Newborn health and the business cycle: The role of birth order

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Abstract: We use 35 years of administrative data to document how newborn health varies with the business cycle in Spain. In panel regressions that include province and year fixed effects as well as province trends, we show that children have significantly better health outcomes at birth in times of high unemployment: a 10 percentage-point increase in the unemployment rate is significantly associated with about 2 log-points higher birth-weight, almost 2 percentage points fewer babies with low birth weight, 0.6 points fewer babies with very low birth-weight, and a 0.4-point drop in mortality rates in the first 24 hours We explore several potential mechanisms. First, we show that the documented association is not driven by in-utero selection: we do not find that high unemployment is associated with more miscarriages, abortions, or stillbirths. Second, we explore the role of composition in terms of parental characteristics. We find evidence that unmarried and younger parents, who typically have unhealthier babies, are relatively less likely to have children when unemployment is high. Finally, we show that there are fewer first births during recessions, and birth order is strongly positively correlated with health at birth. Birth order can account for up to one fifth of the countercyclicality of birth weight.

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1. Introduction

A rich recent literature in economics has explored the association between aggregate economic conditions and health. Multiple studies suggest that adult health may improve during recessions, in the US (Ruhm 2000, 2003, 2005, 2008, 2015, 2016) as well as in other OECD countries.[1] These studies typically relate state or regional unemployment rates with measures of adult health.[2] Following the same approach, Dehejia and Lleras-Muney (2004) found that worse macroeconomic conditions are associated with better newborn health in the US, using state-level variation and 30 years of data. Similar results were found for Sweden (Van den Berg et al. 2016).[3] The channels driving this association are unclear, and may include changes in the selection of new parents throughout the cycle, and changes in maternal behaviors during pregnancy.

We study the relationship between aggregate economic conditions and neonatal health using 35 years of birth records in Spain. We show that newborns are significantly healthier when the unemployment rate in the province is high, confirming the results found in other developed countries. We then explore the drivers of this association.

We find that birth rates are lower in periods of high unemployment, and this effect is driven by the pro-cyclicality of first births. This goes in line with the findings in an ample previous literature showing that the business cycle is associated with fertility, with birth

[1] See Gerdtham & Ruhm (2006), Neumayer (2004), Gerdtham & Johannesson (2005), Tapia Granados (2005), and Tapia Granados & Ionides (2008).

[2] Other studies analyze the impact of unemployment at the individual level on health. Urbanos-Garrido and López-Valcárcel (2015) find that unemployment has negative effecs on adult health using Spanish data.

[3] Some studies in developing countries have found infant health to worsen during recessions. Bhalotra (2010) found that infant mortality in India increases during recessions, and Bozzoli and Quintana-Domeque (2014) report that birth-weight fell significantly during the 2001-2002 crisis in Argentina. Some recent papers for other rich countries also find infant health to be procyclical (De Cao et al. 2018 for the UK, Alessie et al. 2018 for the Netherlands, Kaplan et al. 2017 and Margerison-Zilko et al. 2011 for the US) or not significantly associated with macroeconomic conditions (Salvanes 2014 for Norway).

rates falling during economic downturns (Goldstein et al. 2013, Currie and Schwandt 2014, Chatterjee & Vogl 2016, Hofmann and Hohmeyer 2016).

We also find that higher-order births tend to be healthier on average, even when comparing multiple children to the same mother. This was shown before by Hinkle et al. (2014) and Lehmann et al. (2018) for the US, Wilcox et al. (1996) for the UK, Brenoe and Molitor (2018) for Denmark, and Lundberg and Svaleryd (2016) for Sweden.

By combining these two latter findings, we are able to show that the countercyclicality of newborn health in Spain can be largely explained by the drop in the share of first births in periods of high unemployment. Since first births tend to be less healthy, their lower share leads to an improvement in average health at birth. This is a new result that can help understand a puzzling empirical pattern observed in some industrialized countries (infant health improving during recessions). Our main contribution is thus to provide a credible channel for this pattern.

Spain is a high-income country with large regional heterogeneity as well as large fluctuations in the unemployment rate over time. We exploit high-quality birth- and death-certificate data for the universe of registered births from 1981 to 2015, taking advantage of regional variation across the 50 Spanish provinces. We proxy macroeconomic conditions by the province unemployment rate (defined as one minus the employment-to-population ratio) in the year of conception.[4] Our main measures of health at birth are birth-weight, prematurity, and neonatal mortality.

First, in a regression with province and year fixed-effects (like Dehejia and Lleras-Muney, 2004) as well as province trends, we confirm the US finding that babies are born

[4] We use one minus the employment to population ratio because employment is measured with less error than unemployment in the Labor Force Survey. Our measure is highly correlated with the standard unemployment rate, and we show robustness checks using alternative definitions.

healthier when the local unemployment rate is high. We then explore several potential channels. First, we evaluate the role of in-utero selection, i.e. the possibility that less healthy fetuses are less likely to become live births during bad times. We provide evidence that miscarriages, abortions and stillbirths do not increase during recessions, which allows us to rule out this channel.

Second, we explore selection in parent characteristics. It may be that families with traits associated with better newborn health are relatively more likely to have children when unemployment is high. In a second finding, we show that married and older parents are, indeed, over-represented during recessions, which explains part of the positive infant health effects.

Third, we identify one factor that can account for a relevant fraction of the observed association, and that was previously undocumented in the literature: the number of previous children of the mother, or birth order. We show that there are significantly fewer first births during recessions. Birth order is shown to be positively correlated with health at birth, so that this factor alone can account for up to 22% of the association between unemployment and infant health. We are also able to rule out that birth order is proxying for unobserved parental characteristics, in specifications that exploit only between-sibling variation.

Finally, we turn to maternal health outcomes and health-related behaviors. We merge eight waves of National Health Survey data, covering 1987-2011, and our results point towards improvements in fertility-age women's health and health behaviors during recessions, although the effects are imprecisely estimated.

We conclude that the combination of fewer first births and positive selection in parent characteristics more than compensate for the fall in household income during recessions, leading to healthier babies on average when the economy is weak.

Our work extends the findings in Dehejia and Lleras-Muney (2004) in several directions. First, we confirm their main result, that newborn babies' health is countercyclical, with data for a different developed country, with important differences with respect to the US in terms of the health care system (Spain has universal, public healthcare) as well as the labor market (the Spanish labor market is highly regulated and characterized by high and persistent unemployment). Second, we explore a new potential channel, in-utero selection, and are able to discard that miscarriages, abortions or stillbirths are important drivers. Third, by using pooled National Health Survey data for the same time period, we are able to rule out large changes in maternal health. Fourth, we identify a new mechanism, not explored in the previous literature, which can account for a large fraction of the effect: the fact that first births are procyclical (combined with first births being less healthy). And last, we also document changes in parental characteristics (mainly increases in married and older parents) that contribute to the improvements in newborn health in recessions.

The remainder of the paper is organized as follows. We first present the baseline results (in section 2), showing that province level unemployment is associated with healthier newborns, after controlling for province and year fixed-effects (and province trends). In section 3, we proceed to evaluate the role of three potential channels: in-utero selection, composition effects in terms of observable characteristics of the parents, and mothers-to-be health outcomes and health-promoting behaviors. Section 4 concludes with a brief discussion.

2. The cycle and newborn health

2.1 Econometric specification

In our baseline specification, we regress several measures of health at birth at the individual level on the province unemployment rate, controlling for province and year

fixed-effects as well as province-specific linear trends, using data for the 50 Spanish provinces over 35 years (1981-2015). The specification is the following:

$$(1)\ y_{ipt} = \alpha + \beta u_{pt} + \mu_p + \lambda_t + \mu_p * l + u_{ipt}$$

where y is a measure of newborn health, for baby i born (alive) in province p and conceived in year t. Our measures of babies' health are: the log of birth-weight in grams, indicators for babies born under 2,500 and under 1,500 grams (low birth-weight and very low birth-weight, respectively), and a dummy for death within 24 hours of labor.

Our main explanatory variable is u, the unemployment rate in province p and year t, calculated as the number of individuals aged 16-65 currently out of work over the total number of individuals 16-65.[5] We use unemployment in the year of conception (instead of the year of birth) since we are interested in economic conditions at the time of conception and while in utero (Barker, 1995). We also document that there is persistence in the impact of the business cycle on neonatal health. We did this by regressing neonatal health on lagged unemployment. We include fixed-effects for province (μ) and year (λ) as well as province-specific linear trends. Standard errors are clustered at the province level to allow for serial correlation.

2.2 Data and descriptive statistics

The national unemployment rate from 1981 to 2015 is shown in figure 1, using data from the second quarter of the Labor Force Survey. The lowest historical level was reached in 2004, with an unemployment rate of 50%, while there are three peaks of high unemployment (about 61%) in 1985, 1994 and 2013. Note that the evolution of the number of live births per 1,000 women displays a negative association with the

[5] The Labor Force Survey is conducted quarterly, so we can also perform the analysis with unemployment at the quarterly level. The yearly analysis is more conservative, and it may reduce measurement error.

unemployment rate during our sample period. The national figures hide even larger regional variation. Figure 2 displays the unemployment rate across the 50 Spanish provinces in 2010 (in the middle of the Great Recession). The unemployment rate ranges from 25% to 63% in a single year across Spanish provinces, illustrating the sizeable cross-sectional variation.

Our analysis exploits this regional variation in the evolution of the unemployment rate at the province level over time. The descriptive statistics in table 1 show that the province unemployment rate was almost 55% on average, with a minimum close to 37% and a maximum value of almost 73%.

The health information about newborn babies is derived from (micro-level) birth-certificate data, made publicly available by the National Statistical Institute for the universe of all registered births in Spain. We construct four measures of neonatal health for the population of singleton live births: the natural log of birth-weight in grams,[6] and indicators for low birth-weight (under 2,500 grams), very low birth-weight (under 1,500 grams) and mortality during the first 24 hours of life. We estimate the year of conception by combining individual-level information on date of birth and number of gestational weeks at birth. The number of observations (live singleton births conceived between 1981 and 2015) is 14,545,437.

Table 1 shows that average birth-weight in the sample was 3,272 grams, with about 5% of babies born with less than 2,500 grams, and 0.5% below 1,500. Neonatal mortality rates were low, with about 1.3 deaths during the first 24 hours per 1,000 births. Regarding family characteristics, mothers are on average 30 years of age, 79% are married, and 15%

[6] We drop observations with reported birth-weight below 500 or above 6,500 grams (much less than 1% and most likely misreporting errors).

have a high-skill occupation. About 48% of babies are female, and 52% are first births for the mother.

Figure 3 shows the time trends in two of the measures of infant health: the fraction of low birth-weight babies, and the mortality rate during the first 24 hours. During the 35 year period, 24-hour mortality declined from almost 4 to less than 1 per 1,000 births, while the fraction of low birth-weight babies increased from less than 2.5 to almost 6 percent.[7]

Because of the marked long-term trends in the health variables, it may be hard to detect any time-series correlation with the business cycle. However, in table A1 we report the results of simple time-series specifications, where we regress our measures of newborn health (at the individual level) on the national unemployment rate, controlling only for a linear and a quadratic time trend.[8] As shown in the first row, there is a significant negative correlation between the national unemployment rate and the fraction of low birth-weight babies. However, average birth-weight is also lower in periods of high unemployment. We find no significant association between unemployment and the mortality rate.

2.3 Main results

Table 2 presents the results of estimating equation 1 for our four measures of newborn health. The main explanatory variable is the unemployment rate in the province, and all specifications include province and year fixed-effects as well as province linear trends. Each of the coefficients in the table comes from a different regression.

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[7] This trend of decreasing birth-weight is common to many countries and is typically attributed to the rising age at motherhood as well as the increase in the incidence of multiple births (although multiple births are not included in figure 3).

[8] Standard errors are clustered by year, the level of aggregation of the main explanatory variable.

The results in the first row suggest that high unemployment is significantly associated with fewer low and very low birth-weight babies, as well as higher average birth-weight, and lower mortality rates. A 10 percentage-point increase in the unemployment rate (the standard deviation is 7) is significantly associated with about 2 log-points higher birth-weight, almost 2 percentage points lower fraction of babies with low birth weight, 0.6 points lower fraction of babies with very low birth-weight, and a 0.4-point drop in mortality rates in the first 24 hours. All coefficients are highly significant and consistently point in the same direction: better newborn health when joblessness increases. The magnitude of our estimated effects are in line with DLM's results: they find that a 0.26-0.5 percent reduction in low birth weight for each percentage point increase in unemployment, and our corresponding estimate is 0.2.[9]

In Table A2 we estimate the same regressions, but use the unemployment rate the year before conception (i.e. one lag). The coefficients are smaller than in the main specification, and two of them become insignificant[10]. In Table A3 we show that our results are robust to alternative definitions of the unemployment rate, such as the youth unemployment rate (ages 16-24), which may be more relevant for first pregnancies.

Overall, our results provide evidence that neonatal health improves on average when local labor market conditions worsen. In the next section, we explore several potential channels that could help explain this finding.

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[9] We perform additional regressions where we interact the unemployment rate with quarter of birth dummies. Results, available upon request, show that there are no significant differences on the impact of business cycle conditions on infant health outcomes for babies born in the four quarters of the year.

[10] The results using the lag unemployment rate provide evidence of the persistence of business cycle conditions on newborn's health. Future mothers, even before conception, may change their behaviours when the unemployment rate increases. This is in accordance to some literature pointing towards the importance of pre-pregnancy interventions to improve newborn's health (Whitworth & Dowswell, 2009; Lassi et al. 2014).

3. What drives the countercyclicality of newborn health?

3.1 Selection in-utero

As a first potential driver of newborn health improving during recessions, we explore the possibility that the incidence of miscarriages, abortions or stillbirths increases when local economic conditions worsen. This could generate the observed association, provided that pregnancies not carried to term tend to be associated with worse fetal health, which seems plausible, at least for miscarriages and stillbirths. Regarding abortions, we may expect that worse economic conditions would increase their incidence, although this effect may be muted if unwanted pregnancies are reduced.

Administrative data are available for stillbirths, since registration is required as long as the fetus is considered "viable" (more than 20 weeks of gestation). Abortions are also registered since their legalization in 1985. Miscarriages, however, are not. Thus, we supplement our administrative data with National Fertility Surveys conducted in 1987 and 1999, where a representative sample of women are surveyed on their reproductive history, including all pregnancies, even those ending in miscarriage or abortion.

We estimate equation 1 again, where *i* now refers to a pregnancy, instead of a live birth, and the dependent variable is an indicator for, alternatively, miscarriage, abortion, or stillbirth. The results are reported in table 3. The first two columns use data from the National Fertility Survey, with a sample size of about 9,000 observations, and covering pregnancies between 1981 and 1998. An average of 2% of all pregnancies are terminated via abortion in this sample, while 10% of the remaining ones end in miscarriage.

The results in the first column of table 3 indicate that increases in the local unemployment rate are associated with a lower incidence of miscarriage. Although the coefficient is not significant at any of the standard confidence levels, its sign is consistent with our findings in the previous section, in the sense that pregnancies appear to be healthier when local unemployment is high.

The second and third columns of table 3 analyze the incidence of abortion. The second column uses data from National Fertility Surveys, and the results suggest that higher unemployment is not associated with an increase in the number of abortions. In fact, the sign is negative, although the estimated effect is not statistically significant. This is confirmed in the results using administrative data in the third column (the sample now starts in 1987, the first year with official figures on the number of abortions). Finally, the last column of table 3 analyzes the incidence of stillbirths. According to the data, 0.4% of all pregnancies that reach 20 weeks of gestation do not end in a live birth. Our results suggest that the incidence of stillbirths decreases when the unemployment rate is high.

The results presented in table 3 provide strong evidence that selection in-utero cannot explain the observed positive association between newborn health and the local unemployment rate. We next explore additional potential mechanisms.

3.2 Changes in the composition of parents

The cycle and fertility

Previous literature suggests that fertility declines during recessions.[11] If this is the case, then families who give birth when unemployment is high would be "self-selected", and their (observable and/or unobservable) characteristics could explain the association between the business cycle and the health of newborn babies.

[11] Dating back to Yule 1906, Galbraith and Thomas 1941, Becker 1960, Silver 1965, and Ben-Porath 1973.

Figure 1 shows the annual birth rate (number of births per 1,000 women) in Spain between 1980 and 2015. Fertility declined steadily during the 1980's and early 1990's, reaching its lowest level, about 40 births per 1,000 women, in 1997. The birth rate then increased for the next decade, reaching a peak at 51 in 2007, and falling back down since then (it recently stabilized). Note that the fertility increase from the mid 1990's until 2008 coincides broadly with a long period of falling unemployment (plotted also in figure 1), while the beginning of the recent recession is accompanied by falling birth rates.

In order to formally test whether fertility tends to fall when unemployment is high, we run regressions of the form of equation 1, aggregated at the province-year level, and where the dependent variable is a measure of fertility in province p and year t (the natural log of the total number of births, or the birth rate). We use the unemployment rate as an explanatory variable (as before), and control for year and province fixed-effects, as well as province-specific linear trends.

The results presented in table A4 suggest that, as expected, fertility falls when local economic conditions worsen (as seen in figure 1). A 10-percentage point increase in the unemployment rate is associated with a decline of almost 0.04 in the number of births per woman (first column). The second column reports the results of the same regression, now including only first births, and we can see that the procyclicality of fertility is driven entirely by first births.[12] Business cycle conditions do not appear to significantly affect fertility for higher order births (third column).

The cycle and parental characteristics

The association between unemployment and newborn health could be driven by the composition of families if parents with characteristics associated with healthier babies are

[12] Hofmann et al. (2017) find that job displacement is associated with lower birth-rates (first births), especially during downturns (they do not look at higher-order births).

(relatively) more likely to give birth during recessions. We test for this possibility in three steps. First, we estimate whether (and which) observable characteristics of new parents vary significantly with the cycle. Then, we evaluate the correlation between the relevant observable characteristics and our measures of babies' health. Finally, we run our original neonatal health regressions, controlling for family characteristics, in order to evaluate how much of the original association can be "accounted for" with our observables.

In order to test whether average family characteristics vary with the cycle, we estimate equation 1, using as outcomes a range of observable traits of mothers, fathers, and newborn babies. The results of this analysis are reported in table 4. Each coefficient comes from a different regression, where the corresponding outcome variable is indicated to the left of the coefficient.

We estimate six different regressions evaluating whether the age composition of new mothers and fathers varies with the province unemployment rate (see second column of table 4). Local business cycle conditions are positively associated with mean age of the father and mean age of the mother (although the coefficient is not significant for mothers). The fraction of younger parents is negatively associated with the unemployment rate).[13]

We identify several additional observable family characteristics that are significantly associated with the cycle (see first column of table 4). A higher unemployment rate is associated with a higher fraction of married mothers, and a lower fraction of high-skill-occupation mothers.[14]

We do not observe family income directly, but parental age and occupation, as well as marital status, are correlated with socio-economic status. We find that in periods of high unemployment there are fewer births to very young parents, and more children with

[13] We estimate regressions where the dependent variable is an indicator for the mother being younger than the 10th percentile (23) or older than the 90th (35), and parallel ones for fathers.
[14] "High-skill" occupations include managerial and professional occupations.

married mothers. These results suggest that parents of low socio-economic status are relatively *less* likely to have children during bad times. However, the results for mother's occupation go in the opposite direction, with fewer high-skilled women having children during recessions.

We also find a strong association between the cycle and the number of previous children of the mother. In periods of high unemployment, there are significantly fewer first-time mothers and birth order significantly increases. A 10-point higher unemployment rate is associated with 1.7% fewer first births.

If these compositional changes are driving our initial results, then family characteristics would also have to be correlated with neonatal health. We document these correlations by estimating year-by-year regressions for our newborn health variables, including our observable characteristics as controls (as well as province fixed-effects). Selected results are presented in the first panel of table A5. We report regression results for two of the outcome variables (log birth-weight and mortality during the first 24 hours), and for four years in our 30-year period, one in each decade. We report the coefficients for the variables that were found to vary significantly with local labor market conditions in table 4 (birth order dummies, mother high skill, married mother, young mother, mean age of the father and young father).

Mothers in high-skill occupations have children with significantly lower mortality rates, but with lower birth-weight (although the coefficient is only significant for one year). Married mothers have babies who are heavier and less likely to die within 24 hours. Newborns with older parents are significantly heavier, but their mortality rates do not differ significantly from the average. These results suggest that parents with higher socio-economic status tend to have children who are on average healthier at birth.

The sign and significance levels of these coefficients suggest that these observables might be driving some of the association between local unemployment and neonatal health, but they are unlikely to be responsible for the entire effect (particularly for mortality, the sizes and significant levels are very low).

We also find a strong significant association between the number of previous children of the mother and the health of the newborn. In particular, higher-order births are significantly heavier and face significantly lower mortality rates. Second children are on average 2-3 log-points heavier at birth than first-borns, and face 2 to 9 fewer deaths per 10,000 births. Since there are fewer first births when unemployment is high (see tables 4 and A4), this could be a powerful explanatory factor of why average newborn health is higher.

Notice, however, that the correlation between birth order and neonatal health could be driven by other, unobserved family characteristics that are associated with birth order. We can assess the extent to which this is the case by exploiting only within-mother birth order differences. For the sub-period 2002-2014, we can identify siblings via an individual identifier for the mother, thus we can compare the health of different children born to the same mother. We pool 2002-2014 and estimate neonatal health regressions, controlling for province and year dummies, province trends as well as all family characteristics, and evaluate the change in the coefficients on the birth order indicators when we include mother fixed-effects.[15] Results are reported in panel B of table A5.

The first and third columns do not include mother fixed-effects. The results are similar to those in panel A: babies with high-skill and married mothers are heavier and have lower mortality rates, while those with older parents are heavier at birth. Higher-

[15] The limited time variation in the 2002-2014 subsample prevents us from estimating our main regressions (reported in table 2) with mother fixed-effects.

order births are healthier. Columns 2 and 4 report the results with mother fixed-effects. The association between high-skilled mothers and birth-weight disappears. The correlation between mothers' marital status and neonatal health remains, and the coefficients on father's age also change little.

The reported association between birth order and neonatal health does not appear to be driven by unobserved mother characteristics. The correlations with both birth-weight and mortality remain significant when we exploit only within-mother variation, and the magnitudes even increase slightly. Thus, birth order seems like a potentially important factor in generating the observed association between the cycle and infant health.

We test for this possibility by including individual-level controls in our initial regressions (equation 1, results reported in table 2). We focus on three outcome variables: log birth-weight, low birth-weight, and 24-hour mortality. The first column of table 5 reports the results from table 2 again, as a baseline. The second column adds birth order dummies as the only additional control. The magnitude of the three coefficients is reduced, with birth order able to account for 22% of the association between the cycle and birth-weight. Column 3 adds the rest of the control variables, including parents' ages, marital status and occupations. The magnitudes of the coefficients are further reduced, by as much as 36% in the case of birth-weight, and the coefficient becomes insignificant for both birth weight and the probability of low birth weight when we include all the controls in the regression. So, we are able to "explain" a large fraction of the reported association between neonatal birth weight and business cycle conditions. For mortality, birth order controls account for 2% of the association, and when we include all controls we are able to explain 26% of the association between neonatal mortality and business cycle conditions (and the coefficient remains significant in this case).

In order to assess the explanatory power of birth order effects, next we estimate equation 1 for the subsample of first-time mothers (column 4). For birth weight as well as for the probability of being born with low birth weight, the coefficient of the unemployment rate is not significant at the 5% level. Furthermore, when we add the rest of the individual-level controls, none of the coefficients for the unemployment rate are significant anymore, and the size of the coefficients is reduced by 31% to 39% with respect to the results without controls (column 4).

In sum, observable family characteristics, and in particular birth order, can account for a large fraction of the documented association between local economic conditions and newborn health.

3.3 Maternal health behaviors

A large literature finds that adult health tends to improve during recessions (Ruhm 2000, 2003, 2005, 2015, 2016, Neumayer 2004, Tapia-Granados 2005), at least in part due to increased health-enhancing behaviors.[16] One additional possible explanation for our main finding is thus that (pregnant) women engage in healthier behaviors when unemployment is high. Although in the previous sections we have shown that observable family characteristics can account for a large fraction of the association between newborn health and the business cycle, it may still be that changes in healthy behaviors of mothers could also be playing a role.

In order to test this hypothesis, we merge eight waves of the Spanish National Health Survey, covering 1987-2011, and restrict the sample to women of childbearing age (in the main table, 17 to 40).[17] We do not condition on pregnancy or motherhood in order to

[16] In contrast, the literature has documented significant negative effects of unemployment at the individual level on later (adult) health, see for instance Sullivan and von Wachter (2009).
[17] We explore different age ranges and also restrict the sample to married women in alternative specifications. The main conclusions remain.

abstract from changes over time in selection into motherhood (for instance, the increase in age at first birth). Descriptive statistics are reported in table A6. We define two binary measures of health status. The first one is an indicator of good self-reported overall health status. It recodes a variable with five possible answers. Our measure takes value 1 if the woman reports ok, good or very good health, which is the case for almost 97% of the sample. We also create an indicator of mental health, which takes value 1 for women not reporting any mental health problems (only 1% do). A third measure of health status is the woman's body-mass index (BMI), which is 23 on average in the sample (24 and higher is considered overweight). We also construct four variables measuring health-related behaviors. Almost 48% of women report exercising regularly, and average hours of sleep are about 7.7. About 41% of women in the sample report smoking, while 48% report having consumed alcohol during the 2 weeks prior to the interview.

We run regressions of the form of equation 1, where the dependent variable is now a measure of women's health outcomes or health-related behaviors. The results are presented in table 6. The specifications are parallel to those estimated in table 2 for babies' health, except that now we always control for a cubic polynomial in age. The number of observations is about 30,000. Although most of the coefficients (except for drinking) point towards improvements in health and health behaviors of women when the economy deteriorates, none of them is significant. Good health as well as mental health improves when the unemployment rate increases, and the BMI is reduced. Women also report they sleep and exercise more although, again, the effects are imprecisely estimated.

Overall, the results in this section suggest that, although women's health may improve during recessions, these changes are not estimated with precision given the data available.

6. Conclusions

Using birth- and death-certificates and Labor Force Survey data for Spain between 1980 and 2015, we show that the health of newborn babies improves (on average) when the local unemployment rate is high. We explore several mechanisms that may underlie this association.

First, we show that miscarriages, abortions and stillbirths do not increase during recessions, so that selection in-utero is most likely not driving the effect. Second, we document that parental characteristics vary with the cycle. In particular, women are less likely to have their first child in periods of high unemployment. We also show that, for a given mother, the first child tends to be less healthy at birth than subsequent ones. These two facts combined drive up average health at birth when unemployment is high. Moreover, we show that mothers are more likely to be married and parents are less likely to be young when unemployment is higher. Thirdly, our results point towards some improvements in women's health and health behaviors during recessions, although the effects are imprecisely estimated.

While we have explored three plausible mechanisms, there may still be additional channels underlying the documented positive association between the local unemployment rate and newborn health. For instance, it is possible that pregnant women receive better quality medical care during recessions, either during pregnancy or labor (or both).[18] We have reported that fertility is lower during recessions, so that congestion in the health system during booms may explain part of the results. However, it is also likely that the (public) health system is more underfunded during recessions, which would lead to the opposite effect.

[18] A recent paper (Stevens et al. 2015) finds that the quality of care (in elderly homes) improving during recessions can explain at least part of the procyclicality of adult mortality.

In addition, periods of lower economic activity could result in less pollution and better air quality, which in turn could affect babies' health positively. A recent literature shows that air quality during pregnancy can have important health effects for newborns (Chay and Greenstone 2003, Currie and Schmieder 2009, Currie et al. 2009, Currie and Walker 2011, Coneus and Spiess 2012). Exploring the role of these additional channels is an interesting avenue for further research.

Although there is some consensus that babies' health is procyclical in developing countries, the evidence for richer countries is mixed. De Cao et al. (2019), Kaplan et al. (2017) and Margerison-Zilko et al. (2011) find that the procyclicality of babies' health is also present in the UK and the US. In contrast, DLM's findings for the US are in line with ours in that babies' health is countercyclical in developed countries. Therefore, our results contribute to previous literature showing that, at least in certain developed countries, babies' health is countercyclical. We provide new evidence for Spain, as well as strong evidence on the role of two channels that had not been documented before: in-utero selection, and birth order.

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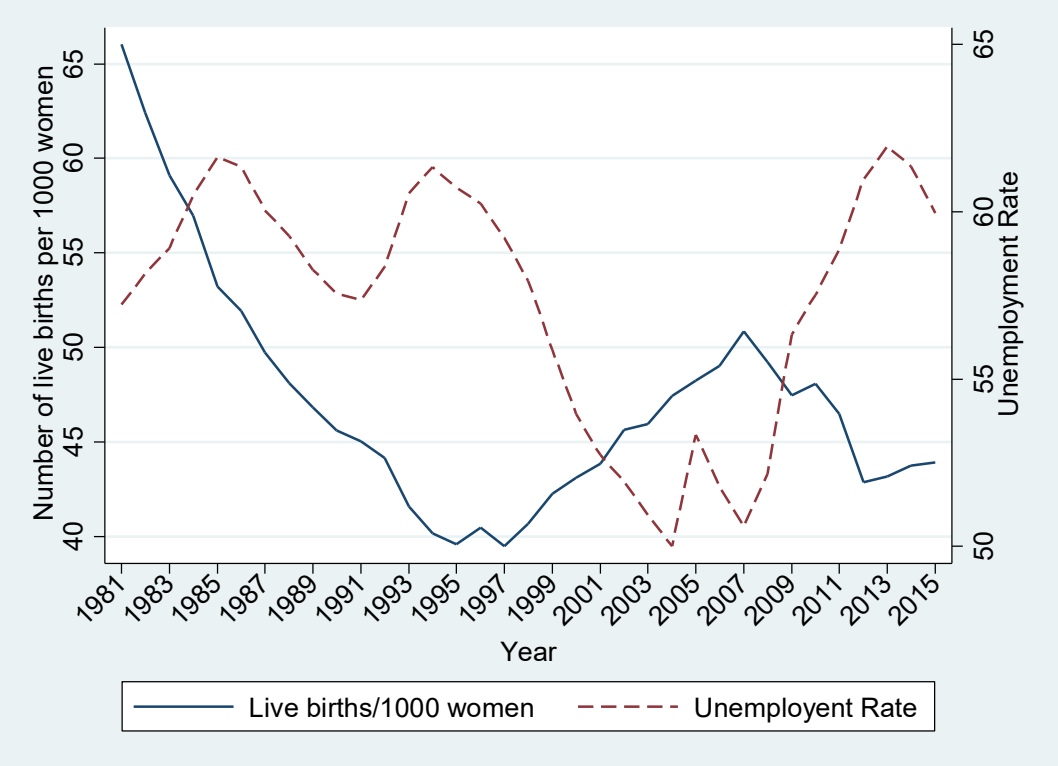
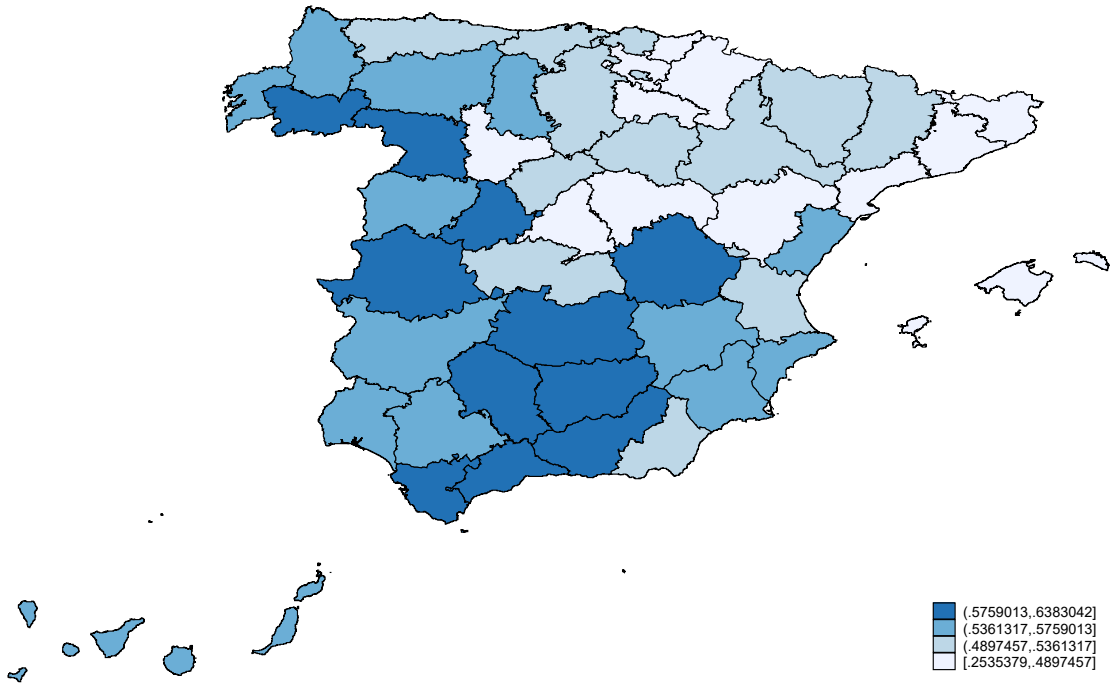
Tables and figures

Figure 1. Unemployment rate and number of live births per 1000 women in Spain, 1981-2015.



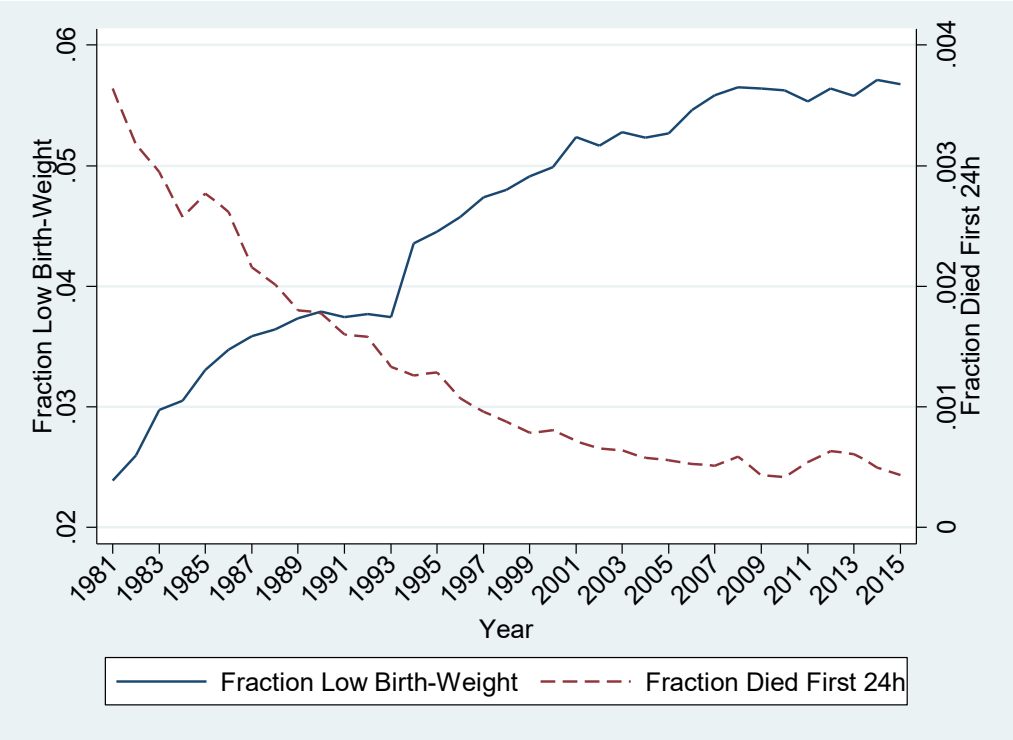
Source: Spanish Labor Force Survey, birth-certificate micro data and Spanish National Statistical Institute, 1981-2015. The unemployment rate is the number of individuals aged 16-65 currently out of work, over the total number of individuals 16-65. The age range for the number of women is 15-45.

Figure 2. Unemployment rate by province, Spain 2010



Source: Labor Force Survey 2010 (second quarter).

Figure 3. Neonatal health in Spain, 1981-2015



Note: Low birth-weight is the fraction of all live singletons weighing less than 2,500 grams at birth. The mortality rate is the fraction of all singleton live births who died within the first 24 hours after birth. Source: Birth-certificate micro data, National Statistical Institute.

Table 1. Descriptive statistics (individual-level birth-certificate data)

Variable	*Mean*	*Std. Dev.*	*Min*	*Max*
Labor Force Survey (province-year)				
Year of conception	1998	10	1981	2015
Unemployment rate	0.55	0.07	0.37	0.73
Birth-certificate data (individual-level)				
Year of conception	1998	10	1981	2015
Birth weight (in grams)	3,272	497	500	6,500
Low birth weight (<2.500)	0.050	0.218	0	1
Very low birth weight (<1.500)	0.0050	0.07	0	1
Mortality before 24h.	0.0013	0.0362	0	1
Age of the mother	29.7	5.5	16	45
Age of the father	31.8	7.3	14	84
Birth order	1.66	0.857	1	5
First birth	0.521	0.499	0	1
Girl	0.483	0.499	0	1
No registered father	0.017	0.131	0	1
Married mother	0.792	0.405	0	1
Mother high-skill occupation	0.154	0.361	0	1
Father high-skill occupation	0.159	0.366	0	1
Mother lives in capital	0.336	0.472	0	1
Mother lives in town <10,000	0.210	0.407	0	1

Sources: Spanish Labor Force Survey, birth-certificate micro data, 1980-2015. The number of (singleton, live) births in the sample is 14,545,437.

Table 2. The effect of the cycle on newborn health, 1981-2015.

	Low Birth Weight	**Very Low Birth Weight**	**Log Birth weight**	**Mortality 24h.**
Unemployment Rate	-0.0194**	-0.0059***	0.0229**	-0.0042**
	(0.0082)	(0.0016)	(0.0099)	(0.0016)
Observations	13,143,962	13,143,962	13,143,596	14,545,437
Province dummies	Y	Y	Y	Y
Year dummies	Y	Y	Y	Y
Province trends	Y	Y	Y	Y

(* p<0.1; ** p<0.05; *** p<0.01)

Notes: Each coefficient comes from a separate regression. The data comes from birth certificates. Only singleton births are included. The unemployment rate is calculated at the province-year level from the Labor Force Survey for the second quarter of each year. Birth outcomes are matched to the unemployment rate by estimated year of conception. All regressions include province and year fixed effects as well as province-specific linear trends. Robust standard errors clustered by province are in brackets.

Table 3. The effect of the cycle on miscarriages, abortions and stillbirths

	Miscarriage	Abortion	Abortion	Stillbirth
Unemployment Rate	-0.2884	-0.0179	-0.0645	-0.0055 **
	(0.2562)	(0.1076)	(0.0633)	(0.0027)
Observations	8,854	9,003	13,782,357	14,601,631
Year & Province dummies	Y	Y	Y	Y
Province trends	Y	Y	Y	Y

(* p<0.1; ** p<0.05; *** p<0.01)

Notes: Each coefficient comes from a separate regression. The unemployment rate is calculated at the province-year level from the Labor Force Survey for the second quarter of each year. The data source for the first two columns is the National Fertility Survey (1987 and 1999), covering births between 1981 and 1998. The third column combines administrative data on the number of abortions by province and year and birth-certificate data, and it covers abortions between 1987 and 2015. The fourth column uses birth-certificate data from 1981 to 2015. All regressions include province fixed effects. Robust standard errors clustered by province are in brackets.

Table 4. The effect of the cycle on parental characteristics

Main exp. var.: Unemployment rate					
Dep. var.			**Dep. var.**		
Birth order for the mother	0.2421	***	Age mother	0.7856	
	(0.0660)			(0.7034)	
First-time mother	-0.1766	***	Mother under 23	-0.0917	***
	(0.0514)			(0.0262)	
Mother high-skill occup.	-0.2107	**	Mother over 35	-0.0180	
	(0.0915)			(0.0313)	
Father high-skill occup.	0.0628		Age father	2.2205	***
	(0.1275)			(0.7202)	
Married	0.1556	**	Father under 25	-0.0867	***
	(0.0692)			(0.0225)	
No father	-0.0059		Father over 38	0.0776	***
	(0.0107)			(0.0245)	
Province capital	0.0776	*	Girl	0.0149	
	(0.0450)			(0.0101)	
Less than 10,000 pop.	-0.0701				
	(0.0556)				
Year & Province dummies	Y			Y	
Province trends	Y			Y	

(* p<0.1; ** p<0.05; *** p<0.01)

Notes: Each coefficient comes from a separate regression. The main data source is birth certificates. Only singleton births are included. The unemployment rate is calculated at the province-year level from the Labor Force Survey for the second quarter of each year. Parent characteristics are matched to the unemployment rate by estimated year of conception. All regressions include province and year fixed effects as well as province-specific linear trends. Robust standard errors clustered by province are in brackets.

Table 5. The effect of the cycle on neonatal health, controlling for parent characteristics

Main exp. var.	**Unemployment rate**					
Dep. var.	**Baseline**		**Birth order dummies**		**All controls**	
Log birth-weight	0.0229	**	0.0179	*	0.0146	
N=13,143,596	(0.0099)		(0.0094)		(0.0098)	
(% "explained" by controls)			22%		36%	
Low birth weight	-0.0194	**	-0.0168	**	-0.0149	
N=13,143,962	(0.0082)		(0.0078)		(0.0092)	
(% "explained" by controls)			13%		23%	
Mortality <1 day	-0.0042	**	-0.0041	**	-0.0031	**
N=14,545,437	(0.0016)		(0.0016)		(0.0013)	
(% "explained" by controls)			2%		26%	
Year dummies	Y		Y		Y	
Province dummies	Y		Y		Y	
Province trends	Y		Y		Y	

Main exp. var.	**Unemployment rate**			
Dep. var.	**First births only**		**First births only, all controls**	
Log birth-weight	0.0143		0.0098	
N=13,143,596	(0.0110)		(0.0117)	
(% "explained" by controls)			31%	
Low birth weight	-0.0210	*	-0.0179	
N=13,143,962	(0.0110)		(0.0125)	
(% "explained" by controls)			15%	
Mortality <1 day	-0.0049	**	-0.0030	
N=14,545,437	(0.0023)		(0.0019)	
(% "explained" by controls)			39%	
Year dummies	Y		Y	
Province dummies	Y		Y	
Province trends	Y		Y	

(* p<0.1; ** p<0.05; *** p<0.01)

Notes: Each coefficient comes from a separate regression. The main data source is birth certificates. Only singleton births are included. The unemployment rate is calculated at the province-year level from the Labor Force Survey for the second quarter of each year. Birth outcomes are matched to the unemployment rate by estimated year of conception. All regressions include province and year fixed effects as well as province-specific linear trends. Robust standard errors clustered by province are in brackets. "All controls" include birth order dummies, a third-order polynomial in age of the mother and age of the father, and dummies for gender, municipality size, no registered father, married mother, and mother/father in a high-skill occupation.

Table 6. The effect of the cycle on women's health

	Good Health	Mental Health	BMI	Hours of Sleep
Unemployment Rate	0.105	0.0369	-1.687	0.201
	(0.083)	(0.033)	(1.367)	(0.667)
Mean Dep.Vble	0.957	0.989	23.4	7.56
Observations	31,057	30,433	28,577	30,914
Cubic in age	Y	Y	Y	Y
Province dummies	Y	Y	Y	Y
Year dummies	Y	Y	Y	Y
Province trends	Y	Y	Y	Y

	Exercise	Smoking	Drinking
Unemployment Rate	0.224	-0.156	0.275
	(0.296)	(0.204)	(0.341)
Mean Dep.Vble	0.476	0.371	0.469
Observations	30,856	31,011	30,755
Cubic in age	Y	Y	Y
Province dummies	Y	Y	Y
Year dummies	Y	Y	Y
Province trends	Y	Y	Y

(* p<0.1; ** p<0.05; *** p<0.01)

Notes: Micro data from National Health Surveys (1987, 1993, 1995, 1997, 2001, 2003, 2006, and 2011) for women aged 17-40. The unemployment rate is calculated at the province-year level from the Labor Force Survey for the second quarter of each year. Each coefficient comes from a separate regression. All regressions include province and year fixed effects as well as province-specific linear trends. Robust standard errors clustered by province are in parentheses.

APPENDIX

Table A1. The effect of the cycle on neonatal health, time series regressions 1981-2015.

	Low Birth Weight	Very Low Birth Weight	Log Birth weight	Mortality 24h.
Unemployment Rate	-0.0149***	-0.0015	-0.0266***	-0.0007
	(0.0058)	(0.0020)	(0.0094)	(0.0005)
Observations	13,143,962	13,143,962	13,143,596	14,545,437
Linear trend	Y	Y	Y	Y
Quadratic trend	Y	Y	Y	Y

(* p<0.1; ** p<0.05; *** p<0.01)

Notes: Each coefficient comes from a separate regression. The data comes from birth certificates. Only singleton births are included. The unemployment rate is calculated at the national level from the Labor Force Survey for the second quarter of each year. Birth outcomes are matched to the unemployment rate by estimated year of conception. Robust standard errors clustered by year are in parentheses.

Table A2. The effect of the cycle on newborn health using lagged unemployment rate, 1982-2015.

	Low Birth Weight	**Very Low Birth Weight**	**Log Birth weight**	**Mortality 24h.**
Lagged Unemployment Rate	-0.0090	-0.0037**	0.0134	-0.0037***
	(0.0080)	(0.0018)	(0.0111)	(0.0012)
Observations	12,775,584	12,775,584	12,775,237	14,041,827
Province dummies	Y	Y	Y	Y
Year dummies	Y	Y	Y	Y
Province trends	Y	Y	Y	Y

(* p<0.1; ** p<0.05; *** p<0.01)

Notes: Each coefficient comes from a separate regression. The data comes from birth certificates. Only singleton births are included. The lagged unemployment rate is calculated at the province-year level from the Labor Force Survey for the second quarter of each year. Birth outcomes are matched to the unemployment rate of the previous year by estimated year of conception. All regressions include province and year fixed effects as well as province-specific linear trends. Robust standard errors clustered by province are in brackets.

Table A3. The effect of the cycle on newborn health using different definitions of the unemployment rate, 1981-2015.

	Low Birth Weight	Very Low Birth Weight	Log Birth weight	Mortality 24h.
PANEL A				
Unemployment Rate 2	-0.0105*	-0.0028**	0.0306***	-0.0021
	(0.0053)	(0.0011)	(0.0070)	(0.0013)
PANEL B				
Youth Unemployment Rate	-0.0065**	-0.0017***	0.0168***	-0.0015*
	(0.0029)	(0.0005)	(0.0033)	(0.0008)
Observations	13,143,962	13,143,962	13,143,596	14,545,437
Province dummies	Y	Y	Y	Y
Year dummies	Y	Y	Y	Y
Province trends	Y	Y	Y	Y

(* p<0.1; ** p<0.05; *** p<0.01)

Notes: Each coefficient comes from a separate regression. The data comes from birth certificates. Only singleton births are included. In Panel A the unemployment rate is calculated at the province-year level from the Labor Force Survey and is defined as the ratio of individuals looking for a job over active population while in Panel B the definition is the same as in Panel A but restricted to individuals aged 16-24. Birth outcomes are matched to the unemployment rate by estimated year of conception. All regressions include province and year fixed effects as well as province-specific linear trends. Robust standard errors clustered by province are in brackets.

Table A4. The effect of the cycle on fertility

	Birth rates (per woman 15-45)				
	All births		**First births**		**Higher-order births**
Unemployment Rate	-0.0377	***	-0.0310	***	-0.0067
	[0.006]		[0.004]		[0.004]
Observations	1,750		1,750		1,750
Province dummies	Y		Y		Y
Year dummies	Y		Y		Y
Province trends	Y		Y		Y

(* p<0.1; ** p<0.05; *** p<0.01)

Notes: Each coefficient comes from a separate regression. Micro data from birth certificates is aggregated by province and year (35 years, 50 provinces: N=1,750). The unemployment rate is calculated at the province-year level from the Labor Force Survey for the second quarter of each year. The number of births is matched to the labor market variables by estimated year of conception. All regressions include province and year fixed effects as well as province-specific linear trends. Robust standard errors clustered by province are in brackets. The number of women used for the birth rate includes age range 15-45.

Table A5. Family characteristics and newborn health.
Panel A. Year-by-year regressions of health on characteristics.

Main dep. var.	**Log birth-weight**							
	1985		**1995**		**2005**		**2015**	
Birth order								
Second	0.0201	***	0.0222	***	0.0253	***	0.0321	***
	(0.0007)		(0.0006)		(0.0006)		(0.0006)	
Third	0.0281	***	0.0206	***	0.0272	***	0.0363	***
	(0.0010)		(0.0012)		(0.0011)		(0.0011)	
Fourth	0.0330	***	0.0158	***	0.0287	***	0.0407	***
	(0.0015)		(0.0024)		(0.0024)		(0.0023)	
Fifth and higher	0.0399	***	0.0314	***	0.0334	***	0.0375	***
	(0.0020)		(0.0032)		(0.0034)		(0.0035)	
Mother high-skill occ.	-0.0015		-0.0017	*	-0.0005		-0.0008	
	(0.0011)		(0.0009)		(0.0007)		(0.0008)	
Married	0.0207	***	0.0201	***	0.0103	***	0.0114	***
	(0.0013)		(0.0011)		(0.0007)		(0.0006)	
Young Mother	-0.0059	***	-0.0039	**	-0.0088	***	-0.0107	***
	(0.0011)		(0.0015)		(0.0015)		(0.0018)	
Age Father	0.0006	***	0.0004	***	0.0005	***	0.0005	***
	(0.0001)		(0.0001)		(0.0001)		(0.0001)	
Young Father	-0.0064	***	-0.0067	***	-0.0084	***	-0.0114	***
	(0.0011)		(0.0016)		(0.0016)		(0.0020)	
Province dummies	Y		Y		Y		Y	
Controls	Y		Y		Y		Y	

Main dep. var.	**Mortality 24h.**							
	1985		**1995**		**2005**		**2015**	
Birth order								
Second	-0.0006	***	-0.0009	***	-0.0004	***	-0.0002	***
	(0.0002)		(0.0001)		(0.0001)		(0.0001)	
Third	-0.0020	***	-0.0014	***	-0.0005	***	0.0002	
	(0.0003)		(0.0002)		(0.0001)		(0.0002)	
Fourth	-0.0018	***	-0.0012	***	-0.0006	**	-0.0003	
	(0.0004)		(0.0004)		(0.0002)		(0.0002)	
Fifth and higher	-0.0012	**	-0.0013	**	-0.0003		0.0009	
	(0.0006)		(0.0006)		(0.0004)		(0.0007)	
Mother high-skill occ.	-0.0012	***	-0.0005	***	-0.0004	***	0.000	
	(0.0003)		(0.0002)		(0.0001)		(0.0001)	
Married	-0.0005		-0.0006	**	-0.0003	***	-0.0001	
	(0.0004)		(0.0002)		(0.0001)		(0.0001)	
Young Mother	-0.0001		-0.0004		-0.0003		-0.0003	
	(0.0003)		(0.0003)		(0.0002)		(0.0002)	
Age Father	-0.000		0.000		0.000		0.000	
	(0.000)		(0.000)		(0.000)		(0.000)	
Young Father	0.0005		0.0005		0.0002		0.0002	
	(0.0003)		(0.0004)		(0.0002)		(0.0002)	
Province dummies	Y		Y		Y		Y	
Controls	Y		Y		Y		Y	

(* p<0.1; ** p<0.05; *** p<0.01)

Notes: Each column comes from a separate regression. The data source is birth certificates. Only singleton births are included. All regressions include province fixed effects, as well as additional controls (age of the mother, a dummy for "older" mother (whether the mother has more than 35 years) and a dummy for "older" father (whether the father has more than 38 years), dummy for gender, whether the place of birth is the capital of the region, whether there is no registered father and whether the father works in a high-skill occupation). Young mother is a dummy that equals one for mothers younger than 23 years and young father is a dummy that equals one for fathers younger than 25 years. Robust standard errors are in brackets.

Panel B. Regressions of health on characteristics with mother fixed-effects, 2002-2014

Main dep. var.	**Log birth-weight**				**Mortality 24h.**			
Birth order								
Second	0.0271	***	0.0271	***	-0.0001	***	-0.0003	***
	(0.0008)		(0.0032)		(0.0000)		(0.0001)	
Third	0.0287	***	0.0323	***	-0.0002	***	-0.0009	***
	(0.0009)		(0.0053)		(0.0000)		(0.0002)	
Fourth	0.0299	***	0.0360	***	-0.0001		-0.0015	***
	(0.0011)		(0.0054)		(0.0001)		(0.0005)	
Fifth and higher	0.0314	***	0.0361	***	0.0001		-0.0013	*
	(0.0014)		(0.0085)		(0.0002)		(0.0007)	
Mother high-skill occup.	0.0055	***	-0.0000		-0.0002	***	-0.0004	**
	(0.0004)		(0.0008)		(0.0000)		(0.0002)	
Married	0.0096	***	0.0028	***	-0.0002	***	-0.0007	***
	(0.0005)		(0.0010)		(0.0000)		(0.0003)	
Young Mother	-0.0118	***	-0.0035	*	0.0000		-0.0000	
	(0.0006)		(0.0018)		(0.0001)		(0.0002)	
Age Father	0.0004	***	0.0005	***	0.0000		-0.0000	
	(0.000)		(0.0002)		(0.0000)		(0.0000)	
Young Father	-0.0079	***	-0.0020		0.0001	**	-0.0001	
	(0.0005)		(0.0017)		(0.0001)		(0.0002)	
Year dummies	Y		Y		Y		Y	
Province Dummies	Y		Y		Y		Y	
Province Trends	Y		Y		Y		Y	
Controls	Y		Y		Y		Y	
Mother fixed effects	N		Y		N		Y	

(* p<0.1; ** p<0.05; *** p<0.01)

Notes: Each column comes from a separate regression. The data source is birth certificates, augmented with mother id. Only singleton births are included. All regressions include province specific linear trend, year and province fixed effects, as well as additional controls (age of the mother, a dummy for "older" mother (whether the mother has more than 35 years) and a dummy for "older" father (whether the father has more than 38 years), dummy for gender, whether the place of birth is the capital of the region, whether there is no registered father and whether the father works in a high-skill occupation). Young mother is a dummy that equals one for mothers younger than 23 years and young father is a dummy that equals one for fathers younger than 25 years. Robust standard errors clustered by province are in brackets.

Table A6. Descriptives, National Health Surveys, 1987-2011 (women 17-40)

Variable	N. obs.	Mean	Std. dev.	Min	Max
Year	31,113	1999	8	1987	2011
Age	31,113	29.1	6.9	17.0	40.0
Health status	31,057	0.9695	0.1719	0	1
Mental health	30,433	0.9919	0.0894	0	1
BMI	28,577	22.8	3.7	14.0	49.0
Exercise	30,856	0.4789	0.4996	0	1
Hours of sleep	30,914	7.7	1.2	1.0	24.0
Drink	30,755	0.4807	0.4996	0	1
Smoke	31,011	0.4114	0.4921	0	1

Source: Spanish National Health Survey (1987, 1993, 1995, 1997, 2001, 2003, 2006, and 2011.