**	(0.001)	0.003	(0.004)
Muslim	1.649***	(0.530)	-4.720	(3.927)	0.315***	(0.065)	0.169	(0.346)	-0.004***	(0.001)	-0.001	(0.007)
Other denomination	-3.793***	(0.553)	-2.509	(2.880)	-0.797***	(0.073)	-0.279	(0.262)	0.007***	(0.001)	0.008	(0.005)
Undenominational	-1.005**	(0.487)	-1.314	(1.755)	0.0715	(0.044)	-0.239**	(0.120)	0.001	(0.001)	0.004*	(0.002)
Education (Base: compulsory school)												
Apprenticeship	3.117***	(0.221)	0.232	(0.493)	0.542***	(0.029)	-0.020	(0.051)	-0.012***	(0.001)	0.001	(0.001)
Vocational high school	5.100***	(0.306)	0.490	(0.737)	0.820***	(0.035)	0.155**	(0.061)	-0.020***	(0.001)	-0.001	(0.001)
Matura	6.890***	(0.410)	0.034	(1.234)	1.031***	(0.040)	0.293***	(0.076)	-0.026***	(0.001)	-0.005***	(0.001)
Academic degree	7.134***	(0.969)	0.162	(2.808)	1.235***	(0.045)	0.360***	(0.098)	-0.034***	(0.001)	-0.005***	(0.002)
Unknown education	0.169	(0.873)	-1.415	(1.597)	0.177*	(0.101)	-0.492***	(0.137)	-0.009***	(0.002)	0.004	(0.003)
Employment (Base: not employed or unemployed)												
Student	4.456***	(0.523)	-1.343	(1.214)	0.348***	(0.084)	-0.217*	(0.132)	-0.008***	(0.002)	0.007**	(0.003)
Retiree	-2.500	(4.100)	4.339	(7.101)	-3.708***	(0.431)	-1.912***	(0.615)	0.067***	(0.009)	0.017	(0.013)
Farmer	3.873***	(0.626)	-1.046	(1.221)	0.252***	(0.060)	0.107	(0.094)	-0.012***	(0.001)	-0.003	(0.002)
Worker	1.854***	(0.252)	0.830*	(0.444)	0.160***	(0.032)	0.220***	(0.045)	-0.001**	(0.001)	-0.000	(0.001)
Employee	2.510***	(0.265)	0.853*	(0.500)	0.091***	(0.028)	0.063	(0.039)	-0.003***	(0.001)	0.002**	(0.001)
Self employed	3.190*	(1.706)	5.077	(4.007)	-0.081	(0.087)	0.121	(0.146)	-0.004**	(0.002)	-0.002	(0.003)
Unknown job	1.532*	(0.884)	-1.609	(1.638)	0.067	(0.095)	-0.081	(0.123)	-0.001	(0.002)	0.004	(0.002)
Regional effects												
City	-3.006***	(0.209)	1.057	(0.905)	0.088***	(0.024)	0.235***	(0.067)	0.005***	(0.000)	-0.001	(0.001)
Western Austria	-0.248	(0.195)	1.123	(1.996)	0.340***	(0.023)	0.059	(0.149)	-0.003***	(0.000)	-0.001	(0.003)
Ethnic background (Base: Austrian)												
German/Swiss	1.318	(1.203)	-5.839	(6.425)	0.567***	(0.092)	-0.021	(0.463)	-0.009***	(0.002)	0.006	(0.010)
Balcan	3.616***	(0.517)	-0.371	(2.640)	-0.144**	(0.073)	-0.082	(0.181)	-0.004***	(0.001)	-0.001	(0.003)
Turkish	-3.584***	(0.620)	-0.972	(3.014)	-0.306***	(0.086)	-0.488**	(0.208)	-0.000	(0.002)	0.001	(0.004)
Other countries	5.014***	(0.493)	-0.475	(2.927)	0.358***	(0.050)	0.403***	(0.152)	-0.008***	(0.001)	-0.002	(0.003)
Birth order												
Second birth	8.886***	(0.219)	4.452***	(0.480)	0.688***	(0.022)	0.640***	(0.033)	-0.028***	(0.001)	-0.026***	(0.001)
Third birth	8.192***	(0.596)	4.331***	(0.948)	0.740***	(0.034)	0.944***	(0.061)	-0.032***	(0.001)	-0.032***	(0.001)
Fourth birth	3.368*	(1.904)	4.782**	(2.250)	0.838***	(0.057)	1.201***	(0.095)	-0.032***	(0.001)	-0.035***	(0.002)
Fifth birth or higher	2.022	(5.534)	5.196	(6.029)	0.939***	(0.091)	1.223***	(0.147)	-0.032***	(0.002)	-0.034***	(0.003)
Period dummies	yes		yes		yes		yes		yes		yes	
Constant	242.6***	(9.690)	314.7***	(15.787)	272.2***	(0.232)	274.8***	(0.606)	0.164***	(0.005)	0.085***	(0.012)
Observations	378,080		378,080		2,036,263		2,036,263		2,036,263		2,036,263	
Adjusted R-squared	0.083		0.115		0.088		0.059		0.115		0.067	
Number of clusters			311,844				1,231,570				1,231,570	
Average per cluster			1.212				1.653				1.653	

[a] Sample is restricted to mothers younger than 22 at birth of the child. Robust standard errors clustered by mothers. Standard errors in parentheses. *, ** and *** indicate statistical significance at the 10-percent level, 5-percent level, and 1-percent level, respectively.

[b] The dependent variable gestation duration is measured in days. Robust standard errors clustered by mothers. Standard errors in parentheses. *, ** and *** indicate statistical significance at the 10-percent level, 5-percent level, and 1-percent level, respectively.

[c] The dependent variable is a dummy indicating whether a premature birth occurred. Premature birth is defined as gestation duration below 37 weeks or birth weight less than 2.5 kilogram. Robust standard errors clustered by mothers. Standard errors in parentheses. *, ** and *** indicate statistical significance at the 10-percent level, 5-percent level, and 1-percent level, respectively.