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The causal impact of maternal educational curricula on infant health at birth

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Abstract
We provide the first causal evidence of the returns to maternal educational curricula on offspring's health at birth. Educational programs that aim to deliver more general knowledge may potentially improve women's earning potential and maternal prenatal in-vestment by increasing the portability of skills across occupations and improving women's ability to make informed decisions about fertility options and health behavior. We study the impacts of a comprehensive educational reform that postponed students' curriculum choices and integrated more general education into the high school system on infant health outcomes. Using a dose-response difference-in-differences (DiD) model research design applied to linked population registries, we find that the reform led to a significant reduction in the incidence of very low birth weight (less than 1,500 grams) and very preterm birth (less than 33 gestation weeks). Overall, the reform's positive effects on infant health at birth seem to be driven by increased mothers' labor market opportunities and better family planning, rather than increased ability to avoid risky behaviours or increased women's earnings via different occupational choices or assortative mating.

Key words: health at birth, educational curricula, vocational education, academic education, comprehensive educational reform
JEL codes: I26; I28; J13; J16

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1 Introduction

Better health at birth leads to improved long-term outcomes, such as higher educational attainment, earnings, and lower risk of disability (Currie, 2011). While prior research has identified several factors that influence health at birth, including maternal years of education, behavior, access to resources, and mental and physical health, there is limited research on other important dimensions of maternal education, such as the content of educational curricula (Almond et al., 2018). This is due to the challenges in randomly assigning different educational curricula to mothers while controlling for their innate abilities and observing the health outcomes of their offspring (Aizer and Currie, 2014). In this paper we aim to close this gap by providing the first empirical evidence on the relationship between maternal educational curricula and children's health at birth by leveraging a policy reform in Spain that postponed students' curriculum choices and integrated more general education into the high school system.

According to standard human capital formation theories, there are two main theoretical predictions as to why increasing maternal general schooling could optimize the infant health production (Cunha and Heckman, 2007; Heckman, 2007). First, educational programs that aim to deliver more general knowledge increase skills' portability across occupations, leading to increased women's earnings potential, particularly in the context of shifting labor demand and technology-induced labor market changes (Goldin, 2001;Hanushek et al., 2017). Additionally, positive assortative mating may amplify the impact of a woman's education on household income through a multiplier effect as a woman's education is causally connected to her partner's education (Behrman and Rosenzweig, 2004). Women with higher purchasing power will tend to acquire more and better quality material health inputs such as better quality medical care, food and housing, which can lead to better children's health outcomes (Currie, 2009). Second, compared to vocational education which focuses on specific practical skills for particular careers, the general education's transferable and flexible nature may have a greater impact on improving children's health outcomes through better maternal information processing skills. The processing of information has been found to play an essential role in the transmission of the benefits of education (Thomas et al., 1991). These processing skills can increase an individual's ability to acquire knowledge related to healthy behaviors and effective family planning (Grossman, 1972). For instance, increased maternal ability to learn about healthy habits can lead to a reduction in smoking rates and an increase in the use of prenatal care (Currie and Moretti, 2003). Additionally, they can explain maternal ability to use contraceptive methods effectively, leading to a reduced likelihood of unplanned pregnancies and greater control over the timing of births (Rosenzweig and Schultz, 1989).

To study the impact of the returns to more general education on offspring's health at birth, we take advantage of the staggered introduction of a national comprehensive educational reform in 1990 across provinces in Spain. The reform exposed students between the ages of 14 and 16 to more general education. It delayed students' choice between tracks from the age of 14 to the age of 16 by introducing a new comprehensive high school system, where students of all abilities were required to complete an additional two-year general curriculum before gaining access to vocational or academic programs. In the pre-reform two-track system, students

were selected into either vocational and academic educational tracks at the age of 14. The new comprehensive system was implemented in a staggered manner across provinces over a 10-year period during which the old and new high school systems coexisted. To identify the effects of more general education on children's outcomes, we constructed an index of exposure to the policy using manually-collected data on the share of 14-year-old students under each high school system during the transition period and implemented a dose-response difference-in-differences (DiD) approach (Callaway et al., 2021). Thus, we compare the health at birth outcomes of children born to mothers with different levels of exposure to the policy for a sample of mothers who were enrolled in high school during the transition period.

Using cross-sectional data from a large-scale survey, we show that the comprehensive educational reform had the intended effect of delivering more general knowledge and learning skills, while maintaining the dynamics of completion of different educational programs and years of schooling constant. We first demonstrate that women received more general education as a result from the policy reform. In particular, we document an increase of 33% in the share of women enrolled in the new comprehensive system, and a decrease in enrollment of about 13% and 25% in the old academic and vocational tracks due to the policy shock. When we examine women who are old enough to have completed their education, we find that the policy reform had no effects on the share of women with a high school degree (regardless of the educational track) or having obtained a college degree. We also rule out that the reform has any impact on years of schooling, as measured by the age at highest educational attainment. These findings suggest that the potential consequences of the policy reform are driven by changes in the stock of knowledge as a result of curricula changes, rather than higher educational attainment or different credential acquisition.

Our differences-in-differences estimates show that children born to mothers exposed to more general curricula tended to have better health outcomes. Using detailed administrative data from birth certificates, we document a lower probability of very low birth weight (less than 1,500 grams) and very preterm birth (less than 33 gestation weeks) among children whose mothers were exposed to the reform. In particular, we find that the reform led to a decrease of 27.14% and 27.5% in the incidence of very low weight and preterm births respectively. Our data reject decreases larger than 10% and 11.48% in the likelihood of low birth weight (less than 2,500 grams) and late preterm (less than 37 weeks) respectively.To provide a sense of the magnitude of our estimates, research by Bitler and Currie (2005) shows that maternal participation in the supplemental nutrition program can lower the probability of very low and preterm birth by 53% and 54%, respectively. Hence, our findings imply that two additional years of general curricula are equivalent to about 50% of the impact of participating in nutritional programs.

To check the validity of our findings, we conduct a series of identification checks addressing the potential endogeneity of the comprehensive policy reform with respect to maternal and children outcomes. Given our policy and setting design, endogeneity in our study can arise from two sources. The first potential source of endogeneity is the non-random adoption of the new comprehensive system across provinces, which may lead to sample selection bias. For instance, provinces with higher resources or provinces with high schools that could anticipate the benefits of the policy may have adopted the new system earlier. To address whether the

exposure to the reform was exogenously determined, we show that the implementation of the reform across provinces, even if not random, was not related to provincial macroeconomic outcomes nor to prior provincial enrollment and educational attainment patterns. These findings suggest that there was no selection on gains by provinces, as they did not sort into expected gains with respect to the implementation of the reform.

The second source of endogeneity is the potential confounding effects of mixing peers, as the policy reform shifted students out of vocational into a joint comprehensive track. The influx of low-achieving peers into the new comprehensive system could have negatively affected the behavior of high-achieving peers and the learning environment, potentially underestimating the true impact of more general education (Duflo et al., 2011; see Sacerdote, 2011 for a review on peer effects). To test whether our estimates of the effects of more general education on children's health at birth represent a lower bound due to the penalties of mixing up peer groups, we conduct two exercises. First, we use the mother's place of residence as a proxy for exposure to peer composition changes and explore how the effects of the reform vary across children born to mothers from rural and urban areas. Students from urban areas may be more susceptible to the peer group changes in the school setting than students from sparsely populated rural areas, as the latter tend to have broader social networks outside of school and stronger pre-existing social ties that are not as reliant on the school environment. This exercise shows no differential effects across the two groups of children, suggesting a limited role of peer composition changes on health outcomes. Second, we use mother's occupation as proxy for their educational achievement and explore whether the reform differently affected children born to higher-achieving and lower-achieving mothers. While mixing with low-achieving peers may provide fewer benefits for higher-achieving mothers, it may offer more advantages for their lower-achieving counterparts. Reassuringly, we found no significant difference in the impact of the reform on children born to higher- and lower-achieving mothers, suggesting also limited evidence on peer group mixing effects on infant health at birth due the policy change [1].

We next empirically test how more general education among mothers maps into the documented infant health changes through increased women's earning potential and improved information processing skills as theoretically predicted by prior literature. To explore these mechanisms, we use data from birth certificates, including information on mothers' labor, marriage market outcomes, and fertility choices, along with hospital discharge records documenting instances of female hospitalizations due to health risks related to behavior. When examining the impact of the policy change on women's earning potential, we find a 3.22% increase in maternal labor force participation. Our analysis does not reveal any significant effects on maternal occupation or the quality of their partners, as measured by the qualification of their mates. Addressing the effects of more general curricula on health behaviour, mothers who are exposed to a more general curriculum due to the policy change are 3.04% more likely to be married at the time of their first birth, which may suggest greater control

[1] It is not surprising we fail to find any peer composition change effects in our setting. Plausibly, this is due to Spain's high enrollment rate of 95% in high school, and the fact that vocational training was provided at both ordinary high schools and vocational schools before and after the comprehensive policy reform, which limited the potential for disruption of existing peer groups (Servicio de Estudios Estadísticos, 1994.)

over the timing of their pregnancies through effective use of contraceptives. We also do not find any impact of the reform on the number of hospitalizations due to diseases related to risky health behaviors. In addition, we document that mothers exposed to the new educational curricula do not differ in terms of fertility patterns or motherhood entry age from those who studied under the previous system, which is particularly relevant for ruling out sample selection bias, given that we only sampled women who had become mothers. Overall, these findings suggest that the observed positive effects on the incidence of very low birth weight and very preterm birth among mothers exposed to a more general curricula resulting from the policy reform are driven by increased maternal labor market opportunities and improved family planning, rather than increased ability to avoid risky behaviors or increased women's earnings through different occupational choices or positive assortative mating.

Our paper contributes to the broad literature that aims to understand the origins and intergenerational transmission of inequality as reviewed by Currie et al. (2010), Aizer and Currie (2014), Björklund and Salvanes (2011), Almond and Currie, 2011 and Almond et al. (2018). Much of this literature has looked at a wide range of health at birth's determinants, such as prenatal substance abuse, maternal air pollution exposure during pregnancy, nutrition, poverty, cash and near-cash transfers, health, stress, participation in social programs, and education. This includes papers by Currie and Moretti (2003), Currie and Neidell (2005), Noonan et al. (2007), Fertig and Watson (2009), Lindeboom et al. (2009), Ludwig and Currie (2010),Currie et al. (2010), Aizer (2011), Hoynes et al. (2011), Almond and Mazumder (2011), Lindo (2011), McCrary and Royer (2011) and Carneiro et al. (2013), among others.

Previous studies on the effects of maternal education on infant health at birth have reached opposite conclusions. Currie and Moretti (2003) use college openings in the US as an instrument and find positive effects on birth weight and gestational age. Similarly, Grytten et al. (2014) exploit the 1960 Norwegian compulsory schooling reform and find a positive relationship between years of education and health at birth. In contrast, McCrary and Royer (2011) exploit school entry age policies in the US and find almost insignificant effects on fertility and infant health. Two studies in the UK, Lindeboom et al. (2009) and Carneiro et al. (2013), report limited effects of maternal education on infant health at birth using the 1947 compulsory schooling reform and variation in schooling cost during a mother's adolescence, respectively. Using data from the 1970 British Cohort Study, Conti et al. (2010) shed light on these findings by showing that women who are more likely to attend college possess certain traits that enable them to obtain higher returns from additional education, in terms of earnings and health behavior, compared to those who are at risk of dropping out in high school and are forced to stay in school. However, while these studies have focused on the effects of maternal education as measured by years of schooling, other aspects of maternal education, such as the specifics of the educational curriculum, have received limited attention. This is due to the challenges in separating additional years of education effects from changes in educational curricula, as they are often driven simultaneously by common policy instruments used in prior literature. Our high-quality population level data containing detailed information on children's health endowment and maternal characteristics as well as our unique policy shock allow us to disentangle the effects of educational curricula from additional schooling. Our results complement the findings of Conti et al. (2010) by providing

causal evidence that infant health a birth is also affected by maternal educational curricula, thereby offering an alternative approach to reconcile the ongoing debate on the effects of maternal education on infant health.

Our unique policy shock and quality of the data also allow us to provide empirical evidence on the theoretical predictions through which more general education among mothers could improve birth outcomes as suggested by prior studies. In doing so, we contribute to the literature that has leveraged comprehensive policy reforms to learn about the effects of modifying quality aspects of education on adult labor market outcomes (e.g. Oosterbeek and Webbink, 2007; Hall, 2012; Bertrand et al., 2020; Bellés-Obrero and Duchini, 2021), adult health outcomes (e.g.Palme and Simeonova, 2015; Basu et al., 2018; Fischer et al., 2021), and marriage market outcomes (e.g. Anderberg et al., 2019). A common identification challenge in earlier studies examining policy reforms like ours is to disentangle the effects of changes in curricula from other changes in quality aspects of education, such as peer composition changes. Comprehensive education reforms that integrate more general education into the high school curricula by shifting students out of vocational into comprehensive tracks also involve more mixed peer groups, which have been often found to affect negatively educational achievement and other social outcomes such as smoking, drinking and criminal behaviour (Sacerdote (2011); Galama et al., 2018). In contrast, our analysis shows that the reform led to a positive pattern of effects on female labor market, marriage market and health outcomes, suggesting little evidence for strong negative effects of more mixed peer groups as found in the literature. These findings are consistent with our analysis on peer composition change effects and with the characteristics of Spain's high school system that was less conducive to mixing groups than more selective high school systems in other countries, such as Germany or the UK.

This paper is organized as follows. The first section contains the institutional framework of the high school systems over the 1970-2002 period. The second section provides a description of the sample, data and variables used as well as a description of the reform exposure index data which constitutes our identification strategy. The third section discusses the methodology used to test the effect of more general education on health at birth. The fourth section presents our findings on the impacts of general education on maternal education and infant health outcomes, along with the results of several identification checks to validate our identification strategy. We also discuss the underlying mechanisms through which increased general education can lead to better infant health at birth. Last, the fifth section draws some conclusions.

2 Institutional Background: LOGSE Reform

This paper exploits a major comprehensive educational reform in Spain, the so-called LOGSE [2], implemented during the 1990s, as an exogenous variation in educational curricula to test the effects of more general education on infant health at birth.

[2]The Organic Law 1/1990 (*Ley Orgánica de Ordenación General del Sistema Educativo*).

2.1 Pre-Reform System

Prior to the introduction of the LOGSE, the Spanish education system was governed by the 1970 LGE [3]. Under this framework, compulsory education (ISCED 1 and 2[4]) was based on a single curriculum framework known as EGB (*Educación General Básica*), which covered students aged 6 to 13. Upon completion of EGB, students were awarded a general admission certificate for higher education and were presented with the choice to pursue either an academic track or a vocational track. The academic track, referred to as *Bachillerato Unificado Polivalente* (BUP; ISCED 3) was a 3-year program that emphasized subjects such as mathematics, language, foreign language, natural and social sciences, physical education, and religious education. In contrast, the vocational track, referred to *Formación Profesional I* (FP I; ISCED 3) was a 2-year curriculum that focused primarily on practical training with limited exposure to general education. Both students who graduated from the vocational track or the academic track were eligible to access upper vocational studies, named *Formación Profesional II* (FP II; ISCED 3). However, only students who graduated from the academic track were able to enroll in the pre-college course, known as the *Curso de Orientación Universitaria* (COU), which was a mandatory requirement for college entry. A visual representation of the main pathways of the Spanish education system prior to the LOGSE is provided in Figure A1 in the appendix for further clarification.

2.2 Challenges To The System

In 1990, Spain reformed its high school system. The motivation for this reform included two main concerns. The first concern was the two-year gap between the age of completing compulsory education (14 years old) and the legal working age (16 years old) following the passage of the 1980 labor reform [5]. The second concern was related to the overly theoretical and outdated nature of the high school academic program, which was viewed as being disconnected from the needs of both the labor market and higher education.

2.3 Post-Reform System

To address these concerns, the Spanish government reformed its education system. The new LOGSE postponed students' curriculum choices between academic and vocational education and introduced a new comprehensive system with a greater focus on academic subjects from age 14 to 16, as well as increased compulsory schooling until age 16. First, the new system integrated more general knowledge into high school education and delayed further specialization to later years. The pre-reform two-track (academic vs. vocational) system was replaced by a new comprehensive system, which focused on general academic subjects such as maths, languages, social sciences and academic field specific subjects. Figure A1 of the appendix shows the educational curricula before and after the reform. This resulted in students aged 14 to 16 receiving additional general education, with those who would

[3]The Law 14/1970 (*Ley General de Educación).*

[4]International Standard Classification of Education (ISCED) adopted by the UNESCO General Conference in its 36th session in November 2011.

[5]The Law 8/1980 of Workers' Statute.

have previously chosen the vocational track gaining two extra years of general education and those on the academic track receiving a more general-focused curriculum with a wider range of academic subjects [6]. Upon completion of the new comprehensive system, students could either move forward to upper secondary education (*Bachillerato*, ISCED 3), i.e. the academic track, or lower vocational studies (*Formación Profesional de Grado Medio; Grado medio*; ISCED 3), i.e. the vocational track. Figure A2 of the appendix shows main pathways of the Spanish education system after LOGSE. As in the pre-reform system, under the post-reform system lower and upper vocational training was provided at both vocational schools and ordinary high schools in aims to promote greater inclusion and accessibility to vocational education after completing the comprehensive stage. Second, the new LOGSE forced students to remain schooled until age 16 starting from the school year 1991-1992, either under the old LGE system or the new LOGSE system (Felgueroso et al., 2014; Bellés-Obrero and Duchini, 2021) [7].

2.4 LOGSE Reform Implementation Process

The new comprehensive system had to be fully implemented by school year 1998-1999 as shown in Figure A3 of the appendix. During this transition period both old and new education systems coexisted. The time series evidence presented in Figure 1 shows the enrollment shift between the pre- and post-reform systems during the 1990s looking at the enrollment share of both systems for 14 years old students. Whereas the 1975 was the last cohort fully under the pre-reform high school system, the 1984 cohort was the first fully under the post-reform high school system. The Spanish central government allowed education centres ten school years to fully implement the new comprehensive system and provinces differed in the pace at which they introduced the LOGSE at different educational levels. As we will see in section 5.3, the staggered implementation of the reform across provinces and over time is as good as random.

3 Data

Our research employs four primary data sources, linked by the year of birth and province of residence of women whose offspring's health at birth is studied.

[6] In Figure A1, it is shown that under the pre-reform system, students who had chosen the academic track were no longer required to take religious education or a subject specific to a particular occupation. Instead, the subject of natural sciences was replaced by two separate subjects, biology and geology, and physics and chemistry. Additionally, four additional subjects specific to academic fields were made available, including technology, music and arts, a second foreign language, and classical culture.

[7] By scholar year 1991-1992, the school enrollment rate of students between the ages of 14 and 16 was 95.05% (Servicio de Estudios Estadísticos, 1994)

3.1 Childbirth Register Data

Information on health at birth comes from the 2000-2018 childbirth microdata published by the Birth Statistics from the Vital Statistics (VS) of the Spanish Statistical Office. Birth Statistics collect data from the Birth Bulletins which are filled out at the time of registering the demographic fact in the Civil Register. Childbirth register data shows characteristics, such as multiplicity of birth, birth order, gestational age, birth weight or parents' demographic and labor features, as well as province of registration. In our analysis, we focus on the health at birth outcomes of children born to mothers belonging to the window cohorts of 1975-1985. We restrict attention to first childbirths among mothers aged 25 to 33. This age range was selected because it is expected that most mothers would have completed their education by age 25, and 33 is the oldest age for the youngest cohort (born in 1985) in our data. Additionally, we exclude immigrants from our sample because mothers born abroad may not have studied under the Spanish education system and therefore may not be representative of the population we are studying. By focusing on mothers who have completed their education prior to having children, we are able to examine the full returns of education on infant health at birth. This approach yields an analysis of 1,521,770 first births between 2000 and 2018 to mothers born from 1975 to 1985 between the age of 25 and 33.

Health at birth is proxied by birth weight, low birth weight (less than 2,500 grams), very low birth weight (less than 1,500 grams), weeks of gestation, preterm birth (less than 38 weeks) and very preterm birth (less than 33 weeks)[8]. We also examine child mortality outcomes, such as the incidence of fetal death and the rate of survival 24 hours after birth. Summary statistics for these health at birth outcomes can be found in Table A2 of the appendix. In our full sample, newborns with weight under 2,500 grams and gestational age less than 38 weeks, classified as low birth weight and preterm, respectively, comprise around 7% and 13%. Very low birth weight (less than 1,500 grams) and very preterm (less than 33 weeks) are around 1%, and mortality at birth rates are just over 0.1%. This is to be expected, given the high degree of medical contact with pregnant women in Spain, as the public healthcare system guarantees universal coverage for all residents and fully covers prenatal care, delivery, and post-care.

To further investigate the mechanisms through which the comprehensive educational reform may affect infant health at birth outcomes, we use maternal background variables. Specifically, we study mothers' occupations, market participation, and partnership choices and motherhood entry age. Summary statistics for these labor and marriage outcomes can be found in Table A3 of the appendix. In our full sample, about 65% of mothers are married, 86% are engaged with paid work outside the home, and just over 45% are occupied in a qualified occupation.

[8]These outcomes have been used by a previous body of research to document the strong relationship between maternal educational attainment and infant health (Currie and Moretti, 2003;Chou et al. 2010; McCrary and Royer 2011, among others). Additionally, these proxies have been used to measure the impact of health at birth on future children outcomes (Behrman and Rosenzweig, 2004; Almond et al., 2004; Oreopoulos et al., 2006, among others).

3.2 Spanish Labor Force Survey

Information on education outcomes comes from the second quarter of the 1991-2018 Spanish Labour Force Survey (LFS). The Spanish LFS is a continuous quarterly survey taken from approximately 65,000 households and 160,000 individuals. LFS collects data on the labor force as well as on the population outside the labor market for all individuals over the age of 16 and gathers information on employment, education and socio-demographic characteristics, such as educational attainment, age at highest qualification, occupation, nationality and province of residence. As we want to observe not solely someone's highest educational attainment but also the educational pathway they have undertaken, we sample female respondents with Spanish nationality aged 17-33. 1991-2018 data from the Spanish LFS provides us a sample of 201,701 women born between 1975 and 1985.

To more accurately observe the enrollment patterns of our sample, we examine whether individuals have obtained a particular certificate by age 25, prior to the completion of their education. Panel A of Table A4 in the appendix presents the summary statistics of the enrollment patterns for our sample. Of the female respondents, 45% followed the academic track, 16% completed the vocational track, and 33% did not attain a qualification higher than compulsory high school education by the age of 25. In Panel B of Table A4, we focus on four categories in order to observe the female degree completion patterns by age 33, once individuals have had the opportunity to fully complete their education. On average, individuals obtained their highest qualification at 20.2 years old, with 34% finishing high school without continuing their studies, 25% obtaining a vocational degree, and 36% obtaining a college degree.

3.3 Health Data

To evaluate the impact of reform on adult health, we use data on hospitalizations from the Spanish MSBD. The MSBD is a clinical-administrative database provided by the Ministry of Health. It gathers data directly from public hospitals and contains administrative and detailed medical records on hospitalizations at discharge. We use data from 2004 to 2015[9] and consider several diseases that are related to health behaviours such as diabetes (obesity), cirrhosis (alcohol abuse), lung cancer (smoking) as well as hypertension, which is related to mental health, smoking and alcohol abuse [10] Our sample includes female patients between the age of 25 to 31 born between 1975 and 1985. We use information on the patient's province of residence and birth year to calculate our main adult health outcomes. We identify the number of female hospitalizations due to diabetes, cirrhosis, lung cancer and hypertension for each cohort and province. Table A5 of the appendix shows the summary statics of female hospitalizations for our sample.

[9] We work only with data from 2004 to 2015 due to data availability limitations and data register changes.

[10] *See Galama et al., 2018; Basu et al., 2018 and Fischer et al., 2021.*

3.4 LOGSE Exposure Index

Our fourth data source is schooling data from the Statistical Office of the Education Ministry. We have personally digitized the province-year data on the number of 14 year-old students enrolled in each academic level during the LOGSE implementation period. We gather data from 1989-1992 to 1999-2000 scholar years, since we also include the first grade of the LOGSE pilot study, the so-called *Bachillerato Experimental*, that took place since 1989 [11]. We create an aggregate index, indicative of the level of exposure to the LOGSE at age 14, that varies across province of residence and year of birth. The 1975 cohort was the first to be exposed to the LOGSE's pilot (1989-1990 school year) and the 1985 cohort was the last to be exposed to the previous educational system (1999-2000 school year). The index is calculated as follows:

$$I^{L}_{t,k} = \frac{\text{LOGSE}}{\text{LOGSE} \ + \ \text{LGE}}$$

Where $\mathrm{I}^{\mathrm{L}}_{t,k}$ is a continuous treatment function that informs about the implementation of **L**, this is the proportion of students under the LOGSE for cohort t in province k. The numerator represents the absolute number of students at age 14 enrolled in the new comprehensive system and, the denominator represents these students along with the total number of students enrolled at age 14 starting the old vocational or academic tracks. Note that the reform induces a change in the educational curricula at the age of 14 so, in order to observe the exact proportion of students expose to the exogenous increase of general education, we exclude repeaters. Hence, the LOGSE exposure index represents the implementation intensity of the reform across provinces and scholar years during the transition period between the old and new high school systems.

To provide a sense of the implementation of the reform, as shown in Figure 2, the LOGSE exposure index over the transition period fluctuated between 0 (i.e. none was under LOGSE) and 1 (i.e. everyone was under the LOGSE in that given province and scholar year). Lighter colors correspond to lower levels of the LOGSE implementation (capture by $\mathrm{I}^{\mathrm{L}}_{t,k}$) for cohort t in province k. The LOGSE was gradually expanded at varying rates across provinces during the transition period. At the beginning of the period (1992-1993 school year), less than 10% of the student population at age 14 was under the new system in almost all provinces, but by the end of the transition period (1997-1998 school year) approximately more than 60% of students were under the new system at 14 years of age.

[11] *Bachillerato Experimental* was the pilot of the LOGSE for the high school system by the 1983 Experimental Reform of Secondary Education that took place between 1989-1990 and 1997-1998 scholar years in only a few high schools, mostly from Basque Country and Navarra regions. *Bachillerato Experimental* was divided in two stages: first cycle of lower secondary education (from the age 14 to 16) including first and second grade, which were compulsory and implied a delay of two years in the access to vocational studies and; upper secondary education (from the age 16 to 18) including third and fourth grades, students could only access to the third grade if they passed the first cycle.

4 Empirical model

In order to identify the effects of more general education on a child's outcomes our research design leverages the staggered implementation of a comprehensive educational reform which triggered an exogenous change in the educational curricula, and compares the health outcomes of children to mothers with different exposure to the policy for a sample of mothers who were enrolled in high school during the 10 year period when the old and new high school systems coexisted. We estimate the following dose-response DiD model separately for each outcome variable:

$$\mathrm{Y}_{itk} = \alpha + \beta \mathrm{I}_{\mathrm{tk}} + y_{\mathrm{t}} + \theta_{\mathrm{i}} + \epsilon_{itk} \tag{1}$$

where Y_{itk} is a child's outcome of interest for mother i of cohort t in province k. Y_{itk} represents a dependent variable of interest: weight at birth, number of gestational weeks, and indicators for low birth weight (under 2,500 grams), very low birth weight (under 1,500 grams), premature birth (32 to 37 weeks), very premature birth (28 to 32 weeks) and child mortality at birth.

I_{tk} is our key regressor that captures the intensity of LOGSE exposure for mothers born in year t in province k. Our coefficient of interest is β, which shows the relationship between our LOGSE exposure index and health at birth outcomes. A positive coefficient will suggest that an increase in general education of mothers is associated with improved health outcomes at birth.

Cohort year fixed effects y_{t} are included to monitor the socio-economic situation of each cohort and province fixed effects θ_{i} to account for any province-level factors that are correlated with the educational systems. Standard errors are clustered at the province level. ϵ_{itk} indicates the model error term [12].

5 Results and Discussion

In this study, we present our findings in four sections. In the first section, we evaluate the effect of the LOGSE reform on educational attainment, enrollment patterns, and degree completion. Our analysis reveals that while the reform did not significantly impact degree completion rates or years of schooling, it did serve to increase the provision of general knowledge by shifting students from the academic and vocational high school programs to the new comprehensive high school system. In the second section, after addressing sample selection concerns driven by fertility choices, we examine the impact of the reform on infant health at birth. Our findings indicate that the reform had positive effects on the incidence of very low birth weight (less than 1,500 grams) and very preterm birth (less than 33 weeks). In the third section, we conduct a series of identification and robustness checks. Last, after addressing the validity of our findings, in the fourth section we empirically test the two theoretical

[12] We adjust the standard error for multiple hypothesis testing.

predictions suggested by prior literature that could explain how more general education induced by the reform maps into the reported infant health at birth changes. Our analysis on the mechanisms shows that the reform led to an increase in labor force participation among mothers and a rise in the likelihood of being married at the time of the first b irth. We do not identify any changes in maternal type of occupation, mate's quality or hospitalization due to diseases related to risky health behaviors.

5.1 Effects o n Education

Effects o n Enrollment

In Table 1 we study how the reform impacted female school enrollment by looking at educational choices of women aged 17 to 24, i.e. while they are potentially still enrolled in the educational system and before education is completed [13]. We find that the LOGSE exposure leads to an increase of 10.38 percentage points in the share of female students enrolled in the comprehensive track, which implies a rise of 33.16% (column 2). In contrast, the reform reduces the share of women enrolled in the academic or vocational track by 13.90% and 25.51% respectively (columns 3 and 4). We find n o e vidence o f a s ignificant im pact of the reform on the share of women without any high school credentials (column 1). Overall, the data presented in Table 1 suggests that the reform led to a shift of women from the academic and vocational high school programs to the comprehensive high school system.

Effects o n D egree Completion

Table 2 reports on the impact of the reform on female educational attainment by looking at age at highest qualification and whether someone has completed a particular degree by age 33 [14]. Column 1 of Table 2 shows that the reform did not modify the age at which the highest qualification w as o btained a nd, t hus d id n ot s ucceed i n i ncreasing t he y ears o f schooling. Columns 2 to 5 of Table 2 show that the LOGSE did not led to a greater percentage of women finishing their schooling with a particular d egree. Hence, the LOGSE did not succeed in increasing the share of women with high school or vocational credentials, nor did it affect the share of women with college degrees. In sum, our degree completion estimates suggest

[13]The Spanish LFS does not provide information on current enrollment. We infer educational enrollment choices by looking at highest educational attainment before education is completed. See panel A of Table A4 for the exact definition o f e ducational e nrollment choices.

[14]We infer the highest educational attainment looking at women aged 25 to 33, i.e. when education is completed. See Panel B of Table A4 of the appendix for the exact definition of degree completion outcomes.

that the reform did not increase educational attainment nor years of schooling [15].

All in all, results from Tables 1 and 2 suggest that the reform did not affect women's educational attainment, but rather induced a change in the educational curricula towards a more general education.

5.2 Effects on Health At Birth

Table 3 reports the reduced-form effects of the reform on our main health at birth outcomes: birth weight, gestational age, and infant mortality at birth. In order to capture the effects of completed education, we consider mothers aged 25 to 33 [16].

Panel A of Table 3 focuses on the effects of the reform on birth weight and the incidence of low birth weight (less than 2,500 grams) and very low birth weight (less than 1,500 grams). Column 1 of Panel A shows no effects of the reform on birth weight. The confidence intervals allows us to reject a positive impact of LOGSE on birth weight larger than 0.74% [17]. Column 2 of Panel A shows negative though not significant effects on low birth weight and we can reject reductions in the incidence of low birth weight larger than 10%. However, when analyzing the incidence of very low birth weight (column 3, Panel A), we estimate a reduction of 0.19 percentage points. Given the overall incidence of births under 1,500 grams this implies a decrease of 27.14% . This result survives a multiple hypothesis testing correction (Romano-Wolf P-value=0.068). Therefore, estimates from Panel A suggest that the reform had little to positive effects on weight at birth.

Next, we evaluate the impact of the reform on gestational length, defined as the number of gestational weeks, as well as the incidence of late preterm (less than 36 weeks) and very

[15]The lack on impact of the LOGSE on years of schooling among women also suggests a limited causal role of the reform on fertility patterns, which alleviates the concern about sample selection bias since we only sample women who has became mothers. Prior literature on the effects of education on infant health at birth has addressed the effect of years of schooling on fertility patterns in order to rule out the sample selection bias that may arise if fertility patterns are affected by the educational policy reforms (Currie and Moretti (2003); McCrary and Royer (2011)). Additional years of schooling may reduce teen pregnancies through the "incarceration" effect, defined as the fertility delay equal to the schooling additional amount of time, by reducing available time to engage in risky behaviour, which may have positive effects on health at birth (see Black et al. (2004); Cygan-Rehm and Maeder (2013); Geruso and Royer (2018)). Moreover, as Becker (1965)'s quality/quantity trade-off suggests, more years of education may induce women to have fewer children of higher quality. As little is known about the effects curricula changes on fertility, using the Spanish administrative registry of births we create a panel of annual birth rates by mother age at province level to test the impact of the LOGSE on fertility patterns. Column 1 of Table A8 of the appendix shows no effects of the LOGSE on birth rates. Column 2 of Table A8 of the appendix shows no effects of the reform on motherhood entry age. Thus, we can defend that the reform has not led to a selected sample of observed mothers and women more and less exposed to the reform form an equivalent sample.

[16]See McCrary and Royer (2011) on the different implications of completed education versus education at motherhood.

[17]The upper bound of the coefficient interval was calculated as the sum of the point estimate of the coefficient (10.9079) and 1.96 times the standard error (7.011). This result was then divided by the average value of the population (3199.580). The calculation can be summarized as: 10.9079 + 1.96 * 7.011/3199.580.

preterm birth (less than 33 weeks). Column 1 of Panel B shows no significant impacts of the reform on the number of gestational weeks. We can reject a positive increase in the number of weeks larger than 0.21%. Column 2 of Panel B shows that there are no significant effects of the reform on the incidence of late preterm and and we can reject a reduction in the incidence larger than 11.48% In contrast, column 3 of Panel B displays a significant decrease of 0.33 percentage points in the incidence of very preterm birth. Given the overall incidence of very preterm births, this implies a decrease of 27.5% . This result also survives a multiple hypothesis testing correction (Romano-Wolf P-value=0.01). Thus, the reform led to a lower share of very preterm births, confirming the positive effects of the LOGSE on infant health at birth.

Panel C displays the effects of the reform on our infant mortality measures:the likelihood of fetal death and the likelihood of survival 24 hours after birth. Given that Spain has a universal public health care system with a 99.9% chance of survival 24 hours after birth and a 0.01% incidence of fetal death, we do not expect to see a significant impact of the reform on our mortality outcomes at birth. Consistently, our results indicate that there is no significant impact on the likelihood of survival 24 hours after birth or on the incidence of fetal death.

5.3 Threats to Identification

To check the validity of our results, we conduct a series of identification checks. We address two identification threats: (i) non-random adoption of the new comprehensive system across provinces, which can lead to sample selection bias, and (ii) possible confounding peer group changes due to shifting students out of vocational into comprehensive tracks as a result of the policy.

5.3.1 Identifying Assumptions

Our identification strategy is based on the staggered introduction of the new comprehensive system across Spanish provinces, which we presume exogenous to education and health at birth patterns prior to the reform. A potential concern is whether provinces anticipate benefits of implementing the policy and select on expected gains (Callaway et al., 2021). In what follows, we present three exercises that support the assumption of exogeneity in the implementation process.

First, to test the potential endogeneity of the implementation of the LOGSE with respect to other macroeconomic outcomes that may impact education and health at birth outcomes, we regress the LOGSE exposure index on provincial GDP per capita, female employment, and labor participation rates. Results displayed in Table A6 of the appendix show that there is no correlation between the LOGSE exposure and any of the macroeconomic variables studied indicating that the rollout of the LOGSE implementation was unrelated to any other economic determinants.

Second, to assess if the implementation of the LOGSE, even if not random, is uncorrelated

to educational curriculum choices prior to the introduction of the reform we test whether prior enrolment patterns predict the timing of the LOGSE implementation. To that end, we follow Ferrara et al. (2012) and Amuedo-Dorantes et al. (2018) and we aggregate the data prior to the introduction of the reform at the cohort and province level to estimate the following model:

$$\text{IYear}_k = \alpha + \beta \text{X}_{1975\text{k}} + \delta Z_{1975\text{k}} + \epsilon_k \tag{2}$$

Our dependent variable IYear_k *is* a dummy for whether the LOGSE exposure index is higher than 0.5 in province k, i.e., it indicates whether over 50% of the students are under the new system in a given province. Our regressors of interest $\text{X}_{1975\text{k}}$ and $Z_{1975\text{k}}$ are aggregated at the cohort and province levels and measured for the 1975 cohort, a cohort not yet exposed to the new system. $\text{X}_{1975\text{k}}$ stands for female education outcomes and $\delta Z_{1975\text{k}}$ includes the macroeconomic controls. Results in Table A7 of the appendix indicate that education outcomes prior to the implementation of the LOGSE do not predict the year in which the LOGSE came to replace the previous system. Therefore, the incidence of the reform does not appear to be explained by prior educational attainment and enrolment patterns.

Third, to ensure that the education and health at birth impacts being captured are not spuriously correlated to the posterior implementation of the LOGSE we perform two placebo checks. To that purpose, we restrict our sample to five cohorts prior to the first cohort exposed to the reform (1970-1975), and create placebo lead variables that capture differences in the take-up of the reform five cohorts later. If differences in school enrolment patterns and health at birth outcomes across cohorts and provinces are spuriously related to the differential implementation of the reform later across provinces and cohorts, the coefficients on the placebo lead variables should be statistically different from zero. Tables A8 and A9 in the appendix show that is not the case, the education and health impacts do not appear to be spuriously correlated to differences in the posterior adoption of the LOGSE across cohorts and provinces.

5.3.2 Potential Confounding Factors

Thus far, our analysis has assumed that the reform's positive effects on infant health at birth are directly driven by the integration of more general education into the high school system. However, a remaining concern is whether the policy reform could have affected adult maternal outcomes, and thereby infant health at birth, through peer composition changes. The reform also introduced changes in the educational curricula through changes in the way to structure educational tracks high school, such as shifting students out of vocational into comprehensive tracks. If the new influx of high-achieving peers towards the new comprehensive system had affected negatively the behaviour of high-achieving peers and the learning environment, our health at birth estimates may provide a lower bound of the effects of more general education. School tracking and peer effects are closely linked, and prior literature has suggested important interactions between school environment, peers, and health. For instance, Robalino and Macy (2018) and Gaviria and Raphael (2001) have shown that the prevalence of smoking, drug use and alcohol consumption among high schools students can be influenced by their peers. Likewise, Basu et al. (2018) observed that the shift from an early-tracking to a comprehensive system, led to an increase in rates of depression

and smoking, with a greater impact on students with lower non-cognitive abilities who might have been more susceptible to the decline in learning environment quality.

To address this concern, we conduct two additional exercises to examine whether the effects on health at birth in response to the LOGSE exposure vary for students who experience different peer composition changes. First, we use the mother's place of residence as a proxy for peer composition changes induced by the reform and explore how the effects vary across mothers from rural areas (less than 50,000 inhabitants) and urban areas (more than 50,000 inhabitants). We hypothesize that students in less populated areas will face fewer changes in the peer composition as a result of the reform than students in more populated areas. In less populated areas, such as small towns and rural areas, exposure to changes in the school environment is expected to be limited due to the tight-knit social structures. Student with extended social connections outside of school, such as through family or community ties, may be less influenced by their peers in the school setting due to pre-existing social ties that are less dependent on the school environment (Carrell et al., 2009). No differential effects across these two groups would suggest that the role of peer composition changes is limited in our analysis. Second, as the reform has no effects on educational attainment, degree completion rates and on the type of occupation, we use mothers' occupation as a proxy for their educational achievement and analyze whether children born to higher-achieving mothers benefit less from the reform than those born to less-achieving mothers. We hypothesize that high-achieving students may benefit less from the influence of low-achieving peers, while low-achieving students may benefit more from exposure to higher-achieving peers. We define high-achieving mothers as those with jobs in managerial or professional occupations. If we observe no differential effects of the policy change on children born to mothers of different educational achievements, this would suggest that the impacts on birth weight and gestational age were not affected by changes in peer composition. To perform these two exercises, we estimate the following model:

$$\mathrm{y}_{itk} = \alpha + \beta_1 \mathrm{D}_i * \mathrm{I}_{tk} + \beta_2 \mathrm{D}_i + \beta_3 \mathrm{I}_{tk} + \gamma_\mathrm{t} + \theta_\mathrm{k} + \epsilon_\mathrm{itk} \tag{3}$$

Where D_i is a dummy variable that takes on a value of 1 if the mother i either (a) has a job in a managerial or professional occupation or (b) lives in an area with less than 50,000 inhabitants. All other variables are defined as in equation (1). We can identify in the interaction $D_i * I_{tk}$ the impact of the reform on the gap in health at birth outcomes between infants born to mothers (a) with high- and low-skilled jobs or (b) living in rural and urban areas. The coefficient of interest, β_1, measures how differences in the health at birth of infants born to mothers exposed to different peer composition changes are affected by the reform. Table 4 shows the results from this exercise. The estimated coefficients corresponding to the interaction between the LOGSE exposure index and mother's occupation are statistically equal to zero (first row of panel A), which suggests that the reform did not affect the health of infants born to mothers of different abilities differently. Panel B provides further support for our findings by showing no economically significant differential effects based on the size of the mother's place of residence. While there appear to be some significant differences in the incidence of low birth weight and the number of gestational weeks at the 10% level (Columns

2 and 4, Panel B), we believe these differences are not relevant due to their varying health at birth implications and the small statistical power. These patterns of findings suggest that peer composition changes due to tracking changes do not play a key role on our health at birth estimates.

5.4 Mechanisms

We have shown that, among women, the main effect of the reform is to induce a switch from the academic and vocational high school programs to the comprehensive high school system, resulting in two additional years of general education, with no significant effects on high school or college degree completion rates or on years of schooling (Tables 1 and 2). More general education among women significantly reduces the incidence of very low birth weight and very preterm birth (Table 3). In this section, we empirically test how more general education among mothers maps into the documented infant health changes through increased women's earning potential and improved information processing skills as theoretically predicted by prior literature.

Effects on Women's Earning Potential

Panel A of Table 5 presents the effects of the LOGSE reform on labor market outcomes. Increased general education can improve women's permanent income and maternal prenatal investment through the labor market by increasing skills' portability across occupations (Goldin, 2001; Hanushek et al., 2017). Our data shows a sharp increase in the share of mothers joining the labor force at the time of their first childbirth (Column 2, Panel A). The reform significantly increase the likelihood of a mother being engaged in paid work outside the home by 2.75 percentage points, which represents a 3.22% rise. We see no economically or statistically significant effects on the type of female occupation (Columns 3 and 4, Panel A) or on the likelihood of still being enrolled in the education system by the age of 33 (Column 1, Panel A), which is consistent with our results on degree completion and educational attainment (Table 2). These findings suggest that the reform had positive effects on maternal labor force participation by the time of their first birth due to a rise in the share of mother being engaged in paid work outside the home, potentially leading to an increase in mothers' earning potential and prenatal investment.

Panel B of Table 5 reports the reform effects on assortative mating. Increased earning potential resulting from more general education may also contribute to positive assortative mating leading to higher household permanent income and prenatal investment through a multiplier effect (Behrman and Rosenzweig, 2004). Our data show no significant effects on mothers' mate quality (Columns 1 and 2, Panel B), as measured by mate's occupation (McCrary and Royer, 2011). Thus, mothers more exposed to the reform with a more general curriculum do not tend to have their children with either higher nor lower qualified partners compared to mothers less exposed to the reform.

Effects on Health Behaviours

Panel A of Table 6 presents the effects of LOGSE on the number of female hospitalizations due to risky health behaviour related diseases. The reform may have had broader effects on adult health that may also be driving the positive effects of more general education on infant health at birth. By providing more portable skills due to the expansion of general education, young women may gain better tools to learn about the negative consequences of risky health behaviours. We consider several diseases that are related to health behaviours such as diabetes (obesity), cirrhosis (alcohol abuse), lung cancer (smoking) and hypertension, which is related to mental health, smoking and alcohol abuse (Fischer et al., 2021). We observe no significant effects on any particular type of risky health behaviour related diseases. Thus, the documented reform's null effects on adult health outcomes from our hospitalization data suggest that the reform's positive effects on the propensity of very low birth weight and very preterm birth are not driven by a lower engagement in risky health behaviour.

Panel B of able 6 reports the reform effects on mothers' marital status and motherhood entry age by the time of the first birth. More portable skills may also improve women's ability to process information about fertility options, leading to greater control over the timing of their pregnancies through effective use of contraceptives. Our data shows no effects on marriage entry age (Column 2, Panel B) but a significant increase in the likelihood of being married by the time of the firth birth of 2.35 percentage points, representing a 3.05% increase (Column 1, Panel B). This higher share of married mothers by the time of the first birth due to the policy change could plausibly indicate a higher ability to plan ahead for motherhood, which may also explain the improved health outcomes at birth.

6 Conclusions

This paper contributes to the ongoing discussion on how education can best reduce intergenerational transmission of inequality. We exploit a unique policy shock that integrated more general education into the high school system while keeping the quantity and other aspects of education quality, such as the composition of peer groups, constant. Our study provides causal evidence that maternal educational curricula also affects infant health at birth. In particular, by leveraging the staggered introduction of a comprehensive educational policy reform across Spanish provinces, we implement a differences-in-differences research design and compare the health outcomes of children born to mothers with different levels of exposure to the reform. Using detailed administrative data from birth certificates, we find that the reform led to a 27.14% decrease in the incidence of very low birth weight (less than 1,500 grams) and a 27.14% decrease in the incidence of very preterm birth (less than 33 gestational weeks).

Our findings are in line with the proposed mechanisms by economic theory and previous literature on the effects of more general knowledge acquisition on improved earning potential and information processing skills (Grossman, 1972; Thomas et al., 1991; Goldin, 2001). Using information on mothers' occupation, marriage market allocation and fertility choices from

the birth register together with and hospital discharge records, we are also able to identify the underlying channels through which the reform may have affected children's health. Our findings suggest that the observed positive effects on children's health at birth may be driven by increased maternal labor supply and better family planning, rather than increased ability to avoid risky behaviours or increased women's earnings via different occupational choices or assortative mating.

Given the recent nature of the policy reform, the estimates of this paper are based on relatively young sample of mothers (aged 25-33). Further research is needed to investigate the impact of educational curricula on maternal labor, health, and social outcomes, as well as on the health of their offspring, throughout their entire reproductive lives. Additionally, while we focus only on health at birth, we leave for future research the investigation of the effects of maternal curricula changes on children health long term outcomes. It is also worth examining other variables that can serve as proxies for understanding the mechanisms through which infant health at birth is affected by changes in the educational curricula. For instance, potential variables may be mothers' prenatal care visits, mental disorders (e.g. anxiety or depression) or earnings.

Overall, this research provides insight into the potential benefits of integrating more general education into the high school system and highlights the importance of considering the impact of educational policies on health outcomes as well as the role of educational curricula, rather than focusing uniquely in quantity of education. More broadly, this paper also contributes to the broader debate on the role of educational curricula in promoting social mobility and reducing inequality.

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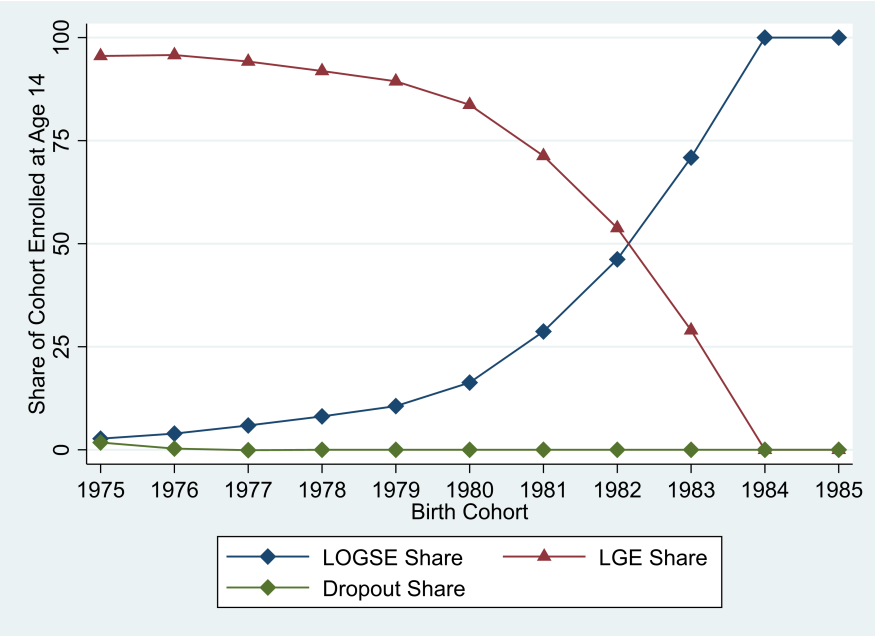

Figure 1: The LOGSE and The LGE Enrollment Shares by Birth Cohort

Notes. This figure shows the dropout shares and enrollment shares at age 14 by birth cohort, split by whether educational systems. The dotted 1975 cohort is the first eligible for the reformed high school system. Source: Annual Education Statistics reports, Statistical Office of the Education Ministry, multiple: 1989-2001.

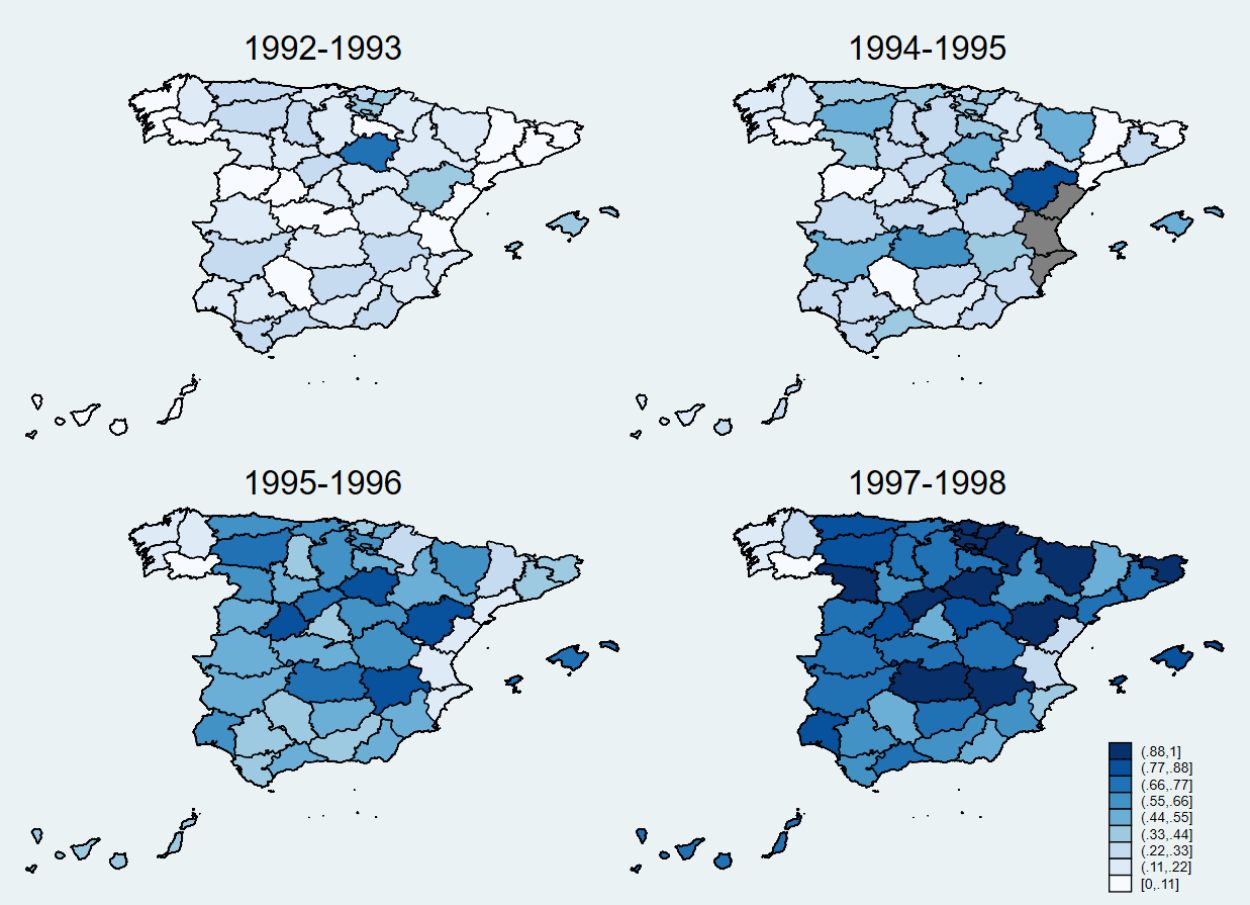

Figure 2: Geographic Variation in the LOGSE Implementation

Notes: This figure shows the proportion of students under the 1990 LOGSE at age 14 (scale 0 to 1) by provinces in school years 1992-1993, 1994-1996, 1995-1996 and 1997-1998. Lighter colours refer to lower levels of the LOGSE exposure, darker colours to higher levels of the LOGSE exposure, grey colours report missing data. Source: 1990-1991 and 1999-2000 Education Statistics (Education Ministry).

List of Tables

Table 1: Reform Effects on High School Enrollment

	(1) No Degree	(2) Comprehensive Education	(3) Academic Education	(4) Vocational Education
Index	0.0014	0.1038***	-0.0609**	-0.0467***
	(0.004)	(0.020)	(0.026)	(0.015)
1975's Cohort Mean	0.011	0.313	0.438	0.183
Std. Dev.	0.10	0.46	0.50	0.39
Observations	109,339	109,339	109,339	109,339
R-squared	0.003	0.019	0.022	0.012

Notes. Standard errors are in parentheses. The estimates are obtained from estimating eq. 1 on a sample of women with Spanish nationality born between 1975 and 1985 between 17 and 24 years old. All specifications include a constant and main controls for birth year and province of residence. Standard errors are clustered at province level for each specification. Data are from 1991-2018 Spanish LFS. ***Significant at 1% level, **Significant at 5% level, * Significant at 10% level.

Table 2: Reform Effects on Degree Completion

	(1) Age at Highest Qualification	(2) No Degree	(3) High School Degree	(4) Vocational Degree	(5) College Degree
Index	0.2198	-0.0007	0.0045	0.0334	-0.0330
	(0.184)	(0.005)	(0.018)	(0.028)	(0.028)
1975's Cohort Mean	19.641	0.013	0.360	0.246	0.343
Std. Dev.	4.32	0.11	0.48	0.43	0.47
Observations	85,004	85,348	85,348	85,348	85,348
R-squared	0.033	0.004	0.026	0.011	0.022

Notes. Standard errors are in parentheses. The estimates are obtained from estimating eq. 1 on a sample of women with Spanish nationality born between 1975 and 1985 between 25 and 33 years old. All specifications include a constant and main controls for birth year and province of residence. Standard errors are clustered at province level for each specification. Data are from 1991-2018 Spanish LFS. ***Significant at 1% level, **Significant at 5% level, * Significant at 10%level.

Table 3: Reform Effects on Health at Birth

	(1)	(2)	(3)
Panel A: Weight at Birth Measures			
	Weight	Low Weight	Very Low Weight
Index	10.9079	-0.0014	-0.0019*
	(7.011)	(0.003)	(0.001)
Romano-Wolf p-value			0.0689
1975's Cohort Mean	3199.580	0.070	0.007
Std.Dev	506.73	0.25	0.09
Obs	1,446,005	1,446,005	1,446,005
R-squared	0.002	0.000	0.000
Panel B: Gestational Age			
	Weeks	Late Preterm	Very Preterm
Index	0.0229	0.0034	-0.0033***
	(0.032)	(0.006)	(0.001)
Romano-Wolf p-value			0.01
1975's Cohort Mean	39.145	0.132	0.012
Std.Dev	1.90	0.34	0.11
Obs	1,296,160	1,296,160	1,296,160
R-squared	0.001	0.001	0.000
Panel C: Mortality at Birth			
	Fetal Death	Survive 24h after Birth	
Index	-0.0001	-0.0000	
	(0.000)	(0.000)	
Romano-Wolf p-value			
1975's Cohort Mean	0.002	0.997	
Std.Dev	0.05	0.05	
Obs	1,513,676	1,513,676	
R-squared	0.001	0.000	

Notes. Standard errors are in parentheses. The estimates are obtained from estimating 1 on a sample of women with Spanish nationality born between 1975 and 1985 between 25 and 33 years old. All specifications include a constant and main controls for birth year and province of residence. Standard errors are clustered at province level for each specification. Data are from 2000-2018 Childbirth microdata of Vital Statistics (INE). ***Significant at 1% level, **Significant at 5% level, * Significant at 10%level.

Table 4: Peer Composition Changes

	(1) Weight	(2) Low Weight	(3) Very Low Weight	(4) Weeks	(5) Late Preterm	(6) Very Preterm
Panel A: High-Achieving Vs Low-Achieving						
Index*HighAchieving	-2.9574	-0.0014	-0.0008	0.0002	0.0033	-0.0001
	(5.065)	(0.002)	(0.001)	(0.018)	(0.003)	(0.001)
High Skills	15.1862***	-0.0096***	-0.0014***	0.0484***	-0.0143***	-0.0028***
	(3.552)	(0.001)	(0.000)	(0.012)	(0.002)	(0.000)
Index	11.1644	-0.0016	-0.0018	0.0383	0.0012	-0.0033**
	(7.095)	(0.003)	(0.001)	(0.036)	(0.007)	(0.001)
1975's Cohort Mean	3199.580	0.070	0.007	39.145	0.132	0.012
Std.Dev	506.73	0.25	0.09	1.90	0.34	0.11
Obs	1,343,986	1,343,986	1,343,986	1,199,747	1,199,747	1,199,747
R-squared	0.002	0.001	0.000	0.002	0.001	0.000
Panel B: Rural Vs Urban						
Index*Rural	-1.3970	0.0028*	0.0004	0.0293*	-0.0032	0.0006
	(2.368)	(0.001)	(0.000)	(0.015)	(0.002)	(0.001)
Rural	-4.4167	-0.0009	-0.0002	0.0029	-0.0014	-0.0003
	(3.108)	(0.001)	(0.000)	(0.010)	(0.002)	(0.000)
Index	11.7451	-0.0030	-0.0021**	0.0053	0.0053	-0.0037***
	(7.305)	(0.003)	(0.001)	(0.033)	(0.006)	(0.001)
1975's Cohort Mean	3199.580	0.070	0.007	39.145	0.132	0.012
Std.Dev	506.73	0.25	0.09	1.90	0.34	0.11
Obs	1,446,005	1,446,005	1,446,005	1,296,160	1,296,160	1,296,160
R-squared	0.002	0.000	0.000	0.001	0.001	0.000

Notes. Standard errors are in parentheses. The estimates are obtained from estimating eq. 3 on a sample of women with Spanish nationality born between 1975 and 1985 between 25 and 30 years old. All specifications include a constant and main controls for birth year and province of residence. Data are from 1991-2018 Childbirth microdata of Vital Statistics (INE). ***Significant at 1% level, **Significant at 5% level, * Significant at 10%level.

Table 5: Reform Effects on Women's Earning Potential

	(1)	(2)	(3)	(4)
Panel A. Labor Market Outcomes				
	Student	Working Mother	Qualified Job	Non-Qualified Job
Index	-0.0012	0.0275**	-0.0035	0.0029
	(0.001)	(0.014)	(0.012)	(0.010)
Romano-Wolf P-value		0.043		
1975's Cohort Mean	0.005	0.853	0.409	0.264
Std.Dev.	0.07	0.35	0.49	0.44
Obs	1,521,770	1,467,386	1,521,770	1,416,631
R-squared	0.001	0.028	0.014	0.010
Panel B. Assortative Mating				
	Mate Qualified Job	Mate Non-Qualified Job		
Index	0.0050	-0.0180		
	(0.012)	(0.013)		
Romano-Wolf P-value				
1975's Cohort Mean	0.340	470		
Std.Dev.	0.47	0.50		
Obs	1,521,770	1,521,770		
R-squared	0.015	0.020		

Notes. Standard errors are in parentheses. The estimates are obtained from estimating eq. 1 on a sample of first deliveries of mothers with Spanish nationality born between 1975 and 1985 between 25 and 33 years old. All specifications include a constant and main controls for birth year and province of residence. Romano-Wolf p-values based on 1,000 studentized bootstrap replications. Data are from 1991-2018 Childbirth microdata from Spanish Statistical Office.

Table 6: Reform Effects on Health Behaviour

	(1)	(2)	(3)	(4)
Panel A. Adult Health				
	Lung Cancer	Diabetes	Cirrhosis	Hyperthension
Index	-0.0424	-0.4339	0.1964	-0.2492
	(0.064)	(0.718)	(0.297)	(0.321)
1975's Cohort Mean	0.029	2.351	0.578	0.111
Std.Dev.	0.22	3.37	1.19	0.50
Obs	2,847	2,847	2,847	2,847
R-squared	0.021	0.067	0.031	0.032
Panel B. Family Planning				
	Married	Marriage Age		
Index	0.0235**	-0.0218		
	(0.011)	(0.072)		
Romano-Wolf p-value	0.043			
1975's Cohort Mean	0.768	26.466		
Std.Dev.	0.42	2.77		
Obs	1,521,770	980,853		
R-squared	0.053	0.024		

Notes. Outcomes in Panel A refer to the number of hospitalization due to lung cancer (column 1), diabetes (column 2), cirrhosis (column 3) and hypertension (column 4) for each cohort and province of residence. Outcomes in Panel B refer to the share of mothers married at the time of the first birth (column 1) and the age at motherhood in years (column 2). The estimates are obtained from estimating eq. 1 on a sample of women with Spanish nationality born between 1975 and 1985 between 25 and 30 years old. All specifications include a constant and main controls for birth year and province of residence. Standard errors are in parentheses. Romano-Wolf p-values based on 1,000 studentized bootstrap replications. Data from Panel A are from 2004-2015 MSBD. Data from Panel B are from 1991-2018 Childbirth microdata from Spanish Statistical Office. ***Significant at 1% level, **Significant at 5% level, * Significant at 10% level.

Appendix

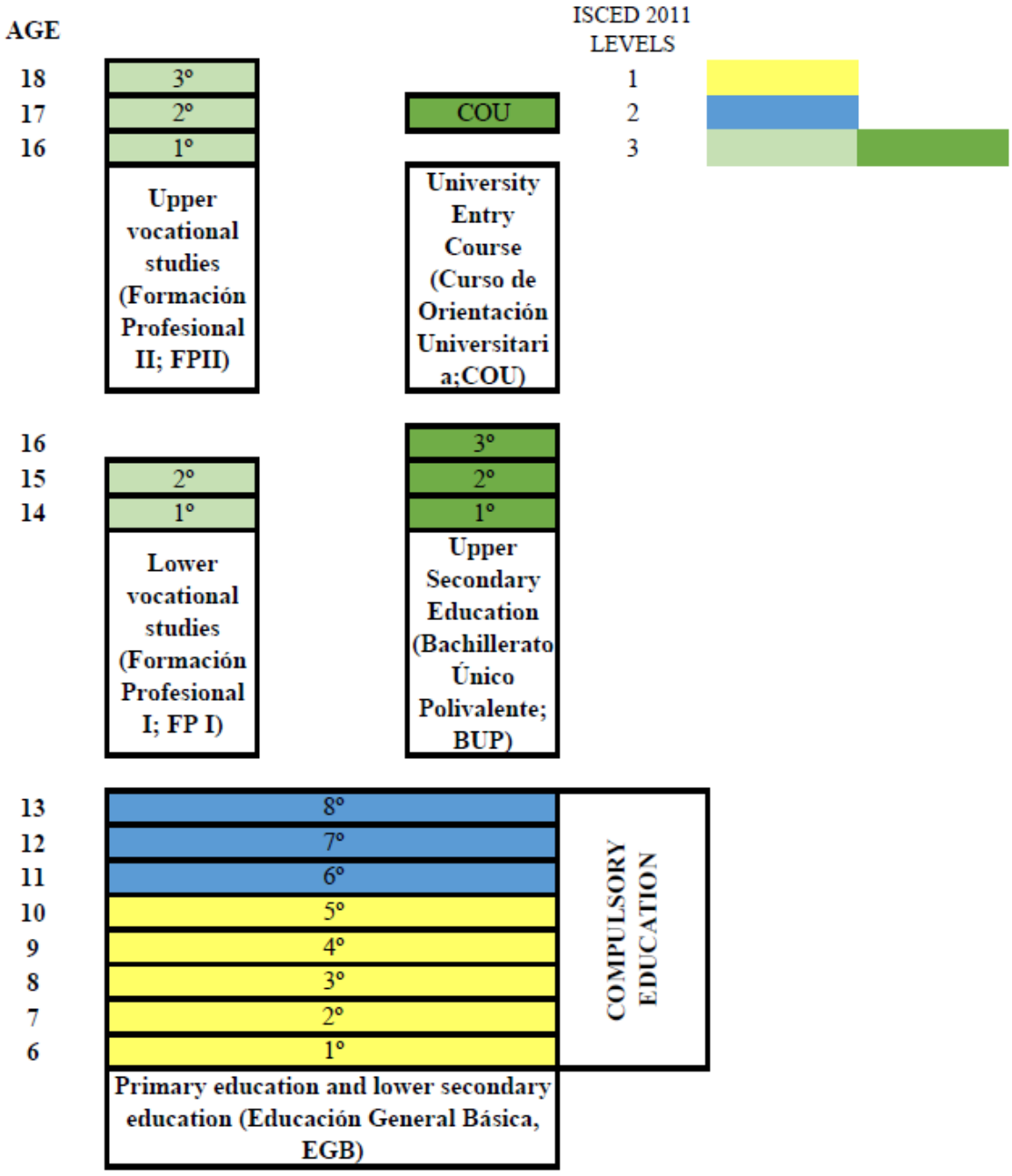

Figure A1: Main Pathways of the Spanish Education System Before the LOGSE
Notes: It is not included the artistic education program (Music and Dance and Dramatic art). Source: Spanish Ministry of Education.

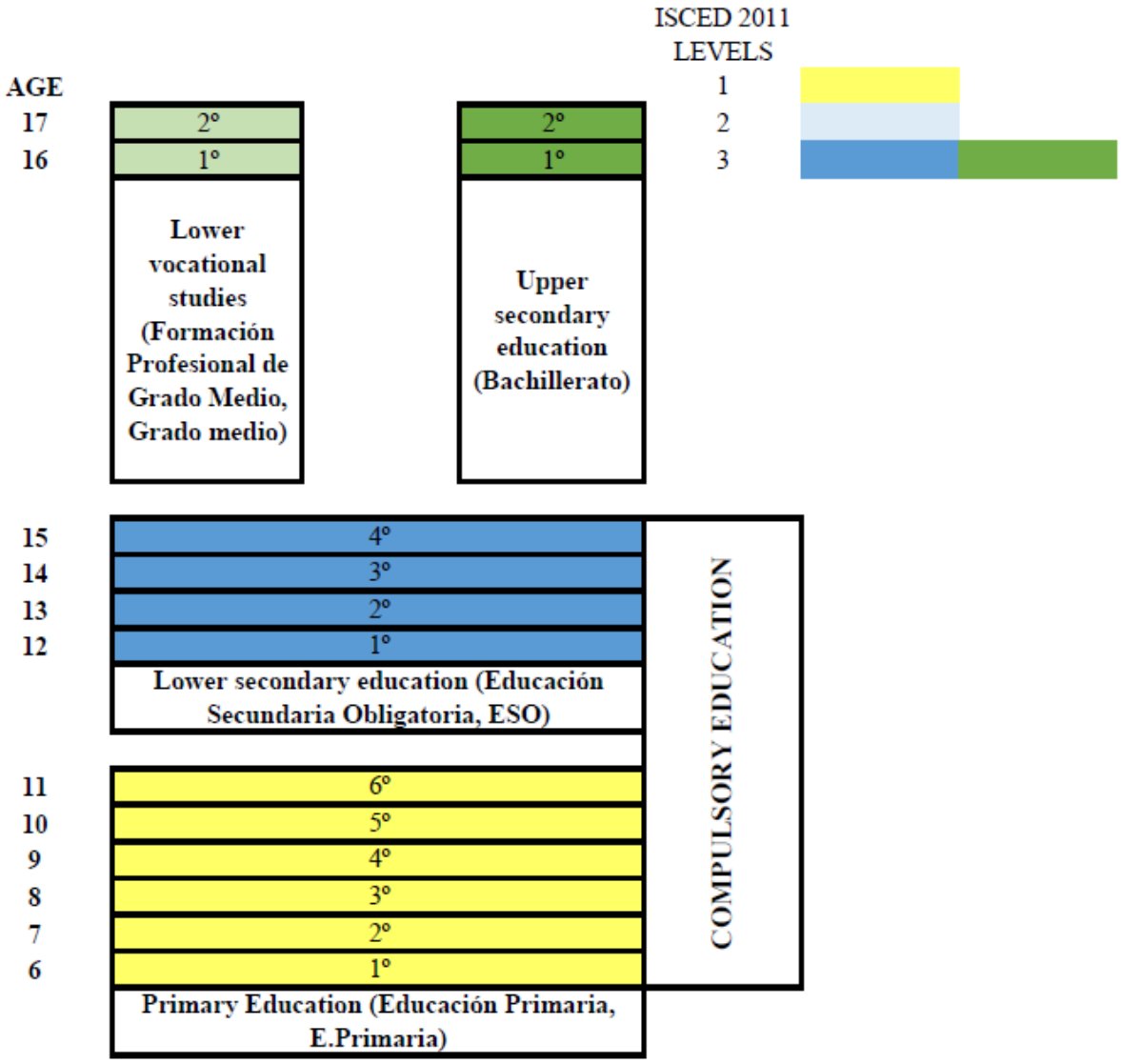

Figure A2: Main Pathways of the Spanish Education System After the LOGSE.
Notes: It is not included the artistic education program (Music and Dance and Dramatic art). Source: Spanish Ministry of Education.

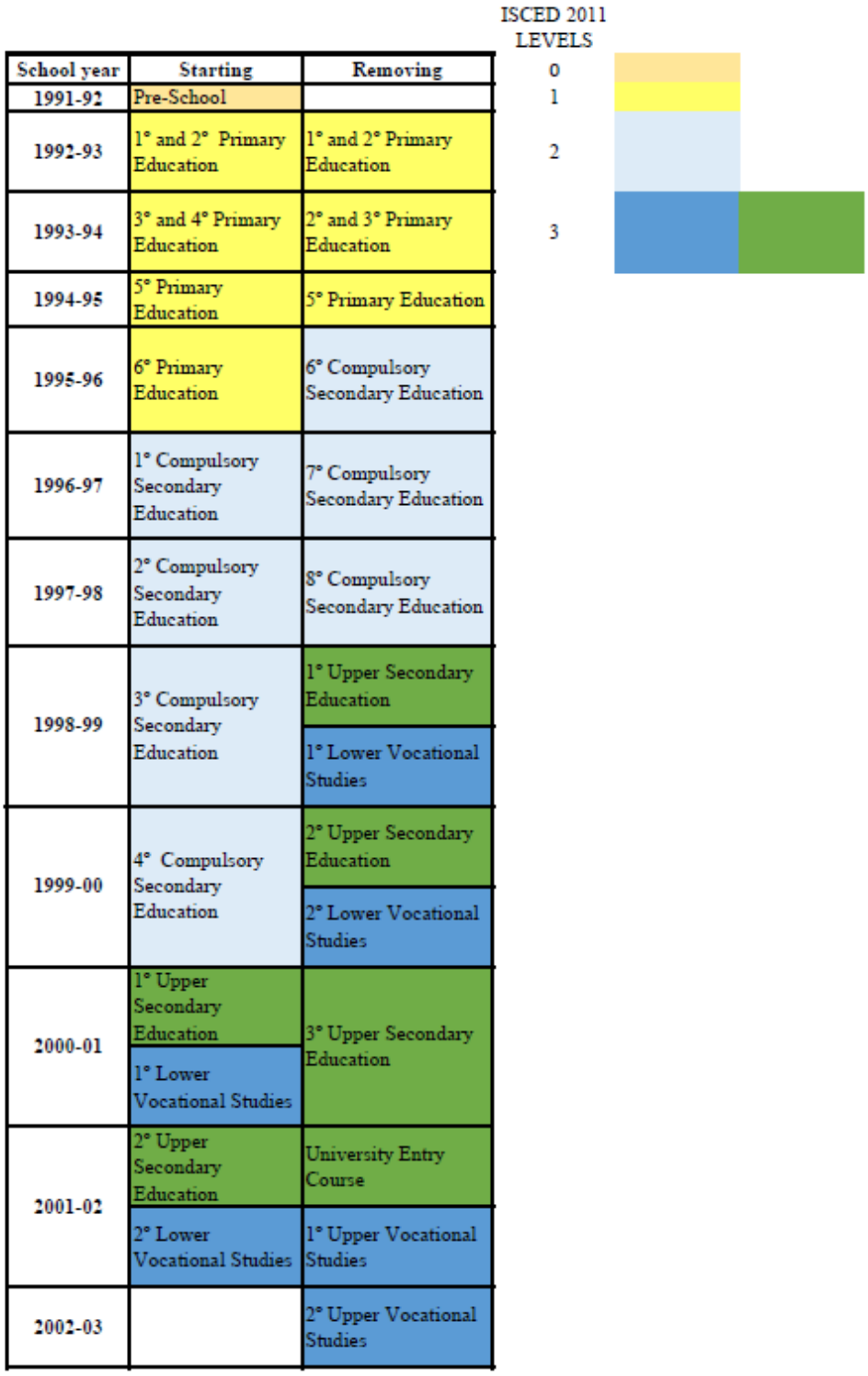

Figure A3: National Calendar of LOGSE The Implementation

Notes: Updated by R.D. 173/1998; Artistic Education Program not included (Music and Dance and Dramatic art). Source: Ministry of Education.

Table A1: Educational Curricula Before and After the Reform At Ages 14 and 15

Age	Pre-Reform System		Post-Reform System
	Vocational Education	**Academic Education**	
14			
	5 Occupation-Specific Subjects	Maths	Maths
	Apprenticeships	Social Sciences	Social Sciences
	Spanish Language	Spanish Language	Spanish Language and Literature
	Humanistic Education	Natural Sciences	Natural Sciences
	Foreign Language	Foreign Language	Foreign Language
	Physical Education	Physical Education	Physical Education
	Civic, Social and Political Education	Drawing	Education in Civic and Ethical Values
	Religious Education	Religious Education	Religious Education (voluntary)
		Music and Arts	Music and Arts
			Technology and Digitalisation
			1 Optative Subject (Second Foreign Language or Classical Culture)
15			
	5 Occupation-Specific Subjects	Maths	Maths
	Apprenticeships	Social Sciences	Social Sciences
	Spanish Language	Spanish Language and Literature	Spanish Language and Literature
	Foreign Language	Foreign Language	Foreign Language
	Physical Education	Physical Education	Physical Education
	Civic, Social and Political Education	Latin	Education in Civic and Ethical Values
	Religious Education	Religious Education	Religious Education or Study Time (voluntary)
	Humanistic Education	1 Occupation-Specific Subject	3 Academic Field-Specific Subjects (Biology and Geology, Physics and Chemistry, Music and Arts, Technology, Second Foreign Language, Classical Culture)
		Natural Sciences	

Notes. Educational curricula corresponding to lower vocational studies (*FP I*, ISCED 2011 level 3) and the first two years of upper secondary education (*BUP* ISCED level 3) of the previous educational system (*LGE*) and last two years of lower secondary education (*ESO* ISCED 2011 level 3) of the new educational system. Source: Laws (Real Decreto 160/1975, Real Decreto 707/1976, Real Decreto 1007/1991).

Table A2: Health at Birth Summary Statistics

	Mean	SD	Min	Max	Definition
Weight	3202.492	513.35	42	6580	Weight at birth in grams of the first-born.
Low Weight	0.072	0.26	0	1	Dummy variable equals to 1 if the weight at birth of the first-born is under 2500 grams; 0 otherwise.
Very Low Weight	0.008	0.09	0	1	Dummy variable equals to 1 if the weight at birth of the first-born is lower than 1500 grams; 0 otherwise.
Preterm	0.128	0.33	0	1	Dummy variable equals to 1 if the first-born is born under 38 weeks of gestation; 0 otherwise.
Very Preterm	0.012	0.11	0	1	Dummy variable equals to 1 if the first-born is born under 33 weeks of gestation; 0 otherwise.
Weeks of Gestation	39.158	1.90	19	46	Number of weeks of gestations of the first-born.
Fetal Death	0.001	0.03	0	1	Dummy variable equals to 1 if the first-born is born dead; 0 otherwise.
Survive 24h after Birth	0.999	0.04	0	1	Dummy variable equals to 1 if the first-born survive the first 24 hours after the birth; 0 otherwise.
N	**1,521,770**				

Notes. Sample: Women born between 1975 and 1985 with Spanish nationality between the age of 25 and 33 at their first birth.
Source: Own Elaboration from 2000-2018 Childbirth microdata of Vital Statistics (INE) for 1975-1985 cohorts.

Table A3: Maternal Background Characteristics Summary Statistics

	Mean	SD	Definition
Student	0.009	0.095	Dummy variable equals to 1 if the mother is a student in any kind of educational stage, 0 otherwise.
Working Mother	0.860	0.345	Dummy variable equals to 1 if the mother is not dedicated to house work, 0 otherwise.
Married	0.644	0.479	Dummy variable equals to 1 if the mother is married, 0 otherwise.
Marriage Age	26.597	2.896	Mother age at first marriage.
Qualified Job	0.454	0.498	Dummy variable equals to 1 if the mother is occupied in a highly trained job (managerial position, scientific or academic profession, administrative or office worker, qualified personnel in primary sector, qualified personnel in secondary sector and construction), 0 otherwise.
Non-Qualified Job	0.272	0.445	Dummy variable equals to 1 if the mother is occupied in a non-qualified job (Catering, personal, protection and sales workers, plant and machinery operators and assemblers or elementary occupations)
Mate Qualified Job	0.434	0.496	Dummy variable equals to 1 if the mother's mate is occupied in a highly trained job (managerial position, scientific or academic profession, administrative or office worker, qualified personnel in primary sector, qualified personnel in secondary sector and construction), 0 otherwise.
Mate Non-Qualified Job	0.398	0.489	Dummy variable equals to 1 if the mother's mate is occupied in a non-qualified job (Catering, personal, protection and sales workers, plant and machinery operators and assemblers or elementary occupations)

Notes. Sample: Women born between 1975 and 1985 with Spanish nationality between the age of 17 and 33 at their first birth.
Source: Own Elaboration from 2000-2018 Childbirth microdata of Vital Statistics (INE) for 1975-1985 cohorts.

Table A4: Education Summary Statistics

	Mean	SD	Definition
Panel A: High School Enrollment			
No Degree	0.010	0.10	Dummy variable equals to 1 if the highest educational degree is lower than primary school; 0 otherwise
Comprehensive Education	0.331	0.47	Dummy variable equals to 1 if the highest educational degree is compulsory education; 0 otherwise.
Academic Education	0.453	0.50	Dummy variable equals to 1 if the highest educational degree is academic secondary (post-compulsory) education or college;0 otherwise.
Vocational Education	0.157	0.36	Dummy variable equals to 1 if the highest educational degree is vocational secondary education; 0 otherwise.
N	**109,339**		
Panel B: Degree Completion			
No Degree	0.011	0.10	Dummy variable equals to 1 if the highest educational degree is lower than primary school; 0 otherwise
High School Degree	0.337	0.22	Dummy variable equals to 1 if the highest educational degree is lower or upper secondary education; 0 otherwise.
College Degree	0.361	0.23	Dummy variable equals to 1 if the highest educational degree is college; 0 otherwise.
Vocational Degree	0.254	0.19	Dummy variable equals to 1 if the highest educational degree is lower or upper vocational education; 0 otherwise.
Age at Highest Qualification	20.209	18.13	Age in years at highest qualification.
N	**85,348**		

Notes. Panel A presents summary statistics on high school enrollment among women of Spanish nationality born between 1975 and 1985, within the age range of 17 to 25. Panel B presents summary statistics on degree completion for sample of women within the age range of 25 to 33. Source: 1991-2018 Spanish LFS.

Table A5: Adult Health Summary Statistics

	Mean	SD	Min	Max	Definition
Lung Cancer	0.039	0.487	0	21	Number of female hospitalization due to lung cancer for each patient's province of residence and cohort (1975-1985)
Diabetes	2.281	4.129	0	59	Number of female hospitalization due to diabetes for each patient's province of residence and cohort (1975-1985)
Cirrhosis	0.314	1.323	0	28	Number of female hospitalization due to cirrohis for each patient's province of residence and cohort (1975-1985)
Hypertension	0.151	1.210	0	41	Number of female hospitalization due to hypertension for each patient's province of residence and cohort (1975-1985)
N	**11,388**				

Notes. Sample: Women born between 1975 and 1985 with Spanish nationality between the age of 25 and 31. Source: 2004-2015 MSBD.

Table A6: Identification Check #1: The LOGSE Exposure Index and Macroeconomic Outcomes

	(1) GDP per capita	(2) Female Employment Rate	(3) Female Labor Parcipation Rate
Index	-0.4598	0.0090	0.0068
	(0.291)	(0.008)	(0.010)
Mean	10.543	0.263	0.364
Std. Dev.	3.33	0.06	0.06
Observations	535	535	535
R-squared	0.963	0.904	0.880

Notes. Table reports OLS coefficients. Standard errors are in parentheses. Each specification includes controls for cohort and province of residence. Data from the Autonomous Cities of Ceuta and Melilla is not included. Data are from 1991 – 2001 Spanish Statistical Office. ***Significant at 1% level, **Significant at 5% level, * Significant at 10% level.

Table A7: Identification Check #2: Predicting the implementation of the LOGSE

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Year of LOGSE Implementation							
No Degree rate of 1975's cohort	28.6246				33.1545*			
	(22.371)				(18.763)			
Compulsory Secondary Education rate of 1975's cohort		4.3962				3.6060		
		(3.047)				(3.296)		
Academic Secondary Education or Higher rate of 1975's cohort			-3.8084				-3.8101	
			(2.452)				(2.401)	
Vocational Education rate of 1975's cohort				-0.1318				2.1913
				(3.018)				(3.179)
Macroeconomic Controls	N	N	N	N	Y	Y	Y	Y
Observations	50	50	50	50	50	50	50	50
R-squared	0.034	0.048	0.062	0.000	0.203	0.191	0.224	0.170

Notes. Standard errors are in parentheses. The estimates are obtained from estimating eq. 2 on a sample of women with Spanish nationality born between 1975 and 1985 between the age of 17 and 33. All variables are measure at the provincial level for the cohort of 1975. Data are from 1991-2018 Spanish LFS. ***Significant at 1% level, **Significant at 5% level, * Significant at 10%level.

Table A8: Identification Check #3: Placebo Check for Spurious Correlations Between School Enrollment and Degree Completion Differences Prior (1984-1989) To the LOGSE

	(1)	(2)	(3)	(4)	(5)
Panel A: School Enrollment					
	No Degree	Comprehensive Education	Academic Education	Vocational Education	
Lag Index	0.001	0.026	0.009	0.008	
	(0.008)	(0.027)	(0.031)	(0.020)	
Observations	148,370	148,370	148,370	148,370	
R-squared	0.006	0.012	0.024	0.014	
Panel B: Degree Completion					
	Age at Highest Qualification	No Degree	Secondary Degree	Vocational Degree	College Degree
Lag Index	0.582*	0.002	-0.036	0.026	0.037
	(0.320)	(0.010)	(0.031)	(0.024)	(0.027)
Romano Wolf P-Value	0.999				
Observations	106,171	126,764	126,764	126,764	126,764
R-squared	0.029	0.009	0.017	0.016	0.020

Notes. Standard errors are in parentheses. The estimates are obtained from estimating eq. 1 on a sample of women with Spanish nationality born between 1970 and 1975 between 17 and 33 years old. All specifications include a constant and main controls for birth year and province of residence. Standard errors are clustered at province level for each specification. Romano-Wolf p-values based on 1,000 studentized bootstrap replications. Data are 1987-2018 Spanish LFS. ***Significant at 1% level, **Significant at 5% level, * Significant at 10%level.

Table A9: Identification Check #4: Placebo Check for Spurious Correlations Between Health at Birth Outcomes Differences Prior (1984-1989) To the LOGSE

	(1)	(2)	(3)
Panel A: Weight at Birth Measures			
	Weight	Low Weight	Very Low Weight
Lag Index	0.3735	0.0035	0.0016
	(6.007)	(0.003)	(0.001)
Obs	903,569	903,569	903,569
R-squared	0.002	0.000	0.000
Panel B: Gestational Age			
	Weeks	Late Preterm	Very Preterm
Lag Index	-0.0142	-0.0023	0.0019
	(0.024)	(0.004)	(0.001)
Obs	808,176	808,176	808,176
R-squared	0.002	0.001	0.000
Panel C: Mortality at Birth			
	Fetal Death	Survive 24h after Birth	
Lag Index	0.0002	0.0000	
	(0.000)	(0.000)	
Obs	949,274	949,274	
R-squared	0.000	0.000	

Notes. Standard errors are in parentheses. The estimates are obtained from estimating eq. 1 on a sample of women with Spanish nationality born between 1970 and 1975 between 25 and 33 years old. All specifications include a constant and main controls for birth year and province of residence. Standard errors are clustered at province level for each specification. Data are 1995-2013 Childbirth microdata of Vital Statistics (INE). ***Significant at 1% level, **Significant at 5% level, * Significant at 10%level.

Table A10: Reform Effect on Fertility Patterns

	(1) Birth Rate	(2) Motherhood Entry Age
Index	-0.0012	-0.0630
	(0.004)	(0.043)
1975's Cohort Mean	0.069	29.518
Std.Dev	0.03	2.36
Obs	4,995	1,521,770
R-squared	0.543	0.010

Notes. Standard errors are in parentheses. The estimate is obtained from estimating eq. 1 on a sample of woman with Spanish nationality born between 1975 and 1985 between 25 and 33 years old. Birth Rate (Column 1) is calculated as the number of first births divided by the number of women born in Spain per mother age and province. All specifications include a constant and main controls for birth year and province of residence. Motherhood Entry Age (Column 2) is mother's age at first birth. Standard errors are clustered at province level for each specification. Data are from 1975-1985 and 2000-2018 Childbirth microdata of Vital Statistics (INE). ***Significant at 1% level, **Significant at 5% level, * Significant at 10% level.

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