Perinatal health in Spain during and after the Great Recession: educational selection into fertility as a protective factor in high unemployment contexts

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Abstract

Higher maternal resources have long been associated with superior birth outcomes. This study analyzes the potentially protective role of maternal educational selection into fertility in adverse macroeconomic contexts. We focus on the case of Spain, a country reaching record-high unemployment levels during the Great Recession starting in 2008. First, we examine whether selection into fertility of more educated mothers took place as province-level unemployment rates rose. Secondly, we assess whether maternal education mitigated the impact of higher unemployment levels on different birth outcomes. The analysis combines register data on the universe of live births with aggregate data on province-level unemployment. We cover the period 2007-2019 to ensure sufficient variability of unemployment rates and perform linear regression and linear probability models with fixed effects to hold constant unobserved heterogeneity across provinces. Findings indicate selection into fertility of mothers with university-level education in times of high unemployment. In addition, while unemployment rates did show an adverse impact on certain birth outcomes –birthweight, the occurrence of low and very low birthweight, and the risk of stillbirth – maternal education mitigated the observed relations. It was itself, moreover, consistently and independently associated with better perinatal health. We thus conclude that fertility selectivity by maternal education cushioned the impact of the adverse economic context derived from the Great Recession through two separate pathways.

Keywords: Perinatal health, selection into fertility, maternal education, unemployment, birth outcomes, Great Recession, Spain

1. Introduction

The importance of perinatal health for children's life prospects is well-established. Adverse birth outcomes potentially affect individuals' subsequent health trajectories, as well as their psychosocial and cognitive development (Almond et al., 2018). At the individual level, greater socioeconomic resources tend to favor better perinatal outcomes. Infants born to mothers with higher educational level (Hvas Mortensen et al., 2011), with higher occupational status (Morales-Suárez Varela et al., 2009), or living in two-parent households (Luo et al., 2004) show lower probabilities of adverse birth outcomes. A negative association between parental unemployment and newborns' health has also been found (Lindo, 2011). Socioeconomic resources affect different variables that influence perinatal outcomes, such as maternal health and habits, working conditions, the possibility of maintaining an optimal nutritional intake, and access to prenatal care (de Graaf et al., 2013).

At the aggregate level, increasing attention has been paid to the influence of macroeconomic shocks and business cycles on birth outcomes, yet evidence is mixed and context dependent. Studies on low-income countries have found perinatal health declines during recessions (see f.i. Bhalotra, 2010; Baird et al., 2011), and similar outcomes have been observed in some medium- and high-income countries as well (Bozzoli and Quintana-Domeque, 2014; Margerison-Zilko et al., 2017; Alessie et al., 2018). Other research, nevertheless, yields evidence of procyclical outcomes entailing improved birth outcomes in times of economic crises and high unemployment rates (Dehejia and Lleras Muney, 2014; Aparicio et al., 2020); not least in relatively affluent societies where recessions tend to be shorter and health and social spending could mitigate their impact (van den Berg et al., 2020). Some authors find both countercyclical and procyclical relations between perinatal health and the economic context depending on the

indicators analyzed and parental socioeconomic status (Eiríksdóttir et al., 2013; Kyriopoulos et al., 2019).

The variable impact of the economic cycle on perinatal health provides opportunities to explore linkages between macro- and micro-level variables potentially conditioning birth outcomes, and thus to gain insights on the mechanisms involved. Positive associations between recessions and perinatal outcomes might seem counterintuitive, as economic hardship could have potentially deleterious effects on maternal health. An adverse economic climate is associated with greater vulnerability to unemployment, worsened employment conditions, and potential income loss at the individual and family levels. As a result, it could translate into higher maternal stress levels and greater difficulties to maintain a healthy pregnancy (Margerison-Zilko et al., 2017). In some contexts, it could also lead to reduced use of prenatal care (Wehby et al., 2017; De Cao et al., 2022). Additionally, the quality of general and prenatal healthcare systems may decline (Quaglio et al., 2013). Nevertheless, some authors have identified other factors present in economic crises that could counteract these effects and act as possible explanations for procyclicality of perinatal health. First, certain unhealthy behaviors (e.g., alcohol consumption, smoking, exposure to occupational hazards) sometimes decrease during economic downturns (Ensor et al., 2010; Wehby et al., 2017), while maternal unemployment may – especially in contexts with high social protection – free time for health-improving activities (see van den Berg., et al., 2020). Second, there is evidence suggesting that adverse economic conditions may contribute to in-utero selection of healthier fetuses (Catalano et al., 2010; Bruckner et al., 2016), although some authors have not found any significant associations between high unemployment and pregnancy losses (Aparicio et al., 2020). Third, environmental changes that affect fetal health – e.g., reductions in pollution – have also been registered during economic downturns (Chay and Greenstone, 2003). Finally, several studies point at the importance of fertility selectivity during recessions, highlighting factors associated with better newborn health such as lower incidence of first births, a greater relative concentration of births among older and married parents

(Aparicio et al., 2020), or increases in parental socioeconomic status within some population groups (Dehejia and Lleras-Muney, 2004).

In this study, using data from Spain – a country hard hit by the 2008 economic recession, having reached exceptionally high unemployment levels (De la Rica and Rebollo-Sanz, 2017), with numerous structural barriers to fertility (Castro Martín et al., 2022), and where procyclical perinatal outcomes have been identified (Aparicio et al., 2020) – we aim to expand knowledge on the relations between economic downturns, fertility selectivity and birth outcomes by examining the potentially protective role of maternal educational selection. We hypothesize that Spain could have seen selection of more educated women into fertility during particularly hard unemployment times, as highly educated women were likely to be more shielded against job loss, to have greater resources to raise a child in an adverse macroeconomic context, and to face greater pressure towards childbearing on account of their generally higher age (see Castro Martín et al., 2018). This, in turn, could have protected perinatal health at least partially, given education's persistent association with better birth outcomes (Eremenko et al., 2023). Surprisingly, fertility selectivity based on educational level has received limited attention in earlier research on birth outcomes during economic crises (for an exception, see Dehejia and LLeras-Muney, 2004). To identify whether the Great Recession resulted in educational selection into fertility in Spain and assess its impact, a three-stage analysis is performed. Firstly, we examine whether higher unemployment rates at the province-level during the recession period and its aftermath were accompanied by a greater relative incidence of births to highly educated women. Secondly, we explore associations between province-level unemployment rates and a wide range of individual-level perinatal health indicators (birthweight, low and very low birthweight (LBW; VLBW), high birthweight (HBW), prematurity, and stillbirth). Finally, we assess whether maternal education – also measured at the micro-level – moderated these relations during the analyzed period, and whether it exerted an independent protective influence on birth outcomes.

Ultimately, we expect to increase understanding of linkages between birth outcomes, macroeconomic conditions, and potentially intervening maternal characteristics. Trying to separate the effects of the two latter variables is a question that has only recently started to be addressed (Margerison-Zilko et al., 2017). We focus on the impact of the unemployment rate since it has proven to be a good measure of economic instability affecting individuals, while correlating strongly with the business cycle and its influence on living conditions, not least health-related ones (Lin, 2006).

2. Previous research on perinatal health and fertility selectivity during economic crises

The abundant literature seeking to understand how economic cycles influence perinatal health yields a complex picture of variation regarding both outcomes and potential determinants. Diversity across contexts is substantial, with evidence supporting both countercyclical and procyclical relations between macroeconomic conditions and different birth outcomes. Some authors have found recessions and/or unemployment to be associated with declines in birthweight (Bozzoli and Quintana-Domeque, 2014) and increases in the odds of LBW (Margerison-Zilko et al., 2011; 2017; Terán et al., 2020), yet others have noted reductions in the incidence of both LBW and VLBW during economic downturns (Dehejia and Lleras-Muney, 2004; Aparicio et al., 2020). While some studies point to a relation between an adverse economic context and a greater probability of being born small for gestational age, others do not (see Margerison-Zilko et al., 2017), and the same is valid for the risk of pre-term birth (PTB) (cf. Margerison-Zilko et al., 2017 and Terán et al., 2020). Other work finds that higher unemployment rates are associated with decreased rates of congenital malformations and lower natal and postneonatal mortality (Dehejia and Lleras-Muney, 2004; van den Berg et al., 2020). There is, nonetheless, also evidence linking economic instability and higher

unemployment with higher rates of infant, neonatal and postneonatal mortality rates (Lin, 2006).

Beyond variations in indicators and measurements, part of the explanation for this complexity could lie in the institutional context, cushioning or amplifying the impact of the economic cycle (van den Berg et al., 2020). Another potentially important underlying factor, however, could be different types of fertility selectivity, which are likely to be shaped by the structural context as well. Economic conditions, at both the aggregate and the individual level, are a major determinant of fertility decisions. Financial and employment insecurity are among the main variables associated with the postponement of childbearing in contemporary societies (Beaujouan, 2020). In Europe and the United States, the overall number of births has been found to decline in times of economic downturn over the past decades (Dehejia and Lleras-Muney, 2004; Comolli, 2017; Alessie et al., 2018).. High unemployment rates have been found to elicit short- and long-term fertility declines (Currie and Schwandt, 2014). The influence of economic downturns on fertility varies nonetheless across population groups, given differences in exposure, in vulnerability to adverse circumstances, and in the costs of having or not having children (Margerison-Zilko et al., 2017). This complex picture suggests that women who conceive during recessions are likely to differ in their characteristics from those conceiving in non-recessive periods.

In this line, Dehejia and Lleras-Muney (2004) found that fertility decreased in times of high unemployment in the US among lower educated single Black mothers, while it increased among their White counterparts. In a similar vein, De Cao et al. (2022) observed that fertility in England between 2003 and 2012 tended to rise among women living in affluent areas as unemployment rose, while the opposite was true for those residing in disadvantaged areas. Different types of age-related selection into motherhood during economic downturns have also been detected in the US (Orsini and Avendano, 2015) and Spain (Aparicio et al., 2020) since the 1980s). Births

during recession periods have also been found to be more common among married mothers (Aparicio et al., 2020) and among those in relatively protected employment situations (Ramiro-Fariñas et al., 2017; Terán et al., 2020).

Selection into fertility of certain population groups during economic crises can be expected to affect perinatal health. There is increasing evidence of the influence of socioeconomic variables on maternal and fetal vulnerability to adverse exogenous events. Some authors have found downturn periods to be associated with improved birth outcomes in high income areas, and with adverse results in less affluent ones (De Cao et al., 2022). Others have observed that mothers in socioeconomically vulnerable groups are more sensitive to external circumstances potentially affecting fetal health (Margerison-Zilko et al., 2016;) and that this sensitivity is present for longer periods during pregnancy (Kyriopoulos et al., 2019). This said, protective effects of parental resources are not absolute – sometimes they are overridden by environmental or medical factors (Alessie et al., 2018). As noted, institutional contexts also matter. While universal access to free prenatal care has not proven entirely effective in preventing unemployment-related adverse birth outcomes (Raatikainen et al., 2006), a high degree of social protection – which lessens the financial and psychological effects of employment loss – is associated with reduced maternal stress and a lower impact on perinatal health (van den Berg et al., 2020).

3. The potential importance of maternal educational selection

One of the socioeconomic variables most consistently associated with enhanced perinatal outcomes is parental – and especially maternal – education. The latter correlates with healthy birthweight in a wide range of countries, and all else equal, with lower LBW and PTB risks (Silvestrin et al., 2013; El-Sayed et al., 2012). Furthermore, it seems to protect against being born small for gestational age (SGA) (Bushnik et al., 2017). Women with higher education have been

found to attend more prenatal visits and to start their pregnancy follow-up earlier (Silvestrin et al., 2013). They have also been observed to show healthier interpregnancy intervals, better habits during pregnancy – e.g., they are less likely to smoke (Nagahawatte, 2008) –, and lower incidence of overweight, depressed mood or anxiety, and certain physical complaints (Baron et al., 2015). Their chances to lead a healthy lifestyle are greater, as education facilitates access to information and resources that protect health (Adler et al., 2002). Mothers' educational level seems to exert protective effects against adverse perinatal outcomes that go beyond those of income (Bushnik et al., 2017).

Beyond the noted effects on maternal health during pregnancy, higher education has been found to protect against the risk of unemployment (especially for women) and related stress during economic crises (Nagore García, 2017; Córdoba-Doña et al., 2016). Against this backdrop, selection of more educated mothers could be a factor contributing to countercyclicality of birth outcomes in certain countries, or at least cushioning the impact of economic downturns. During harsh economic conditions, as education usually correlates with more protected employment situations, highly educated women could be more prone to decide to conceive (even though this is not a general finding in all countries, see Wehby et al., 2017). Because of greater resources and better health, they might even have a higher chance of conception and of carrying a pregnancy to term (Margerison-Zilko et al., 2017). In summary, maternal educational selection is likely to be at play during economic crises and can potentially affect birth outcomes through a broad range of mechanisms. Due to the latter, it may have a substantial moderating or direct impact on perinatal health, perhaps even more so than that of other types of fertility selectivity based on age, employment, union status, or birth order. Nevertheless, its occurrence and importance in adverse economic contexts has received very limited attention (for an exception, see Dehejia and Lleras-Muney, 2004), which calls for work that examines both dimensions.

4. The Spanish case: could educational selection have protected newborns' health following the Great Recession?

Spain is one of the countries with lowest fertility in the world, while it also occupies one of the highest positions regarding postponement of first births and of childbearing more generally. Although these trends are hardly new, they accentuated markedly with the deep economic crisis starting in 2008. Underlying the lowest-low fertility pattern characteristic of Spanish society is a labor market featuring high structural levels of unemployment and high rates of temporary jobs, which especially affect individuals of reproductive age precluding early family formation, along with a lack of affordable housing and work-family reconciliation difficulties (Castro Martín et al., 2018; 2022).

The recession starting in 2008 particularly exacerbated unemployment, which reached record high levels in the European context (De la Rica and Rebollo-Sanz, 2017). Hardest-hit regions tended to experience the most significant fertility declines (Puig-Barrachina et al., 2020). As highly educated individuals are usually more protected against unemployment, it seems reasonable to expect some fertility selectivity in terms of maternal education in periods when unemployment was most severe. Nevertheless, while recent work points at socioeconomic selection of mothers during the Great Recession – with relative increases in births among older, employed women with professional and administrative occupations (Terán et al., 2020), permanent employment (Ramiro-Fariñas et al., 2017), and stable couple situations (Aparicio et al., 2020) –, the potential occurrence and impact of changes in the educational profile of mothers has not been systematically examined at the national level. Neither has it been tied to variations in unemployment rates or analyzed as a potential modulator of the latter's effect on a broad array of perinatal outcomes.

Maternal educational selection could, moreover, to some extent underlie certain trends and patterns already identified in Spain. Earlier research spanning over a long period (1981-2015)

has detected general countercyclicality of birth outcomes – rises in unemployment have been found to be associated with higher birthweight, lower incidence of LBW and VLBW, and declines in newborn mortality rates (Aparicio et al., 2020). While the authors attribute these results to fewer first births during recessions and a relative increase of births to older and married women, educational selection may be behind these findings as well. Highly educated individuals in Spain have their children at later ages (Castro Martín et al., 2018). Furthermore, while cohabitation has become an increasingly widespread context for childbearing, recent survey data suggest that university-level education could be currently less frequent among cohabitant mothers than among married ones (Cordero Coma et al., 2023). Since economic downturns inhibit fertility, it is plausible that higher order births in such contexts largely correspond to either older mothers who cannot postpone childbearing, or to women with relatively protected socioeconomic situations. Highly educated women are more likely to be overrepresented among both groups.

Despite the noted tendency to countercyclical birth outcomes since the early 1980s, there are also studies showing specific adverse outcomes during the Great Recession which likewise point at maternal educational selection. Greater odds of stillbirth were detected in regions with the highest unemployment rates, especially for low educated as well as African born women (Luque-Fernández et al., 2013). There is evidence of a negative impact of the crisis on birthweight and the probability of LBW, which was, again, most marked for women from more disadvantaged social backgrounds (Terán et al., 2020). Still, the latter analysis did not look into fertility selectivity based on education, but rather highlighted the importance of employment and professional status. Earlier work (Ramiro-Fariñas et al., 2017) noted certain educational selection into childbearing during the recession, yet only among women with temporary jobs; with those with lower levels of education experiencing greater fertility declines. Overall, employment stability appeared more important than education for the decision to have children. Nevertheless, this study was based on data from one single region – Andalusia – traditionally marked by unrelentingly high unemployment levels, which may have increased the

relative prominence of employment stability against any other potential selectivity variables. These considerations, together with the very persistent socioeconomic gaps in perinatal health documented throughout the past decades in Spain – including a maternal educational gradient (Eremenko et al., 2023) – make it pertinent to study whether fertility selectivity by maternal education cushioned the impact on perinatal health of high unemployment during the Great Recession. We also believe it is important to assess these relations over a variety of birth outcomes. Previous research has identified that birthweight, the probability of LBW, and the risk of stillbirth were particularly affected during the economic recession in Spain among socially vulnerable women (Luque-Fernández et al., 2013; Terán et al., 2020). Therefore, we expect that the potentially protective effects of maternal education may be greatest for these indicators.

5. Data and methods

The study draws on register data on the universe of births in Spain collected by the National Statistics Institute (Instituto Nacional de Estadística, INE). The Birth Statistics, based on the Statistical Bulletin of Births, include pregnancy and birth-related information provided by parents and healthcare personnel immediately after birth, as well as basic socioeconomic indicators. Only babies born after 22 weeks of gestation and with a weight higher than 500 grams are included in our study. The analysis comprises births having occurred in the years 2007-2019. Covering not only the economic recession formally circumscribed to 2008-2014, but also the year before its inception and its aftermath allows the variability in unemployment rates needed to assess their impact on educational selection and perinatal outcomes. The total number of births covered by the mentioned data source amounts to 5,749,020 births during the analyzed period. When measuring birth outcomes, we focus on live births – which reduces the initial sample to 5,731,004 births – except when we analyze the impact of relevant variables on stillbirth, which requires the use of the total sample. After excluding observations with missing

information on relevant variables, we draw on samples that include a minimum of 4,339,002 live births and 9,677 stillbirths.

One of our main independent variables, the unemployment rate, is based on province-level estimates by INE corresponding to each year's third trimester. Maternal education – which acts as dependent variable at the province-year level when selection into fertility is assessed, and as an individual-level covariate when we examine its impact on perinatal health – is measured in three categories: completed university-level education; completed secondary-level education; and completed primary-level education or less. As to the main outcomes, we include the following individual-level perinatal health indicators: birthweight in grams; LBW (<2,500 grams); VLBW (<1,500 grams); HBW (≥4,000 grams and <7,000 grams) –; prematurity (< 37 weeks of gestation); and stillbirth. Descriptive statistics are presented as supplementary material (table 1).

We first provide a descriptive overview of the evolution of unemployment and maternal education throughout the period under study and assess whether selection into fertility of more educated women was more common in provinces with high unemployment rates. To this end, we regress the proportion of births to women with university-level, secondary-level, and primary-level education or less, in each province and year, on the province-level unemployment rate corresponding to the year before birth. We apply province-level fixed effects with robust standard errors to these linear regression models to control for time-invariant unobserved societal heterogeneity (e.g., potential differences in healthcare and social protection systems; in employment opportunities related to the labor market structure; or in baseline levels of maternal education, which are also likely to correlate with the unemployment rate). We do not expect significant yearly variations in prenatal care potentially affecting our findings, given the path-dependency of Spanish healthcare systems during the analyzed period (Bruquetas-Callejo and Perna, 2020). The models are specified as follows:

$$R_{p,t}^{E} = \beta \cdot X_{p,t-1} + \alpha_p + u_{p,t}$$

Where

$R_{p,t}^{E}$ is the ratio (percentage) of births to women in the educational category E in province p and year t over the total number of births in that same province and year, β is the coefficient associated with the e covariate $X_{p,t-1}$ (the unemployment rate, which takes different values according to province index p and time (year) t, but in which time is lagged 1 year backwards), , α_p is a fixed effect adjustment, taking different values for the province index p, that measures time-invariant province-level characteristics, , and $u_{p,t}$ is an unknown error term at the province-year level . Different values of E (university-level education, secondary-level education, and primary-level education or less) will correspond to different models with different resulting coefficients (for ease of exposition we have omitted the superscript E from β, etc.).

The second stage in the analysis focuses on individual-level perinatal outcomes and how these were influenced by province-level unemployment rates and the mother's education. After a description of how birth outcomes evolved during the recession period by maternal education level, we perform linear regression and linear probability models with heteroscedasticity-robust standard errors to assess relations between the yearly unemployment rate (third trimester) in the mother's province of residence and the noted individual-level perinatal outcomes in the ensuing year. We initially estimate a basic model that only includes the province-level unemployment rate as independent variable. We control for individual foetus- and birth related factors associated with perinatal results – fetal sex (female=1; male=0) (Kirchengast et al., 2016); the occurrence of a multiple birth (Heino et al., 2016); the occurrence of a pre-term birth when relevant (Butler & Berhman, 2007); and the occurrence of a first birth (Björkegren & Svaleryd, 2023) –, as well as for individual maternal characteristics previously related to fertility selectivity

and perinatal health in Spain (maternal age measured in years; married versus non-married status; see Aparicio et al., 2020). We subsequently expand the model by adding maternal education as a covariate (through thedichotomous variables “university-level education” and “secondary-level education”, taking “primary-level education or less” as reference category). Lastly, we add to this full model the interactions of university-level and secondary-level maternal education with the unemployment rate, to assess a potentially mitigating effect of the two former variables on the latter’s impact. Again, we estimate all regression models with fixed effects to control for unobserved heterogeneity at the province-level. The models are specified as follows:

$$P(Y_i = 1) = \beta \cdot X_i + \gamma \cdot C_i + \alpha_p + u_i$$

Where

$P(Y_i = 1)$ is the probability that Y_i takes the value 1, the index i enumerates the individual observations, β is the vector of linear probability coefficients associated with the vector of covariates of interest X_i, and the C_i are control variables varying with observation i, with their corresponding coefficients γ , α_p is a fixed effect adjustment, taking different values for the province index p , that capture time-invariant province-level characteristics , and u_i is an unknown individual error term.

6. Results

As shown in figure 1, unemployment soared in Spain during the Great Recession. Starting at 8% in 2007, the national unemployment rate peaked at over 25% in 2013. Over the recession period, the proportion of women giving birth who had completed university studies rose visibly; from 29.8% in 2008 to 37.1% in 2014. This shift was accompanied by a significant decrease in the share of mothers with secondary-level education (from 55% to 49%), although the percentage

corresponding to lower educated women also declined (from 15.3% to 13.8%). From 2014 onwards, unemployment descended gradually, and the proportion of women who became mothers with higher education, after a rise between 2015 and 2016, only experienced slight variations. The percentage corresponding to women with secondary-level studies grew somewhat between 2017 and 2018 and then resumed its decreasing trend. Finally, the group with primary-level studies or less fell markedly from 2015 onwards. It would thus seem that there was a growing representation of highly educated individuals among conceiving women as unemployment rose during the economic crisis, even though the trend has continued beyond the recession.

[Figure 1 about here]

Given women's notable educational expansion in Spain over the past decades (López-Rodríguez and Gutiérrez, 2023), the increase in the relative proportion of highly educated mothers could have been reflective of changes in the educational composition of the female population of reproductive age more generally. Figure 2 shows that the percentage of women in core reproductive ages who had completed university studies indeed showed a visible increase during the recession; especially among women aged 35-44, who largely mirror the trajectory observed in figure 1. This trend subsequently continued, although mostly among women aged 25-34 years old since 2016.

[Figure 2 about here]

Nevertheless, when the percentage of births corresponding to women with university-level, secondary-level, and primary-level education in each province and year are regressed on the province's unemployment rate in the previous year, interesting correlations emerge. As seen in

figure 3, an increase in the unemployment rate in a given province is associated with an increase in the proportion of births to highly educated women, and with decreases in the share of births to women with primary-level and, especially, secondary-level education (all relations are statistically significant at the 0.001 level). There is thus evidence pointing at selection into fertility of highly educated women as unemployment rates rose within each province.

[Figure 3 about here]

The national-level evolution of birth outcomes by mothers' education presented in figure 4 shows, descriptively and for most indicators, a clear relation between higher maternal education and better perinatal health during the analyzed period. No clear-cut association emerges between mothers' educational level and birthweight, although women with university studies consistently had – on average – larger babies (within the non-pathological range) than those with secondary-level education. Mean birthweight also experienced less fluctuations within the former group – as compared to the latter – among births stemming from conceptions that took place during the recession period (that is, births occurring between 2009-2015). Lower educated women had on average larger babies from 2009 onwards, yet this is likely to reflect their greater propensity to HBW. In fact, the incidence of pathological birthweights – LBW, VLBW and HBW – bore a consistent, negative relation to mothers' level of education during the whole recession period (and in the case of VLBW and HBW, also during its aftermath). So did the occurrence of prematurity and stillbirth.

[Figure 4 about here]

Figures 5 to 7, lastly, reflect the results of OLS regression/linear probability models with province-level fixed effects estimating the relation of different individual-level perinatal outcomes with the province's unemployment rate in the previous year. They also show how this relation is modulated by the inclusion of maternal education in the models, both by itself and in interaction with unemployment. Higher unemployment rates within provinces are significantly associated with lower birthweight (figure 5), as well as with an increased probability of LBW and VLBW (figures 5 and 6). When maternal education is introduced in the models, the statistical significance of the unemployment variable is maintained, and the size of its coefficient increases slightly in all cases. Mothers' education bears itself a clear association with the three noted outcomes – university-level education appears to favor higher birthweight, while both university- and secondary-level studies are associated with a lower probability of LBW and VLBW.

[Figure 5 about here]

[Figure 6 about here]

Introducing interactions between the mother's education and the province's unemployment rate does not eliminate the statistical significance of the latter, while the magnitude of its association with the mentioned birth outcomes is strengthened. Both university-level and secondary-level education – as opposed to primary-level studies or less –seem to mitigate the negative association of birthweight with the unemployment rate, given the positive sign and statistical significance of their interactions with the latter variable. They also appear to cushion

the impact of the macroeconomic context on the risk of LBW, and, in the case of secondary-level education, also of VLBW.

HBW and prematurity (figures 6 and 7) do not appear to have become more prevalent with unemployment rises during the analyzed period – in fact, the association in these cases is statistically significant yet negative throughout the estimated models. Maternal education, in contrast, once again exhibits an evident protective association with perinatal health, which in the case of these two indicators is most pronounced for higher education. The interaction of secondary education with the unemployment rate is significant and positive when the probability of HBW is analyzed, which suggests that mothers in this group would be more vulnerable to HBW in periods of higher unemployment than those with primary-level studies or less. The same is valid for women with university-level studies in the case of prematurity. The probability of stillbirth (figure 7), finally, appears to be positively associated with higher unemployment rates in the full model not including interactions, while maternal education – especially at the university-level – again exhibits the protective relation observed across other perinatal outcomes. Control variables and unstandardized coefficients are presented as supplementary material in tables 2 to 7.

[Figure 7 about here]

7. Conclusions and discussion

This paper has explored whether educational selection into fertility took place in Spain as a response to shifts in unemployment rates during and after the Great Recession. It has also examined the role of maternal education in cushioning the impact of high unemployment rates on different birth outcomes, either by itself or by moderating the relation between these

variables. Our results are indicative of actual maternal educational selection in Spain during the analyzed period – as unemployment rates rose within provinces, the relative proportion of women with university-level education, as opposed to those of women with primary- and especially secondary-level studies, increased. Since we assess these within-province changes from year to year, it is unlikely that they should merely reflect compositional changes in the population, which aremore sustained and gradual processes.. We find, moreover, that university-level education conferred clear protection against LBW, VLBW, pathologically HBW, prematurity and stillbirth, while also being associated with higher birthweight. In addition, it also appears to have reduced the negative impact of macro-level unemployment on birthweight and on the incidence of LBW, a very important indicator of perinatal health in the Spanish context. Hence, selection of more educated mothers into fertility in times of higher unemployment worked as a protective factor for babies' health through different pathways.

Interestingly, nevertheless, maternal education could not fully override the independent relation between the province-level unemployment rate and perinatal health, which also varied considerably across birth outcomes. In line with earlier research focusing on alternative indicators of macroeconomic hardship (Terán et al., 2020; looking at the recession context as a whole) and more restricted crisis periods (Luque-Fernández et al., 2013; covering years 2007-2010), an adverse labor market context was associated with an increased probability of LBW – and to a lower degree also of VLBW and stillbirth –, as well as with decreased birthweight. Maternal education was only clearly effective in reducing this negative influence in the case of birthweight and LBW.

One of the limitations of this study lies in the lack of data that allows us to assess micro-level mechanisms underlying the above relations. Likewise, we cannot single out the factors that explain the consistently protective effect of maternal education on the different perinatal health indicators regardless of the macroeconomic context. There is an urgent need for large-scale data

development that makes it possible to follow pregnancies among Spanish women and thus to trace the specific social and health-related processes leading to improved outcomes at birth.

Despite these limitations, we believe that our findings contribute to existing research on fertility and perinatal health in several important respects. First, we provide further evidence on the relations between adverse macroeconomic contexts and birth outcomes focusing on a country with notably unfavorable conditions in a crucial respect affecting individual life courses, namely unemployment rates. Second, we confirm that the relation between the structural context and perinatal health is complex and must be examined in depth and distinguishing across indicators – even within a very same country and provinces, with relatively large variations in unemployment rates, and with comparatively very high levels at times, we find that certain negative outcomes increased as unemployment rose (reduced birthweight, LBW, VLBW and stillbirth), while others became less prevalent (HBW, prematurity). Third, we corroborate that the protective effect of maternal education – and especially, but not solely, of university-level studies – for perinatal health, observed in earlier work and other contexts, was consistently evident in Spain during both harsh and more favorable labor market conditions. Finally, we have shown that selection into fertility of more educated mothers occurred as the provinces' labor market context worsened, which is an innovative finding within the Spanish childbearing literature; long showing a negative educational gradient of reproduction (Requena, 2022) or focusing on other types of selection (related to marital status, age, or employment situation). Further studies should examine whether educational selection into fertility is starting to become an increasingly common phenomenon not restricted to recessions or high unemployment periods. This might well be the case in contexts – such as the Spanish one – where economic uncertainty is widespread and long-lasting among cohorts of reproductive age, especially among those who have not completed university studies. Our research raises further considerations regarding equity in access to fertility in general and to the desired number of children in particular, as well as on the intergenerational reproduction of advantages.

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Supplementary Materials

Table 1. Descriptive statistics (2007-2019), initial sample (missing values excluded from the computations for each variable)

Dichotomous variables	**Percentage**
Low birthweight*	8.12
Very low birthweight*	0.93
High birthweight*	5.69
Premature births*	7.64
Stillbirths	0.31
Mothers with university-level education	35.43
Mothers with secondary-level education	51.28
Married mothers	60.14
Newborns of female sex	48.46
Multiple births	4.13
First births	53.58

Numerical variables	**Mean**	**Standard deviation**	**Range**
Birthweight*	3214.19	542.41	500-6590
Unemployment rate	17.70	8.10	3.02-41.26
Maternal age	31.88	5.50	12-61

**Live births*

Source: INE (Birth Statistics microdata, 2007-2019).

Regression models with unstandardized coefficients and control variables

Table 2. Regression of birthweight (OLS with province-level fixed-effects). Robust standard errors within brackets.

***p<0.001, ** p<0.01, *p<0.05

	Basic model	**Full model with maternal education**	**Full model with maternal education and interactions**
Unemployment rate	-0.234*	-0.267*	-1.017***
	(0.108)	(0.102)	(0.241)
University-level		9.841**	-2.397
maternal education		(3.651)	(7.374)
Secondary-level		-6.419	-24.398***
maternal education		(4.028)	(6.309)
University-level			0.661*
maternal education *			(0.303)
unemployment rate			
Secondary-level			0.990***
maternal education *			(0.231)
unemployment rate			
Newborn of female	-124.406***	-124.663***	-124.662***
sex	(0.716)	(0.692)	(0.692)
Multiple birth	-530.972***	-530.729***	-530.727***
	(3.061)	(2.901)	(2.902)
Premature birth	-831.206***	-829.280***	-829.284***

	(8.527)	(8.320)	(8.317)
First birth	-92.214***	-95.049***	-95.030***
	(2.385)	(2.506)	(2.494)
Age of mother	8.181***	5.371***	5.405***
	(0.859)	(0.799)	(0.797)
Square of age of mother	-0.160***	-0.125***	-0.125***
	(0.013)	(0.013)	(0.013)
Married mother	26.223***	23.866***	23.840***
	(1.353)	(1.308)	(1.313)
Constant	3306.898***	3362.541***	3375.795***
	(13.211)	(13.332)	(15.053)
Observations	4,689,491	4,339,002	4,339,002
Number of provinces	52	52	52
R-square (within)	0.288	0.289	0.289
Fraction of variance due to fixed-effects	0.006	0.006	0.006

Source: INE (Birth Statistics microdata, 2007-2019). Authors' estimations.

Table 3. Regression of LBW (linear probability models with province-level fixed-effects). Robust standard errors within brackets.

***p<0.001, ** p<0.01, *p<0.05

	Basic model	**Full model with maternal education**	**Full model with maternal education and interactions**
Unemployment rate	0.0001**	0.0001***	0.0003***
	(0.00003)	(0.00003)	(0.0001)
University-level maternal education		-0.016***	-0.013***
		(0.001)	(0.001)
Secondary-level maternal education		-0.005***	-0.002
		(0.001)	(0.002)
University-level maternal education * unemployment rate			-0.0002*
			(0.0001)
Secondary-level maternal education * unemployment rate			-0.0002**
			(0.0001)
Newborn of female sex	0.018***	0.018***	0.018***
	(0.0004)	(0.0004)	(0.0004)
Multiple birth	0.314***	0.314***	0.314***
	(0.003)	(0.004)	(0.004)
Premature birth	0.478***	0.477***	0.477***
	(0.005)	(0.005)	(0.005)
First birth	0.018***	0.021***	0.021***

	(0.001)	(0.001)	(0.001)
Age of mother	-0.003***	-0.001***	-0.001***
	(0.0003)	(0.0002)	(0.0002)
Square of age of mother	0.0001***	0.00003***	0.00004***
	(3.98e-06)	(3.63e-06)	(3.64e-06)
Married mother	-0.008***	-0.007***	-0.007***
	(0.0003)	(0.0002)	(0.0002)
Constant	0.057***	0.027***	0.024***
	(0.005)	(0.004)	(0.004)
Observations	4,689,491	4,339,002	4,339,002
Number of provinces	52	52	52
R-square (within)	0.347	0.349	0.388
Fraction of variance due to fixed-effects	0.001	0.001	0.001

Source: INE (Birth Statistics microdata, 2007-2019). Authors' estimations.

Table 4. Regression of VLBW (linear probability models with province-level fixed-effects). Robust standard errors within brackets.

***p<0.001, ** p<0.01, *p<0.05

	Basic model	**Full model with maternal education**	**Full model with maternal education and interactions**
Unemployment rate	0.00003***	0.00004***	0.0001***
	(0.00001)	(0.00001)	(0.00002)
University-level		-0.002***	-0.002***
maternal education		(0.0002)	(0.0004)
Secondary-level		-0.001***	-0.001
maternal education		(0.0001)	(0.0003)
University-level			-0.00003
maternal education *			(0.00002)
unemployment rate			
Secondary-level			-0.00004*
maternal education *			(0.00002)
unemployment rate			
Newborn of female	0.001***	0.001***	0.001***
sex	(0.0001)	(0.0001)	(0.0001)
Multiple birth	0.022***	0.021***	0.021***
	(0.001)	(0.001)	(0.001)
Premature birth	0.096***	0.095***	0.095***
	(0.002)	(0.002)	(0.002)
First birth	0.003***	0.003***	0.003***

	(0.0001)	(0.0001)	(0.0001)
Age of mother	-0.0003***	-0.00001	-0.00002
	(0.0001)	(0.0001)	(0.0001)
Square of age of mother	6.30e-06***	2.88e-06*	2.92e-06*
	(1.22e-06)	(1.29e-06)	(1.29e-06)
Married mother	-0.001***	-0.001***	-0.001***
	(0.0001)	(0.0001)	(0.0001)
Constant	-0.001	-0.003**	-0.004***
	(0.001)	(0.001)	(0.001)
Observations	4,689,491	4,339,002	4,339,002
Number of provinces	52	52	52
R-square (within)	0.085	0.084	0.084
Fraction of variance due to fixed-effects	0.0004	0.0004	0.0004

Source: INE (Birth Statistics microdata, 2007-2019). Authors' estimations.

Table 5. Regression of HBW (linear probability models with province-level fixed-effects). Robust standard errors within brackets.

***p<0.001, ** p<0.01, *p<0.05

	Basic model	**Full model with maternal education**	**Full model with maternal education and interactions**
Unemployment rate	-0.0001**	- 0.0001**	-0.0003**
	(0.00003)	(0.00003)	(0.0001)
University-level		-0.018***	-0.022***
maternal education		(0.001)	(0.002)
Secondary-level		-0.013***	-0.017***
maternal education		(0.001)	(0.002)
University-level			0.0002
maternal education *			(0.0001)
unemployment rate			
Secondary-level			0.0002**
maternal education *			(0.0001)
unemployment rate			
Newborn of female	-0.035***	-0.035***	-0.035***
sex	(0.001)	(0.001)	(0.001)
Multiple birth	-0.033***	-0.032***	-0.032***
	(0.001)	(0.001)	(0.001)
Premature birth	-0.046***	-0.047***	-0.047***
	(0.002)	(0.002)	(0.002)
First birth	-0.025***	-0.023***	-0.023***

	(0.001)	(0.001)	(0.001)
Age of mother	0.001***	0.002***	0.002***
	(0.0003)	(0.0003)	(0.0003)
Square of age of mother	-0.00002***	-0.00003***	-0.00003***
	(3.76e-06)	(4.07e-06)	(4.06e-06)
Married mother	0.004***	0.005***	0.005***
	(0.001)	(0.001)	(0.001)
Constant	0.082***	0.072***	0.075***
	(0.004)	(0.004)	(0.005)
Observations	4,689,491	4,339,002	4,339,002
Number of provinces	52	52	52
R-square (within)	0.014	0.014	0.014
Fraction of variance due to fixed-effects	0.003	0.003	0.003

Source: INE (Birth Statistics microdata, 2007-2019). Authors' estimations.

Table 6. Regression of prematurity (linear probability models with province-level fixed-effects). Robust standard errors within brackets.

***p<0.001, ** p<0.01, *p<0.05

	Basic model	**Full model with maternal education**	**Full model with maternal education and interactions**
Unemployment rate	-0.0005***	-0.0004***	-0.001***
	(0.0001)	(0.0001)	(0.0001)
University-level maternal education		-0.027***	-0.031***
		(0.001)	(0.002)
Secondary-level maternal education		-0.014***	-0.016***
		(0.001)	(0.002)
University-level maternal education * unemployment rate			0.0002*
			(0.0001)
Secondary-level maternal education * unemployment rate			0.0001
			(0.0001)
Newborn of female sex	-0.009***	-0.009***	-0.009***
	(0.0002)	(0.0002)	(0.0002)
Multiple birth	0.455***	0.455***	0.455***
	(0.007)	(0.007)	(0.007)
First birth	0.006***	0.009***	0.009***
	(0.001)	(0.001)	(0.001)
Age of mother	-0.010***	-0.007***	-0.007***

	(0.0004)	(0.0004)	(0.0004)
Square of age of	0.0002***	0.0001***	0.0001***
mother	(5.90e-06)	(5.84e-06)	(5.82e-06)
Married mother	-0.005***	-0.002***	-0.002***
	(0.001)	(0.001)	(0.001)
Constant	0.216***	0.182***	0.184***
	(0.007)	(0.007)	(0.007)
Observations	4,812,938	4,441,460	4,441,460
Number of provinces	52	52	52
R-square (within)	0.120	0.124	0.124
Fraction of variance	0.001	0.001	0.001
due to fixed-effects			

Source: INE (Birth Statistics microdata, 2007-2019). Authors' estimations.

Table 7. Regression of stillbirth (linear probability models with province-level fixed-effects). Robust standard errors within brackets.

***p<0.001, ** p<0.01, *p<0.05, (*) p<0.1

	Basic model	**Full model with maternal education**	**Full model with maternal education and interactions**
Unemployment rate	4.16e-06	0.00002*	0.00003
	(9.85e-06)	(8.88e-06)	(0.00002)
University-level maternal education		-0.002***	-0.001**
		(0.0002)	(0.0003)
Secondary-level maternal education		-0.001***	-0.001***
		(0.0001)	(0.0003)
University-level maternal education * unemployment rate			-0.00002
			(0.00002)
Secondary-level maternal education * unemployment rate			-3.91e-06
			(0.00001)
Newborn of female sex	0.0001	0.0001*	0.0001*
	(0.00006)	(0.00004)	(0.00004)
Multiple birth	-0.007***	-0.004***	-0.004***
	(0.0004)	(0.001)	(0.001)
Premature birth	0.025***	0.018***	0.018***
	(0.001)	(0.001)	(0.001)
First birth	0.001***	0.0004***	0.0004***

	(0.0001)	(0.0001)	(0.0001)
Age of mother	-0.00003	0.0002***	0.0002***
	(0.00006)	(0.00004)	(0.00004)
Square of age of mother	1.43e-06	-1.18e-06	-1.13e-06
	(9.56e-07)	(6.75e-07)	(6.82e-07)
Married mother	-0.001***	-0.001***	-0.001***
	(0.0004)	(0.0002)	(0.0002)
Constant	-0.001	-0.002**	-0.002***
	(0.001)	(0.001)	(0.001)
Observations	4,827,089	4,451,137	4,451,137
Number of provinces	52	52	52
R-square (within)	0.014	0.010	0.010
Fraction of variance due to fixed-effects	0.001	0.0004	0.0004

Source: INE (Birth Statistics microdata, 2007-2019). Authors' estimations.

NOTE 1: To correct for the heteroscedasticity that is inherent to linear probability models, we use robust standard errors (through the Stata vce(robust) command, which in fixed effects models estimated through the xtreg instruction also takes into account potential autocorrelation of errors).

NOTE 2: We decided not to measure maternal age in categories as these could have been largely correlated with maternal education.

Figure captions

Fig.1. Evolution of the national unemployment rate and of the educational level of women giving birth in Spain, 2007-2019. Source: INE (national unemployment rate, third trimester of each year, and Birth Statistics microdata).

Fig.2. Percentage of women aged 25-44 with higher education in Spain, 2007-2019 Source: Spanish Ministry of Education and Vocational Training/Ministry of Universities (EDUCAbase: Explotación de las variables educativas de la Encuesta de Población Activa/Nivel de Formación de la Población).

Fig.3. Mean predicted values of the percentage of births to women with university-level, secondary-level, and primary-level education for different unemployment rates within provinces, 2007-2019. Source: INE (province-level unemployment rates, third trimester of each year, and Birth Statistics microdata). Authors' estimations.

Fig.4. National-level evolution of birth outcomes in Spain by maternal education, 2007-2019. Source: INE (Birth Statistics microdata).

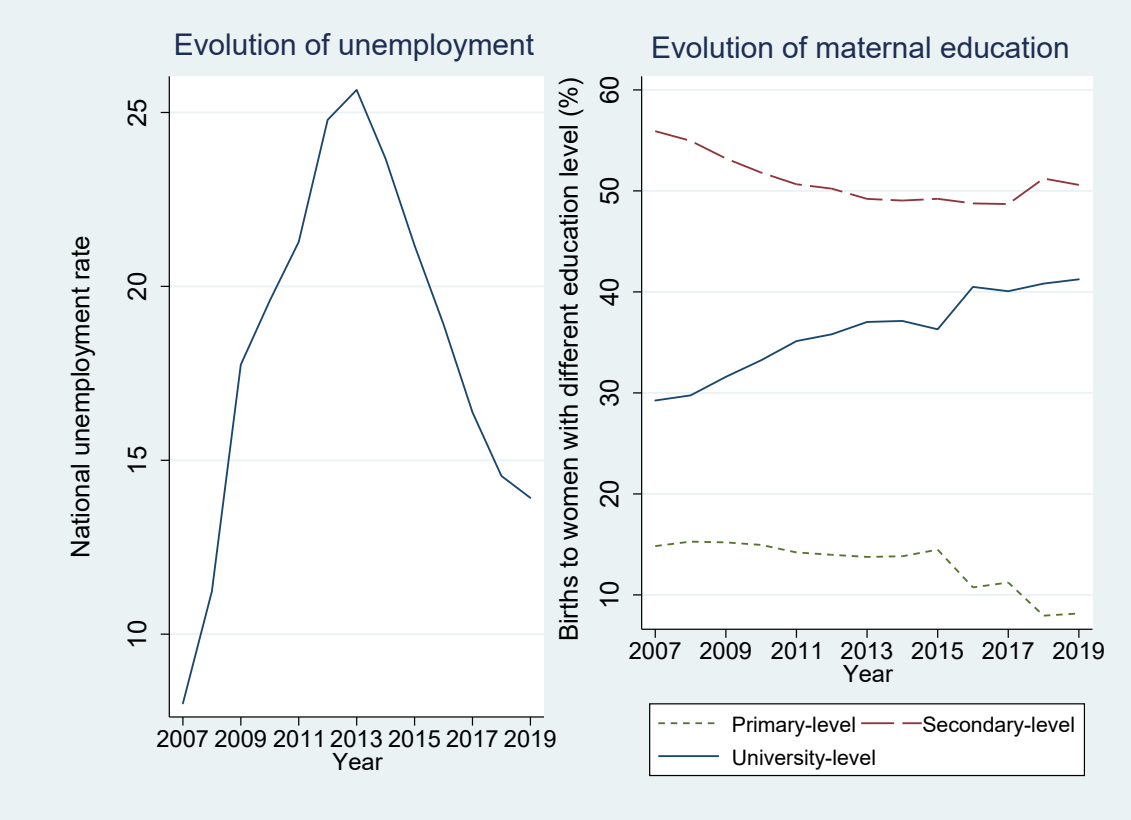
Fig.5. Estimated coefficients (standardized, mean=0, SD=1) of the regression (OLS/linear probability models) of birthweight and LBW on unemployment rates, maternal education, and the interaction between both. Models are adjusted for fetal and maternal characteristics. Confidence level: 95%. Source: INE (Statistical Birth Statistics microdata, 2007-2019). Authors' estimations.

Fig.6. Estimated coefficients (standardized, mean=0, SD=1) of the regression (linear probability models) of VLBW and HBW on unemployment rates, maternal education, and the interaction between both. Models are adjusted for fetal and maternal characteristics. Confidence level: 95%. Source: INE (Birth Statistics microdata, 2007-2019). Authors' estimations.

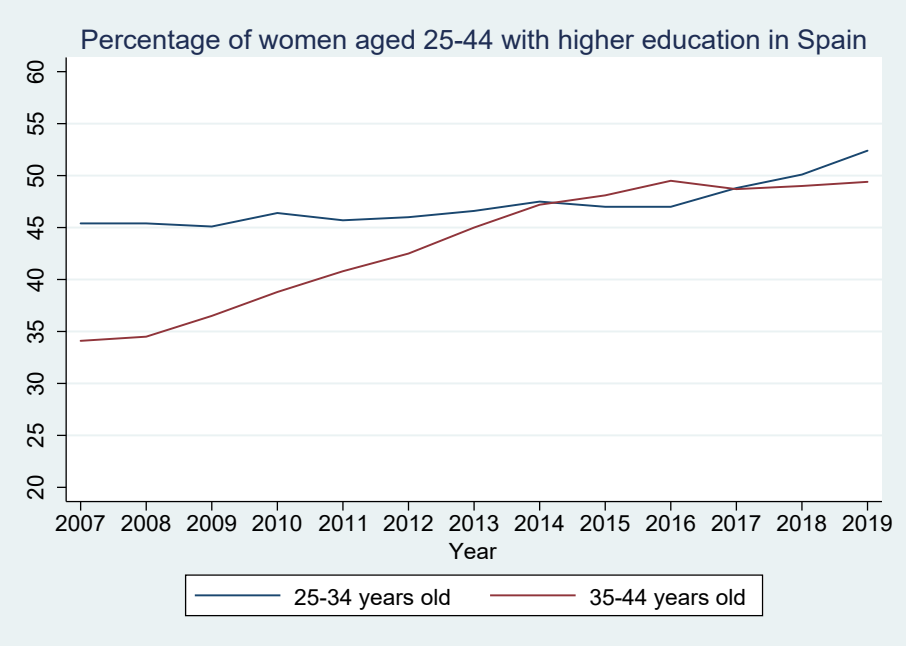
Fig.7. Estimated coefficients (standardized, mean=0, SD=1) of the regression (linear probability models) of PTB and stillbirths on unemployment rates, maternal education, and the interaction between both. Models are adjusted for fetal and maternal characteristics. Confidence level: 95%. Source: INE (Birth Statistics microdata, 2007-2019). Authors' estimations.

Figures

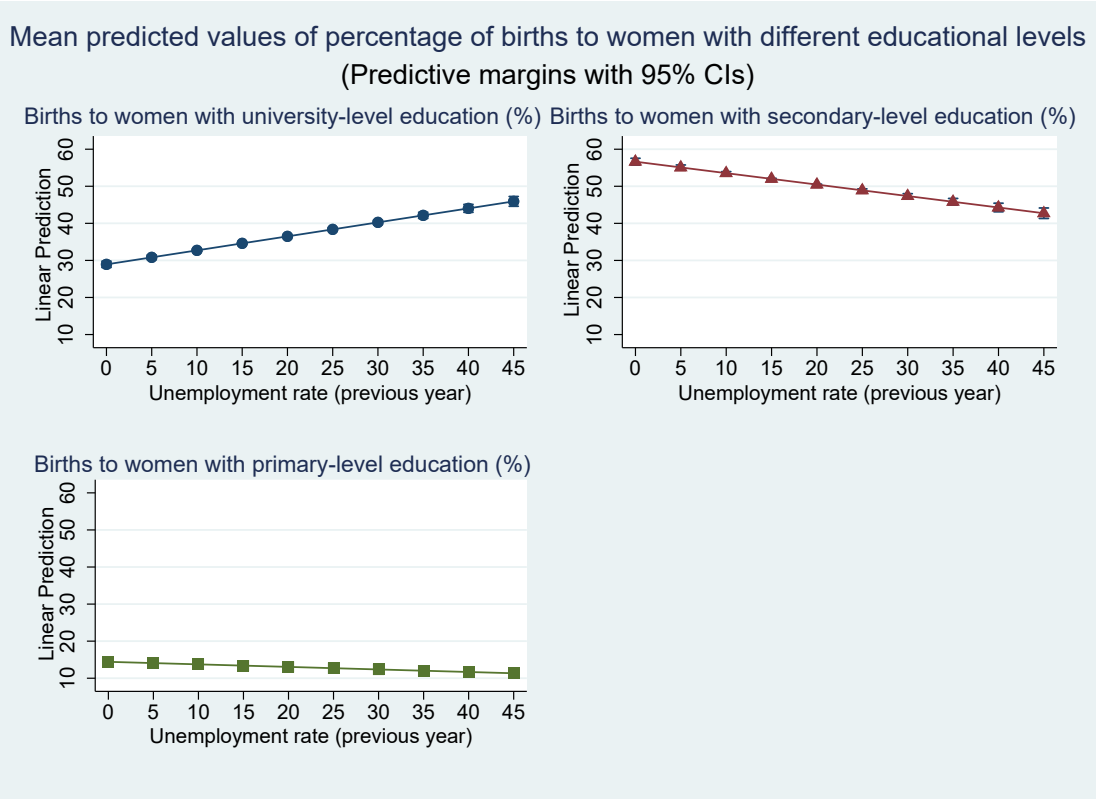
[Figure 1]



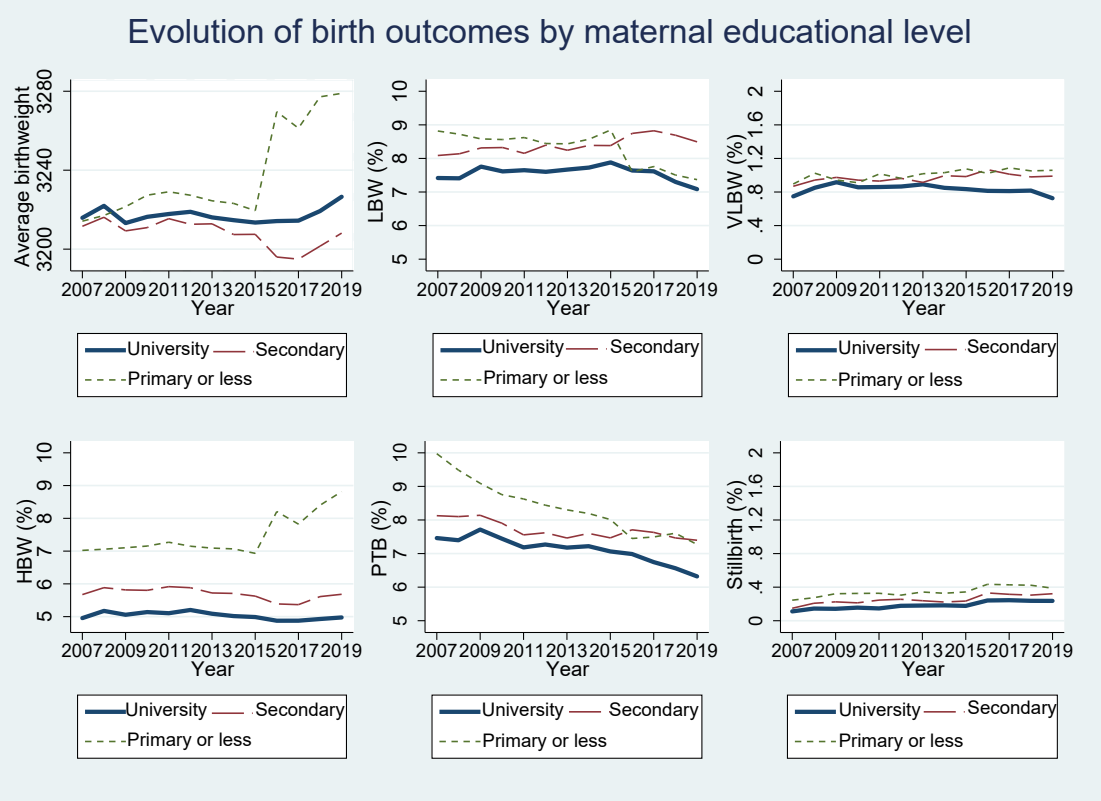
[Figure 2]



[Figure 3]



[Figure 4]



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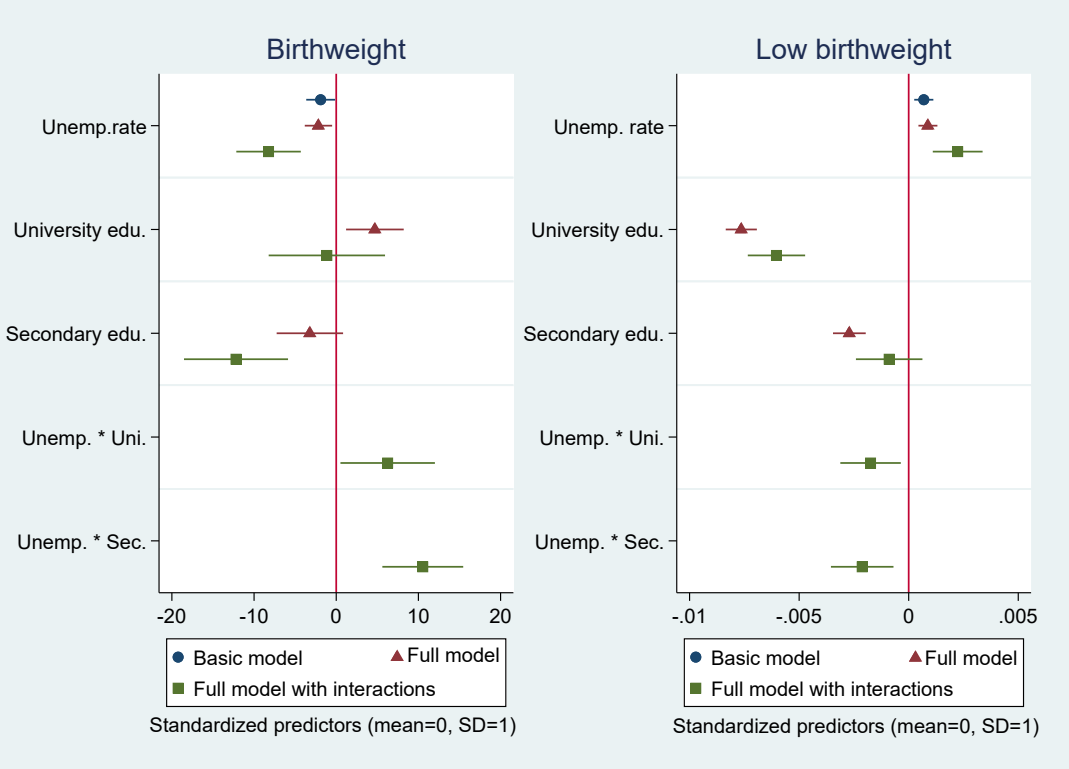
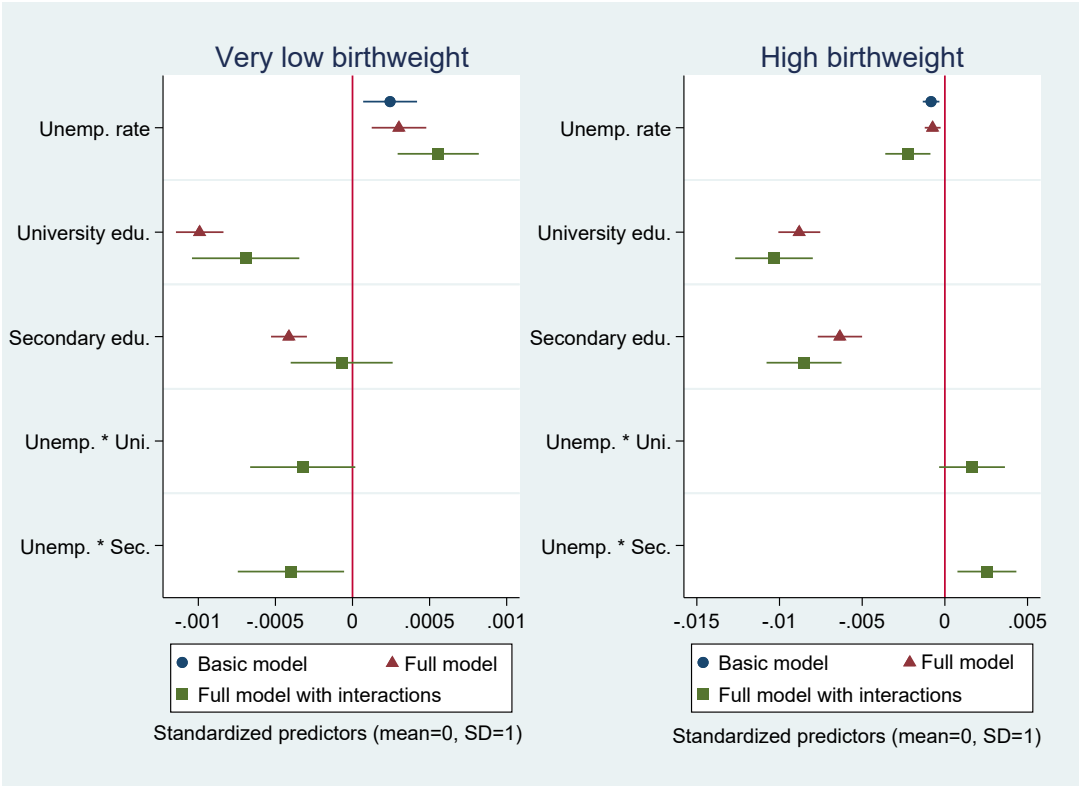


[Figure 6]



[Figure 7]