HEALTH ECONOMICS
Health Econ. **23**: 426–445 (2014)
Published online 20 May 2013 in Wiley Online Library (wileyonlinelibrary.com). DOI: 10.1002/hec.2923

BIRTH WEIGHT AND FAMILY STATUS REVISITED: EVIDENCE FROM AUSTRIAN REGISTER DATA

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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 the range of 40 to 60 g. The significant impact is retained if we include mother fixed effects or use an instrumental variable approach to account for unobserved mother heterogeneity. However, the magnitude of the causal effect (37 g) clearly indicates the importance of selection into marriage. Divorce around pregnancy results in significantly lower birth weights than the birth weights of babies born to single mothers. Family status effects in the 2000s are stronger than they were in the 1980s, and quantile regressions suggest that family effects are more pronounced at the lower quantiles of the birth weight distribution and less pronounced at higher quantiles. We conclude that the life situation of expectant mothers has an important influence on the birth weight of newborns, especially at the lower tail of the birth weight distribution. Copyright © 2013 John Wiley & Sons, Ltd.

Received 19 December 2011; Revised 5 February 2013; Accepted 26 February 2013

JEL Classification: I12; J12; J13; C21

KEY WORDS: low birth weight; family status; newborn health; fixed effects; instrumental variable estimations

1. INTRODUCTION

Birth weights of newborn babies play an important role in several respects. (i) Low birth weight entails high direct treatment costs 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) emphasized the role of childhood health in determining health, educational attainment, and social status in adulthood. They argue that nutrition *in utero* can have an effect on 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 in adulthood, either directly, by the illness itself, or indirectly, by restricting educational attainment and life chances. By using data from the UK's National Child Development Study, the authors found that children who have experienced poorer *in utero* environments and poorer childhood health have lower educational attainment, poorer health, and lower socio-economic status in adulthood. Black *et al*. (2007) used a rich administrative dataset from Norway and apply twin techniques. They too find significant effects of birth weight on long-run outcomes such as height, adult IQ, earnings, and education. Berman and Rosenzweig (2004) used

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Minnesota Twin Registry data of female monozygotic twins and found that the heavier twin continues to be taller, has greater educational attainment, and 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 behind newborns' health may help 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 the mother's family status. The empirical analysis is based on Austrian birth register data for the period from 1984 to 2007. We found that the birth weight of newborns is significantly higher for married mothers than for single mothers if we control for a series of socio-economic mother characteristics and for mother fixed effects (FEs). Although the quantitative effects decrease, the result is confirmed by an area variation instrumental variable (IV) approach where we instrument the individual propensity for a mother to get married by the women's age-specific marriage ratio at the community level. Divorce of the expectant mother around pregnancy decreases the infant's birth weight. 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. The influence of marriage and divorce is higher in the years after 2000 than in 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 the 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, making it possible for the couple to overcome free-rider incentives. In a similar vein, Duncan *et al.* (2006) argue that marriage makes monitoring of mutual behavior in a family easier and that children may behave better when someone is watching regularly. 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 the neuroendocrine function and 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, thus 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 married mothers can be expected to be higher because married people are happier than unmarried people (Alesina *et al.*, 2004; Blanchflower and Oswald, 2004). In this context, Chapman and Guven (2010) emphasize the importance of marriage quality. Happiness might also have an indirect effect on birth weight through 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 examined the relationship between the marital status of mothers and the weight of newborns and found that the birth weight of newborn babies is, *ceteris paribus*, significantly higher if the mother is married than if she is unmarried (Zeitlin *et al.*, 2002; Luo *et al.*, 2004; Raatikainen *et al.*, 2005).[2]

[1]Almond *et al.* (2005) utilize within-twins variation for US twin pairs. As compared with more conventional previous studies, they found 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.

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

DOI: 10.1002/hec

Several authors evaluate the effects of demographics and prenatal maternal behavior at different quantiles of the birth weight distribution (Abrevaya, 2001; Koenker and Hallock, 2001; Abrevaya and Dahl, 2008; Wehby *et al*., 2009). In general, quantile regressions for birth weight show that most factors (including family status, race, education, and prenatal care) have a significantly higher impact at lower quantiles and a lower impact 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 of an IV approach is the paper by Buckles and Price (2010), who consider the requirement of blood tests for obtaining a marriage license across the USA as an instrument for marriage. Their IV estimates confirm the positive ordinary least squares (OLS) effects of marriage on the 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 (2010) used incarceration rates for men 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 mothers were never married. Dahl (2010) presents an IV approach that utilizes variation in US state laws that regulate the minimum age at which individuals are allowed to marry. Using these marriage laws as an instrument for early marriage, the author estimates that a woman who marries young is 31% more likely 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) 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 women whose marriage decisions are influenced by factors such as male incarceration percentages or the presence of blood test requirements to obtain a marriage certificate.

This paper contributes to the literature in several ways: first, we extend similar previous studies to present empirical evidence of the 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 free 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 than in 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 FE. Third, in an attempt to infer causal effects, we control for time-variant heterogeneity by implementing an IV approach. Finally, as our data cover a lengthy time period, 24 years, we can study whether the impacts of certain characteristics on birth weight have changed over time.

The rest of the paper is organized as follows: Section 2 describes the data and presents the empirical strategy, Section 3 reports the empirical results, and Section 4 summarizes the main findings and concludes the study.

[3]Using state-level panel data on maternally linked births to control for unobserved heterogeneity, Abrevaya and Dahl (2008) found positive impacts of marriage on birth weight. The results remain significantly positive throughout the range of quantiles and are quite similar to the cross-section specifications. Björklund *et al*. (2010) exploited the 1989 reform of the Widow's Pension System in Sweden that raised the attractiveness of marriage. Using grade point average at age 16 years, the authors found that children with married parents do better than their counterparts with cohabitating parents. However, the differences are reported to disappear if observable family background is controlled for or IV estimations are used.

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

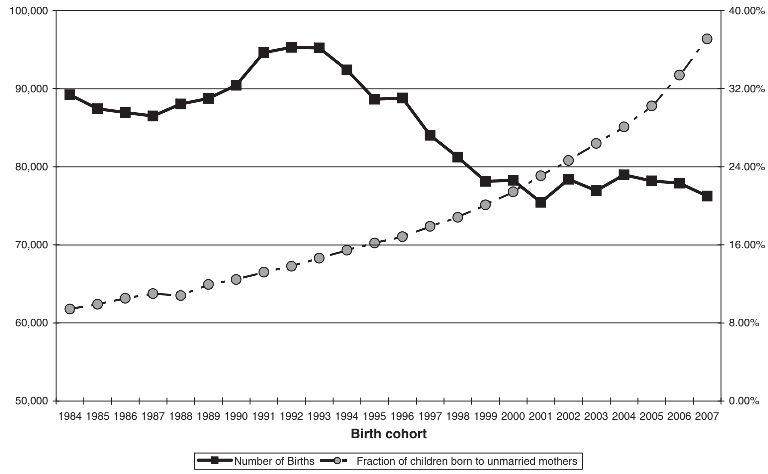

Figure 1. Number of births and proportion of out-of-wedlock births

2. METHODS

In this study, we analyze birth register data from Austria. The Austrian Bismarckian-type health care system offers pregnant women a comprehensive mother–child care program that was introduced in 1974. This program comprises at least five basic prenatal health exams for the expectant mother and her unborn baby. The costs incurred are covered by the mandatory provincial sickness funds (*Gebietskrankenkassen*), and the mothers receive the services free of charge.[5]

2.1. Data

The register data used in the empirical analysis cover all 1,974,710 live births in Austria between 1984 and 2007. The data include information on the birth dates of the child and the parents; the mother's marital status and date of marriage; the place and method of birth; health outcomes such as birth weight, gestation duration, and Apgar scores; and maternal socio-economic characteristics such as age, education, religion, employment, and citizenship at the time of birth. Because information on marriages during pregnancy is partly missing in the birth register, we matched the missing information for 204,159 observations from the Austrian marriage register. The variable on divorce around pregnancy—a proxy for a burdening and stressful family life—is matched from the Austrian divorce register.[6]

As Figure 1 shows, fertility in Austria has declined over time. Since the 1980s, the number of annual births has decreased 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 significantly. At the same time, the proportion of children born out of wedlock increased from less than 10% of births in 1984 to 38% in 2007.

Descriptives for newborns' birth weight and socio-economic controls for married and unmarried mothers are depicted in Table I. In our sample, 82.0% of mothers are married, and the birth weight of their newborns is, on average, 89.8 g higher than that of newborns of unmarried mothers. A significant difference can also be

[5]Austrian social security data reveal that more than 90% of women who gave birth in the period between 1998 and 2007 also underwent the five basic prenatal health checks.
[6]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.

DOI: 10.1002/hec

Table I. Descriptive statistics

	Married mothers		Unmarried mothers		
	Mean	Std. dev.	Mean	Std. dev.	*p*-value
Dependent variables					
Birth weight (g)	3,296.294	(543.008)	3,206.450	(570.886)	<0.01
Gestation period (days)	277.183	(13.095)	276.322	(15.050)	<0.01
Premature birth	0.074	(0.262)	0.099	(0.299)	<0.01
Family status					
Married before pregnancy	0.745	(0.436)			
Married during pregnancy	0.253	(0.435)			
Divorced around pregnancy	0.004	(0.062)			
Sex, age of mother, multiple birth					
Boy	0.513	(0.500)	0.511	(0.500)	
Age of mother	26.590	(5.125)	25.766	(5.909)	<0.01
Multiple birth	0.025	(0.155)	0.023	(0.148)	<0.01
Religious denomination of mother					
Catholic (base)	0.773	(0.419)	0.804	(0.397)	<0.01
Protestant	0.044	(0.205)	0.048	(0.214)	<0.01
Muslim	0.086	(0.280)	0.020	(0.141)	<0.01
Other denomination	0.036	(0.186)	0.035	(0.185)	<0.05
Undenominational	0.061	(0.240)	0.092	(0.290)	<0.01
Education of mother					
Compulsory school (base)	0.245	(0.430)	0.245	(0.430)	
Apprenticeship	0.357	(0.479)	0.409	(0.492)	<0.01
High school	0.179	(0.383)	0.155	(0.361)	<0.01
Matura	0.122	(0.327)	0.117	(0.321)	<0.01
Academic degree	0.098	(0.297)	0.075	(0.264)	<0.01
Employment of mother					
Not employed or unemployed (base)	0.268	(0.443)	0.167	(0.373)	<0.01
Student	0.011	(0.104)	0.034	(0.180)	<0.01
Retiree	0.001	(0.023)	0.002	(0.047)	<0.01
Farmer	0.033	(0.178)	0.010	(0.099)	<0.01
Worker	0.186	(0.389)	0.236	(0.425)	<0.01
Employee	0.488	(0.500)	0.533	(0.499)	<0.01
Self-employed	0.013	(0.115)	0.019	(0.135)	<0.01
Regional variables					
City	0.332	(0.471)	0.374	(0.484)	<0.01
Western Austria	0.597	(0.491)	0.664	(0.472)	<0.01
Ethnic background					
Austrian (base)	0.846	(0.361)	0.918	(0.274)	<0.01
German/Swiss	0.012	(0.108)	0.013	(0.113)	<0.01
Balcan states	0.038	(0.191)	0.037	(0.189)	<0.01
Other states	0.064	(0.245)	0.026	(0.161)	<0.01
Turkish	0.040	(0.196)	0.006	(0.076)	<0.01
Number of observations	1,619,357		355,353		

observed for the gestation period and the occurrence of premature births, which is 2.5 percentage points lower among married mothers.[7] Married and unmarried mothers also differ in several socio-economic characteristics. Married mothers are, on average, 0.82 years older at the time of birth, better educated, and less likely to be employed. A lower percentage of married mothers live in cities and in western Austria, as compared with their unmarried counterparts.[8] About 15.4% (8.2) of married (unmarried) mothers have foreign citizenship.

Obviously, our empirical analysis of live births may suffer from sample selection problems because of selective termination of pregnancy, which in turn can be affected by marital status. Another potential level of selection is the

[7]Premature birth is defined as either a gestation duration of less than 37 weeks or a birth weight of less than 2500 g.
[8]The city dummy is equal to 1 if a community has more than 10,000 inhabitants and 0 otherwise. Western Austria includes the provinces Upper Austria, Salzburg, Carinthia, Styria, Tyrol, and Vorarlberg.

probability of becoming pregnant, which can also depend on women's marital status. Unfortunately, data on abortions and miscarriages, which would possibly allow us to account for sample selection by estimating a Heckman-type selection model, are not available. Abortion is not notifiable in Austria, nor is the medical procedure covered by health insurance. As a consequence, official statistics about abortions do not exist. The same holds true for miscarriages.[9] If we assume, however, that abortion rates are higher among unmarried women, that there is favorable selection (in birth weight) from pregnancies to live births, and that the birth weight of newborns is significantly lower for single mothers (the main result of this paper), married mothers are overrepresented in the live births sample, and the estimated impacts of marital status represent the lower bounds of the true effects.

2.2. Estimation strategy

To analyze the contribution of the mother's family status to 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.

Ordinary least squares estimates are expected to be biased because of unobserved heterogeneity of the mothers. To correct for time-invariant heterogeneity, we estimate the FE model for child *i* and mother *j* by

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

with mother FE η_j. The FEs control for genetic endowment and behavioral aspects, such as smoking and drinking, which are constant over time (across births). Obviously, a mother FE model cannot identify the true causal effect of the family status on birth weight, as a mother may change her behavior between births.[10]

To control for unobserved heterogeneity, we implement an IV approach. We construct an age-specific ratio of married women at the community level in 1981 and use this as exogenous area-level variation. The marriage ratio *mr* is constructed as

$$mr = \frac{married^{81}_{a,c}}{married^{81}_{a,c} + unmarried^{81}_{a,c}}, \tag{3}$$

with $married^{81}_{a,c}$ as the number of married women in a 5-year age cohort *a* and community *c* in the year 1981. Note that the mother's age cohort *a* and community *c* are identified at the time of the child's birth and then matched with the number of married and unmarried women in 1981. The marriage ratio is a proxy for the local marriage exposure for mothers. A higher local age-specific marriage ratio is expected to increase a mother's individual propensity to be married and is identified through variation across communities and 5-year age cohorts. Apart from a statistically significant effect of the instrument on the probability to be married at the first stage, the validity of the instrument requires the following: (i) strict exogeneity (exclusion restriction); (ii) no reversed causality; and (iii) no direct impact on birth weight. While (ii) and (iii) can easily be justified, the fulfillment of the exclusion restriction might be potentially threatened if there is a regional sorting of mothers (Gautier *et al.*, 2005). This problem occurs if married mothers moved systematically to communities with higher marriage ratios before they got married. To overcome the potential of sorting, we use the historical marriage ratio for the year 1981. Although marriage ratios for communities are highly correlated over time, the marriage ratio of 1981 should not be relevant to the sorting of unmarried mothers into their respective

[9]A descriptive analysis of aggregated data on stillbirths reveals that stillbirth rates are low and that the differences between married and unmarried mothers are minor.

[10]Birth-individual heterogeneity may also be introduced by different fathers. Unfortunately, we cannot observe father characteristics for children born out of wedlock in our data.

DOI: 10.1002/hec

communities in the 1990s or 2000s.[11] One drawback of the instrument is that it cannot be used in an FE framework because local area variation over time is small and mothers rarely move between subsequent births. As a consequence, the variation across births is almost completely absorbed by mother and birth cohort FE, and the causal effect cannot be identified.

The IV specification closely follows the empirical model in Equation 1. The first stage is given by

$$fam_i = \alpha + \gamma_1 mr_i + \gamma_2 X_i + \gamma_3 bc_i + \gamma_4 bo_i + \varepsilon_i, \tag{4}$$

with mr denoting the local age-specific marriage ratio.

The second stage,

$$bw_i = \alpha + \beta_1 fam_i + \beta_2 X_i + \beta_3 bc_i + \beta_4 bo_i + \mu_i, \tag{5}$$

gives us the causal effect of family status on birth weight. Equations 4 and 5 are jointly estimated by maximum likelihood, and the first stage is based on a probit model. β_1 is now expected to be unbiased from endogeneity and can be interpreted as the causal effect of marriage on birth weight for those mothers whose marriage decision was affected by the local age-specific marriage ratio.

To answer the question whether mothers change their behavior between subsequent births, we estimate a dynamic version of our model where we include the birth weight of the previous child ($bw_{i-1,j}$) as an additional regressor:

$$bw_{i,j} = \alpha + \beta_1 fam_{i,j} + \beta_2 bw_{i-1,j} + \beta_3 X_{i,j} + \beta_4 bc_{i,j} + \beta_5 bo_{i,j} + \eta_j + \mu_{i,j} \tag{6}$$

In a simple OLS framework, we expect a positive sign for β_2, which would reflect a common mother effect (genetics) for two subsequent newborns. However, including $bw_{i-1,j}$ as a control variable together with mother FE η_j may capture the unobservable behavioral changes of mothers between subsequent births.

Finally, we employ quantile regressions, as suggested by Koenker and Hallock (2001), to analyze the effect of family status at different points on the birth weight distribution. Quantile regressions including FE are estimated on the basis of Koenker (2004).

3. EMPIRICAL RESULTS

This section presents our estimation results. First, we provide findings on the influence of family status and very briefly discuss the results for further groups of controls (Table II). For all sets of right-hand-side variables, we compare OLS with mother FE specifications and present a separate regression that includes births with a gestation period of more than 36 weeks. To control for time-variant heterogeneity, we provide the results of the IV estimation (Table III) and of a so-called dynamic specification that includes the birth weight of the previous child as a regressor (Table IV). To account for the fact that mother and child characteristics may influence birth weights differently for low and normal birth-weight infants, we present the results of quantile regressions (including and not including mother FE) in Tables V and VIII. Whether the impact of the mother's family status changes over time can be seen in Table VI. Finally, regression results for the alternative outcomes gestation period and the probability of premature birth are shown in Table VII.

3.1. OLS and time-invariant heterogeneity

Table II shows that marriage significantly increases infant birth weight. In the OLS specification, the birth weight of infants born to married mothers is, on average, 54 g 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

[11]The necessary information to construct the instrument is based on the decennial Austrian Census. The 1981 census is therefore the latest available point in time before our observation period starts.

DOI: 10.1002/hec

Table II. OLS and time-invariant heterogeneity[a]

	All observations				Gestation duration > 36 weeks			
	OLS		Mother FE		OLS		Mother FE	
Family Status								
Married before pregnancy	54.07***	(1.26)	42.64***	(4.01)	38.10***	(1.08)	27.89***	(3.42)
Married during pregnancy	48.76***	(1.36)	41.13***	(4.20)	30.18***	(1.18)	28.41***	(3.59)
Divorced around pregnancy	−77.86***	(7.42)	−19.18**	(9.08)	−55.51***	(6.14)	−18.41**	(7.69)
Sex, multiple birth, and age								
Boy	131.88***	(0.74)	142.33***	(0.87)	141.98***	(0.65)	150.99***	(0.75)
Age of mother	11.17***	(0.67)	−4.74***	(1.45)	5.75***	(0.58)	−7.60***	(1.25)
Age of mother squared	−0.29***	(0.01)	0.00	(0.02)	−0.16***	(0.01)	0.08***	(0.02)
Twins	−1060.02***	(3.65)	−1037.61***	(5.59)	−782.46***	(2.92)	−831.16***	(4.83)
Religious denomination of mother (base: catholic)								
Protestant	−4.77**	(2.11)	−1.29	(7.95)	−2.93	(1.86)	3.77	(6.88)
Muslim	27.75***	(2.69)	25.36*	(12.94)	27.90***	(2.34)	32.77***	(10.62)
Other denomination	−23.05***	(2.92)	−6.10	(9.47)	−11.96***	(2.50)	4.84	(7.95)
Undenominational	−2.85	(1.80)	−4.55	(4.38)	−0.64	(1.57)	2.56	(3.70)
Education of mother (base: compulsory school)								
Apprenticeship	37.76***	(1.20)	0.11	(1.80)	29.16***	(1.05)	1.18	(1.51)
Vocational high school	61.70***	(1.45)	5.35**	(2.19)	45.79***	(1.27)	1.99	(1.86)
Matura	81.55***	(1.65)	12.60***	(2.78)	60.61***	(1.46)	3.91*	(2.37)
Academic degree	94.44***	(1.84)	16.51***	(3.67)	68.05***	(1.61)	6.31**	(3.12)
Employment of mother (base: not employed or unemployed)								
Student	36.60***	(3.32)	−7.47	(4.84)	39.63***	(2.88)	2.34	(4.14)
Retiree	−126.86***	(16.25)	−34.54	(21.73)	−58.83***	(13.28)	4.14	(17.48)
Farmer	45.10***	(2.58)	5.85*	(3.43)	36.88***	(2.32)	1.71	(2.99)
Worker	14.61***	(1.27)	6.15***	(1.60)	15.53***	(1.10)	7.03***	(1.36)
Employee	15.42***	(1.15)	−2.94**	(1.43)	16.24***	(1.01)	−0.93	(1.24)
Self employed	14.34***	(3.51)	5.72	(5.23)	13.83***	(3.06)	6.91	(4.45)

DOI: 10.1002/hec

Regional effects								
City	−22.56***	(1.00)	5.03**	(2.43)	−17.49***	(0.88)	5.49***	(2.09)
Western Austria	−12.94***	(0.95)	−1.81	(5.60)	−16.79***	(0.84)	−3.28	(4.82)
Ethnic background (base: Austrian)								
German/Swiss	39.19***	(3.93)	−14.06	(16.72)	30.32***	(3.52)	−6.14	(14.88)
Balcan	60.76***	(2.93)	−20.07***	(6.64)	66.16***	(2.52)	−25.64***	(5.55)
Turkish	−7.92**	(3.55)	−38.39***	(7.27)	−6.34**	(3.07)	−45.19***	(5.89)
Other countries	61.47***	(2.07)	10.63*	(5.76)	61.30***	(1.80)	1.17	(4.87)
Birth order								
Second birth	143.19***	(0.84)	140.41***	(1.21)	126.96***	(0.73)	133.13***	(1.06)
Third birth	184.90***	(1.39)	185.82***	(2.22)	168.28***	(1.21)	176.12***	(1.93)
Fourth birth	207.85***	(2.31)	217.91***	(3.43)	193.83***	(2.01)	209.70***	(2.97)
Fifth birth or higher	236.90***	(3.84)	245.65***	(5.29)	226.74***	(3.31)	243.61***	(4.55)
Period dummies	Yes		Yes		Yes		Yes	
Constant	2966.04***	(9.07)	3222.53***	(22.14)	3089.85***	(7.76)	3307.10***	(19.10)
Observations	1,974,709		1,974,709		1,866,921		1,866,921	
Adjusted R-squared	0.122		0.139		0.088		0.142	
Number of clusters			1,207,430				1,163,645	
Average per cluster			1.635				1.604	

OLS, ordinary least squares; FE, fixed effect.
[a]The dependent variable birth weight is measured in grams. Robust standard errors clustered by mothers. Standard errors in parentheses.
*Statistical significance at the 10% level; **statistical significance at the 5% level; ***statistical significance at the 1% level.

Table III. Time-variant heterogeneity[a]

	OLS	Mother FE	IV
Family status			
Married	52.19*** (1.19)	42.42*** (4.06)	37.28*** (4.34)
Sex, multiple birth, and age	Yes	Yes	Yes
Religious denomination of mother	Yes	Yes	Yes
Education of mother	Yes	Yes	Yes
Employment of mother	Yes	Yes	Yes
Regional effects	Yes	Yes	Yes
Ethnic background	Yes	Yes	Yes
Birth order	Yes	Yes	Yes
Period dummies	Yes	Yes	Yes
First stage (dependent variable: married)			
Marriage ratio			0.426*** (0.03)
F-statistic			191.55
Observations	1,974,305	1,974,305	1,974,305
Adjusted *R*-squared	0.122	0.139	
Number of clusters		1,207,244	
Average per cluster		1.635	

OLS, ordinary least squares; FE, fixed effect; IV, instrumental variable.
[a]The dependent variable birth weight is measured in grams. Robust standard errors clustered by mothers in the OLS and FE specification, and by communities in the IV model. Standard errors in parentheses.
IV is estimated by maximum likelihood.
*Statistical significance at the 10% level; **statistical significance at the 5% level; ***statistical significance at the 1% level.

Table IV. The impact of previous birth weight[a]

	OLS		Mother FE	
Family status				
Married before pregnancy	64.57*** (2.16)	40.89*** (1.80)	50.67*** (7.18)	61.61*** (7.08)
Married during pregnancy	51.11*** (2.84)	35.09*** (2.38)	51.73*** (8.26)	65.04*** (8.13)
Divorced around pregnancy	−82.74*** (11.61)	−59.34*** (10.38)	−8.07 (15.35)	−11.21 (14.83)
Previous birth weight		0.44*** (0.00)		−0.31*** (0.00)
Sex, multiple birth, and age	Yes	Yes	Yes	Yes
Religious denomination of mother	Yes	Yes	Yes	Yes
Education of mother	Yes	Yes	Yes	Yes
Employment of mother	Yes	Yes	Yes	Yes
Regional effects	Yes	Yes	Yes	Yes
Ethnic background	Yes	Yes	Yes	Yes
Birth order	Yes	Yes	Yes	Yes
Period dummies	Yes	Yes	Yes	Yes
Observations	746,002	746,002	746,002	746,002
Adjusted *R*-squared	0.084	0.267	0.110	0.203
Number of clusters			572,519	572,519
Average per cluster			1.303	1.303

OLS, ordinary least squares; FE, fixed effect.
[a]The dependent variable birth weight is measured in grams. Robust standard errors clustered by mothers. Standard errors in parentheses.
*Statistical significance at the 10% level; **statistical significance at the 5% level; ***statistical significance at the 1% level.

remains similar, with a highly significant coefficient of 49 g. This means that being married is crucial, but the time of marriage is of minor importance. Divorce during pregnancy is associated with a reduction in the infant's birth weight by 78 g; this is a greater reduction than that for babies born to single mothers.[12]

[12]Unfortunately, our data do not allow for a distinction between single mothers and 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) found that pregnancy outcomes are worse among mothers living without a partner than among mothers in common-law unions and married mothers.

DOI: 10.1002/hec

Table V. Quantile regressions[a]

	10%		25%		50%		75%		90%	
Family status										
Married before pregnancy	81.31***	(3.26)	54.10***	(1.66)	41.44***	(1.30)	34.04***	(1.25)	23.76***	(1.49)
Married during pregnancy	74.09***	(2.88)	46.91***	(1.75)	34.30***	(1.30)	28.40***	(1.20)	17.82***	(1.62)
Divorced around pregnancy	−106.85***	(17.22)	−83.58***	(10.99)	−75.93***	(7.06)	−52.39***	(8.16)	−40.96***	(15.31)
Sex, multiple birth, and age										
Boy	96.09***	(1.45)	119.76***	(1.05)	138.28***	(0.96)	147.83***	(0.82)	168.59***	(0.98)
Age of mother	20.31***	(1.30)	11.18***	(0.79)	6.61***	(0.87)	5.86***	(0.62)	5.03***	(1.04)
Age of mother squared	−0.54***	(0.02)	−0.31***	(0.01)	−0.19***	(0.02)	−0.15***	(0.01)	−0.12***	(0.02)
Twins	−1260.63***	(7.74)	−1099.91***	(3.75)	−1015.73***	(1.75)	−983.76***	(2.80)	−987.11***	(4.02)
Religious denomination of mother (base: Catholic)										
Protestant	−6.28	(3.91)	−3.87	(2.44)	−3.88**	(1.80)	−2.75	(2.29)	−3.36	(2.84)
Muslim	32.40***	(4.54)	27.88***	(2.63)	27.43***	(2.84)	28.00***	(2.40)	26.17***	(3.80)
Other denomination	−22.76***	(4.98)	−22.46***	(2.75)	−19.43***	(3.10)	−16.13***	(3.57)	−10.81***	(3.89)
Undenominational	−11.79***	(2.75)	−4.50**	(1.98)	−1.12	(1.55)	−0.30	(1.61)	2.29	(2.53)
Education of mother (base: compulsory school)										
Apprenticeship	61.19***	(1.83)	41.42***	(1.57)	32.30***	(1.23)	24.05***	(1.37)	16.25***	(1.31)
Vocational high school	99.11***	(2.76)	69.53***	(1.63)	51.13***	(1.63)	39.05***	(1.61)	25.41***	(2.17)
Matura	130.60***	(2.56)	91.51***	(2.50)	66.71***	(1.41)	52.41***	(1.97)	36.99***	(2.46)
Academic degree	161.66***	(2.69)	110.68***	(1.93)	77.07***	(1.79)	55.68***	(1.97)	37.14***	(2.72)
Employment of mother (base: not employed or unemployed)										
Student	40.97***	(5.13)	45.74***	(4.07)	41.69***	(3.82)	34.12***	(3.80)	28.57***	(4.56)
Retiree	−219.13***	(25.33)	−153.66***	(16.81)	−102.07***	(12.58)	−80.36***	(20.84)	−37.42*	(21.55)
Farmer	73.72***	(3.93)	50.07***	(2.46)	40.15***	(2.50)	31.04***	(3.25)	21.36***	(3.46)
Worker	9.26***	(1.88)	14.09***	(1.40)	16.38***	(1.83)	16.20***	(1.45)	18.90***	(1.55)
Employee	19.92***	(2.11)	18.45***	(1.71)	16.04***	(1.90)	13.40***	(1.24)	12.80***	(1.82)
Self employed	16.92***	(5.14)	17.85***	(4.03)	18.55***	(4.53)	11.35**	(4.89)	10.53**	(4.45)
Regional effects										
City	−36.65***	(1.87)	−25.73***	(0.91)	−18.13***	(1.07)	−11.14***	(0.94)	−9.70***	(1.28)
Western Austria	−1.11	(1.61)	−8.34***	(1.19)	−14.76***	(0.92)	−19.44***	(1.05)	−24.11***	(1.17)
Ethnic background (base: Austrian)										
German/Swiss	44.28***	(6.20)	32.40***	(4.63)	36.94***	(4.74)	32.22***	(3.04)	35.58***	(8.33)
Balcan	40.23***	(4.80)	52.08***	(3.72)	66.20***	(2.92)	70.27***	(4.16)	83.46***	(2.82)
Turkish	8.34	(5.88)	1.15	(3.80)	−10.94***	(2.86)	−18.02***	(3.96)	−18.70***	(3.58)
Other countries	57.99***	(3.53)	55.14***	(2.06)	58.65***	(1.78)	66.92***	(1.86)	78.08***	(2.45)
Birth order										
Second birth	163.23***	(1.57)	137.93***	(1.06)	131.96***	(1.06)	133.53***	(1.09)	137.93***	(1.78)
Third birth	190.10***	(1.93)	174.10***	(1.73)	176.90***	(1.38)	182.46***	(1.38)	196.59***	(1.61)
Fourth birth	198.50***	(5.03)	190.09***	(2.42)	199.56***	(2.42)	214.35***	(2.61)	228.88***	(3.11)
Fifth birth or higher	196.49***	(6.33)	201.22***	(4.28)	225.24***	(3.23)	255.41***	(3.94)	287.28***	(4.89)
Period dummies	yes		yes		yes		yes		yes	
Constant	2272.66***	(17.47)	2702.66***	(10.10)	3055.52***	(11.37)	3350.73***	(9.02)	3624.21***	(13.66)
Observations	1,974,710		1,974,710		1,974,710		1,974,710		1,974,710	

[a]The dependent variable birth weight is measured in grams. Bootstrapped standard errors in parentheses.
*Statistical significance at the 10% level; **statistical significance at the 5% level; ***statistical significance at the 1% level.

Table VI. Period effects[a]

	1980s				1990s				2000s			
	OLS		Mother FE		OLS		Mother FE		OLS		Mother FE	
Family Status												
Married before pregnancy	73.06***	(2.79)	34.93**	(16.00)	55.49***	(1.90)	41.98***	(8.80)	40.48***	(1.96)	43.38***	(12.49)
Married during pregnancy	67.77***	(2.84)	29.90*	(16.33)	47.24***	(2.02)	40.84***	(9.09)	35.40***	(2.33)	38.04***	(12.89)
Divorced around pregnancy	−90.32***	(13.34)	−13.10	(24.43)	−61.88***	(10.22)	−23.96	(15.16)	−90.43***	(18.40)	−57.99*	(31.56)
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	521,721		521,721		866,963		866,963		586,025		586,025	
Adjusted R-squared	0.100		0.120		0.116		0.138		0.148		0.142	
Number of clusters			416,964				618,799				447,526	
Average per cluster			1.251				1.401				1.309	

OLS, ordinary least squares; FE, fixed effect.
[a]The dependent variable birth weight is measured in grams. Robust standard errors clustered by mothers. Standard errors in parentheses.
*Statistical significance at the 10% level; **statistical significance at the 5% level; ***statistical significance at the 1% level.

DOI: 10.1002/hec

Table VII. Alternative outcomes

	Gestation period[a]				Premature birth (full sample)[b]			
	OLS		Mother FE		OLS		Mother FE	
Family status								
Married before pregnancy	0.56***	(0.03)	0.61***	(0.11)	−0.02***	(0.00)	−0.01***	(0.00)
Married during pregnancy	0.91***	(0.03)	0.84***	(0.12)	−0.02***	(0.00)	−0.01***	(0.00)
Divorced around pregnancy	−1.05***	(0.20)	−0.16	(0.27)	0.02***	(0.00)	0.00	(0.01)
Sex, multiple birth, and age								
Boy	−0.55***	(0.02)	−0.40***	(0.02)	0.00***	(0.00)	−0.01***	(0.00)
Age of mother	0.39***	(0.02)	0.25***	(0.04)	−0.01***	(0.00)	0.00	(0.00)
Age of mother squared	−0.01***	(0.00)	−0.01***	(0.00)	0.00***	(0.00)	0.00***	(0.00)
Twins	−24.73***	(0.14)	−23.20***	(0.21)	0.58***	(0.00)	0.53***	(0.00)
Religious denomination (Base: catholic)								
Protestant	−0.19***	(0.05)	−0.43*	(0.23)	0.00***	(0.00)	0.00	(0.01)
Muslim	0.32***	(0.07)	0.15	(0.36)	0.00***	(0.00)	0.00	(0.01)
Other denomination	−0.76***	(0.07)	−0.26	(0.27)	0.01***	(0.00)	0.01	(0.01)
Undenominational	0.08*	(0.05)	−0.24*	(0.12)	0.00	(0.00)	0.00	(0.00)
Education (Base: compulsory school)								
Apprenticeship	0.55***	(0.03)	0.01	(0.05)	−0.01***	(0.00)	0.00	(0.00)
Vocational high school	0.83***	(0.04)	0.21***	(0.06)	−0.02***	(0.00)	0.00	(0.00)
Matura	1.05***	(0.04)	0.42***	(0.08)	−0.03***	(0.00)	−0.01***	(0.00)
Academic degree	1.26***	(0.05)	0.55***	(0.10)	−0.03***	(0.00)	−0.01***	(0.00)
Employment (Base: not employed or unemployed)								
Student	0.32***	(0.09)	−0.26*	(0.14)	−0.01***	(0.00)	0.01***	(0.00)
Retiree	−3.75***	(0.44)	−1.95***	(0.65)	0.07***	(0.01)	0.02	(0.01)
Farmer	0.25***	(0.06)	0.12	(0.10)	−0.01***	(0.00)	0.00	(0.00)
Worker	0.17***	(0.03)	0.23***	(0.05)	0.00**	(0.00)	0.00	(0.00)
Employee	0.10***	(0.03)	0.08*	(0.04)	0.00***	(0.00)	0.00**	(0.00)
Self employed	−0.09	(0.09)	0.13	(0.15)	0.00**	(0.00)	0.00	(0.00)
Regional effects								
City	0.05**	(0.02)	0.24***	(0.07)	0.01***	(0.00)	0.00	(0.00)
Western Austria	0.35***	(0.02)	0.14	(0.15)	0.00***	(0.00)	0.00	(0.00)
Ethnic background (Base: Austrian)								
German/Swiss	0.57***	(0.09)	−0.31	(0.45)	−0.01***	(0.00)	0.01	(0.01)
Balcan	−0.12	(0.07)	−0.10	(0.19)	0.00***	(0.00)	0.00	(0.00)
Turkish	−0.31***	(0.09)	−0.53**	(0.21)	0.00	(0.00)	0.00	(0.00)
Other countries	0.38***	(0.05)	0.45***	(0.16)	−0.01***	(0.00)	0.00	(0.00)
Birth order								
Second birth	0.70***	(0.02)	0.65***	(0.03)	−0.03***	(0.00)	−0.03***	(0.00)
Third birth	0.77***	(0.04)	0.95***	(0.06)	−0.03***	(0.00)	−0.03***	(0.00)
Fourth birth	0.87***	(0.06)	1.21***	(0.10)	−0.03***	(0.00)	−0.03***	(0.00)
Fifth birth or higher	0.97***	(0.09)	1.24***	(0.15)	−0.03***	(0.00)	−0.03***	(0.00)
Period dummies	yes		yes		yes		yes	
Constant	272.31***	(0.23)	274.62***	(0.62)	0.16***	(0.01)	0.08***	(0.01)
Observations	1,974,709		1,974,709		1,974,709		1,974,709	
Adjusted R-squared	0.088		0.058		0.114		0.066	
Number of clusters			1,207,430				1,207,430	
Average per cluster			1.635				1.635	

OLS, ordinary least squares; FE, fixed effect.
[a]The dependent variable gestation duration is measured in days. Robust standard errors clustered by mothers. Standard errors in parentheses.
[b]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 2500 g. Robust standard errors clustered by mothers. Standard errors in parentheses.
*Statistical significance at the 10% level; **statistical significance at the 5% level; ***statistical significance at the 1% level.

If we control for time-invariant heterogeneity by including mother FE, the coefficients of the mother's family status remain highly significant, although their quantitative importance decreases somewhat. As can be seen in the FE specification in Table II, the birth weight of infants born to married mothers is 43 g higher

Table VIII. Quantile Regressions with mother FE[a]

	10%		25%		50%		75%		90%	
Family status										
Married before pregnancy	76.07***	(2.08)	47.59***	(1.83)	35.41***	(1.37)	27.47***	(1.39)	17.35***	(1.76)
Married during pregnancy	68.67***	(3.01)	40.84***	(2.02)	28.18***	(1.85)	21.34***	(2.05)	10.82***	(1.75)
Divorced around pregnancy	−110.46***	(14.21)	−84.22***	(7.65)	−77.60***	(6.40)	−55.37***	(7.11)	−44.36***	(11.53)
Sex, multiple birth, and age	Yes		Yes		Yes		Yes		Yes	
Religious denomination of mother	Yes		Yes		Yes		Yes		Yes	
Education of mother	Yes		Yes		Yes		Yes		Yes	
Employment of mother	Yes		Yes		Yes		Yes		Yes	
Regional effects	Yes		Yes		Yes		Yes		Yes	
Ethnic background	Yes		Yes		Yes		Yes		Yes	
Birth order	Yes		Yes		Yes		Yes		Yes	
Period dummies	Yes		Yes		Yes		Yes		Yes	
Constant	2,292.79***	(16.31)	2,718.81***	(11.68)	3,072.12***	(9.50)	3,368.33***	(10.58)	3,635.75***	(13.46)
Observations	1,974,710		1,974,710		1,974,710		1,974,710		1,974,710	

[a]The dependent variable birth weight is measured in grams. Bootstrapped standard errors in parentheses.
*Statistical significance at the 10% level; **statistical significance at the 5% level; ***statistical significance at the 1% level.

than that of infants born to single mothers. The coefficient for the group of babies whose mothers married during pregnancy is 41 g. The impact of a divorce during pregnancy is considerably reduced in the FE model. Infants born to mothers who divorced during pregnancy have a birth weight that is approximately 19 g lower than that of the base group of newborns of single mothers in the FE variant.

As a robustness check, we re-estimate our FE model in the sample restricted to mothers who change their marital status. We find that the effects for mothers being married before pregnancy and getting divorced around pregnancy remain almost unchanged whereas the effect for mothers marrying during pregnancy drops from 41 to 16 g. Although the control variable effects obviously change in the restricted sample, the significant impact of marriage (divorce) on birth weight is confirmed.

Newborn boys are significantly heavier than newborn girls, with a weight difference of approximately 132 (142) g in the OLS (FE) specification, and twins are lighter than single births by more than 1 kg. 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, and significant impacts can also be found for the mother's employment status.[13]

In the right panel of Table II, we present regression results that include only births after a gestation period of more than 36 weeks. In doing so, we study the role that premature birth plays.[14] 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 28 g higher than the weight of babies born to single mothers in the FE model. We conclude from this that the positive 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 divorces around pregnancy. The signs of the control variables remain almost unchanged as compared to the specification including all births.

3.2. Time-variant heterogeneity

Table III includes the regression results of our IV estimation strategy in direct comparison to OLS and FE results with identical samples.[15] The first-stage results show a highly statistically significant impact of our instrument on the individual propensity to be married. The marginal effect of the instrument is 0.098. This means that an increase in the instrument (marriage ratio) by one standard deviation (0.258) would increase a mother's propensity to be married by 2.52%. According to the F-statistic on the excluded instrument (1740.6), we reject the hypothesis of a weak instrument. It can be seen from Table III that the IV specification largely confirms previous OLS and FE results. Married mothers give birth to newborns whose birth weight is *ceteris paribus* 37 g higher than that of babies born to single mothers. Hence, our evidence is in support of the existing literature that OLS overestimates the true causal effect of marriage. As compared with the slightly higher FE result, the IV estimate indicates that time-variant heterogeneity plays an important role and that mothers do change their behavior during pregnancy between subsequent births. The fact that the IV effect of marriage on infants' birth weight is smaller than the OLS and FE results indicates a positive selection of mothers (with respect to their newborns' birth weight) into marriage. It is interesting to see that from the initial difference in means

[13]Mothers who are native to Turkey and the Balkans give birth to babies with a significantly lower birth weight than babies born to Austrian mothers in the FE specification. Finally, the birth weight of babies increases significantly with the birth order in both specifications, with a weight difference between the first-born and the second-born babies of approximately 140 g and a difference of more than 230 g for the fifth or higher birth.

[14]In general, gestation length can either serve as a separate outcome (Table VII) 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.

[15]In the IV specification, we group the previous marriage statuses into a single category, "married", and instrument the individual probability of a mother to be married by her exposure to the local marriage density.

DOI: 10.1002/hec

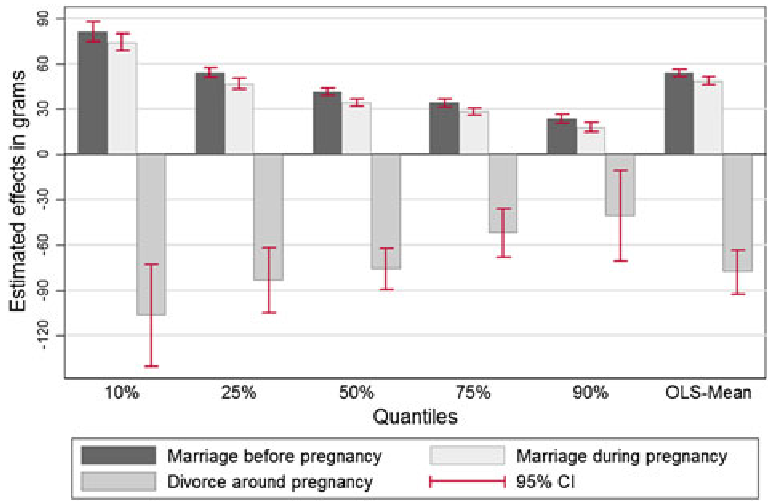

Figure 2. Estimated birth weight effects across quantiles

of 90 g between married and unmarried mothers, less than 40 g is left after controlling for socio-economic characteristics and unobserved heterogeneity. Therefore, most of the observed difference in birth weight with respect to family status can be simply explained by selection rather than causality.

In our attempt to capture the mother's behavioral changes between two subsequent births, we estimate a dynamic model that includes the birth weight of the previous child as a control. The estimation results are summarized in Table IV. The impacts of marriage on newborns' birth weight are similar to previously presented models as the coefficients of the marriage variables lie in the range of 35 to 65 g. The fact that the marriage coefficients change if we control for previous birth weight indicates a correlation between previous birth weight and the family status of a mother. The statistically significant and positive association between the birth weight of children born subsequently in the OLS specification supports the aforementioned hypothesis of a joint mother effect. As can be seen from the right panel in Table IV, the coefficient of the previous birth weight becomes negative if we control for mother FE. An increase (decrease) in the birth weight of a previous child by 1 g decreases (increases) the birth weight of the same mother's subsequent child by 0.3 g. This significantly negative effect may be interpreted as the result of behavioral changes of a mother between two subsequent births. Mothers tend to improve their health behavior during pregnancy in response to a lower birth weight of the previous child. Part of this negative effect is, however, due to a regression-toward-the-mean effect.[16]

3.3. Robustness checks

The results so far represent estimates that approximate the conditional mean of birth weights after controlling for socio-economic characteristics. However, some percentiles of the birth weight distribution may be more affected by the right-hand side variables than others are. 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 V. 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. As can be seen from Figure 2, marriage of a mother before

[16]The joint inclusion of mother FE and the birth weight of the previous child requires a very specific sample of mothers who gave birth to at least three children.

DOI: 10.1002/hec

(during) pregnancy increases the baby's birth weight by 81 (74) g in the 0.10 quantile, whereas the same effects amount to only 24 (18) g in the 0.90 quantile.[17] The previous results 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 divorce around the time of pregnancy diminishes substantially from the lowest decile (107 g) to the highest (41 g). The results indicate that the positive (negative) influence of marriage (divorce) is of particular importance for lower birth weight babies.[18]

Until now, 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, which includes birth weights above 4,350 g (macrosomia), is compatible with this view.

The disparities between the sexes are much smaller at the lower tail of the distribution than at the higher quantiles. While boys are 96 g heavier in the 0.10 quantile, the difference increases to 169 g in the 0.90 quantile. The effect of twin births decreases in absolute numbers, from 1260 g in the 0.10 quantile to 987 g in the 0.90 quantile, and higher education affects the behavior of pregnant women, particularly at the lower tail of the birth weight distribution. The place of a mother's residence in any of the western provinces of Austria decreases the baby's birth weight by 24 g in the highest decile. This indicates 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.

The estimation results in Table VI indicate that the impact of the mother's family status changes over time. To make the period effects visible, 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 before pregnancy increases from the 1980s (35 g) through the 1990s (42 g) until the most recent decade (more than 43 g) in the FE specification. A similar pattern can be observed for 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 58 g is not only statistically significant but also quantitatively important.

Finally, Table VII presents the regression results for two alternative outcomes: the length of the gestation period and the probability of premature birth. Getting married before pregnancy increases the gestation period by 0.56 days as compared with the pregnancy duration of single mothers. The effect increases to 0.91 days for mothers who marry during pregnancy. In contrast to the results for the birth weight specifications, the divorce variable remains insignificant in the FE variant. These results are confirmed by estimates of probabilities for premature births. Being married reduces a mother's probability of having a premature delivery by two percentage points in the linear probability model and by one percentage point in the FE specification. A divorce increases the same probability by 2 percentage points in the OLS variant, and the effect remains insignificant if we include FEs.

4. SUMMARY AND CONCLUSIONS

In this paper, we present regression results for the impact of mothers' family status on the birth weight of newborns for all Austrian births between 1984 and 2007. We control for a series of important observable characteristics of mothers and for time-invariant heterogeneity by mother FE and also offer an IV approach to account for potential endogeneity of marital status. As compared with single mothers, we find positive and

[17]Statistical tests show that the differences in marital status effects between the quantiles are significant with all p-values smaller than 0.01.
[18]The estimation results for quantile regressions including mother FE are presented in Table VIII. All qualitative results remain unchanged, and the quantitative differences are minor.

significant effects on the newborns' birth weight if the mothers marry either before or during pregnancy. Similarly, a newborn's birth weight decreases significantly if the mother divorces around the time of pregnancy.[19] Although the effects decrease quantitatively, we confirm a significantly positive impact of marriage on birth weight in our IV specification, which would allow a causal local average treatment effect interpretation. The marriage of a mother—triggered by the local exposure to marriage at the community level—increases the birth weight by approximately 37 g. From a policy perspective, we argue for family measures particularly targeted at single mothers at least. Such measures can be expected to reduce vertical income differences among parents and to contribute toward improving the initial health status of otherwise underprivileged newborns.

"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, and family status effects do not, interestingly, diminish over time. On the contrary, the FE coefficients are larger in the 2000s than in previous decades, indicating that being a single mother is no less stressful today than it was 20 years ago. One possible explanation for this might be that fathers are more capable and willing to take on domestic and family responsibilities at present than they were in the past.

In accordance with 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 employment status and ethnic background of the mother. Newborn boys are significantly heavier than girls, the birth weight of twins is more than 1 kg less than that of single births, and the age of the mother has a negative weight effect on newborns. These results would, at least, not contradict the introduction of selective health measures for particular groups of pregnant women.

In this paper, we study the determinants of birth weight for a Bismarckian type national health system that provides preventive prenatal health care for all pregnant women.[20] Our results fit well into the available empirical evidence, in both qualitative and largely quantitative respects. However, most of the coefficients are quantitatively smaller than those, for example, estimated in US data. This presumably indicates the importance of access to healthcare services. The utilization of preventive prenatal health services for expectant mothers may reduce the extent of socio-economic gradients in birth weight (and probably future children's health) observed in more privately managed health systems.

From a methodological perspective, we (i) control for a series of socio-economic characteristics such as age, education, and employment status that at least partly capture behavioral effects[21] and (ii) estimate mother FE models that control for maternal behavior that does not change over time. Finally, (iii) we use the area-level variation in marriage density to instrument the individual propensity to get married and thereby control for the time-variant heterogeneity of mothers. The IV approach confirms the significant impact of marriage on birth weight; however, it also demonstrates the importance of selection into marriage. As compared with the raw data, the difference in birth weights between newborns of married and unmarried mothers decreases by more than 60% in the IV estimation. This is additional evidence that correlational studies clearly overstate the true causal effects of family status on the birth weight of newborn infants.

ACKNOWLEDGEMENTS

For their helpful discussions and comments, we would like to thank Martin Halla, Michael Hummer, Rudolf Winter-Ebmer, and in particular two anonymous referees of this journal. Financial support was provided by the Austrian Science Fund (FWF) under project no. S10306-G14.

[19]The results remain stable if we include in our sample only births after a gestation period of more than 36 weeks (normal birth weight babies).

[20]It was mentioned earlier that 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, in which participation is a prerequisite for entitling the mother to child care benefits.

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

DOI: 10.1002/hec

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