If not now, when? The timing of childbirth and labor market outcomes

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Abstract

We study the effect of childbirth and birth timing on female labor market outcomes in Italy. The impact is traced up to 21 years since school completion by estimating a factor analytic model with dynamic selection into treatments. We find that childbirth, especially the first delivery, negatively affects female earnings and participation. Women having their first child soon after school exit catch up with childless women after 12-15 years. The negative consequences are smaller if the first child is delayed up to 7-9 years after school completion or if a second childbirth occurs within 6 years since school exit.

Keywords: Female labor supply; fertility; childbirth; discrete choice models; dynamic treatment effect; factor analytic model.
JEL classification codes: C33, C35, J13, J22

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1 Introduction

When is the best time to have kids? Most women face this question at some point. Economic considerations play an important role, not only because children are an expensive endeavor, but also because the opportunity cost of career interruptions is often high. The *motherhood penalty*, i.e. the monetary loss faced by women after giving birth, varies considerably across countries and groups of women, defined on the basis of education and race (Grimshaw and Rubery, 2015; Herr, 2016; Leung et al., 2016). To complicate matters, the opportunity cost of career interruptions may vary over the working life since, for example, the human capital may accumulate at a different pace over time and the employment protection and the consequent job stability typically increase with seniority. Postponed childbearing has thus been used to reduce losses after the childbirth (Miller, 2011; Troske and Voicu, 2013). However, while the delay of childbirth may help to contain the adverse labor market outcomes, it might also explain the reduction in total fertility rates, as the probability of conception declines with age (Bratti and Tatsiramos, 2012).

Our paper adds to the debate on the best time to give birth, in terms of labor market outcomes, by answering the following research questions: i) What is the causal impact of childbirth on female labor earnings and the number of days worked in a year? ii) How does the childbirth impact change over the lifetime? iii) Does the timing of birth matter? To investigate these issues, we use an Italian dataset, obtained by merging survey data and administrative archives, and compare women who gave birth to childless women, once we net out the spurious effects determined by (potentially) time-varying observed and unobserved common determinants of labor market outcomes and fertility.

Our contribution to the existing empirical literature is threefold. The first one is methodological and involves the identification of the effect of childbirths and their timing on labor market outcomes. We set up a factor analytic dynamic model (Carneiro et al., 2003; Heckman and Navarro, 2007): i) with multiple dynamic treatments (one for each birth); ii) in which women giving birth at different times differ in unobserved determinants jointly affecting fertility choices and labor market outcomes (dynamic selection); iii) where the impact of each birth varies with birth timing. Our model is close to those proposed by Carneiro et al. (2003) and by Fruehwirth et al. (2016), and extends them in two different directions: compared to the former, we allow the unobserved factor determining the dynamic treatments and the outcomes to be time-varying; with respect to the latter, we consider that units can receive multiple dynamic treatments (more than one child).[1] Moreover, we propose a novel formulation for the average dynamic treatment effects. We achieve the nonparametric identification by exploiting: i) the loading factor structure of the unobserved determinants; ii) the longitudinal information in our data, which allows for the reconstruction of the complete fertility and working histories, thereby providing multiple observations over time of the endogenous variables; iii) measures of the latent factor which are free of selection into treatment (Carneiro et al., 2003), such as the employment experience before school completion and the number of siblings when the woman was 14; and iv) treatment-specific overidentifying restrictions based on spacing between pregnancies and siblings-sex composition.

Our approach, as that of Fruehwirth et al. (2016), falls in between the quasi-experimental approach, used to identify the effect of a static treatment and that does not model the selection process, and a structural dynamic model, because the selection is specified with a threshold-crossing decision rule. We improve upon the identification strategies so far adopted to quantify the effect of delaying childbirths (see Bratti, 2015, for a review). In particular, we combine a rich longitudinal structure, which allows for a flexible specification of time-varying Unobserved Heterogeneity (UH), with the treatment-specific exogenous variation, commonly used in quasi-experimental settings,[2] and with pre-sample information on the labor market status and the family of origin, as additional overidentifying measurements (Carneiro et al., 2003). Because the model set-up accommodates multiple dynamic treatments and dynamic selection into treatment, it becomes crucial to account for selection on the time-varying unobservables jointly affecting fertility choices and labor market outcomes at different times by means of a rich and flexible specification. This is provided by the factor structure with a latent trait and factor loadings that are allowed to vary over time. Our model and research questions are close to Troske and Voicu (2013). However, their

[1] Carneiro et al. (2003) study the impact of different schooling levels on future returns, whereas Fruehwirth et al. (2016) estimate how retention affects subsequent school performance. Differently from our model and Carneiro et al. (2003), Fruehwirth et al. (2016) also incorporate essential heterogeneity, i.e. they allow the treatment effect to vary with the time-varying unobserved determinants.

[2] Instrumental variables strategies using sibling-sex composition or biological fertility shocks for the timing of birth are adopted by Angrist and Evans (1998), Miller (2011), and Karimi (2014).

identification strategy is largely based on parametric assumptions and the UH is not allowed to vary over time, although they model fertility and labor market histories up to 23 years.

Second, we allow the motherhood effect to vary over time and trace it for a longer period than what is typically done in the literature. Existing studies often stop at 5 years after the childbirth (e.g. Pacelli et al., 2013; Fitzenberger et al., 2013), and the motherhood penalty rarely disappears by that time. By reconstructing working histories up to 21 years after school completion, we are able to identify not only short run effects, but also long run impacts of childbirth.

Third, the time profile of the impact of childbirth is allowed to vary according to birth timing since school completion,[3] which is taken as the starting point of fertility choices.[4] In the empirical literature, an extra year of delay is typically assumed to affect linearly or log-linearly the labor market outcomes (see e.g. Miller, 2011; Bratti and Cavalli, 2014; Karimi, 2014; Herr, 2016). Instead, we assume that the impact of delaying childbirth could be non-linear over the time elapsed since school completion. This turns to be important for drawing policy implications.

We find that childbearing, especially the first one, negatively affects female labor supply. The effect is amplified if the birth occurs soon after school completion. The gap in earnings between mothers and childless women takes about 12-15 years to close if the first delivery occurs within 3 years since school completion. The adverse effects on yearly earnings and number of days at work in a year are smaller if the first child is delayed up to 7-9 years after exiting formal education. The timing of the second childbirth also matters: the penalties are much shorter-lasting if both the first and the second childbirths occur within 6 years after school completion. In this case, the duration of the motherhood penalty is indeed on average 6 years shorter than in the case of only one childbirth within 6 years after school completion.

There are two main reasons why our analysis is of large interest, especially in contexts where the policy maker primarily aims at improving the share of women in the workforce by weakening the eventual detachment from the labor market of new mothers. First, by providing a detailed description of the heterogeneity of childbirth effect by birth timing and over time, we can suggest whether (and when) policies aimed at i) speeding up the return to work of new mothers are

[3]Our definition of the timing of birth with respect to the moment of school completion is similar to the definition with respect to the labor market entry analysed by Herr (2016) and used by Karimi (2014).

[4]Only 195 women in our sample had a kid before school completion. We removed them from the sample.

(mostly) needed; ii) delaying or not motherhood are effective in reducing the time out of the workforce. Second, Italy is an interesting case study because it has one of the lowest levels of both female employment and fertility, and the highest age at first birth in Europe.[5] Shedding more light on the instruments that might be effective in increasing new-mothers' workforce participation and reducing the propensity to postpone maternity is of utmost importance for facing the demographic change. It is worth stressing that we quantify the effect of childbirth disregarding from our estimand the component due to fertility intentions (like occupational sorting), which is confined to the time-varying UH. However, if policy relevance rests in interventions speeding up the return to work of new mothers, the effect we quantify is indeed the most relevant, since the policy maker can only observe childbirths but not plans or fertility intentions.

The paper is organized as follows. Section 2 summarizes the literature. Section 3 describes the data and the sample. Section 4 explains the econometric model. Section 5 reports the estimated effects. Section 6 concludes. An online Appendix contains additional descriptive statistics, details on the estimation strategy, the full set of estimation results, and several sensitivity checks.

2 Literature Review

There is a long tradition of studies on female labor supply and fertility.[6] The two processes are often modeled jointly, in recognition of the fact that motherhood matters for female career choices and vice versa (Browning, 1992; Iacovou, 2001). Within this strand of literature, we are mainly interested in the two blocks focusing on the *motherhood penalty* and on the *timing of childbirth*.[7]

From a theoretical viewpoint, the impact of childbirth on earnings may have an unclear sign. On the one hand, motherhood can positively affect labor supply and earnings, if new mothers are willing to work more to face the extra costs of raising children. On the other hand, female reservation wages may increase, especially if free childcare services are not available or limited and, at the same time, both the degree of their labor market attachment and human capital accumulation

[5] In 2015 the employment rate for women aged 20-64 stood at 50.6% in Italy versus 64.3% in the EU-28 area. In the same year in Italy the fertility rate was as low as 1.35 and the age at first birth reached 30.8, the highest ever value (Eurostat online database: http://ec.europa.eu/eurostat/data/database).

[6] See, among others, Killingsworth and Heckman (1986), and Blundell and MaCurdy (1999).

[7] See e.g. Dustmann and Schömberg (2012) and Asai (2015) (and the literature cited therein) for studies on the impact of maternity/parental leave reforms on children's long-term outcomes and mothers' labor market performance.

may decrease. Depressing effects on labor market performance can therefore be expected.[8]

Empirical research suggests that the reasons behind losses in labor market outcomes include career break and downward occupational mobility (Bratti et al., 2005; Fitzenberger et al., 2013; Waldfogel, 1997; Herr, 2016), hazard reduction and transition to flexible work schedules (Felfe, 2012), as well as family-oriented career choices made both before and after becoming a mother (Adda et al., 2017). A non-negligible loss in wages/earnings and a reduction in the hours worked after the childbirth were found in many countries (Harkness and Waldfogel, 2003). The empirical evidence is vast for the US (Taniguchi, 1999; Miller, 2011; Herr, 2016), where the motherhood wage gap for women with a high-school diploma or a college degree was found to be about 10% per child (Anderson et al., 2002). More recently, Wilde et al. (2010) reported at least twice that loss. By using individual fixed effects models, the estimated wage losses for the first child are found to be about 6% in the US and 9% in the UK (Waldfogel, 1998) and Spain (Fernández-Kranz et al., 2013).[9] Kleven et al. (2019) estimate that in Denmark, while fathers and mothers have similar labor market outcomes until the first childbirth, they diverge immediately after it and a 20% child penalty in earnings persists also in the long-run. Angelov et al. (2016) find similar results in Sweden. In Italy, three years after the childbirth the full-time wages of mothers are still significantly lower than those of childless women by about 3% (Pacelli et al., 2013).

A further relevant policy question is: how long does the motherhood penalty last? Earlier studies argued that the wage losses are persistent (Waldfogel, 1997) while, more recently, they were found to be temporary. Still, the wage gap between mothers and childless women may take almost a decade to close (Datta Gupta and Smith, 2002; Lalive and Zweimüller, 2009; Fernández-Kranz et al., 2013; Lundborg et al., 2017). For Italy, Pacelli et al. (2013) find that there is no sign of the wage gap closing five years after childbirth. At the same time, Rondinelli and Zizza (2011) argue that the effect of motherhood on female participation tends to be non-persistent once motherhood is instrumented with infertility shocks. This latter finding is supported by Michaud and Tatsiramos (2011) who, focusing on 7 European countries, show that Italy and Spain exhibit

[8] See Ermisch (1990) for a review of the theoretical models.

[9] These results are less robust for studies focusing only on college-educated women. Amuedo-Dorantes and Kimmel (2005) find that college-educated mothers might experience wage boost as compared to similar childless women, mainly because of better job matches with more female-friendly firms.

relatively low direct birth effects on female employment, explained by reliance on family ties.

The theoretical research on fertility decisions has also focused on the timing of births. Life cycle models emphasize that an early birth raises parents' utility due to the longer life spent with the child. Having a child earlier can however generate higher costs or lower expected earnings: with an imperfect capital market, the opportunity costs of the time spent caring for children and the net direct expenditures may not be affordable at the start of career (Hotz et al., 1997). Even with a perfect capital market, motherhood generates costs for the time spent out of the labor market and for the loss of human capital, with both of these costs varying over the working life. Theoretical models consider the female human capital before childbirth, the decay of job skills, the rate of return to human capital, and the length of the time spent out of the labor force as the main determinants of the optimal time for motherhood (see e.g. Cigno, 1983; Tomes, 1985; Cigno and Ermisch, 1989; Walker, 1995). They are often assumed to be positively linked with the postponement of pregnancy (Gustafsson, 2001).

From an empirical perspective, an increasing number of studies investigate how the timing of childbirth determines the amount of loss in future earnings and the way the motherhood penalty changes over the lifetime. For Italy, Bratti and Cavalli (2014) find that delaying the first birth by one year increases labor market participation by 1.2 percentage points (p.p.) and weekly working time by half an hour. They also find that late motherhood does not prevent a worsening of new mothers' job conditions. The dynamic life-cycle model in Adda et al. (2017) and the dynamic treatment approach by Fitzenberger et al. (2013) confirm a strong and quite persistent negative effect of childbirth on earnings, but cannot define a clear-cut effect of the timing of birth. On the one hand, the delay makes it possible to reach a higher-wage career track. On the other hand, it may increase the probability of exiting the labor force (Frühwirth-Schnatter et al., 2016). Miller (2011) reports a substantial improvement in labor market outcomes if motherhood is delayed in the US: an increase in earnings by 9% per year of delay, in wages by 3%, and in working hours by 6%. Similarly, Troske and Voicu (2013) find that in the US delaying the first birth generates a higher pre-natal levels of labor market participation, partially off-setting the negative labor supply effect of the first child. They also find that the negative impact of the second child is reduced if the time between the two births is shorter. Focusing on highly educated women in Sweden, Karimi

(2014) finds instead that motherhood delay produces significant adverse effects on both earnings and wages. Apart from the fact that the Swedish context is very different from the American one, the explanation offered to this contrasting finding is that spacing between several births gets more stringent with every delay. Looking only at the first birth, typically done by most of existing studies, might therefore not be enough. To understand how the effect of the first birth evolves over time one should consider the possibility of overlapping effects from the subsequent childbirths.

3 Data and Sample

3.1 Sample Selection Criteria

Our empirical analysis is based on the AD-SILC, which is obtained by matching two data sources: i) the IT-SILC database gathered by the Italian National Institute of Statistics (ISTAT); ii) the administrative data on labor market contracts from the National Social Insurance Agency (INPS). Since INPS manages social security, the database contains gross earnings and the number of working days for each working episode in each year for all the salaried employees. Furthermore, we matched the AD-SILC with the regional time series of unemployment, employment, and fertility rates from ISTAT, used as time-varying controls in our empirical analysis.

We mainly exploit the IT-SILC to rebuild fertility histories. We extract data on Italian women interviewed in 2005 and 2011, and aged between 26 and 45 at the time of the interview.[10] These two waves are the only ones with the *ad hoc* module on intergenerational transmission of poverty and disadvantages, which provides information on the family situation when the respondents were 14 years old. We exploit this predetermined information to model fertility decisions after school-leaving. We do not include in the analysis women younger than 26 at the moment of the survey interview, because the module on intergenerational transmission was submitted only to individuals older than 25. We exclude from our sample women older than 45 at the time of the interview to reduce the risk of errors in rebuilding mothers' childbearing history: the older the woman, the higher the risk of not assigning a child to her, simply because the child might have already left

[10]This implies that we removed from the 2005 (2011) dataset women born after 1980 (1986) and before 1960 (1966).

home.[11] To have at least 3 years of labor market data between graduation and the IT-SILC interview, we further select women who obtained their highest educational diploma before 2003 if interviewed in 2005, and before 2009 if interviewed in 2011.[12] Since the regional time series of unemployment, employment, and fertility rates gathered from ISTAT and used as time-varying controls are available from 1977, we further limit the sample to women who exited formal education after 1976. From the starting female sample of 50,673 units, these selection criteria[13] reduce the sample size to 9,387 women for whom, thanks to the INPS administrative data, we rebuilt all their past labor market histories up to the moment in which they were interviewed for the IT-SILC. This procedure to construct the sample leads to a period of observation of women's labor market outcomes which depends on the year of birth, the year of school exit, and the year of the IT-SILC interview. We observe longer-lasting labor market trajectories for women who are born earlier, exited school sooner, and were interviewed in 2011.

3.2 Descriptive Statistics

The construction of the sample is such that only women who completed school more than 3 years before the IT-SILC interview are kept. We can therefore observe, for all the 9,387 women, their labor market outcomes at least up to 3 years after school completion. The number of women for whom we observe longer labor market histories is decreasing with the size of the time window after school completion. In our empirical analysis, we look at the effect of childbirth on labor market outcomes until at most 21 years after school completion. The number of women for whom

[11] The imputation to each woman younger than 46 of her complete fertility history is likely to be measurement error free, because: i) the IT-SILC regards children of the household being educated away from home as household members; ii) in Italy children typically leave home very late, on average when older than 26 (Leopold, 2012); iii) according to Eurostat, Italy has the highest mean age of women at birth of the first child (29 years in 1997 and 31 in 2015).

[12] For the 141 women interviewed both in 2005 and 2011, we only keep the 2011 data, since more recent and therefore richer in the construction of the fertility history.

[13] To have a homogeneous sample and drop strange observations in terms of timing of education, we removed women younger than 13 or older than 32 at the time of their highest diploma (399 observations). We also removed women with more than 3 children at the time of the IT-SILC interview (96 units) or women who had children before completing education (195 women). In 67 cases, relevant data on parents and siblings were missing and observations were therefore removed. This IT-SILC sample was then merged with the INPS database. There were 628 women who were among the respondents of the IT-SILC survey, but they did not appear in the INPS database. This happens for example when a woman has never had a payroll employment position up to the moment of the IT-SILC interview. We deleted them. We excluded 37 women because they died during the period and 30 women because of missing or inconsistent information, such as starting date of the working period prior to the ending date, or daily earnings higher than €400. Table A.1 in the online Appendix reports in detail the impact of each selection criterion on the sample size.

we can observe 21 years of labor market experience between school completion and the IT-SILC interview amounts to 3,596. Table 1 shows in detail the number of observations from 3 to 21 years after school completion grouped by periods of three years, together with some descriptive statistics concerning the main time-invariant characteristics. As mentioned in the previous subsection, women observed for a longer period necessarily belong to older cohorts and/or exited school when younger: on average they are therefore less educated, have a larger number of siblings, and are less likely to have been at work in the year before school completion. The sample observed 3 years after school completion has an average age at diploma of 18.8. Graph (a) of Figure A.2 in the online Appendix gives more information on the age distribution at diploma: 71.7% of the sample completed school when 19 years old or younger, 90.5% when 25 or younger.

Table 1: Sample composition at different years after school completion

Years after school completion	Number of women	Year of birth	Age at diploma	Primary education	Secondary education	Tertiary education	Number of siblings at 14	Employment 1 year before school exit
3 years	9,387	1971.3	18.78	0.29	0.45	0.26	1.39	0.101
6 years	9,008	1971.0	18.48	0.29	0.47	0.24	1.41	0.093
9 years	8,228	1970.4	18.06	0.33	0.47	0.20	1.44	0.081
12 years	7,296	1969.7	17.64	0.36	0.47	0.17	1.48	0.075
15 years	6,148	1968.7	17.24	0.40	0.46	0.14	1.51	0.066
18 years	4,895	1967.8	16.77	0.44	0.45	0.11	1.54	0.056
21 years	3,596	1966.9	16.28	0.50	0.42	0.08	1.58	0.046

Herr (2016) showed that an appropriate measure to determine the impact of the timing of childbirth on labor market outcomes is based on the "career timing", rather than the biological age. Hence, we define the timing as the time elapsed since school completion. The yearly labor earnings measure gross earned income from the labor market as a salaried employee, excluding maternal/parental leave benefits, and other types of transfers. Table 2 shows summary statistics of the labor market outcomes and fertility variables from 3 to 21 years after school completion. The average number of kids per woman reaches the unity between 15 and 18 years after school completion. The labor earnings increase during the first 9 years and then remain stable.

Table 3 reports the mean labor earnings and the mean fraction of days spent in employment in a year by the number of kids from 3 to 21 years after school completion. The number of children is negatively correlated both to earnings and to the fraction of days in employment, almost in each year after school completion. The earnings and employment penalties are however slowly declining over time. While 6 years after school completion women with one child earn 23% less and work 15% less than childless women, 21 years after school completion these figures decline to

Table 2: Outcome variables at different years after school completion

		Number of childbirths†		Yearly labor earnings (€)§		Fraction of days at work in a year	
Years after school completion	Observations	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
3 years	9,387	0.056	0.246	7,612.42	9,742.48	0.441	0.461
6 years	9,008	0.197	0.467	10,525.25	10,889.79	0.568	0.462
9 years	8,228	0.411	0.669	11,941.37	11,740.24	0.619	0.457
12 years	7,296	0.693	0.812	12,154.15	12,296.94	0.627	0.458
15 years	6,148	0.960	0.890	12,070.04	12,438.80	0.626	0.458
18 years	4,895	1.167	0.916	12,047.93	12,689.56	0.626	0.462
21 years	3,596	1.316	0.923	12,012.06	12,565.84	0.626	0.465

§ Yearly labor earnings are in 2014 prices and deflated by the ISTAT consumer price index.
† The timing of childbirth is equal to the delivery date minus 3 months, to take into account in the econometric analysis that women could start reacting, and therefore being "treated", before the delivery.

20% and 10%, respectively. Further descriptive statistics can be found in Section A of the online Appendix.

Table 3: Yearly labor earnings and fraction of days worked in a year at different years after school completion by the number of kids

Years after school completion	Number of childbirths†	Frequency Absolute	Frequency Relative	Yearly labor earnings (€)§	Fraction of days at work in a year
3 years	0	8,893	0.947	7,684.46	0.445
	1	460	0.049	6,418.28	0.380
	2 or 3	34	0.004	4,925.55	0.426
6 years	0	7,492	0.832	11,104.52	0.588
	1	1,272	0.141	7,797.85	0.476
	2 or 3	244	0.027	6,957.06	0.423
9 years	0	5,633	0.685	13,164.38	0.666
	1	1,868	0.227	9,470.68	0.539
	2 or 3	727	0.088	8,813.43	0.459
12 years	0	3,741	0.513	14,283.50	0.704
	1	2,178	0.299	10,418.32	0.585
	2 or 3	1,377	0.189	9,114.74	0.483
15 years	0	2,345	0.381	14,797.25	0.725
	1	1,923	0.313	11,263.10	0.612
	2 or 3	1,880	0.306	9,493.69	0.516
18 years	0	1,440	0.294	15,010.76	0.726
	1	1,469	0.300	12,233.02	0.656
	2 or 3	1,986	0.406	9,762.74	0.529
21 years	0	869	0.242	15,601.20	0.733
	1	995	0.277	12,540.29	0.661
	2 or 3	1,732	0.482	9,907.82	0.551

§ See footnote § of Table 2. † See footnote † of Table 2.

In what follows we outline an econometric model to identify the impact of childbirths occurring at different time after school completion ("birth timing") on labor market outcomes at different moments in the future. Since at the maximum we rebuild 21 years of labor market career after school exit, we are able to identify long-term impacts of childbirths only if they took place soon after school completion. The later the childbirth occurs, the shorter is the follow-up horizon for the estimation of future effects. Moreover, because the procedure followed to construct the sample is such that we are able to observe longer labor market trajectories for women from older cohorts and with lower education, these women will weight more in the identification of longer lasting childbirth effects. In Subsection 5.3 we mention a sensitivity analysis to check if our findings are affected by this kind of changing composition of the sample across different follow-up horizons: we limit our sample to women who exited school with a secondary school diploma when 17-20 years old.

4 Econometric Model

4.1 General Framework

We consider a model with multiple treatments (one for each delivery), multiple time periods, and treatment effects that are heterogeneous over the birth timing. In this respect, our set-up is close to the models in Carneiro et al. (2003) and Fruehwirth et al. (2016).

Let $i = 1, \dots, n$ index a woman and $t = 1, \dots, T_i$ index the time elapsed since school completion. The observable time elapsed since school completion (T_i) differs across women and depends on the time between the IT-SILC interview and the year of school completion. We denote by R_i^k the random variable indicating the duration between school completion and the time period in which the k-th childbirth occurs, i.e. the birth timing, with $R_i^k \in \{1, \dots, R, \infty\}$, and $k = 1, \dots, K$. We let $R_i^k = \infty$ for women who do not give birth for the k-th time before the end of the observed time window. We observe childbirth k in our time window if $R_i^k \leq T_i \;\; \forall \;\; k$. Finally, since we retained in our sample only women who had at most three kids, K is equal to 3.[14]

Let us denote as Y_{it}^j the j-th labor market outcome, with $j = 1, \dots, J$, and let us define a dummy variable D_{ir}^k, which is equal to 1 if woman i gives birth for the k-th time at time r, with $r = 1, \dots, R$, and 0 if $R_i^k = \infty$. To clarify the notation, consider the evaluation of the effect of a second childbirth occurring 6 years after school completion on labor earnings, denoted by $j = 1$, fifteen years after school completion: then the treatment dummy will be denoted as D_{i6}^2 and the outcome Y_{i15}^1, with $r = 6$ and $t = 15$ indexing the years after school completion.

We assume no anticipation of treatment, often referred to as the *no anticipation* assumption (Abbring and van den Berg, 2003). We thus rule out the possibility that labor earnings and participation t years after school completion might be affected by the event of a childbirth $t + 1$ years

[14] Since we restricted the sample to women with 3 or less kids at the moment of the IT-SILC interview, if a woman has twins at her first or second delivery, then $K = 2$. In our sample we observe 100 twin births, 67 at the first delivery and 33 at the second delivery.

after school completion, conditioning on all prior information. As pointed out by Abbring and van den Berg (2003), this assumption does not rule out that forward looking women act on their labor market outcomes in t based on the *probability* of a childbirth in $t+1$. Therefore this assumption holds several months into the pregnancy, when there is still a positive probability of miscarriage.[15] However, since this probability is almost zero in the third trimester and the compulsory maternity leave generally starts two months before the expected delivery date, the no anticipation assumption may be violated when approaching the delivery date. Hence, given that the dates of childbirths are recorded in the IT-SILC on a quarterly basis, we modify the treatment timing by bringing forward the delivery date by one quarter, so as to avoid assigning to the control group at time t those women who will deliver at time $t+1$ but may already be on compulsory maternity leave in t.[16]

For woman i the observed labor market outcome j at time t can be written as

$$Y_{it}^{j} = \sum_{k=1}^{K} \sum_{r=1}^{\min\{t,R\}} \beta_{tr}^{jk} D_{ir}^{k} + \mu_t^j(X_{it}^j) + \epsilon_{it}^j, \tag{1}$$

where β_{tr}^{jk} is the effect of receiving the k-th treatment at time r on outcome j at time t, μ_t^j is a function of observed covariates X_{it}^j, and ϵ_{it}^j collects the individual- and time-varying unobservables. Following the example above, the parameter of interest for the evaluation of the effect of a second childbirth occurring 6 years after school completion on labor earnings 15 years after school completion is $\beta_{15,6}^{1,2}$. The *no anticipation* assumption implies $\beta_{tr}^{jk} = 0$ for $r > t$ and $\forall\ k$.

The occurrence of childbirth k at time r after school completion is modeled as a function of a treatment-time specific index as follows

$$V_{ir}^{k} = \nu^k(Z_i^k) + u_{ir}^k, \tag{2}$$

where ν^k is a function of observed covariates Z_i^k, which play a role in the decision of having a child in r, and u_{ir}^k denotes the individual and treatment-time unobserved heterogeneity. Equation (2) is

[15] The *no anticipation* assumption is violated if the individual knows about the realization of treatment and not just that the treatment is going to occur with some probability. It is different from a *randomized assignment* assumption, which is violated by anticipatory effects based on the probability of treatment. As mentioned by Fruehwirth et al. (2016), non anticipation can actually be stated in terms of a *no perfect foresight* assumption. Anticipatory effects are then accounted for by allowing for endogenous selection into treatment.

[16] In a sensitivity check shown in online Appendix G, we define the treatment as starting 9 months before the delivery.

a reduced-form expression not including the labor market outcomes of interest in its observable component. Selection into treatment k at time r occurs according to the following rules:

$$D^1_{ir} = \mathbb{1}\left(R^1_i = r | D^1_{ir'} = 0, r' < r\right), \tag{3}$$

$$D^k_{ir} = \mathbb{1}\left(R^k_i = r | D^k_{ir'} = 0, D^{k-1}_{ir'} = 1, r' < r\right), \tag{4}$$

where $\mathbb{1}(\cdot)$ is the indicator function and $R^k_i = r$ whenever V^k_{ir} crosses some threshold (see online Appendix B). Equation (3) is the selection into the treatment level $k = 1$ (the first childbirth), which may be taken by woman i at time r only if no other first deliveries have occurred before r, at time $r' < r$. Equation (4) refers to following deliveries after the first childbirth, which may only occur if woman i has already given birth for the $k-1$-th time ($D^{k-1}_{ir'} = 1$) and the k-th delivery has yet to occur at time r. To keep the model tractable in the estimation, we restrict the set of the time index t to $\{3, 6, 9, 12, 15, 18, 21\}$ and the time at which the k-th childbirth occurs has to be read accordingly, with $r = 3$ denoting the first three years after school completion, $r = 6$ the second three-year period, and so forth.

The treatment effects of interest on outcome j at time t are those with respect to women who are still childless at t. The average treatment effect on outcome j at time t of the first birth occurring in r is simply

$$\text{ATE}^j_t(1, r) = \beta^{j1}_{tr}. \tag{5}$$

For $k > 1$, the treatment effects with respect to women who are still childless at t are

$$\text{TE}^j_{it}(2, r, D^1_{i1}, D^1_{i2}, \ldots, D^1_{ir-1}) = \beta^{j2}_{tr} + \sum_{r'=1}^{r-1} \beta^{j1}_{tr'} D^1_{ir'} \tag{6}$$

for the second birth, and

$$\text{TE}^j_{it}(3, r, D^2_{i2}, \ldots, D^2_{ir-1}, D^1_{i1}, \ldots, D^1_{ir-2}) = \beta^{j3}_{tr} + \sum_{r''=2}^{r-1} \sum_{r'<r''} \left(\beta^{j2}_{tr''} + \beta^{j1}_{tr'}\right) D^2_{ir''} D^1_{ir'} \tag{7}$$

for the third delivery. On the one hand, the coefficients β^{j2}_{tr} and β^{j3}_{tr} capture differential effects on the outcomes at time t due to an additional birth. Such parameters are invariant to the timing of the previous births. On the other hand, Equations (6) and (7) clarify that the impact of the second and third child with respect to childless women varies with the timing of the previous deliveries. Notice that our framework falls between the model by Carneiro et al. (2003), who specify multiple treatments evaluated at different times, and the one by Fruehwirth et al. (2016), where the effect of the birth timing r of one treatment is related to the outcome of interest over t.

A compact quantification of the treatment effects of a second and third child with respect to childless women could be obtained by averaging Equations (6) and (7) with respect to the observed timing of previous births. For the second child, the average treatment effect can be formalized as

$$\begin{aligned}\text{ATE}_t^j(2,r) &\equiv \text{E}[\text{TE}_{it}^j(2,r,D_{i1}^1,D_{i2}^1,\dots,D_{ir-1}^1)|D_{ir}^2=1,r'<r]\\ &=\beta_{tr}^{j2}+\sum_{r'=1}^{r-1}\beta_{tr'}^{j1}\text{E}(D_{ir'}^1|D_{ir}^2=1,r'<r). \end{aligned}\tag{8}$$

Hence, each $\beta_{tr'}^{j1}$ is weighted by the expected fraction of women who delivered their first child in a given r', among those who delivered the second child in r. Similarly, for the third child the average treatment effect could be defined as

$$\text{ATE}_t^j(3,r)=\beta_{tr}^{j3}+\sum_{r''=2}^{r-1}\sum_{r'<r''}\left(\beta_{tr''}^{j2}+\beta_{tr'}^{j1}\right)\text{E}(D_{ir''}^2,D_{ir'}^1|D_{ir}^3=1,r'<r''<r),\tag{9}$$

where $(\beta_{tr''}^{j2}+\beta_{tr'}^{j1})$ is weighted by the expected fraction of women delivering the first child in a given r' and the second child in r'', among those who delivered the third child in r.

Table A.4 in the online Appendix shows the empirical counterparts of the conditional expectations in Equations (8) and (9) when we group time in 3-year intervals. Since the theoretical definitions in those equations implicitly assume that only one birth can occur in each time unit, we trivially adjust the computations to account for multiple deliveries in the same 3-year interval.

4.2 Identification

The identification of the childbirth effect relies on properly accounting for unobserved, and possibly time-varying, heterogeneity across women that might affect the occurrence of a delivery and labor market outcomes at the same or at a later time. For example, women with high labor market attachment may be less inclined to start a family soon after leaving school and more disposed instead to make an effort on their job to pursue their career, resulting in better labor market performances. However, their degree of commitment might change over time, for instance if they get married/divorced or if, when aging, they change their preferences about childbearing. Such heterogeneity could also represent relevant unobserved health shocks affecting both fertility and labor market decisions.

To account for selection on time-varying unobservables, we need to specify the joint distribution of the unobserved components determining the outcome, ϵ_{it}^{j}, with $t = 1, \ldots, T$ and $j = 1, \ldots, J$, in Equation (1) and the selection into treatment, u_{ir}^{k} with $r = 1, \ldots, R$ and $k = 1, \ldots, K$, in Equation (2). Following the factor analytic dynamic model of Carneiro et al. (2003),[17] we assume a factor structure in which the unobserved terms of both outcome and selection equations are composed of a latent trait called *factor*, representing the individual UH, and error terms that are conditionally independent given the factor. This type of structure greatly simplifies the problem of recovering the joint distribution of ϵ_{it}^{j} and u_{ir}^{k}, by assigning to the latent factor the task of capturing all the cross-equation dependence.

We therefore rewrite the error terms in Equations (1) and (2) as

$$\epsilon_{it}^{j} = \alpha_t^{j}\theta_{it} + \varepsilon_{it}^{j} \quad (10)$$

$$u_{ir}^{k} = \lambda_r^{k}\theta_{ir} + v_i^{k}, \quad (11)$$

where θ_{is}, $s = t, r$, is a latent factor in $\boldsymbol{\theta}_i = (\theta_{i1}, \ldots, \theta_{iT_i})$, which follows a multivariate distribution with $\mathrm{cov}(\theta_{is}, \theta_{is'}) \neq 0$, for all $s \neq s'$. The latent factor collects the unobserved differences across women that determine both the selection into treatments and the treatment effects. In this framework, UH is allowed to vary over time by means of both the factor distribution and a linear combination of the factor with time-varying coefficients, called *factor loadings*, denoted as α_t^{j}, $t = 1, \ldots, T$, and λ_r^{k}, $r = 1, \ldots, R$ and $k = 1, \ldots, K$. The error terms ε_{it}^{j} and v_i^{k} are such that $\mathrm{E}(\varepsilon_{it}^{j}) = \mathrm{E}(v_i^{k}) = 0$, are independent of θ_{is}, $s = t, r$, and mutually independent for all j, t, k, r; also ε_{it}^{j} is independent of $\varepsilon_{it''}^{j'}$ for all $j \neq j'$ and $t \neq t''$, and v_i^{k} is independent of $v_i^{k'}$ for all $k \neq k'$.

[17] See also Heckman and Navarro (2007), Fruehwirth et al. (2016), and Cockx et al. (2019).

The specification described in Equations (10) and (11) is a combination of the factor structures assumed by Carneiro et al. (2003) and Fruehwirth et al. (2016). Differently from their framework though, we assume that common unobservable traits are collected in a single factor rather than in a multidimensional set of latent variables.[18] The factor loadings in the treatment selection equations, λ_r^k, vary according to the treatment timing r, thereby allowing UH to determine the choice of having a child differently over time. However, we assume that unobserved heterogeneity cannot affect labor market outcomes at time t in a different manner according to the treatment timing r. We do so by imposing the implicit constraint $\alpha_{tr}^{jk} = \alpha_t^j$, $r = 1, \ldots, R, \infty$, $k = 1, \ldots, K$, which rules out essential heterogeneity (Heckman et al., 2006).[19]

Because our factor structure is a special case of the one proposed by Carneiro et al. (2003) combined with the dynamic structure assumed by Fruehwirth et al. (2016), their identification results related to the factor analysis can be invoked directly and specialized to fit the case of a single latent factor. In addition, Carneiro et al. (2003) pointed out that factor models are identified by arbitrary normalisations and suggested that a set of selection-free measurements reduces the degree of arbitrariness while providing greater interpretability. We adopt this strategy and rely on predetermined information to specify the additional measures

$$M_i^l = \omega^l(S_i^l) + \xi^l \theta_{i1} + e_i^l \quad l = 1, 2, \tag{12}$$

where M_i^l are information of woman i that are predetermined with respect to school completion and fertility choices. Specifically M_i^1 is a latent variable describing propensity to work at least one day in a year before school completion.[20] M_i^2 is the number of siblings the woman had when she was 14 years old. The last two columns of Table 1 report the sample means of these two variables. Furthermore, ω^l collects a linear combination of observed covariates S_i^l, ξ^l is a factor loading and e_i^l is a zero-mean error term independent of S_i^l and θ_{i1}, which is taken at the first period. Both

[18] While the identification results, recalled later in this section, would hold for our case with multiple factors as well (see Fruehwirth et al., 2016), this further extension would make the estimation of our model computationally cumbersome, given the high number of treatment and selection equations. Note that the number of parameters in our preferred specification is already 359 (see column (4) of Table 4).

[19] Fruehwirth et al. (2016) also specified time-varying factor loadings in the selection equations. In addition, they considered essential heterogeneity, differently from Carneiro et al. (2003).

[20] In the construction of the likelihood, this latent variable is the basis for the definition of a binary variable (see Section B of the online Appendix). Its expression as an unobserved propensity is used here to avoid abuse of notation.

measures should be of help in pinning down the distribution of the factor θ.

M_i^1 is likely to be determined by a series of unobserved characteristics, like for example labor force attachment, financial constraints, and family and social background, which should also be strong determinants of fertility choices and labor market participation. The number of siblings M_i^2 measures the family size and the fertility of parents. There is a vast empirical literature on the positive relation between the childhood family size and fertility in adulthood. See for example Murphy and Knudsen (2002), Booth and Kee (2009), Lyngstad and Prskawetz (2010), Murphy (2013), and the literature cited therein for earlier studies. Multiple explanations have been provided for it: e.g. genetics, socialization factors, socio-economic background, cultural influence, and human capital transmission. Furthermore, these unobserved characteristics are also likely to strongly determine labor market attachment and career orientation.

The final objective is the nonparametric identification of the joint distribution (up to a scale normalization) of the latent factor and error terms for each outcome j, treatment k and time of treatment r, that is the joint distribution of $(\theta_{i1}, \dots, \theta_{iT_i})$, $(\varepsilon_{i1}^j, \dots, \varepsilon_{iT}^j)$, v_i^k, and (e_i^1, e_i^2), defined in Equations (10)-(12).

To illustrate the rationale of the identification strategy, we break down the identification discussion in three main steps. The first step consists in identifying the joint distribution of $(\boldsymbol{\epsilon}_i^j, u_{ir}^k, \boldsymbol{\vartheta}_i)$, where $\boldsymbol{\epsilon}_i^j = (\epsilon_{i1}^j, \dots, \epsilon_{iT}^j)$, $\boldsymbol{\vartheta}_i = (\vartheta_i^1, \vartheta_i^2)$, with $\vartheta_i^l = \xi^l \theta_i + e_i^l$, and $l = 1, 2$. Nonparametric identification of this distribution is obtained following Heckman and Smith (1998), once the conditions required for Theorems 1 and 2 by Carneiro et al. (2003) are satisfied. Most of these requirements are assumptions and regularity conditions that we assume to hold (see Heckman and Smith, 1998, for further details), while we discuss here the requirement of exclusion restrictions. In Carneiro et al. (2003), having a continuous variable that is included among the set of observed determinants of one outcome but excluded from the others is enough to satisfy a support condition necessary to prove the nonparametric identification.[21] We therefore use in $\nu^k(Z_i^k)$ and in $\omega^l(S_i^l)$, in Equations (2) and (12), the employment rate, the unemployment rate, and the total fertility rate of the region at the time when the woman was born. These regional rates will also enter $\mu_t^j(X_{it}^j)$, but measured at the time t in which the labor market outcome is evaluated.[22] Table B.1 in online Appendix B

[21] See Assumption A-3 in Carneiro et al. (2003) and its comment at page 378.

[22] Bhargava (1991) and Mroz and Savage (2006) discussed how the time-variation of exogenous variables helps to

elucidates in detail the exclusions across equations. The sequentiality of the births gives rise to a set of exclusion restrictions that can be used to differentiate the set of covariates in the selection equations across k:

$$\begin{aligned}
\nu_i^1(Z_i^1) &= \nu^1(Z_i), \\
\nu_i^2(Z_i^2) &= \nu^1(Z_i) + \gamma_R^2 \bar{R}_i^1 + \gamma_B^2 B_i, \\
\nu_i^3(Z_i^3) &= \nu^1(Z_i) + \gamma_{R_1}^3 \bar{R}_i^1 + \gamma_{R_2}^3 (\bar{R}_i^2 - \bar{R}_i^1) + \gamma_S^3 G_i. \qquad (13)
\end{aligned}$$

Here Z_i is a set of woman i's characteristics listed in Table B.1, $\bar{R}_i^k$ is the time elapsed since school completion to the occurrence of the k-th childbirth, B_i is a dummy variable equal to 1 if the first delivery was a twin birth, and G_i is a dummy variable equal to 1 if the first two children are of the same gender.[23] We create these treatment-specific exclusion restrictions exploiting the fact that the k'-th delivery can occur only conditional on the k-th childbirth, with $k' > k$.

The second step concerns the identification of the factor loadings and of the elements of the variance-covariance matrix $V(\boldsymbol{\theta}_i)$. Once the joint distribution of $(\boldsymbol{\epsilon}_i^j, u_{ir}^k, \boldsymbol{\vartheta}_i)$ is identified, cross moments can be used to identify the factor loadings and to recover the elements in $V(\boldsymbol{\theta}_i)$ and, following Carneiro et al. (2003), we use the information provided by the variance-covariance structure, assuming covariances are non-zero.

First take the normalization $\alpha_t^1 = 1$, for $t = 1, \dots, T$, so that

$$\text{cov}(\epsilon_{it'}^1, \epsilon_{it}^1) = \text{cov}(\theta_{it'}, \theta_{it}), \quad \forall\, t' \neq t. \qquad (14)$$

Let us then consider the covariance between ϵ_{it}^1 and $\epsilon_{it'}^j$

$$\text{cov}(\epsilon_{it}^1, \epsilon_{it'}^j) = \alpha_t^j \text{cov}(\theta_{it'}, \theta_{it}), \quad \forall\, t' \neq t \text{ and } j > 1, \qquad (15)$$

identify the causal impacts of endogenous variables in dynamic discrete time panel data models.

[23] In theory, we could control in the equation for the second delivery for the same-gender dummy in case of a twin birth at the first delivery, similarly to what we do in the equation for the third delivery with G_i. However, all the 67 twin births observed in the first delivery are same-sex twins.

so that the ratios

$$\frac{\mathrm{cov}(\epsilon_{it}^1, \epsilon_{it'}^j)}{\mathrm{cov}(\epsilon_{it'}^1, \epsilon_{it}^1)} = \alpha_t^j \quad \forall\, t' \neq t \text{ and } j > 1,$$

identify the factor loadings for the outcome equations. Assuming that $\alpha_t^j \neq 0$, for all t and $j > 1$, the variances $V(\theta_{it})$ can be recovered using

$$\mathrm{cov}(\epsilon_{it}^1 \epsilon_{it}^j) = \alpha_t^j\, V(\theta_{it}), \quad t = 1, \ldots, T,$$

since the factor loading is already identified. Once the factor loadings of the outcome equations are identified and the elements of $V(\boldsymbol{\theta}_i)$ are recovered, the factor loadings for the selection equations can be obtained from any ratio of the type

$$\frac{\mathrm{cov}(\epsilon_{it'}^1, u_{ir}^k)}{\mathrm{cov}(\epsilon_{it'}^1, \epsilon_{it}^1)} = \lambda_r^k, \quad \forall\, k, t' \neq t, \text{ and } t = r,$$

and similarly, the factor loadings for the measurement equations can be identified using any ratio for $t = 2, \ldots, T$ of the type

$$\frac{\mathrm{cov}(\epsilon_{it}^1, \vartheta_i^l)}{\mathrm{cov}(\epsilon_{it}^1, \epsilon_{i1}^1)} = \xi^l, \quad l = 1, 2.$$

Finally, the information on the variances of ϵ_{it}^j and ϑ_i^l are used to identify the variances $V(\varepsilon_{it}^j)$ and $V(e_i^l)$, respectively.

With the identification of the joint distribution of $(\boldsymbol{\epsilon}_i^j, u_{ir}^k, \boldsymbol{\vartheta}_i)$ and of the factor loadings in hand, the third and final step consists in the nonparametric identification of the joint distribution of $(\boldsymbol{\theta}_i, \boldsymbol{\varepsilon}_i^j, v_i^k, \boldsymbol{e}_i)$, where $\boldsymbol{\varepsilon}_i^j = (\varepsilon_{i1}^j, \ldots, \varepsilon_{iT}^j)$ and $\boldsymbol{e}_i = (e_i^1, e_i^2)$. The result can be easily proven on the basis of Kotlarski (1967)'s identification theorem, as also suggested by Carneiro et al. (2003).[24]

[24] To illustrate the rationale of the identification strategy, consider a simple case when only one outcome is evaluated in the first period $t = 1$, in which only the first birth ($k = 1$) can occur at the same time as the outcome evaluation, $r = 1$, and there are no selection-free measurements. The model described by Equations (1)-(2), (10)-(11), and (12) can be rewritten as

$$\begin{aligned} Y_i &= \beta D_i + \mu(X_i) + \epsilon_i \\ V_i &= \nu(Z_i) + u_i, \end{aligned}$$

and the final objective is to nonparametrically identify the distributions of θ_i, ε_i, and v_i. Suppose there are two noisy measurements of the random variable θ_i, such that

$$E_{i1} = \theta_i + \varepsilon_i^*, \qquad E_{i2} = \theta_i + v_i^*,$$

4.3 Estimation

The detailed discussion on the specifications of the outcome, selection, and measurement equations, and of the related distributional assumptions used to build the likelihood function are in online Appendix B. It also contains the description of the maximum likelihood estimation of the parameters and the approaches for modeling the distribution of the latent factor $\boldsymbol{\theta}_i$.

5 Estimation Results

The baseline model described in Section 4 was estimated under 4 different assumptions on the latent factor: i) without UH; ii) with time-constant latent factor continuously distributed as a mixture of 3 normals; iii) with time-constant latent factor with discrete distribution (10 support points); iv) with time-varying latent factor with discrete distribution (10 support points). Table 4 reports some post-estimation statistics of these 4 models.

When the presence of time-constant UH is accounted for, the log-likelihood value increases substantially. Approximating non-parametrically the distribution of the time-constant latent factor using either a mixture of 3 normals or a discrete distribution with 10 support points leads to very similar values of the log-likelihood. A Vuong (1989) test for non-nested models rejects the null hypothesis that the two models are equivalent in favor of the discrete distribution of the latent factor. The point estimates of the effects of interest are however very similar. When we take into account that the latent factor could be time-varying, there is a further important increase in the log-likelihood function and an improvement both in the Akaike Information Criterion (AIC) and in the Bayesian Information Criterion (BIC).[25] The full set of estimation results of the four models

where ε_i^* and v_i^* are measurement errors. If ε_i^*,v_i^*, and θ_i are mutually independent, $\mathrm{E}(\varepsilon_i^*) = \mathrm{E}(v_i^*) = 0$, and the characteristic functions of ε_i^*,v_i^*, and θ_i are non-vanishing, then we can recover the distributions of ε_i^*,v_i^*, and θ_i from the joint distribution of E_{i1}, E_{i2} (see also Evdokimov and White (2012) for more general conditions). To apply Kotlarski's theorem, the joint distribution of ϵ_i, u_i and λ in (10)-(11) have to be identified, while α in Equation (10) has to be normalized to 1. Then we can rewrite

$$\epsilon_i = \theta_i + \varepsilon_i, \qquad \frac{u_i}{\lambda} = \theta_i + v_i^*,$$

where $v_i^* = \frac{v_i}{\lambda}$. Applying Kotlarski's theorem, the densities of θ_i, ε_i and v_i^* are nonparametrically identified, where ε_i is equal to ε_i^* and the density of v_i can also be identified since λ is known. The above result can be easily extended to the rest of the outcome, treatment, and measurement equations.

[25] The estimated covariance matrix of the discrete time-varying UH suggests that the UH is characterized by some time persistence, as the off-diagonal coefficients are positive and statistically significant (see Table D.7 in online Ap-

are in the online Appendix, from Section C to F. In what follows, Subsections 5.1 and 5.2 only show the impact of childbirth and birth timing on yearly labor earnings and the yearly fraction of days spent in employment from Models 1 (without UH) and 4 (with time-varying UH).

Table 4: Summary statistics of the estimated models under different assumptions on the UH

	(1) Without latent factor	(2) With time-constant latent factor	(3) With time-constant latent factor	(4) With time-varying latent factor
Number of parameters	285	310	321	359
Log-likelihood	−134,981.1	−119,289.4	−119,248.4	−100,743.1
AIC	270,532.3	239,198.9	239,138.9	202,204.2
BIC	272,569.2	241,414.5	241,433.1	204,770.1
Distribution of the latent factor	–	Mixture of 3 normals‡	Discrete	Discrete
Number of support points of the latent factor	–	–	10	10
Vuong statistic:§ Model (2) vs Model (3)		$z = -2.237$		

‡ We used the Gauss-Legendre quadrature rule with 13 points for the numerical integration over the normal distributions.

§ We computed the unadjusted Vuong (1989) test for non-nested models to determine whether the model with the mixture of 3 normals, Model (2), and the model with the discrete distribution (with 10 support points), Model (3), for the UH could be statistically rejected against the other. The test statistic z equal to -2.237 means that we reject the null hypothesis that Models (2) and (3) are equivalent in favor of Model (3), with a two tail p-value equal to 0.025.

5.1 Impact of Childbirth and Birth Timing on Yearly Labor Earnings

Table 5 reports the estimated impact of childbirth and birth timing on yearly labor earnings t years after school completion, with $t = 3, 6, \ldots, 21$, without UH (panel a) and with time-varying UH (panel b). When we control for time-varying UH, the negative effect of childbirths on earnings becomes smaller in the first 15 years after school completion. Later, the inclusion of time-varying UH instead magnifies the impact of the first and the second births. This is compatible with the effect of omitted variables, such as a certain degree of labor market attachment, career orientation, family background, couple formation, and timing of marriage, influencing fertility choices and labor earnings in opposite directions in the first 15 years. If unobservables were not accounted for, the negative impact of childbirth on earnings would be overestimated because those women having one or more kids would have earned less in the first 15 years, also in the counterfactual scenario without children. Later, there is instead evidence of positive correlation through unobservables between fertility and earnings, suggesting that motherhood is more likely with higher earnings.[26]

pendix D). Therefore, the UH seems to capture latent traits which affect labor and fertility decisions for a few decades, starting at least with school completion, although subject to some evolution over time. This specification is different from the one with time-constant UH, where the autocorrelations are equal to 1 and the autocovariances are therefore equal to the product of the related standard deviations. The estimated statistically significant variances of the latent factor confirm the need for a model where UH is accounted for.

[26]This partially differs from the results in Di Tommaso (1999), who found that in Italy the probability of childbearing is very sensitive to and negatively affected by an increase in wages.

Table 5: Average treatment effects of childbirths on yearly labor earnings (€)[§] with respect to childless women

Years since school completion	$t=3$	$t=6$	$t=9$	$t=12$	$t=15$	$t=18$	$t=21$
a) Without UH							
1st childbirth							
$r \in [0,3]$	**-3,256.99*** **	**-4,588.84*** **	**-4,844.16*** **	**-5,837.28*** **	**-5,041.59*** **	**-3,159.89* **	**-1,284.03**
	(509.27)	**(1,004.47)**	**(1,130.98)**	**(1,459.89)**	**(1,525.49)**	**(1,863.68)**	**(2,014.18)**
$r \in [4,6]$	–	**-4,224.79*** **	**-3,653.00*** **	**-3,608.79*** **	**-3,500.74*** **	**-1,716.97**	**-1,805.72**
		(521.367)	**(698.26)**	**(1,004.43)**	**(1,134.59)**	**(1,378.55)**	**(1,499.03)**
$r \in [7,9]$	–	–	**-4,125.42*** **	**-2,956.97*** **	**-2,398.24** **	**-1,002.49**	**-1,308.58**
			(520.22)	**(703.64)**	**(933.99)**	**(1,079.57)**	**(1,136.19)**
$r \in [10,12]$	–	–	–	-4,242.67***	-2,527.12***	-1,360.87	-1,853.21*
				(584.54)	(750.17)	(1,033.99)	(1,050.31)
$r \in [13,15]$	–	–	–	–	-4,604.16***	-2,767.90***	-2,653.69**
					(730.34)	(1,002.74)	(1,098.27)
$r \in [16,18]$	–	–	–	–	–	-4,797.12***	-3,286.31**
						(1,209.99)	(1,303.84)
$r \in [19,21]$	–	–	–	–	–	–	-5,577.67***
							(1,518.84)
2nd childbirth							
$r \in [1,6]$	–	-6,732.90***	-5,831.39***	-4,411.59***	-3,953.92**	-2,392.14	-1,529.14
		(948.62)	(1,350.63)	(1,590.51)	(1,988.00)	(2,331.13)	(2,757.33)
$r \in [7,9]$	–	–	-5,499.00***	-4,400.72***	-3,485.27***	-3,228.78**	-2,867.78*
			(642.66)	(1,041.39)	(1,154.96)	(1,371.56)	(1,690.59)
$r \in [10,12]$	–	–	–	-5,988.97***	-4,468.64***	-3,417.98***	-3,831.26***
				(737.53)	(952.95)	(1,113.29)	(1,221.82)
$r \in [13,15]$	–	–	–	–	-5,470.19***	-3,524.73***	-3,250.53***
					(831.53)	(962.12)	(1,034.46)
$r \in [16,18]$	–	–	–	–	–	-5,859.67***	-4,971.79***
						(1,000.06)	(1,238.42)
$r \in [19,21]$	–	–	–	–	–	–	-5,953.42***
							(1,273.62)
3rd childbirth							
$r \in [1, \min(t,12)]$	–	–	-5,698.84***	-6,362.85***	-7,615.03**	-7,396.75**	-6,927.64*
			(1,584.15)	(1,565.63)	(2,958.82)	(3,209.96)	(3,960.85)
$r \in [13,15]$	–	–	–	–	-5,971.77***	-4,139.40*	-3,583.28*
					(1,972.48)	(2,321.45)	(2,155.49)
$r \in [16, \min(t,21)]$	–	–	–	–	–	-6,290.38**	-6,102.21***
						(2,484.36)	(2,103.88)
b) With time-varying UH							
1st childbirth							
$r \in [0,3]$	**-2,118.85*** **	**-2,214.15*** **	**-2,575.16*** **	**-3,888.21*** **	**-3,574.70*** **	**-2,571.86**	**-723.93**
	(224.08)	**(496.54)**	**(842.05)**	**(1,181.72)**	**(1,286.52)**	**(1,641.35)**	**(1,798.58)**
$r \in [4,6]$	–	**-2,788.87*** **	**-1,528.01*** **	**-2,072.26*** **	**-2,264.35** **	**-814.74**	**-701.01**
		(264.25)	**(394.74)**	**(804.01)**	**(952.21)**	**(1,199.84)**	**(1,358.20)**
$r \in [7,9]$	–	–	**-2,647.11*** **	**-2,156.74*** **	**-1.978.21** **	**-851.46**	**-1,301.50**
			(294.74)	**(562.18)**	**(783.15)**	**(943.18)**	**(1,026.78)**
$r \in [10,12]$	–	–	–	-4,587.15***	-3,048.33***	-1,992.61**	-2,696.22***
				(466.36)	(627.64)	(901.57)	(941.20)
$r \in [13,15]$	–	–	–	–	-5,252.28***	-3,611.45***	-3,486.83***
					(608.28)	(868.59)	(980.83)
$r \in [16,18]$	–	–	–	–	–	-5,970.15***	-4,282.46***
						(1,044.77)	(1,166.02)
$r \in [19,21]$	–	–	–	–	–	–	-6,529.77***
							(1,354.62)
2nd childbirth							
$r \in [1,6]$	–	-4,035.70***	-2,106.47***	-1,356.47	-1,408.18	-240.63	331.12
		(460.68)	(748.45)	(1,282.88)	(1,698.76)	(2,066.90)	(2,511.46)
$r \in [7,9]$	–	–	-2,484.99***	-2,061.22**	-1,726.67*	-2,117.08*	-1,604.14
			(359.76)	(838.22)	(975.90)	(1,199.43)	(1,563.04)
$r \in [10,12]$	–	–	–	-5,199.30***	-4,014.12***	-3,166.51***	-3,700.26***
				(580.40)	(795.30)	(974.89)	(1,105.43)
$r \in [13,15]$	–	–	–	–	-5,468.60***	-3,982.13***	-3,907.06***
					(685.01)	(832.20)	(932.27)
$r \in [16,18]$	–	–	–	–	–	-6,202.87**	-5,335.99**
						(866.80)	(1,103.29)
$r \in [19,21]$	–	–	–	–	–	–	-7,456.72**
							(1,134.91)
3rd childbirth							
$r \in [1, \min(t,12)]$	–	–	-3,549.04***	-4,667.98***	-5,915.24**	-6,251.31**	-6,050.81*
			(894.268)	(1,229.17)	(2,487.57)	(2,779.92)	(3,635.75)
$r \in [13,15]$	–	–	–	–	-4,763.64***	-3,451.27*	-2,694.54
					(1,620.79)	(1,998.24)	(1,925.15)
$r \in [16, \min(t,21)]$	–	–	–	–	–	-6,619.79***	-6,533.49***
						(2,138.6)	(1,869.05)

Notes: In bold the estimation results plotted in Figure D.1, online Appendix D. *** Significant at 1%; ** significant at 5%; * significant at 10%. Standard errors are in parentheses. For the average treatment effects of the second and third childbirth, we report the estimation of Equations (8) and (9), with standard errors computed by the delta method.

[§] Yearly labor earnings are in 2014 prices and deflated by the ISTAT consumer price index.

By looking at the results with time-varying UH and focusing initially on the impact on earnings of the first childbirth, we realize that the first childbirth generates a sizeable, negative, and long-lasting effect. For example, a woman having the first child within three years since school-completion experiences a significant decrease in yearly labor earnings by €2,214 at time $t = 6$ and further by €2,575, €3,888, and €3,575, respectively at time 9, 12 and 15. Then, after persisting for about 12-15 years, the penalty fades away. Table 6 displays the penalties of the first child relatively to the average earnings of childless women at time t: the decrease is in the range of 20%, 19.6%, 27.2% and 24.2%, respectively at time 6, 9, 12 and 15. Figure D.1 in online Appendix D helps to visually quantify the magnitude and the duration of the impact on labor earnings of the first birth occurring at different times since school completion. Graph (a) reports the results based on the model without UH. Graph (b) shows instead the findings based on the model with time-varying UH.[27]

Table 6: Estimated impacts of the 1st childbirth on yearly labor earnings, relative to the average in t for childless women (with time-varying UH).

Years since school completion	$t = 3$	$t = 6$	$t = 9$	$t = 12$	$t = 15$	$t = 18$	$t = 21$
$[0, 3]$	-28.5%	-20.0%	-19.6%	-27.2%	-24.2%	-17.1%	-4.6%
$[4, 6]$	–	-25.1%	-11.6%	-14.5%	-15.3%	-5.4%	-4.5%
$[7, 9]$	–	–	-20.1%	-15.1%	-13.4%	-5.7%	-8.3%
$[10, 12]$	–	–	–	-32.1%	-20.6%	-13.3%	-17.3%
$[13, 15]$	–	–	–	–	-35.5%	-24.1%	-22.3%
$[16, 18]$	–	–	–	–	–	-39.8%	-27.4%
$[19, 21]$	–	–	–	–	–	–	-41.9%

Notes: These figures are computed by evaluating the change in labor earnings implied by the estimated coefficients reported in Table 5 relative to the average labor earnings of childless women in t. The average labor earnings of childless women at different years (t) since school completion are reported in Table 3.

Two points are worth of mention by looking at Figure D.1 and Table 5. First, Graph (b) suggests that having the first child soon after school completion magnifies the negative effect on labor earnings: women conceiving the first-born 0-3 years after leaving school (similarly for 4-6 years) experience significant penalties at least up to 15 years since the diploma for at least, on average, 12-15 years after the childbirth. Those conceiving the first child 7-9 years since school completion are instead able to catch up much faster with childless women by taking on 9 years or less. Their earnings gap profile almost overlaps the profile of women giving birth immediately after school completion. Hence, women delaying the first child until the 7th-9th year

[27] The horizontal axis of Figure D.1 stands for the years since school completion. See Figure D.3 for the plot of the same estimation results but with the horizontal axis measuring time after childbirth.

after school completion avoid the loss of earnings that women having a child soon after leaving school experience in the preceding years.

Second, delaying too much the first child generates a substantial loss of earnings, at least in the short and medium run. Table 5 shows indeed that women delivering the first child later than 9 years after school completion face increasing penalties. For example, the earnings of a woman delivering the first child 10-12 years after school completion suffer a penalty of €4,587 in $t = 12$ and further €3,048, €1,993 and €2,696 at time 15, 18 and 21, respectively. Relative to the average earnings of childless women, the decrease ranges between 32% and 13% (see Table 6). As the negative impact of delaying too much is large in both absolute and relative terms, these large penalties cannot be explained by earnings that are higher in absolute value and therefore by a temporary absence from the labor market for maternal/parental leave being more costly in absolute terms. There might be however other explanations, like older women taking more time to recover from delivery, childbirth in a key moment for the career progression, higher depreciation of human capital for women with larger work experience (Mincer and Ofek, 1982), loss of most job skills because of the career interruption (Happel et al., 1984), or more time spent caring for the child as they are more likely to experience the last maternity compared to women who gave birth sooner.

As regards the impact of the second and third birth, the bottom of Table 5 shows the estimates of Equations (8) and (9). It therefore illustrates the impact of further births on earnings with respect to women who are still childless in t.[28] The second childbirth, like the first one, has also differential effects depending on its timing. Women delivering the second child within 6 years since school completion experience on average an overall effect of the two childbirths with respect to childless women which is short-lasting. After significant penalties from the two early childbirths of €4,035 and €2,106, respectively in time 6 and 9, those mothers catch up with childless women already 12 years after school completion.[29] Comparing the earnings penalties of a woman having only one

[28] The estimated coefficients in Equations (8) and (9) are instead shown in Table D.1 in the online Appendix; these coefficients can be interpreted as the impact of the second birth with respect to one-child women, or the impact of the third birth with respect to women with two children. When looking at the impact on earnings of the second birth with respect to one-child women from Table D.1, we find that the effect is relevant only in the short-term. This is in line with the results of other studies that instrumented fertility using the occurrence of twins at birth (Jacobsen et al., 1999) or the in vitro fertilization (IVF) success (Lundborg et al., 2017).

[29] Similar penalties both in size and duration are experienced by women having the second child 7-9 years after school

child within 6 years since school completion with a woman having two children within the same 6 years is informative. While by $t = 12$ the latter catches up with childless women, the former does it only by $t = 18$. Although this finding could be seen as inconsistent with human capital theory which predicts that earnings should depend on the absolute duration of time out of the labor market, there are other contrasting forces at stake. First, a woman with one child and a woman with two short spacing pregnancies could be characterized by similar time spent out of the labor market. Second, employers could perceive women with two kids as less risky and costly to hire compared to women with one kid, as the former are more likely to have reached their intended lifetime fertility. Indeed, despite the diffusion of the one-child family model, most of Italian women still manifest the preference for two kids (Testa, 2014). Third, a second birth soon after school exit might substantially change the financial needs of the household, lower the reservation wages and push women to participate in the labor market sooner and/or more intensively compared to one-child women, thereby offsetting the differences due to the lower human capital accumulation for women with two kids. Earnings penalties are instead somewhat longer lasting if the second birth timing is in 10-12 or 13-15.

Understanding the impact of the third childbirth and its timing on earnings is more challenging since the identification is based on a much smaller number of observations. Although the point estimates indicate sometimes large negative effects of the third childbirth, the corresponding 95% intervals are fairly large. We therefore refrain from drawing conclusions based on them.

Summarizing, the main findings on the impact of childbirth and birth timing on earnings are:

1. Women incur a sizable and significant loss in labor earnings after childbearing, especially after the first one. Our findings are very much consistent with those in Lundborg et al. (2017) who, exploiting the randomness of IVF success, found that the first child generates long-lasting negative effects on earnings with magnitudes similar to ours.[30]
2. The timing of the first child matters. With respect to the previous literature on the effect of delaying the first childbirth (Miller, 2011; Karimi, 2014; Herr, 2016; Leung et al., 2016), we are able to detect non-linearities in the impact of the birth timing. The loss in earnings

completion. Table 3 shows that 278 (727) women had at least two kids 6 (9) years since school-completion.

[30] Lundborg et al. (2017) found that 6-10 years since IVF the earnings penalty amounts to 30,000 Danish krone, which was about €4,000 in 2008.

caused by the first birth is much smaller if it occurs 7-9 years since school completion. Given that more than 70% of our sample exit education before turning 20, most of the women face smaller penalties if they become mothers around the age of 26-28.

3. Although most of the negative effect and of its persistence come from the first birth, also the timing of the second childbirth matters. We find evidence of shorter-lasting earnings penalties if the first and second childbirths occur within 6 years since school completion. In this case, the duration of the motherhood penalty is indeed 6 years shorter than in the case of only one child within 6 years since school completion.

5.2 Impact of Childbirth and Birth Timing on Yearly Fraction of Days Spent at Work

Table 7 reports the point estimates of the impact of childbirth on the yearly fraction of days spent with a contract of salaried employment. Women conceiving the first-born 0-3 or 4-6 years after school completion display a small penalty at the beginning, but a relevant long-lasting effect, which amounts to 5.3-7.4 p.p. in $t = 15$. Then they catch up with childless women. In the last year of observation ($t = 21$), they even spend more time in the labor market than childless women (about 6 p.p. but not significant at 5%). Fitzenberger et al. (2013) found much larger negative effects for new mothers in Germany, ranging from 50 p.p. one year after the delivery to 20 p.p. five years after. There are at least two explanations for this quantitative difference. First, in our analysis we evaluate the impact on the fraction of days in a year covered by an employment contract, whereas Fitzenberger et al. (2013) look at whether the woman is at work. Their dependent variable is therefore more responsive to shocks and the point estimates are not directly comparable. Second, the maternity leave coverage is quite long (36 months of job-protected leave) in Germany, and the detachment from the labor market induced by the childbirth could therefore be magnified.

Graph (b) of Figure D.2 in online Appendix D allows to compare the impact of the first childbirth for women delivering 7-9 years after school completion with the one for women delivering soon after their diploma.[31] The catching up profiles are quite similar to each other, with the only

[31] The horizontal axis of Figure D.2 stands for the years after school completion. See Figure D.4 for the plot of the same estimation results but with the horizontal axis measuring time after childbirth.

Table 7: Average treatment effects of childbirths on yearly fraction of days spent in employment with respect to childless women

Years since school completion	$t=3$	$t=6$	$t=9$	$t=12$	$t=15$	$t=18$	$t=21$
a) Without UH							
1st childbirth							
$r \in [0,3]$	-0.070***	-0.149***	-0.159***	-0.179***	-0.144***	-0.092	0.028
	(0.024)	(0.037)	(0.040)	(0.046)	(0.049)	(0.061)	(0.074)
$r \in [4,6]$	–	-0.095***	-0.129***	-0.140***	-0.104***	-0.056	0.006
		(0.021)	(0.026)	(0.032)	(0.037)	(0.045)	(0.053)
$r \in [7,9]$	–	–	-0.095***	-0.112***	-0.092***	-0.033	-0.017
			(0.019)	(0.025)	(0.032)	(0.038)	(0.044)
$r \in [10,12]$	–	–	–	-0.085***	-0.098***	-0.047	-0.066
				(0.019)	(0.026)	(0.035)	(0.041)
$r \in [13,15]$	–	–	–	–	-0.107***	-0.084**	-0.093**
					(0.025)	(0.035)	(0.043)
$r \in [16,18]$	–	–	–	–	–	-0.085**	-0.077*
						(0.035)	(0.044)
$r \in [19,21]$	–	–	–	–	–	–	-0.117**
							(0.049)
2nd childbirth							
$r \in [1,6]$	–	-0.177***	-0.218***	-0.165***	-0.190***	-0.139*	-0.034
		(0.036)	(0.047)	(0.056)	(0.066)	(0.083)	(0.094)
$r \in [7,9]$	–	–	-0.184***	-0.189***	-0.152***	-0.108**	-0.026
			(0.029)	(0.037)	(0.038)	(0.049)	(0.057)
$r \in [10,12]$	–	–	–	-0.183***	-0.171***	-0.124***	-0.093**
				(0.024)	(0.031)	(0.036)	(0.042)
$r \in [13,15]$	–	–	–	–	-0.153***	-0.128***	-0.095**
					(0.027)	(0.034)	(0.039)
$r \in [16,18]$	–	–	–	–	–	-0.169***	-0.173***
						(0.034)	(0.043)
$r \in [19,21]$	–	–	–	–	–	–	-0.179***
							(0.043)
3rd childbirth							
$r \in [1, \min(t,12)]$	–	–	-0.140**	-0.188***	-0.243***	-0.198**	-0.166
			(0.068)	(0.053)	(0.074)	(0.090)	(0.109)
$r \in [13,15]$	–	–	–	–	-0.211***	-0.152**	-0052
					(0.058)	(0.077)	(0.076)
$r \in [16, \min(t,21)]$	–	–	–	–	–	-0.253***	-0.247***
						(0.064)	(0.063)
b) With time-varying UH							
1st childbirth							
$r \in [0,3]$	-0.005	-0.012	-0.016**	-0.073***	-0.074**	-0.064	0.062
	(0.005)	(0.008)	(0.008)	(0.031)	(0.037)	(0.052)	(0.065)
$r \in [4,6]$	–	-0.014***	-0.011**	-0.062***	-0.053*	-0.016	0.059
		(0.005)	(0.005)	(0.022)	(0.027)	(0.037)	(0.047)
$r \in [7,9]$	–	–	-0.014***	-0.074***	-0.076***	-0.027	-0.018
			(0.004)	(0.017)	(0.024)	(0.031)	(0.039)
$r \in [10,12]$	–	–	–	-0.105***	-0.127***	-0.077***	-0.105***
				(0.014)	(0.020)	(0.029)	(0.036)
$r \in [13,15]$	–	–	–	–	-0.140***	-0.123***	-0.130***
					(0.020)	(0.029)	(0.038)
$r \in [16,18]$	–	–	–	–	–	-0.143***	-0.126***
						(0.030)	(0.039)
$r \in [19,21]$	–	–	–	–	–	–	-0.168***
							(0.044)
2nd childbirth							
$r \in [1,6]$	–	-0.026**	-0.014	-0.020	-0.074	-0.055	0.036
		(0.009)	(0.012)	(0.038)	(0.050)	(0.067)	(0.085)
$r \in [7,9]$	–	–	-0.016***	-0.080***	-0.077***	-0.075*	0.013
			(0.006)	(0.025)	(0.029)	(0.041)	(0.051)
$r \in [10,12]$	–	–	–	-0.150***	-0.158***	-0.127***	-0.101***
				(0.017)	(0.023)	(0.030)	(0.037)
$r \in [13,15]$	–	–	–	–	-0.151***	-0.162***	-0.138***
					(0.021)	(0.029)	(0.035)
$r \in [16,18]$	–	–	–	–	–	-0.191***	-0.196***
						(0.028)	(0.038)
$r \in [19,21]$	–	–	–	–	–	–	-0.255***
							(0.040)
3rd childbirth							
$r \in [1, \min(t,12)]$	–	–	-0.024	-0.107***	-0.176***	-0.152*	-0.149
			(0.018)	(0.039)	(0.055)	(0.078)	(0.097)
$r \in [13,15]$	–	–	–	–	-0.168***	-0.134**	-0.033
					(0.044)	(0.063)	(0.068)
$r \in [16, \min(t,21)]$	–	–	–	–	–	-0.291***	-0.289***
						(0.054)	(0.057)

Notes: In bold the estimation results plotted in Figure D.2, online Appendix D. *** Significant at 1%; ** significant at 5%; * significant at 10%. Standard errors are in parentheses. For the average treatment effects of the second and third childbirth, we report the estimation of Equations (8) and (9), with standard errors computed by the delta method.

difference that childbearing sooner implies a small effect in the first years after the childbirth. Women childbearing sooner are on average younger and they and their partners are more likely to be in less protected jobs. This might explain the smaller effect in the first years after the childbirth. For example, a woman in a couple with reduced employment protection could smooth her parental leave over time differently from what a new mother would do if the employment situation would be more stable. For example, if the employment stability of the couple is low, she could be more likely to mix the horizontal part-time with her parental leave, hence fully counting as a day at work in the construction of the yearly fraction of days at work, rather than staying at home all day in parental leave. The first choice could better prove her career attachment, reduce the problems generated to the employer and, therefore, the likelihood of job loss, especially in case of temporary contracts. Once the earning and employment stability of the couple is attained, for example because the partner reaches a permanent position, the labor market participation of the mother could decrease, explaining the increased penalty from the 12th year since school completion.

The penalties become larger if the childbirth occurs after the 10th year since school completion. Panel b) of Table 7 shows indeed that women with the timing of the first child in 10-12 experience a reduction in the fraction of time spent at work of 12.7, 7.7 and 10.5 p.p. in time 15, 18 and 21, respectively. Table 8 quantifies the estimates relatively to the average fraction of days spent at work by childless women. In relative terms, in those years the decrease is between 14.3% and 17.5%. Women delaying the first childbirth further are found to incur even larger penalties. Frühwirth-Schnatter et al. (2016) found something similar in terms of labor force participation for Austrian women who gave birth later in life. Our findings enrich the empirical evidence in Bratti and Cavalli (2014), who found that in Italy delaying the first birth increases the labor market participation of new mothers two years later. However, differently from us, Bratti and Cavalli (2014) did not study medium/long-run effects and did not take into account that the impact of delaying the first child could be heterogeneous over the waiting time.

The short-run effect of childbirth (reported in the diagonal of panel b of Table 7) is rather stable for those giving birth within 9 years after school completion. Then, the immediate effect of the first birth jumps from -1.4 at $t = 9$ to -10.5 p.p. at $t = 12$, growing further in the subsequent periods. A similar profile is also displayed in panel b of Table 5 for earnings. Possible mechanisms explaining

Table 8: Estimated impacts of the 1st childbirth on the fraction of days worked in a year, relative to the average in t for childless women (with time-varying UH).

Years since school completion	$t = 3$	$t = 6$	$t = 9$	$t = 12$	$t = 15$	$t = 18$	$t = 21$
$[0, 3]$	-1.1%	-2.0%	-2.4%	-10.4%	-10.2%	-8.8%	8.5%
$[4, 6]$	–	-2.4%	-1.7%	-8.8%	-7.3%	-2.2%	8.0%
$[7, 9]$	–	–	-2.1%	-10.5%	-10.5%	-3.7%	-2.5%
$[10, 12]$	–	–	–	-14.9%	-17.5%	-10.6%	-14.3%
$[13, 15]$	–	–	–	–	-19.3%	-16.9%	-17.7%
$[16, 18]$	–	–	–	–	–	-19.7%	-17.2%
$[19, 21]$	–	–	–	–	–	–	-22.9%

Notes: These figures are computed by evaluating the change in the fraction of days worked in a year implied by the estimated coefficients reported in Table 7 relative to the average fraction of days worked in a year of childless women in t. The average fractions of days worked in a year of childless women at different years (t) since school completion are reported in 3.

these increasing profiles if the first birth occurs 10 or more years after school exit may include: i) the achievement of a more stable contract, so that staying longer in parental leave is less risky; ii) being in a higher career track and having therefore more financial resources for a longer period outside the labor market; iii) being less fit to affront both pregnancy and child-rearing combined with work activity; iv) being more inclined to be fully dedicated to a long-awaited child.

The second childbirth plays a role on the fraction of time spent in employment similar to the one played on earnings. If the second childbirth occurs early, the catch up with childless women is even faster than the one of women having only one child within the same number of years since school completion. For example, a woman having two childbirths within 6 years since school completion significantly reduces the fraction of time spent in employment by 2.6 p.p. only in $t = 6$. Then, the gap with childless women is no longer significantly different from zero. A woman having instead only one child within 6 years since school completion has a significantly lower fraction of time in employment up to $t = 15$.

Finally, while Table 7 shows that women conceiving the first child within 6 years after school completion spend more time at work than childless women 21 years after school completion (not significant at 10%), Table 5 reports that the earnings of those women are somewhat smaller than the earnings of childless women (although not significant at 10%). This suggests that having the first child at the beginning of the career generates: i) either a long-lasting negative effect on the wage rate, likely because becoming mother soon causes women to follow a different career path in downgraded jobs, with lower wage rates and less chances of promotion throughout the remainder of their working career; ii) or a shift to horizontal part-time work; iii) or both. These explanations are consistent with Leung et al.'s (2016) hypothesis that human capital accumulates faster in the initial stage of career. Hence, women giving birth soon after school completion are less able to benefit from this higher accumulation rate.

Summarizing, the main findings on the impact of childbirth and birth timing on the fraction of time spent in employment are:

1. Childbearing significantly reduces the yearly fraction of time spent in employment.
2. The timing matters. The reduction in the time spent in employment caused by the first child becomes large after the 9th year since school completion.
3. Similar to earnings, the second childbirth within few years since school completion speeds up the catching up with childless women in terms of the fraction of time spent in employment.

5.3 Sensitivity Analysis

We run several sensitivity analyses which are reported and commented in online Appendix G. In a nutshell, we checked the robustness of our findings by: i) defining the treatment as starting 9 months before the delivery date, instead of 3; ii) including among the regressors of the labor market outcomes the accumulated work experience up to the previous period; iii) re-estimating under different combinations of exclusion restrictions; iv) re-estimating using only women who exited school between 17 and 20 years of age with a secondary school diploma, to have a more homogeneous subsample; v) splitting the sample in those born in the 1960s and those born later, to verify the presence of cohort differences in the effects; vi) running routines to assess whether the estimated parameter vector could be a local optimum.

6 Conclusions

We studied to what extent childbirth impacts on labor market outcomes of women, with a special focus on the heterogeneity of the effect across different childbirth timings. Shedding light on how the fertility timing affects female labor force participation is of utmost importance to understand whether and how "tempo policies" (Lutz and Skirbekk, 2005), i.e. policies to modify the timing of births, could be of help in reducing the motherhood labor market penalties without increasing the mean age at childbearing and, therefore, without necessarily affecting completed cohort fertility.

To isolate the impact of the timing of childbirths, we set up an econometric model with multiple treatments (one for each childbirth), multiple time periods, and in which treatment effects are allowed to be heterogeneous according to the time in which a childbirth occurs since school completion. Compared to previous studies, our model is equipped to deal with the fact that: i) women having children at different moments after school completion might differ in unobservables determining both fertility choices and labor market outcomes (dynamic selection); ii) identifying not only the short-run effects, but also long-lasting consequences, is policy relevant; iii) the impact of delaying the childbirth could be non-linear over the elapsed time since school exit.

We provide evidence that in Italy childbearing has a negative and relevant impact on female labor market participation and earnings. Birth timing matters in shaping the profile of the motherhood penalties. The negative birth effect is especially long-lasting if the first delivery occurs soon after school completion: the gap between early mothers and childless women takes about 12-15 years to close. Furthermore, we find increasing penalties in the short- and medium-run if the first childbirth is delayed too much. Penalties are however smaller and shorter-lasting if:

- The first childbirth occurs 7-9 years after school completion. At the start of the career the age-earnings profile could be steeper and the loss due to career interruption larger. It also suggests that the age-earnings profile becomes relatively flatter 7-9 years since school exit.
- Both the first and the second child are delivered soon, within 6 years since school exit. This might substantially change the financial needs of the household, lower the reservation wages, and press women to participate in the labor market more intensively.

If the policy maker aims at weakening the impact of motherhood on the labor market participation, our general finding of negative and relevant impact of childbirths calls for interventions. A policy mix addressing the different facets of the problem is the most promising route, although one needs to be cautious since our analysis does not incorporate general equilibrium effects.[32]

On the side of opportunity cost of working, it could be of help to reduce the cost of childcare services, so as to lower the value of the outside option. Since we found that the first child especially generates negative and long-lasting effects for women delivering soon after school completion,

[32]See Abbring and Heckman (2007, Section 4) for a discussion on the risk of using standard treatment effect estimates for the evaluation of policies affecting the economy at large.

policies aimed at enlarging access to affordable childcare services and at increasing employment stability for new labor market entrants would be mostly desirable. New labor market entrants are indeed more likely to be financially constrained and less likely to afford childcare, because of a larger employment instability and lower earnings.

On the side of employment value, a complementary reform to make work pay more after the mandatory maternity leave, either via an in-work benefit or a tax credit, could increase the pace at which new mothers return to work. We find that the penalties from the first childbirth are larger if it occurs too late. If the in-work benefit/tax credit for the first child is designed so as to decrease after about 10 years since school exit, it would create the incentive for bringing forward the first childbirth, with also positive effects on female employment and earnings. Similarly, if the in-work benefit/tax credit were made more generous for women having soon both the first and the second child, it would aim at the replacement rate without posing a long-lasting threat to their labor market participation.

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Online Appendix

A Further Descriptive Statistics

Table A.1 reports in detail the impact of each selection criterion on the sample size. It shows that 85% of the removed observations is due to the age being lower than 26 or higher than 45 at the moment of the IT-SILC interview. A further 7% and 2% of the removed observations are due to women born abroad and women still in education at the moment of the IT-SILC interview, respectively. Together, these 3 selection criteria amount to about 94% of the total loss in terms of number of women from the initial 2005 and 2011 waves of the IT-SILC.

Table A.1: Sample size across selection criteria

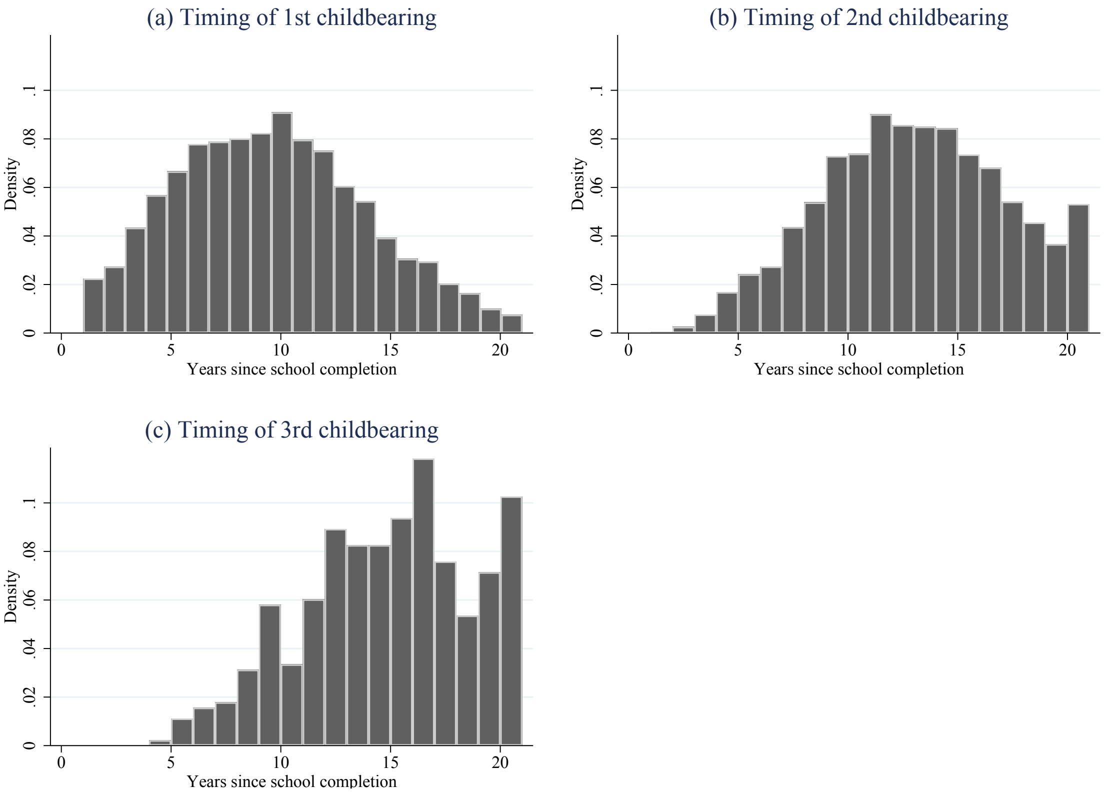
	Women left in the sample	Women removed
Women in IT-SILC, waves 2005 and 2011	50,673	–
After removing women with missing province of birth	50,664	9
After removing women born abroad	47,739	2,925
After keeping women between 26 and 45 years of age at the moment of IT-SILC interview	12,671	35,068
After removing women in education at the moment of IT-SILC interview	11,915	756
After keeping women who exited education after 1976	11,351	564
After keeping women who got their highest educational diploma before 2003 (2009) if interviewed in 2005 (2011)	10,839	512
After removing women younger than 13 or older than 32 at the time of their highest diploma	10,440	399
After removing women with more than 3 children at the time of the IT-SILC interview	10,344	96
After removing women who had children before completing education	10,149	195
After removing women with missing information on parents and/or siblings	10,082	67
After removing women never appearing in the INPS database	9,454	628
After removing women who died during the period under analysis	9,417	37
After removing women with inconsistent information or daily earnings higher than €400	9,387	30
Final sample	9,387	41,286

Figure A.1 shows the timing of childbirth by plotting the fraction of women childbearing in each year after school completion, conditional on having the corresponding pregnancy before the end of the 21st year since school completion. Among the total sample of 9,387 women, 5,566 had the first child within the 21st year since school completion, 3,140 gave birth to a second child, and 448 had also the third one.

To have a better understanding of the raw relationship between childbirth, birth timing and the labor market outcomes, we run a series of separate Ordinary Least Squares (OLS) regressions for each $t \in \{3, 6, 9, 12, 15, 18, 21\}$

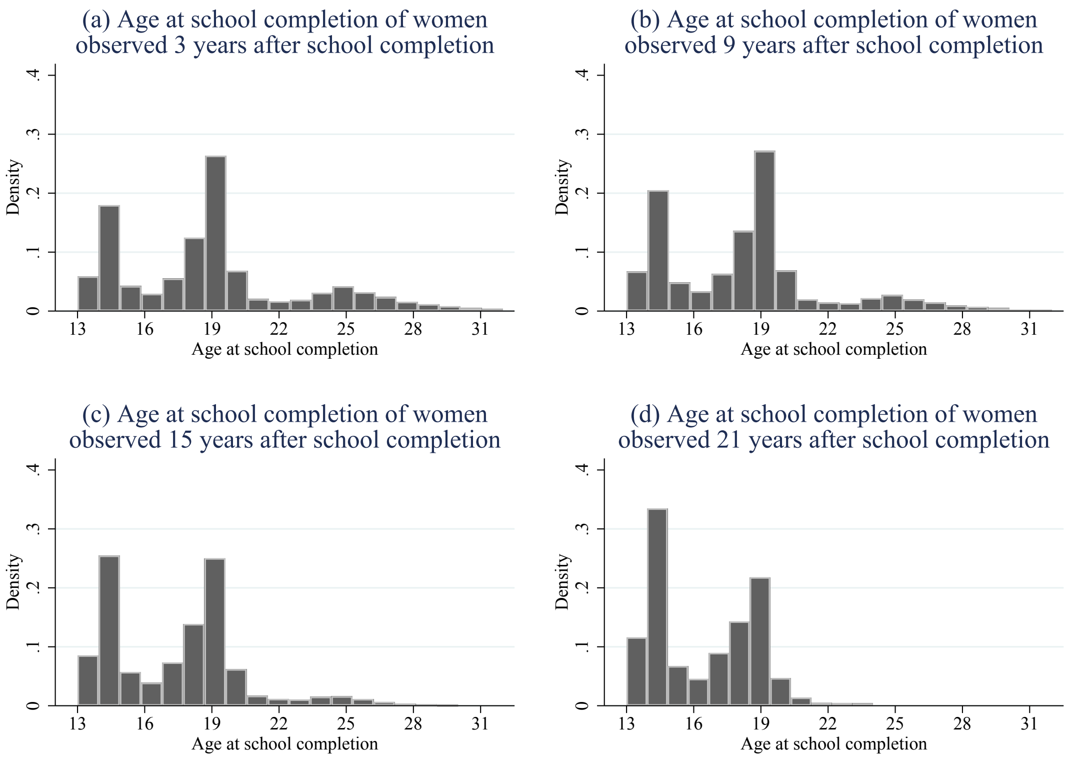
$$Y_{it} = \sum_{r=3}^{t} \beta_{tr}^{1} D_{ir}^{1} + \sum_{r=3}^{t} \beta_{tr}^{2} D_{ir}^{2} + \sum_{r=3}^{t} \beta_{tr}^{3} D_{ir}^{3} + \boldsymbol{x}_{it}' \boldsymbol{\pi}_t + \epsilon_{it}, \tag{A.1}$$

Figure A.1: The timing of childbirth (delivery date minus 3 months)



Notes: The histograms display the fraction of women having the 1st, the 2nd, and the 3rd childbirth in each year after school completion, conditional on having the corresponding expected childbirth within the end of our time-window, i.e. before the 21st year since school completion. The timing of the childbirth is defined as the delivery date minus 3 months. Graph (a) is drawn using the 5,566 women with first childbirth before the 21st year since school completion; graph (b) using the 3,140 women having the second childbirth before the 21st year since school completion; graph (c) on the basis of the 448 women having the third childbirth before the end of the time window.

Figure A.2: The age at school completion



Notes: The histograms display the distribution of women across the age at school completion for the samples observed at different moments after school completion. Graph (a) is drawn using all the 9,387 women for whom we can observe the labor market outcomes 3 years after school completion. Similarly graphs (b), (c), and (d) are drawn using 8,228, 6,148, and 3,596 women for whom we can observe the labor market outcomes 9, 15, and 21 years since school completion, respectively.

where:

- Y_{it} is either labor earnings or fraction of time spent in employment t years after school completion.
- $\boldsymbol{x}_{it}$ is a vector of covariates: the constant, age at school completion, educational attainment, regional dummies, calendar year dummies, regional unemployment, employment, and fertility rates in the t-th year after school completion.
- D^k_{ir}, with $k = 1, 2, 3$, are dummies equal to 1 if the k-th child is born between $r - 2$ and r years after school completion.
- β^k_{tr} is the impact of the k-th childbirth between $r - 2$ and r years after school completion on labor market outcome t years after school completion.
- ϵ_{it} is the error term.

The estimated β^1_{tr} for the t and r of interest are graphically displayed, along with 95% confidence intervals, in Figure A.3. Tables A.2 and A.3 report the point estimates of all the β^k_{tr}s. Figure A.3(i) shows the evolution over time of the earnings penalty related to the first childbirth, with respect to childless women, for different timing of the first childbirth. The continuous line is the earnings gap with respect to childless women childbearing the first child between 0 and 3 years after school completion. Similarly, the dotted line is the earnings gap if childbirth occurs between 4 and 6 years after school completion. Finally, the dashed line is the earnings gap if the childbearing of the first child occurred between the 7th and the 9th year after school completion. Figure A.3(ii) focuses instead on the penalty in terms of fraction of time spent in employment. The penalties due to childbirth are substantial and the highest for women conceiving a child soon after school completion: they have much lower earnings until the 21st year since school completion. The maximum penalty is reached 12 years after school completion, when it is more than €6,000. Then, they are able to slightly catch up with childless women but, 21 years after school completion (and 18-20 years from childbearing), their earnings are still significantly lower than those of childless women by about €2,500. Also, women having a child later suffer relevant and significant earnings penalties, with a similar profile but smaller in size and with minor cumulative forgone earnings. We find a similar descriptive evidence when looking at panel (b): i) the reduction in the fraction of time spent in employment is the largest for women bringing forward the first pregnancy; the catching-up response starts 12–15 years after school completion, independently of the timing of the first childbirth.

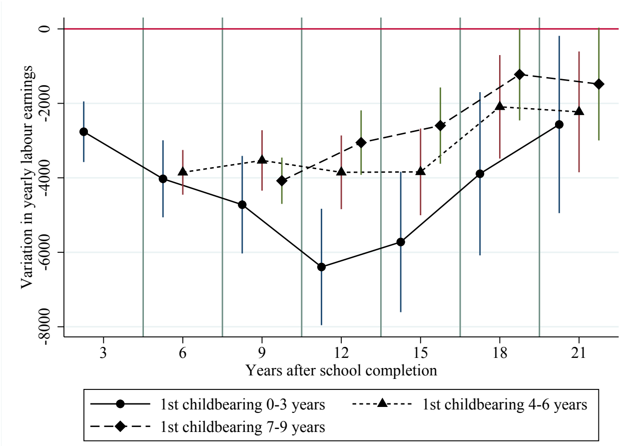
Figure A.4 displays the additional impact of the second childbirth on earnings and the time spent in employment. Those women having the second childbirth within the 6th year since school completion face an additional immediate penalty, as the impact of the second child becomes not significantly different from zero already 9 years after school completion. For women who delay the second childbirth up to 10 years since school completion, it seems that there is a further penalty in terms of both labor earnings and numbers of days at work in a year.

The estimation results presented in Figures A.3 and A.4 cannot be given a causal interpretation: the process determining fertility and birth timing is indeed endogenous because of unobserved traits, both time-constant and time-varying, which jointly determine both the labor market outcomes and the decision of whether and when to have children. In other words, women having kids could be systematically different from childless women. Moreover women having children in different stages of their lives could be systematically different from each other. The proposed econometric model is aimed at disentangling the true causal effect of childbirth and birth timing from the spurious one induced by systematic differences across women with different fertility histories, due to time-varying and time-constant characteristics unobserved by the analyst.

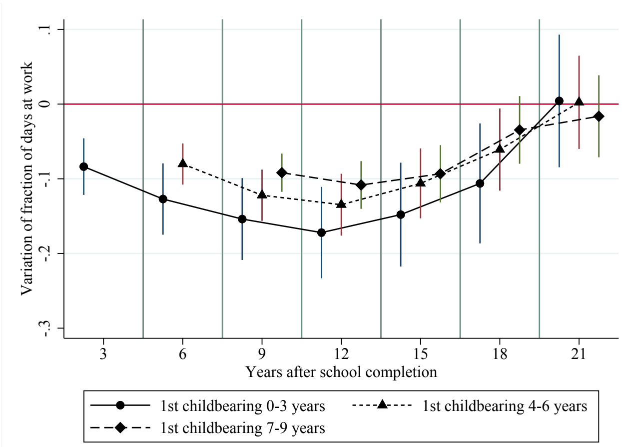
Table A.5 shows the distribution of the age at school completion by birth decade. The moment of school exit was delayed across cohorts, but not so much. Both the average age and the median age at school completion increased by 1 year between those born in the 1960s and those born in the 1980s. The 90th percentile has instead remained stable at 25 years of age. The only important change is at the 25th percentile, which moved from 14 (15) in the 1960s (1970s) to 18 in the 1980s.

Figure A.3: First childbirth, its timing and labor market outcomes

(i) Over time variation of yearly labor earnings after the 1st childbirth occurring 0-3, 4-6, or 7-9 years after school completion



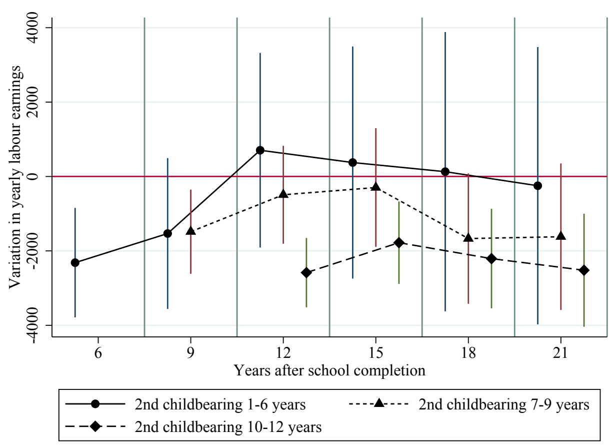
(ii) Over time variation of the fraction of days worked in a year after the 1st childbirth occurring 0-3, 4-6, or 7-9 years after school completion



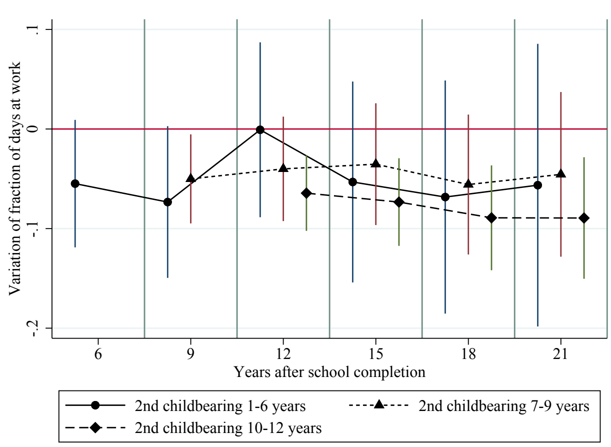
Notes: These graphs are obtained by estimating linear equations for earnings, panel (a), or fraction of time spent in employment, panel (b), 3 to 21 years after school completion and by plotting the OLS estimates of the coefficients of the dummies indicating the time interval in which the 1st childbirth occurred (delivery date minus 3 months), conditional on: the constant, the time period in which the eventual 2nd and 3rd pregnancies occurred, the age at which the diploma was obtained, the type of diploma (tertiary, secondary, or less), dummies for the region of residence, the regional unemployment, employment, and fertility rates, and time dummies for the calendar year in which earnings are evaluated. The vertical segments crossing the dots are 95% confidence intervals robust to heteroskedasticity.

Figure A.4: Second childbirth, its timing and additional impact on labor market outcomes

(i) Over time variation of yearly labor earnings after 2nd childbirth occurring 1-6, 7-9, or 10-12 years after school completion



(ii) Over time variation of the fraction of days worked in a year after 2nd childbirth occurring 1-6, 7-9, or 10-12 years after school completion



Notes: These graphs are obtained by estimating linear equations for earnings, panel (a), or fraction of time spent in employment, panel (b), 3 to 21 years after school completion and by plotting the OLS estimates of the coefficients of the dummies indicating the time interval in which the 2nd childbirth occurred (delivery date minus 3 months), conditional on: the constant, the time period in which the 1st pregnancy occurred, the time period in which an eventual 3rd pregnancy occurred, the age at which the diploma was obtained, the type of diploma (tertiary, secondary, or less), dummies for the region of residence, the regional unemployment, employment, and fertility rates, and time dummies for the calendar year in which earnings are evaluated. The vertical segments crossing the dots are 95% confidence intervals robust to heteroskedasticity.

Table A.2: OLS estimated coefficients of the impact of childbirth and birth timing on yearly labor earnings (€)[§]

Years since school completion	$t = 3$	$t = 6$	$t = 9$	$t = 12$	$t = 15$	$t = 18$	$t = 21$
1st childbirth							
$r \in [0, 3]$	**-2,761.52*****	**-4,026.25*****	**-4,721.42*****	**-6,394.05*****	**-5,723.17*****	**-3,890.44*****	**-2,567.28****
	(415.33)	**(527.59)**	**(668.28)**	**(797.47)**	**(961.48)**	**(1,118.46)**	**(1,214.40)**
$r \in [4, 6]$	–	**-3,852.05*****	**-3,532.45*****	**-3,851.67*****	**-3,840.44*****	**-2,092.59*****	**-1,921.48****
		(306.29)	**(413.96)**	**(504.97)**	**(594.01)**	**(708.91)**	**(840.16)**
$r \in [7, 9]$	–	–	**-4,077.70*****	**-3,053.58*****	**-2,597.13*****	**-1,223.35***	**-1,481.06***
			(317.31)	**(441.63)**	**(522.61)**	**(629.84)**	**(772.49)**
$r \in [10, 12]$	–	–	–	-4,212.51***	-2,530.11***	-1,346.80**	-1,796.11**
				(330.89)	(458.15)	(569.92)	(728.98)
$r \in [13, 15]$	–	–	–	–	-4,413.49***	-2,567.81***	-2,376.74***
					(420.39)	(559.34)	(755.05)
$r \in [16, 18]$	–	–	–	–	–	-4,400.75***	-2,701.51***
						(536.28)	(737.95)
$r \in [19, 21]$	–	–	–	–	–	–	-5,167.58***
							(857.69)
2nd childbirth							
$r \in [1, 6]$	–	**-2,316.40*****	**-1,533.01**	**705.71**	**375.12**	**129.20**	**-248.59**
		(750.84)	**(1,034.25)**	**(1,334.06)**	**(1,591.56)**	**(1,915.10)**	**(1,901.55)**
$r \in [7, 9]$	–	–	**-1,483.94****	**-491.26**	**-296.60**	**-1,668.43***	**-1,618.63**
			(577.44)	**(670.86)**	**(813.90)**	**(894.05)**	**(1,005.07)**
$r \in [10, 12]$	–	–	–	**-2,583.90*****	**-1,778.90*****	**-2,207.94*****	**-2,519.87*****
				(474.92)	**(565.51)**	**(682.47)**	**(775.40)**
$r \in [13, 15]$	–	–	–	–	-2,676.46***	-2,227.42***	-1,773.85**
					(495.38)	(620.57)	(759.19)
$r \in [16, 18]$	–	–	–	–	–	-3,767.84***	-2,717.20***
						(619.20)	(735.61)
$r \in [19, 21]$	–	–	–	–	–	–	-2,865.21***
							(693.93)
3rd childbirth							
$r \in [1, \min(t, 12)]$	–	-3,440.78	376.69	-1,400.54	-3,536.09***	-4,644.37***	-4,386.95***
		(2,202.91)	(1,588.04)	(1,333.71)	(1,180.33)	(1,324.58)	(1,472.27)
$r \in [13, 15]$	–	–	–	–	-1,646.78*	-915.21	49.70
					(907.20)	(1,277.67)	(1,514.94)
$r \in [16, 18]$	–	–	–	–	–	-2,865.30***	-1,825.24
						(936.85)	(1,282.23)
$r \in [19, 21]$	–	–	–	–	–	–	-2,543.95*
							(986.48)
Observations	9,387	9,008	8,228	7,296	6,148	4,895	3,596
R^2	0.256	0.261	0.256	0.255	0.251	0.224	0.228

Notes: In bold the estimation results plotted in Figures A.3 and A.4. The constant, age at school completion, educational attainment, regional dummies, calendar year dummies, regional unemployment, employment, and fertility rates in the t-th year after school completion are also included in the equation for the labor earnings. Their OLS estimated parameters are not reported for the sake of brevity. They are available from the authors upon request. *** Significant at 1%; ** significant at 5%; * significant at 10%. In parentheses we report standard errors robust to heteroskedasticity.

[§] Yearly labor earnings are in 2014 prices and deflated by the ISTAT consumer price index.

Table A.3: OLS estimated coefficients of the impact of childbirth and birth timing on the fraction of days spent in employment

Years since school completion	$t = 3$	$t = 6$	$t = 9$	$t = 12$	$t = 15$	$t = 18$	$t = 21$
1st childbirth							
$r \in [0, 3]$	**-0.084***	**-0.127***	**-0.154***	**-0.172***	**-0.148***	**-0.106***	**0.004**
	(0.019)	**(0.024)**	**(0.028)**	**(0.031)**	**(0.035)**	**(0.041)**	**(0.045)**
$r \in [4, 6]$	–	**-0.080***	**-0.122***	**-0.135***	**-0.106***	**-0.061***	**0.002**
		(0.014)	**(0.017)**	**(0.021)**	**(0.024)**	**(0.028)**	**(0.032)**
$r \in [7, 9]$	–	–	**-0.092***	**-0.108***	**-0.093***	**-0.035**	**-0.016**
			(0.013)	**(0.016)**	**(0.020)**	**(0.023)**	**(0.028)**
$r \in [10, 12]$	–	–	–	-0.085***	-0.099***	-0.046**	-0.064**
				(0.014)	(0.017)	(0.021)	(0.026)
$r \in [13, 15]$	–	–	–	–	-0.107***	-0.082***	-0.090***
					(0.017)	(0.021)	(0.028)
$r \in [16, 18]$	–	–	–	–	–	-0.083***	-0.071**
						(0.024)	(0.030)
$r \in [19, 21]$	–	–	–	–	–	–	-0.120***
							(0.039)
2nd childbirth							
$r \in [1, 6]$	–	**-0.055***	**-0.073***	**-0.001**	**-0.053**	**-0.068**	**-0.056**
		(0.033)	**(0.039)**	**(0.045)**	**(0.051)**	**(0.060)**	**(0.072)**
$r \in [7, 9]$	–	–	**-0.050***	**-0.040**	**-0.035**	**-0.056**	**-0.046**
			(0.023)	**(0.027)**	**(0.031)**	**(0.036)**	**(0.042)**
$r \in [10, 12]$	–	–	–	**-0.064***	**-0.073***	**-0.089***	**-0.089***
				(0.019)	**(0.022)**	**(0.27)**	**(0.031)**
$r \in [13, 15]$	–	–	–	–	-0.045**	-0.092***	-0.064**
					(0.019)	(0.023)	(0.028)
$r \in [16, 18]$	–	–	–	–	–	-0.111***	-0.108***
						(0.023)	(0.029)
$r \in [19, 21]$	–	–	–	–	–	–	-0.096***
							(0.032)
3rd childbirth							
$r \in [1, \min(t, 12)]$	–	-0.048	0.084	0.005	-0.080	-0.083	-0.138*
		(0.128)	(0.059)	(0.043)	(0.049)	(0.058)	(0.072)
$r \in [13, 15]$	–	–	–	–	-0.079	-0.032	0.015
					(0.049)	(0.048)	(0.058)
$r \in [16, 18]$	–	–	–	–	–	-0.134***	-0.171***
						(0.047)	(0.053)
$r \in [19, 21]$	–	–	–	–	–	–	-0.112**
							(0.054)
Observations	9,387	9,008	8,228	7,296	6,148	4,895	3,596
R^2	0.214	0.218	0.221	0.213	0.197	0.165	0.151

Notes: In bold the estimation results plotted in Figures A.3 and A.4. The constant, age at school completion, educational attainment, regional dummies, calendar year dummies, regional unemployment, employment, and fertility rates in the t-th year after school completion are also included in the equation for the fraction of time spent in employment. Their OLS estimated parameters are not reported for the sake of brevity. They are available from the authors upon request. *** Significant at 1%; ** significant at 5%; * significant at 10%. In parentheses we report standard errors robust to heteroskedasticity.

Table A.4: Empirical counterparts of the conditional expectations[§] in Equations (8) and (9)

a) Expected fraction of women having the 1st childbirth in r', conditional on having the 2nd child in r: $\mathrm{E}(D^1_{ir'} | D^2_{ir} = 1, r' \leq r)$

	Timing of 2nd childbirth[†]						
	$r \in [0,3]$	$r \in [4,6]$	$r \in [7,9]$	$r \in [10,12]$	$r \in [13,15]$	$r \in [16,18]$	$r \in [19,21]$
Timing of 1st childbirth[†]							
$r' \in [0,3]$	1.000	0.662	0.215	0.055	0.017	0.004	0.008
$r' \in [4,6]$	–	0.338	0.598	0.292	0.080	0.052	0.012
$r' \in [7,9]$	–	–	0.187	0.522	0.316	0.103	0.054
$r' \in [10,12]$	–	–	–	0.132	0.499	0.404	0.171
$r' \in [13,15]$	–	–	–	–	0.089	0.386	0.403
$r' \in [16,18]$	–	–	–	–	–	0.050	0.318
$r' \in [19,21]$	–	–	–	–	–	–	0.035
Total number of 2nd childbirths	34	213	520	767	729	497	258

b) Expected fraction of women having the 1st childbirth in r' and the 2nd one in r'', conditional on having the 3rd child in r:
$\mathrm{E}(D^2_{ir''}, D^1_{ir'} | D^3_{ir} = 1, r' \leq r'' \leq r)$

	Timing of 3rd childbirth[†]						
	$r \in [0,3]$	$r \in [4,6]$	$r \in [7,9]$	$r \in [10,12]$	$r \in [13,15]$	$r \in [16,18]$	$r \in [19,21]$
Timing of 1st and 2nd childbirths[†]							
$r' \in [0,3]$ and $r'' \in [0,3]$	NA[§]	0.231	0.083	0.026	0.009	0.020	0.000
$r' \in [0,3]$ and $r'' \in [4,6]$	–	0.769	0.333	0.141	0.044	0.020	0.027
$r' \in [0,3]$ and $r'' \in [7,9]$	–	–	0.104	0.103	0.044	0.010	0.014
$r' \in [0,3]$ and $r'' \in [10,12]$	–	–	–	0.013	0.018	0.010	0.000
$r' \in [0,3]$ and $r'' \in [13,15]$	–	–	–	–	0.000	0.000	0.014
$r' \in [0,3]$ and $r'' \in [16,18]$	–	–	–	–	–	0.000	0.000
$r' \in [0,3]$ and $r'' \in [19,21]$	–	–	–	–	–	–	0.000
$r' \in [4,6]$ and $r'' \in [4,6]$	–	0.000	0.146	0.064	0.044	0.020	0.014
$r' \in [4,6]$ and $r'' \in [7,9]$	–	–	0.271	0.282	0.211	0.140	0.027
$r' \in [4,6]$ and $r'' \in [10,12]$	–	–	–	0.128	0.140	0.080	0.041
$r' \in [4,6]$ and $r'' \in [13,15]$	–	–	–	–	0.018	0.010	0.000
$r' \in [4,6]$ and $r'' \in [16,18]$	–	–	–	–	–	0.030	0.000
$r' \in [4,6]$ and $r'' \in [19,21]$	–	–	–	–	–	–	0.000
$r' \in [7,9]$ and $r'' \in [7,9]$	–	–	0.063	0.064	0.026	0.080	0.041
$r' \in [7,9]$ and $r'' \in [10,12]$	–	–	–	0.154	0.254	0.140	0.192
$r' \in [7,9]$ and $r'' \in [13,15]$	–	–	–	–	0.061	0.060	0.137
$r' \in [7,9]$ and $r'' \in [16,18]$	–	–	–	–	–	0.010	0.014
$r' \in [7,9]$ and $r'' \in [19,21]$	–	–	–	–	–	–	0.000
$r' \in [10,12]$ and $r'' \in [10,12]$	–	–	–	0.026	0.061	0.120	0.027
$r' \in [10,12]$ and $r'' \in [13,15]$	–	–	–	–	0.053	0.160	0.233
$r' \in [10,12]$ and $r'' \in [16,18]$	–	–	–	–	–	0.030	0.055
$r' \in [10,12]$ and $r'' \in [19,21]$	–	–	–	–	–	–	0.014
$r' \in [13,15]$ and $r'' \in [13,15]$	–	–	–	–	0.018	0.010	0.014
$r' \in [13,15]$ and $r'' \in [16,18]$	–	–	–	–	–	0.050	0.069
$r' \in [13,15]$ and $r'' \in [19,21]$	–	–	–	–	–	–	0.000
$r' \in [16,18]$ and $r'' \in [16,18]$	–	–	–	–	–	0.000	0.027
$r' \in [16,18]$ and $r'' \in [19,21]$	–	–	–	–	–	–	0.041
$r' \in [19,21]$ and $r'' \in [19,21]$	–	–	–	–	–	–	0.000
Total number of 3rd childbirths	0	13	48	78	114	100	73

[†] The timing of childbirths is equal to the delivery date minus 3 months, to take into account in the econometric analysis that women could start reacting, and therefore being "treated", before the delivery.
[§] NA stands for "Not Applicable" because none in our dataset had three childbirths within 3 years since school completion.

Table A.5: Distribution of the age at school completion by birth decade

	Age at school completion		
	Born between 1960 and 1969	Born between 1970 and 1979	Born between 1980 and 1985
Mean	18.362	19.034	19.380
Std. Dev.	4.170	4.290	3.682
10th percentile	14	14	14
25th percentile	14	15	18
50th percentile	18	19	19
75th percentile	19	20	22
90th percentile	25	26	25
Observations	3,887	4,764	736

B Estimation

Here we describe in detail the specifications of the outcome, selection, and measurement equations, and the related distributional assumptions, in order to build the densities composing the final likelihood function. Next we discuss the Maximum Likelihood (ML) estimation of the model parameters and the approaches for modeling the distribution of the latent factor $\boldsymbol{\theta}_i$.

As illustrated in Section 3, our dataset allows us to follow women over time up to several years after school completion. We however decided to stop at 21 years in order to retain a large enough number of women in our sample (3,596). Because estimating the parameters for 21 outcomes, along those entering selection and measurements equations, may be computationally intractable, we restrict the set of periods for which it is of interest evaluating the effect of the timing of childbirth and choose to assess the treatment effects every three years after school completion. For this reason, it is convenient to redefine the set for the time index t as $\widetilde{T} = \{3, 6, 9, 12, 15, 18, 21\}$. As a consequence, the time at which the k-th childbirth occurs has to be read accordingly, with $r = 3$ denoting the first three years after school completion, $r = 6$ the second three-year period, and so forth.

Measurement Equations

The two additional measurement equations, for which a general expression is given in Equation (12), contain predetermined information on woman i. The first measure is indicated as $\widetilde{M}_i^1$ and is a dummy variable equal to 1 if a woman worked for at least one day in the year before school completion. It is based on M_i^1 in (12) as follows

$$\widetilde{M}_i^1 = \mathbb{1}\{M_i^1 \geq 0\}, \quad M_i^1 = \boldsymbol{s}_i'\boldsymbol{\zeta}^1 + \xi^1\theta_{i3} + e_i^1,$$

where $\mathbb{1}(\cdot)$ is an indicator function and e_i^1 is assumed to be normally distributed with zero mean and unit variance. The second measure is the number of siblings the woman had when she was 14 years old, which is specified as a continuous variable:

$$M_i^2 = \boldsymbol{s}_i'\boldsymbol{\zeta}^2 + \xi^2\theta_{i3} + e_i^2,$$

where e_i^2 has zero mean and variance $V(e_i^2) = \varpi^2$. In both equations the explanatory variables $\boldsymbol{s}_i$, listed in Table B.1, are independent of θ_{i3}. When the latent factor is specified as time-varying, we let the measurements be functions of the θ_{i3} entering the outcome and treatment equations the first time we model them, i.e. three years after school completion.

Let the parameters of the measurement equations be collected into $\boldsymbol{\tau}_1$ and $\boldsymbol{\tau}_2$, respectively. The joint density of $\boldsymbol{M}_i \equiv (\widetilde{M}_i^1, M_i^2)$ can be written as

$$g(\boldsymbol{M}_i|\boldsymbol{s}_i, \theta_{i3}; \boldsymbol{\tau}) = g_1(\widetilde{M}_i^1|\boldsymbol{s}_i, \theta_{i3}; \boldsymbol{\tau}_1)g_2(M_i^2|\boldsymbol{s}_i, \theta_{i3}; \boldsymbol{\tau}_2), \tag{B.1}$$

with $\boldsymbol{\tau} = (\boldsymbol{\tau}_1', \boldsymbol{\tau}_2')'$, $g_1(\widetilde{M}_i^1|\boldsymbol{s}_i, \theta_{i3}; \boldsymbol{\tau}_1) = \Phi(\boldsymbol{s}_i'\boldsymbol{\zeta}^1 + \xi^1\theta_{i3})^{\widetilde{M}_i^1}\left[1 - \Phi(\boldsymbol{s}_i'\boldsymbol{\zeta}^1 + \xi^1\theta_{i3})\right]^{1-\widetilde{M}_i^1}$, where $\Phi(\cdot)$ is the standard normal distribution function, and $g_2(M_i^2|\boldsymbol{s}_i, \theta_{i3}; \boldsymbol{\tau}_2)$ is the normal density function.

Outcome Equations

A general expression for the outcome equation is given in Equation (1). In our empirical study, we jointly analyse two labor market outcomes, namely labor earnings of year t, $j = 1$, and the fraction of days the woman worked in t out of the total working days in that same year, $j = 2$. For the labor market outcome j for woman i in year t we adopt the following specification:

$$Y_{it}^{j} = \sum_{k}\sum_{r}\beta_{tr}^{jk}D_{ir}^{k} + \boldsymbol{M}_{i}'\boldsymbol{\pi}_{M} + \boldsymbol{x}_{it}'\boldsymbol{\pi}_{x}^{j} + \alpha_{t}^{j}\theta_{it} + \varepsilon_{it}^{j}, \qquad t,r \in \widetilde{T}, r \leq t, k = 1,\ldots,K. \tag{B.2}$$

In Equation (B.2), β_{tr}^{jk} and D_{ir}^{k} represent the treatment effects and dummies, defined in Subsection 4.1. The vector $\boldsymbol{x}_{it}$ is independent of θ_{it} and contains woman i's time-constant and time-varying characteristics listed in Table B.1. The factor structure for the unobservable component is the same as discussed in Subsection 4.2, where we change the factor loading normalisation to $\alpha_{3}^{1} = 1$ if $\theta_{it} = \theta_{i}$, otherwise $\alpha_{t}^{1} = 1, \forall\, t \in \widetilde{T}$. Finally, we assume that $\varepsilon_{it}^{j} \sim N\left(0, (\sigma_{t}^{j})^{2}\right)$.

The number of women giving birth for the k-th time in each period r is sometimes too small to have strong statistical identification of the related treatment effects. We therefore need to place the following additional restrictions on the parameters:

- Since there are no women who experienced three pregnancies in the first three years after school completion, $\beta_{t,3}^{j,3} = 0, \forall\, t \in \widetilde{T}$.
- Since only 27 women had the second pregnancy within the first 3 years after school completion: i) $\beta_{3,3}^{j,1} = \beta_{3,3}^{j,2}$; ii) $\beta_{t,3}^{j,2} = \beta_{t,6}^{j,2}, \forall\, t \geq 6$. The former states that three years after school completion the effect of the first childbirth is equal to the effect of the second childbirth. The latter imposes that starting from 6 years after school completion, the effect of the second childbirth is the same whether it occurred in the first or the second three year period.
- As only 10 women had 3 pregnancies in the first six years after school completion, $\beta_{6,6}^{j,3} = \beta_{6,6}^{j,2}$. This means that six years after school completion, the effect of the second pregnancy occurred in the second three-year period is the same as that of the third pregnancy.
- Since only 60 (129) women had the third pregnancy within the first nine (twelve) years since school completion, i) $\beta_{9,6}^{j,3} = \beta_{9,9}^{j,3}$, i.e. nine years after school completion, the effect of the third childbirth is the same, independently on when it occurred during the first nine years; ii) $\beta_{t,6}^{j,3} = \beta_{t,9}^{j,3} = \beta_{t,12}^{j,3}, \forall\, t \geq 12$, i.e. starting from twelve years after school completion, the effect of the third childbirth is the same, independently on when it occurred during the first

twelve years.

Let us collect all the parameters for the outcome model into $\boldsymbol{\psi} \equiv (\boldsymbol{\beta}, \boldsymbol{\pi}, \boldsymbol{\alpha}, \boldsymbol{\sigma})$, bearing in mind the additional restrictions. Because we are working with an unbalanced panel, let us also define a dummy variable d_{it} equal to 1 if woman i is observed in t and 0 otherwise, with $d_{i3} = 1$ for $i = 1, \ldots, n$ (see Section 4 for details). Then, we can write the density function for the outcomes of interest for woman i as

$$f\left(\boldsymbol{Y}_i | \boldsymbol{X}_i, \boldsymbol{\theta}_i; \boldsymbol{\psi}\right) = \prod_{j=1,2} \prod_{t \,\in\, \widetilde{T}} f\left(Y_{it}^j | \boldsymbol{X}_i, \theta_{it}; \boldsymbol{\psi}\right)^{d_{it}} \tag{B.3}$$

where

- the vector $\boldsymbol{Y}_i \equiv \left(Y_{i3}^1, Y_{i6}^1, \ldots, Y_{i21}^1, Y_{i3}^2, Y_{i6}^2, \ldots, Y_{i21}^2\right)$ collects the observed outcomes, i.e. labor earnings and fraction of days in employment 3, 6, 9, 12, 15, 18, and 21 years after school completion;
- the matrix $\boldsymbol{X}_i \equiv (\boldsymbol{D}_i, \boldsymbol{M}_i, \boldsymbol{x}_{i3}, \ldots, \boldsymbol{x}_{i21})$ collects regressors, with $\boldsymbol{D}_i$ being the matrix containing the treatment dummies;
- $\boldsymbol{\theta}_i \equiv (\theta_{i1}, \ldots, \theta_{iT})$;
- $f(\cdot)$ is the normal density function.

Selection Equations

The mechanism describing the selection into treatment is outlined in Equations (3) and (4) in Subsection 4.1 There we defined the treatment dummy D_{ir}^k as a function of the period r when the k-th childbirth occurs, with $k = 1, 2, 3$. The timing of the k-th pregnancy is described by the random variable R_i^k, which takes value r according to whether the latent index V_{ir}^k in Equation (2) belongs to the time interval $(r-1, r]$.

Let us first outline the expressions for the index functions of the selection equations for the first, second, and third pregnancies:

$$V_{ir}^1 = \boldsymbol{M}_i'\gamma_M + \boldsymbol{z}_i'\gamma_z + \lambda_r^1\theta_{ir} + v_i^1, \tag{B.4}$$

$$V_{ir}^2 = \boldsymbol{M}_i'\gamma_M + \boldsymbol{z}_i'\gamma_z + \gamma_R^2\bar{R}_i^1 + \gamma_B^2 B_i + \lambda_r^2\theta_{ir} + v_i^2, \tag{B.5}$$

$$V_{ir}^3 = \boldsymbol{M}_i'\gamma_M + \boldsymbol{z}_i'\gamma_z + \gamma_{R_1}^3\bar{R}_i^1 + \gamma_{R_2}^3(\bar{R}_i^2 - \bar{R}_i^1) + \gamma_G^3 G_i + \lambda_r^3\theta_{ir} + v_i^3. \tag{B.6}$$

The vector $\boldsymbol{z}_i$ is independent of θ_{ir} and collects the individual characteristics of woman i; the rest of the covariates are the treatment-specific exclusion restriction required for identification and discussed in Subsection 4.2.[33] In order to reduce the dimension of the parameter vector to be estimated, we assume a simplified structure for the factor loadings in the selection equations, which is $\lambda_r^k = \alpha_r^1\eta^k$, where α_r^1 is the same factor loading in the equation of outcome 1 with $r = t$, and $k = 1, \dots, K$. Notice that this is not an identifying assumption, as we have shown in Subsection 4.2 that all the factor loadings λ_{ir}^k, $k = 1, .., K$ and $r = 1, \dots, R$ are identified. Finally we assume $v_i^k \sim N(0, 1)$.

Table B.1: Observed covariates and exclusions across equations

	Selection-free measurements		Treatments			Outcomes
Regressors included in outcome, treatment, and measurement variables equations	Employment 1 year before school completion	Number of siblings at 14	Timing 1st delivery	Timing 2nd delivery	Timing 3rd delivery	Labor market outcome t years after school completion
Age at school completion	–	–	Yes	Yes	Yes	Yes
Education (primary, secondary, tertiary)	–	–	Yes	Yes	Yes	Yes
Fraction of time at work 1 year before school completion	–	–	Yes	Yes	Yes	Yes
Mother's age at delivery	Yes	Yes	Yes	Yes	Yes	Yes
Number of siblings at 14	Yes	–	Yes	Yes	Yes	Yes
Mother's highest education	Yes	Yes	Yes	Yes	Yes	Yes
Mother at work at 14	Yes	Yes	Yes	Yes	Yes	Yes
Quarter of birth	Yes	Yes	Yes	Yes	Yes	Yes
Regional unemployment rate at t	–	–	–	–	–	Yes
Regional employment rate at t	–	–	–	–	–	Yes
Regional fertility rate at t	–	–	–	–	–	Yes
Regional unemployment rate at birth	Yes	Yes	Yes	Yes	Yes	–
Regional employment rate at birth	Yes	Yes	Yes	Yes	Yes	–
Regional fertility rate at birth	Yes	Yes	Yes	Yes	Yes	–
Twins in the 1st delivery	–	–	–	Yes	–	–
Time until 1st delivery	–	–	–	Yes	Yes	–
Spacing between 1st and 2nd delivery	–	–	–	–	Yes	–
First 2 kids of the same gender	–	–	–	–	Yes	–
IT-SILC wave (2005 or 2011)	Yes	Yes	Yes	Yes	Yes	Yes
Year of birth	Yes	Yes	Yes	Yes	Yes	Yes
Geographical area at birth (5 areas)	Yes	Yes	Yes	Yes	Yes	–
Geographical area at t (5 areas)	–	–	–	–	–	Yes
Year of observation	Yes	–	–	–	–	Yes
Indicators for timing of the 1st delivery	–	–	–	–	–	Yes
Indicators for timing of the 2nd delivery	–	–	–	–	–	Yes
Indicators for timing of the 3rd delivery	–	–	–	–	–	Yes

[33]See Table B.1 for the detailed list of regressors.

We specify the selection into treatments as ordered choice models with dependent variables R_i^k. As we did for the outcomes and in order to reduce the dimension of our model, we do not consider 21 years separately, but we rather set the categories as three-year periods. The dependent variable for the first childbirth, R_i^1, therefore takes values in the set $\widetilde{R^1} = \{\widetilde{T}, \infty\}$. Concerning the second childbirth, we further restrict the set of possible values taking a span of 6 years after school completion as the first period and the set of values for r becomes $\widetilde{R^2} = \{6, 9, 12, 15, 18, 21, \infty\}$. Similarly the set for the third childbirth R_i^3 takes the first 12 years as the first period and is defined as $\widetilde{R^3} = \{12, 15, 21, \infty\}$.[34]

The dependent variable for the k-th childbirth is therefore observed according to the following rule:

$$R_i^k = \begin{cases} \min \widetilde{R^k} & \text{if } V_{ir}^k \leq \delta_1^k \\ r, \ r \in \widetilde{R^k}_- & \text{if } \delta_q^k < V_{ir}^k \leq \delta_{q+1}^k \\ \infty & \text{if } V_{ir}^k > \delta_{Q^k}^k, \end{cases}$$

where the notation $\widetilde{R^k}_-$ indicates the set without the first element and ∞. Notice that we have introduced the threshold parameters δ_q^k, with $q = 1, \ldots, Q^k$ where $Q^1 = 7$, $Q^2 = 6$, $Q^3 = 3$.

Because of the dynamic structure of the model, estimation has to be based on treatment-time specific probabilities. This feature introduces a censoring problem concerning women having yet to experience the k-th childbirth, in period r in which their observation window ends, i.e. in the year of the IT-SILC interview. For these women, a separate likelihood contribution accounting for right censoring has to be specified. Let us define a dummy variable c_{ir} equal to 1 if woman i is right censored, meaning she has yet to give birth for the k-th time in the last period r in which her pregnancy can be observed, i.e. the year of the IT-SILC interview, and 0 otherwise. Let ν_i^k collect the linear indexes of Equations (B.4)–(B.6) containing only combinations of observable explanatory variables. Then the probability that woman i gives birth for the k-th time at r can be

[34] These aggregations of time periods ensure that there are not too few observations in each ordered time window. We moreover specify the factor loadings of the first ordered time windows as $\alpha_3\eta^2$ and $\alpha_3\eta^3$ for the second and third birth, respectively.

written as

$$P(R_i^k) = \begin{cases} \Phi(\delta_1^k - \nu_i^k - \alpha_r^1\eta^k\theta_{ir})^{1-c_{ir}}\left[1 - \Phi(\delta_1^k - \nu_i^k - \alpha_r^1\eta^k\theta_{ir})\right]^{c_{ir}} & \text{if } r = \min \widetilde{R^k} \\ \left[\Phi(\delta_{q+1}^k - \nu_i^k - \alpha_r^1\eta^k\theta_{ir}) - \Phi(\delta_q^k - \nu_i^k - \alpha_r^1\eta^k\theta_{ir})\right]^{1-c_{ir}} & \\ \quad \left[1 - \Phi(\delta_{q+1}^k - \nu_i^k - \alpha_r^1\eta^k\theta_{ir})\right]^{c_{ir}} & \text{if } r \in \widetilde{R^k}_- \\ \left[\Phi(\delta_{Q^k}^k - \nu_i^k - \alpha_r^1\eta^k\theta_{ir}) - \Phi(\delta_{Q^k-1}^k - \nu_i^k - \alpha_r^1\eta^k\theta_{ir})\right]^{1-c_{ir}} & \\ \quad \left[1 - \Phi(\delta_{Q^k}^k - \nu_i^k - \alpha_r^1\eta^k\theta_{ir})\right]^{c_{ir}} & \text{if } r = \infty \end{cases}$$

where $\Phi(\cdot)$ is the standard normal cdf.

Let all the parameters for the selection equations be collected in $\boldsymbol{\varphi} = (\boldsymbol{\gamma}, \boldsymbol{\alpha}, \boldsymbol{\eta}, \boldsymbol{\delta})$, and define a dummy variable m_{ik}, for $k = 2, 3$ equal to 1 if woman i experienced the $k - 1$-th pregnancy and therefore contributes to the likelihood for the k-th pregnancy, and 0 otherwise. m_{i1} is always equal to 1. Then, we can write the probability of being selected into treatment for woman i as

$$P\left(\boldsymbol{R}_i | \boldsymbol{Z}_i, \boldsymbol{\theta}_i; \boldsymbol{\varphi}\right) = \prod_{k=1}^{3} \prod_{r \,\in\, \widetilde{R^k}} P\left(R_i^k | \boldsymbol{Z}_i, \theta_{ir}; \boldsymbol{\varphi}\right)^{m_{ik}}, \tag{B.7}$$

where $\boldsymbol{R}_i \equiv \left(R_i^1, R_i^2, R_i^3\right)$, and $\boldsymbol{Z}_i \equiv \left(\boldsymbol{z}_i, \bar{R}_i^1, \bar{R}_i^2, B_i, G_i, \boldsymbol{M}_i\right)$.

Likelihood Function

Let $\boldsymbol{\phi} = (\boldsymbol{\psi}, \boldsymbol{\varphi}, \boldsymbol{\tau})$ collect all the parameters for measurement, selection, and outcome equations. The likelihood for woman i is the joint density of $(\boldsymbol{M}_i, \boldsymbol{R}_i, \boldsymbol{Y}_i)$ conditional on observable and unobservable characteristics. Using the chain rule and on the basis of expressions (B.3), (B.7), and (B.1), the individual contribution to the likelihood function can be written as

$$\mathscr{L}_i(\boldsymbol{\phi} | \boldsymbol{w}_i, \boldsymbol{Z}_i, \boldsymbol{X}_i, \boldsymbol{\theta}_i) = g(\boldsymbol{M}_i | \boldsymbol{w}_i, \theta_{i3}; \boldsymbol{\tau}) P\left(\boldsymbol{R}_i | \boldsymbol{Z}_i, \boldsymbol{\theta}_i; \boldsymbol{\varphi}\right) f\left(\boldsymbol{Y}_i | \boldsymbol{X}_i, \boldsymbol{\theta}_i; \boldsymbol{\psi}\right). \tag{B.8}$$

In the absence of UH, that is the distribution of $\boldsymbol{\theta}_i$ is degenerate, the ML estimator $\widehat{\boldsymbol{\phi}}$ can be obtained by maximising $\sum_{i=1}^{n} \ln[\mathscr{L}_i(\boldsymbol{\phi} | \boldsymbol{w}_i, \boldsymbol{Z}_i, \boldsymbol{X}_i)]$ with respect to $\boldsymbol{\phi}$.

In order to account for the presence of individual time-varying unobserved heterogeneity, we assume that the vector of latent factors $\boldsymbol{\theta}_i = (\theta_{i3}, \ldots, \theta_{i21})$ follows a multivariate discrete distribution with H support points. The unobserved heterogeneity $\boldsymbol{\theta}_i$ takes values $\boldsymbol{\theta}^h$, $h = 1, \ldots, H$, following a multinomial logit parametrization

$$p^h = Pr(\boldsymbol{\theta}_i = \boldsymbol{\theta}^h) = \frac{\exp(\rho^h)}{\sum_{u=1}^{H} \exp(\rho^u)},$$

with normalizations $\boldsymbol{\theta}^1 = 0$ and $\rho^H = 0$. Since the number of observations is decreasing with t approaching $T = 21$, we constrain $\theta^h_{18} = \theta^h_{21}$, $\forall h = 1, \ldots, H$. In other words, we constrain the UH to be constant from 18 to 21 years after school completion.

Under the assumption of discrete distribution of the UH, the i-th contribution to the likelihood becomes

$$\mathscr{L}_i(\boldsymbol{\phi}, \boldsymbol{\rho}, \boldsymbol{\Theta} | \boldsymbol{w}_i, \boldsymbol{Z}_i, \boldsymbol{X}_i) = \sum_{h=1}^{H} p^h \mathscr{L}_{ih}(\boldsymbol{\phi}, \rho^h | \boldsymbol{w}_i, \boldsymbol{Z}_i, \boldsymbol{X}_i, \boldsymbol{\theta}_i = \boldsymbol{\theta}^h), \tag{B.9}$$

where $\mathscr{L}_{ih}$ denotes the likelihood in Equation (B.8), conditional on $\boldsymbol{\theta}_i$ taking value $\boldsymbol{\theta}^h$, and the matrix $\boldsymbol{\Theta}$ collects the vectors of support points $(\boldsymbol{\theta}^1, \ldots, \boldsymbol{\theta}^H)$. If a single time-constant latent factor is assumed, the individual unobserved heterogeneity follows a univariate discrete distribution with H support points, with probability $p^h = Pr(\theta_i = \theta^h)$ defined as above, and the likelihood for woman i is a special case of Equation (B.9). The ML estimator of $\boldsymbol{\phi}$, $\boldsymbol{\rho}$, and $\boldsymbol{\Theta}$ is obtained by maximising the log-likelihood based on Equation (B.9).

In the estimation, we increased the number of support points H and checked whether the BIC and the AIC were decreasing. We continued until we reached 10. In the model with time-varying latent factor this amounts to the estimation of 74 parameters related to the latent factor.[35] Given this high number of parameters, the related computational difficulties, and the fact that the estimated coefficients of the treatments of interest became stable when adding the last support points, we stopped at 10. The model with time-constant latent factor and discrete distribution of θ_i with 10 support points delivered estimation results very close to those from the model in which

[35] 9 weights for the probability masses, 54 support points (we constrain $\theta^h_{18} = \theta^h_{21}$, $\forall h = 1, \ldots, H$, otherwise they would have been 63), 11 loading factors, of which 2 for the measurement outcomes, 3 for the selection equations, and 6 for the equations of the fraction of days spent in employment (they would be 7 instead of 6 without the constraint of time-constant UH from 18 until 21 years after school completion).

the distribution of θ_i is a mixture of three normal distributions, but a higher log-likelihood value (see Subsection 5).[36]

[36]We do not report the estimation results of the model with the time-constant latent factor for the sake of brevity. They are however available from the authors upon request.

C Full Set of Estimation Results for the Model without UH

Table C.1: Estimated coefficients of the impact of childbirth and birth timing on yearly labor earnings (€)§ without UH

Years since school completion	$t=3$	$t=6$	$t=9$	$t=12$	$t=15$	$t=18$	$t=21$
1st childbirth							
$r \in [0,3]$	-3,256.99***	-4,588.84***	-4,844.16***	-5,837.28***	-5,041.59***	-3,159.89*	-1,284.03
	(509.27)	(1,004.47)	(1,130.98)	(1,459.89)	(1,525.49)	(1,863.68)	(2,014.18)
$r \in [4,6]$	–	-4,224.79***	-3,653.00***	-3,608.79***	-3,500.74***	-1,716.97	-1,805.72
		(521.367)	(698.26)	(1,004.43)	(1,134.59)	(1,378.55)	(1,499.03)
$r \in [7,9]$	–	–	-4,125.42***	-2,956.97***	-2,398.24**	-1,002.49	-1,308.58
			(520.22)	(703.64)	(933.99)	(1,079.57)	(1,136.19)
$r \in [10,12]$	–	–	–	-4,242.67***	-2,527.12***	-1,360.87	-1,853.21*
				(584.54)	(750.17)	(1,033.99)	(1,050.31)
$r \in [13,15]$	–	–	–	–	-4,604.16***	-2,767.90***	-2,653.69**
					(730.34)	(1,002.74)	(1,098.27)
$r \in [16,18]$	–	–	–	–	–	-4,797.12***	-3,286.31**
						(1,209.99)	(1,303.84)
$r \in [19,21]$	–	–	–	–	–	–	-5,577.67***
							(1,518.84)
2nd childbirth							
$r \in [1,6]$	–	-2,267.12**	-1,389.87	672.40	566.82	280.0	-68.76
		(1,156.66)	(1,539.62)	(1,808.14)	(2,189.92)	(2,519.90)	(2,957.64)
$r \in [7,9]$	–	–	-1,501.32**	-433.54	141.68	-1,334.31	-1,267.16
			(747.302)	(1,284.19)	(1,391.00)	(1,681.68)	(1,946.41)
$r \in [10,12]$	–	–	–	-2,514.62***	-1,586.71	-2,041.5	-2,307.12*
				(814.55)	(1,079.91)	(1,258.66)	(1,350.65)
$r \in [13,15]$	–	–	–	–	-2,679.68***	-2,093.52*	-1,510.92
					(841.42)	(1,074.28)	(1,131.62)
$r \in [16,18]$	–	–	–	–	–	-3,793.29***	-2,797.92**
						(1,034.89)	(1,289.30)
$r \in [19,21]$	–	–	–	–	–	–	-3,226.65***
							(1,247.32)
3rd childbirth							
$r \in [1,\min(t,12)]$	–	–	13.19	-1,420.91	-3,630.76	-4,249.22	-4,052.27
			(1,717.14)	(1,585.99)	(3,063.90)	(3,267.79)	(3,979.48)
$r \in [13,15]$	–	–	–	–	-1,707.42	-897.75	-306.35
					(1,974.28)	(2,311.68)	(2,156.89)
$r \in [16,\min(t,21)]$	–	–	–	–	–	-2,779.11	-2,384.62
						(2,443.53)	(2,093.98)

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%. Standard errors are reported in parentheses.
§ Yearly labor earnings are in 2014 prices and deflated by the ISTAT consumer price index.

Table C.2: Estimated coefficients of the impact of childbirth and birth timing on yearly fraction of days spent in employment without UH

Years since school completion	$t = 3$	$t = 6$	$t = 9$	$t = 12$	$t = 15$	$t = 18$	$t = 21$
1st childbirth							
$r \in [0, 3]$	-0.070***	-0.149***	-0.159***	-0.179***	-0.144***	-0.092	0.028
	(0.024)	(0.037)	(0.040)	(0.046)	(0.049)	(0.061)	(0.074)
$r \in [4, 6]$	–	-0.095***	-0.129***	-0.140***	-0.104***	-0.056	0.006
		(0.021)	(0.026)	(0.032)	(0.037)	(0.045)	(0.053)
$r \in [7, 9]$	–	–	-0.095***	-0.112***	-0.092***	-0.033	-0.017
			(0.019)	(0.025)	(0.032)	(0.038)	(0.044)
$r \in [10, 12]$	–	–	–	-0.085***	-0.098***	-0.047	-0.066
				(0.019)	(0.026)	(0.035)	(0.041)
$r \in [13, 15]$	–	–	–	–	-0.107***	-0.084**	-0.093**
					(0.025)	(0.035)	(0.043)
$r \in [16, 18]$	–	–	–	–	–	-0.085**	-0.077*
						(0.035)	(0.044)
$r \in [19, 21]$	–	–	–	–	–	–	-0.117**
							(0.049)
2nd childbirth							
$r \in [1, 6]$	–	-0.046	-0.069	0.0001	-0.060	-0.059	-0.054
		(0.043)	(0.053)	(0.064)	(0.072)	(0.089)	(0.101)
$r \in [7, 9]$	–	–	-0.055*	-0.046	-0.041	-0.049	-0.032
			(0.032)	(0.042)	(0.045)	(0.056)	(0.065)
$r \in [10, 12]$	–	–	–	-0.063**	-0.072**	-0.079*	-0.079*
				(0.027)	(0.035)	(0.041)	(0.047)
$r \in [13, 15]$	–	–	–	–	-0.044	-0.081**	-0.050
					(0.028)	(0.037)	(0.042)
$r \in [16, 18]$	–	–	–	–	–	-0.107***	-0.106**
						(0.034)	(0.043)
$r \in [19, 21]$	–	–	–	–	–	–	-0.101**
							(0.041)
3rd childbirth							
$r \in [1, \min(t, 12)]$	–	–	0.068	-0.0003	-0.075	-0.076	-0.119
			(0.073)	(0.056)	(0.078)	(0.094)	(0.109)
$r \in [13, 15]$	–	–	–	–	-0.049	-0.032	0.016
					(0.057)	(0.077)	(0.077)
$r \in [16, \min(t, 21)]$	–	–	–	–	–	-0.128**	-0.140**
						(0.061)	(0.060)

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%. Standard errors are reported in parentheses.

Table C.3: Estimated coefficients of the covariates of the labor market outcome equations without UH

	labor earnings			Fraction of days spent in employment		
	Coeff.		Std. Err.	Coeff.		Std. Err.
Age at school completion/10[§]	6,740.64	***	583.95	0.091	***	0.023
Education - Reference: Lower secondary or less						
Higher secondary	1479.66	***	155.33	0.079	***	0.006
Tertiary	2186.22	***	207.06	0.086	***	0.009
Fraction of days worked one year before school completion	1,806.26	***	172.55	0.118	***	0.010
Age of respondent's mother at respondent's birth/10[§]	-115.59		85.43	-0.011	***	0.004
Age of respondent's mother at respondent's birth is missing	-110.96		196.63	-0.021	***	0.008
Number of siblings at 14 if IT-SILC wave is 2005/10	-688.60		484.57	-0.009		0.019
Number of siblings at 14 if IT-SILC wave is 2011/10	1,503.94	**	648.20	0.044	*	0.026
IT-SILC wave 2011	-116.47		153.32	-0.016	**	0.006
Respondent's mother has at least secondary education	149.82		94.68	-0.033	***	0.005
Respondent's mother was employed when respondent was 14	152.77	*	90.72	0.011	***	0.004
Quarter of birth - Reference: January, February, March						
April, May, June	-364.93	***	116.04	-0.010	**	0.005
July, August, September	-27.34		112.96	-0.007		0.005
October, November, December	-90.67		121.99	0.005		0.005
Regional unemployment rate at t	-22,550.40	***	3,726.35	-1.258	***	0.145
Regional employment rate at t	16,018.30	***	2,230.39	0.642	***	0.086
Regional fertility rate at t	1,963.20	***	385.28	-0.136	***	0.016
Year of birth/10 (normalized to its minimum)	-208.76		568.24	0.041	*	0.022
Geographical area at t- Reference: North-West						
North-East	285.78	**	112.02	0.033	***	0.005
Center	-1,919.47	***	118.57	-0.035	***	0.005
South	-3,463.47	***	257.32	-0.066	***	0.010
Islands (Sardinia and Sicily)	-2,887.58	***	345.23	-0.071	***	0.013
Calendar year of t - Reference: After 2005						
Before 1985	-627.03		1,551.86	0.012		0.060
Between 1986 and 1990	-78.64		1,215.75	-0.006		0.047
Between 1990 and 1995	-110.94		940.97	-0.046		0.036
Between 1996 and 2000	-341.92		641.85	-0.034		0.025
Between 2001 and 2005	-282.73		390.66	-0.011		0.016
Constant at $t = 3$	-4,519.72	*	2,362.85	0.296	***	0.091
$\ln(\sigma_3^2)^\ddagger$	-0.327	***	0.013	-1.774	***	0.031
Constant at $t = 6$	-926.07		2,237.72	0.436	***	0.086
$\ln(\sigma_6^2)^\ddagger$	-0.115	***	0.015	-1.775	***	0.031
Constant at $t = 9$	1,312.28		2,117.44	0.512	***	0.081
$\ln(\sigma_9^2)^\ddagger$	0.037	***	0.013	-1.803	***	0.032
Constant at $t = 12$	2,443.59		2,016.94	0.545	***	0.077
$\ln(\sigma_{12}^2)^\ddagger$	0.133	***	0.014	-1.791	***	0.036
Constant at $t = 15$	2,958.07		1,939.77	0.563	***	0.074
$\ln(\sigma_{15}^2)^\ddagger$	0.170	***	0.015	-1.767	***	0.039
Constant at $t = 18$	2,990.36		1,863.68	0.556	***	0.071
$\ln(\sigma_{18}^2)^\ddagger$	0.244	***	0.016	-1.712	***	0.047
Constant at $t = 21$	3,380.09	*	1,802.92	0.558	***	0.070
$\ln(\sigma_{21}^2)^\ddagger$	0.236	***	0.021	-1.676	***	0.054

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%.

§ Normalized to zero.

‡ We estimated the model using labor earnings divided by 10,000 to reduce numerical problems. Then, we multiplied all the estimated coefficients by 10,000 before reporting them in the tables with estimations results, apart from the natural logarithms of the variances of the underlying normal distributions. Hence, the latter must be interpreted as the log of the variance of the normal distribution of labor earnings divided by 10,000, i.e. $\ln(\sigma_t^2 \cdot 10,000)$.

Table C.4: Estimated coefficients of the measurement equations without UH

	Employment 1 year before school completion			Number of siblings at 14		
	Coeff.		Std. Err.	Coeff.		Std. Err.
Age of respondent's mother at respondent's birth/10[§]	-0.046		0.040	-0.046	*	0.024
Age of respondent's mother at respondent's birth is missing	0.079		0.089	-0.033		0.054
Number of siblings at 14 if IT-SILC wave is 2005/10	0.327		0.212	–		–
Number of siblings at 14 if IT-SILC wave is 2011/10	1.204	***	0.303	–		–
IT-SILC wave 2011	-0.104		0.064	-0.546	***	0.031
Respondent's mother has at least secondary education	-0.091	**	0.045	-0.170	***	0.034
Respondent's mother was employed when respondent was 14	-0.042		0.044	-0.125	***	0.031
Quarter of birth - Reference: January, February, March						
April, May, June	-0.022		0.054	0.050		0.034
July, August, September	-0.101	*	0.054	-0.028		0.035
October, November, December	-0.114	**	0.057	-0.066	*	0.037
Regional unemployment rate at birth	-0.547		1.114	-1.749	***	0.576
Regional employment rate at birth	1.989	***	0.723	-1.554	***	0.431
Regional fertility rate at birth	0.024		0.124	0.821	***	0.061
Year of birth/10 (normalized to its minimum)	-0.989	***	0.061	-0.045		0.030
Geographical area at birth - Reference: North-West						
North-East	0.249	***	0.054	0.134	***	0.039
Center	-0.094		0.060	-0.109	**	0.046
South	-0.128		0.117	0.179	**	0.070
Islands (Sardinia and Sicily)	-0.094		0.139	0.344	***	0.076
Calendar year of t - Reference: After 2001						
Before 1981	-2.926	***	0.149	–		–
Between 1982 and 1986	-2.391	***	0.126	–		–
Between 1987 and 1991	-1.690	***	0.105	–		–
Between 1992 and 1996	-1.308	***	0.094	–		–
Between 1997 and 2001	-0.749	***	0.086	–		–
Constant	0.492		0.527	1.675	***	0.299
$\ln(\sigma^2)$	–		–	0.340	***	0.009

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%.
[§] Normalized to zero.

Table C.5: Estimated coefficients of the (ordered probit) equations for the timing of childbirth without UH

	Coeff.		Std. Err.		Coeff.		Std. Err.
(a) Variables with common effect for all the childbirth equations				***(b) Ordered probit thresholds specific to each childbirth equation***			
Age at school completion/10[§]	-0.599	***	0.044	*(b.1) Ordered probit thresholds of 1st childbirth equation*			
Education - Reference: Lower secondary or less				δ_1^1 (birth in $[0,3]$)	-2.609	***	0.218
Higher secondary	0.044		0.028	$\ln(\delta_2^1-\delta_1^1)$ (birth in $[4,6]$)	-0.331	***	0.030
Tertiary	0.064		0.045	$\ln(\delta_3^1-\delta_2^1)$ (birth in $[7,9]$)	-0.627	***	0.027
Fraction of days worked one year before school completion	-0.139	***	0.045	$\ln(\delta_4^1-\delta_3^1)$ (birth in $[10,12]$)	-0.727	***	0.027
Age of respondent's mother at respondent's birth/10[§]	0.077	***	0.017	$\ln(\delta_5^1-\delta_4^1)$ (birth in $[13,15]$)	-1.053	***	0.034
Age of respondent's mother at respondent's birth is missing	-0.004		0.039	$\ln(\delta_6^1-\delta_5^1)$ (birth in $[16,18]$)	-1.399	***	0.047
Number of siblings at 14 if IT-SILC wave is 2005/10	-0.337	***	0.087	$\ln(\delta_7^1-\delta_6^1)$ (birth in $[19,21]$)	-1.846	***	0.073
Number of siblings at 14 if IT-SILC wave is 2011/10	-0.631	***	0.130	*(b.2) Ordered probit thresholds of 2nd childbirth equation*			
IT-SILC wave 2011	0.021		0.030	δ_1^2 (birth in $[1,6]$)	-1.480	***	0.225
Respondent's mother has at least secondary education	0.050	**	0.023	$\ln(\delta_2^2-\delta_1^2)$ (birth in $[7,9]$)	0.031		0.042
Respondent's mother was employed when respondent was 14	-0.049	**	0.020	$\ln(\delta_3^2-\delta_2^2)$ (birth in $[10,12]$)	-0.134	***	0.035
Quarter of birth - Reference: January, February, March				$\ln(\delta_4^2-\delta_3^2)$ (birth in $[13,15]$)	-0.350	***	0.035
April, May, June	-0.021		0.025	$\ln(\delta_5^2-\delta_4^2)$ (birth in $[16,18]$)	-0.670	***	0.041
July, August, September	0.044	*	0.025	$\ln(\delta_6^2-\delta_5^2)$ (birth in $[19,21]$)	-1.109	***	0.056
October, November, December	0.081	***	0.026	*(b.3) Ordered probit thresholds of 3rd childbirth equation*			
Regional unemployment rate at birth	0.118		0.433	δ_1^3 (birth in $[1,12]$)	-1.183	***	0.243
Regional employment rate at birth	-0.136		0.312	$\ln(\delta_2^3-\delta_1^3)$ (birth in $[13,15]$)	-0.580	***	0.094
Regional fertility rate at birth	-0.386	***	0.051	$\ln(\delta_3^3-\delta_2^3)$ (birth in $[16,21]$)	-0.341	***	0.073
Year of birth/10 (normalized to its minimum)	-0.031		0.023	***(c) Variables only included in the 2nd childbirth equation***			
Geographical area at birth - Reference: North-West				Time until 1st childbirth	2.125	***	0.047
North-East	-0.063	**	0.027	Twins in the 1st childbirth	-1.671	***	0.298
Center	-0.024		0.029	***(d) Variables only included in the 3rd childbirth equation***			
South	-0.101	**	0.051	Time until 1st childbirth	1.322	***	0.116
Islands (Sardinia and Sicily)	-0.031		0.061	Spacing between 1st and 2nd childbirth	2.232	***	0.168
				First 2 kids of the same gender	-0.124	**	0.063

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%.
[§] Normalized to zero.

D Full Set of Estimation Results for the Model with Time-Varying UH

We briefly comment on the estimated coefficients associated with the other explanatory variables entering the equations for the labor market outcomes, the fertility equations for the timing to different childbirths, and the equations for the selection-free measurements.

Table D.3 reports the estimated coefficients of the covariates entering the equations of the labor market outcomes. We find that labor earnings are increasing in education and, given the same educational level, in the age at which the diploma was obtained, likely because women with longer lasting majors or further attainments, e.g. master or Ph.D., are better paid in the labor market. Women with better educated mothers enjoy higher earnings. It seems that the quarter of birth matters in explaining earnings variation: women born in the first quarter earn more, although the magnitude of the effect is limited. This is in line with the positive and small effect of school starting age on earnings found by Fredriksson and Öckert (2013) for Swedish prime-aged women. labor earnings are higher in the North of Italy and in the regions with larger fertility rates. We find a positive (negative) correlation between earnings and the (un)employment rate. Not so many covariates exhibit significant associations with the fraction of days spent in employment. Women with tertiary education and living in regions with low fertility rates and high employment rates show a larger participation at the intensive margin.

In Subsection 4.2, we explained why the model includes two selection-free measurements, i.e. the binary variable equal to one if the woman worked for at least one day in the year before school completion and the number of siblings at 14. Table D.4 reports the estimated parameters of these two equations. We find that the probability of having worked at least one day in the year before school completion is larger if the number of siblings is higher, in presence of a higher employment rate, for women from older cohorts, and in more recent time. The number of siblings is smaller if respondent's mother was employed and had higher education, in regions with low fertility rates, and especially in the Center.

Table D.5 reports the estimated coefficients of the equations for the timing of childbirth, defined as the delivery date minus 3 months. Given the discretisation of the timing in three-year periods and the ordered probit structure (see Appendix B for details), a positive coefficient implies that the corresponding regressor negatively affects the probability of having a child in the first 3 years after school completion. We find that: the older the woman at school completion, the sooner she gives birth; if respondent's mother was older when she gave birth and had higher education, then the respondent is more likely to delay the childbearing; if the woman has a larger number of siblings, she is more likely to have a child soon; childbearing soon is more likely when the respondent's mother used to work when the respondent was 14, where the regional fertility rate is higher, in the North-East, and for women born in the first half of the year. The timing to the first childbirth and the spacing between the first-born and the second child are strong predictors of the timing of the next pregnancies. The longer a childbirth is delayed, the larger the probability that the next births will not occur before the end of the 21st year since school completion. If a woman had twins at the first childbirth, she is significantly less likely to delay the subsequent pregnancy. Finally, as in Angrist and Evans (1998), mothers of same-sex siblings are significantly more likely to have the third child and to have it sooner.

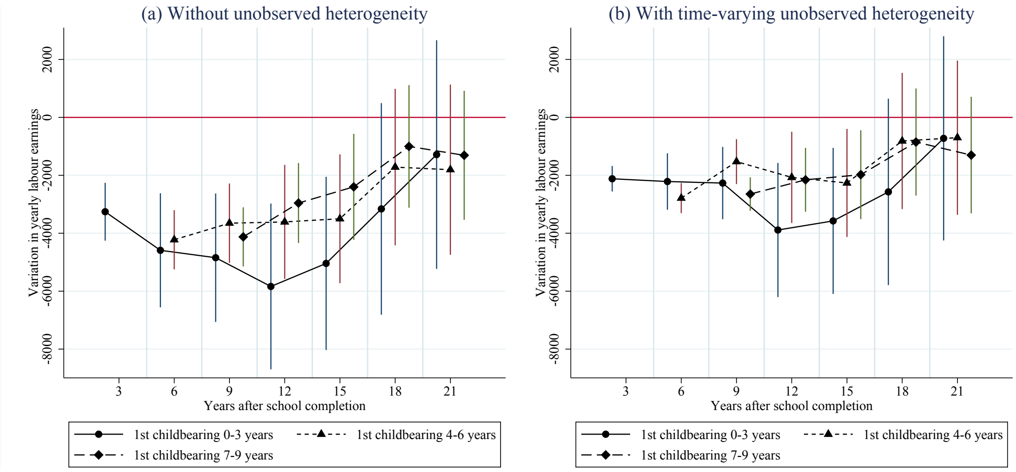
Table D.6 reports the estimated discrete distribution of the time-varying latent factor with 10 support points. Table D.8 displays the loading factors connecting this distribution and the error terms of each of the 19 equations (2 selection-free measurements, 3 timing-to-fertility equations, 7 equations for labor earnings and 7 for the time spent in employment). Since the loading factors entering the earnings equations are normalized to 1, the support points of the latent factor are in 2014 Euro.

Table D.1: Estimated coefficients of the impact of childbirth and birth timing on yearly labor earnings (€)[§] with time-varying UH

Years since school completion	$t = 3$	$t = 6$	$t = 9$	$t = 12$	$t = 15$	$t = 18$	$t = 21$
1st childbirth							
$r \in [0, 3]$	-2,118.85***	-2,214.15***	-2,575.16***	-3,888.21***	-3,574.70***	-2,571.86	-723.93
	(224.08)	(496.54)	(842.05)	(1,181.72)	(1,286.52)	(1,641.35)	(1,798.58)
$r \in [4, 6]$	–	-2,788.87***	-1,528.01***	-2,072.26***	-2,264.35**	-814.74	-701.01
		(264.25)	(394.74)	(804.01)	(952.21)	(1,199.84)	(1,358.20)
$r \in [7, 9]$	–	–	-2,647.11***	-2,156.74***	-1,978.21**	-851.46	-1,301.50
			(294.74)	(562.18)	(783.15)	(943.18)	(1,026.78)
$r \in [10, 12]$	–	–	–	-4,587.15***	-3,048.33***	-1,992.61**	-2,696.22***
				(466.36)	(627.64)	(901.57)	(941.20)
$r \in [13, 15]$	–	–	–	–	-5,252.28***	-3,611.45***	-3,486.83***
					(608.28)	(868.59)	(980.83)
$r \in [16, 18]$	–	–	–	–	–	-5,970.15***	-4,282.46***
						(1,044.77)	(1,166.02)
$r \in [19, 21]$	–	–	–	–	–	–	-6,529.77***
							(1,354.62)
2nd childbirth							
$r \in [1, 6]$	–	-1,627.34***	-89.08	1,917.87	1,7235.82	1,737.31	1,047.35
		(568.15)	(853.40)	(1,447.52)	(1,856.84)	(2,224.65)	(2,686.57)
$r \in [7, 9]$	–	–	-589.00	417.75	766.52	-917.03	-786.18
			(423.36)	(1,024.11)	(1,173.13)	(1,470.30)	(1,786.30)
$r \in [10, 12]$	–	–	–	-2,652.88***	-1,723.97*	-2,081.30*	-2,422.07**
				(642.31)	(907.00)	(1,101.08)	(1,221.84)
$r \in [13, 15]$	–	–	–	–	-2,615.12***	-2,289.41**	-1,771.60*
					(696.32)	(931.87)	(1,019.93)
$r \in [16, 18]$	–	–	–	–	–	-3,561.24 ***	-2,510.00**
						(894.24)	(1,147.43)
$r \in [19, 21]$	–	–	–	–	–	–	-3,918.11***
							(1,109.33)
3rd childbirth							
$r \in [1, \min(t, 12)]$	–	–	-1,328.19	-1,867.08	-3,512.71	-4,225.11	-4,273.93
			(970.12)	(1,247.14)	(2,578.34)	(2,840.12)	(3,652.86)
$r \in [13, 15]$	–	–	–	–	-1,480.81	-823.15	22.03
					(1,624.73)	(1,990.29)	(1,931.12)
$r \in [16, \min(t, 21)]$	–	–	–	–	–	-3,344.08	-1,537.42
						(2,105.44)	(1,861.15)

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%. Standard errors are in parentheses.
[§] Yearly labor earnings are in 2014 prices and deflated by the ISTAT consumer price index.

Figure D.1: Impact on labor earnings of the 1st birth occurring 0-3, 4-6, or 7-9 years after school completion without UH (a) and with time-varying UH (b)



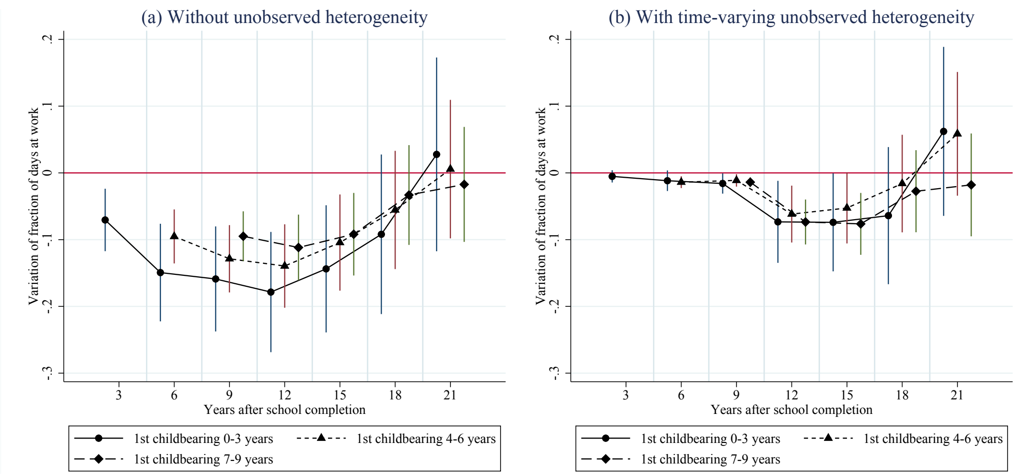
Notes: The vertical segments crossing the dots are 95% confidence intervals.

Table D.2: Estimated coefficients of the impact of childbirth and birth timing on yearly fraction of days spent in employment with time-varying UH

Years since school completion	$t = 3$	$t = 6$	$t = 9$	$t = 12$	$t = 15$	$t = 18$	$t = 21$
1st childbirth							
$r \in [0, 3]$	-0.005	-0.012	-0.016**	-0.073***	-0.074**	-0.064	0.062
	(0.005)	(0.008)	(0.008)	(0.031)	(0.037)	(0.052)	(0.065)
$r \in [4, 6]$	–	-0.014***	-0.011**	-0.062***	-0.053*	-0.016	0.059
		(0.005)	(0.005)	(0.022)	(0.027)	(0.037)	(0.047)
$r \in [7, 9]$	–	–	-0.014***	-0.074***	-0.076***	-0.027	-0.018
			(0.004)	(0.017)	(0.024)	(0.031)	(0.039)
$r \in [10, 12]$	–	–	–	-0.105***	-0.127***	-0.077***	-0.105***
				(0.014)	(0.020)	(0.029)	(0.036)
$r \in [13, 15]$	–	–	–	–	-0.140***	-0.123***	-0.130***
					(0.020)	(0.029)	(0.038)
$r \in [16, 18]$	–	–	–	–	–	-0.143***	-0.126***
						(0.030)	(0.039)
$r \in [19, 21]$	–	–	–	–	–	–	-0.168***
							(0.044)
2nd childbirth							
$r \in [1, 6]$	–	-0.013	0.000	0.049	-0.007	-0.008	-0.025
		(0.010)	(0.013)	(0.045)	(0.054)	(0.073)	(0.092)
$r \in [7, 9]$	–	–	-0.003	-0.014	-0.015	-0.047	-0.032
			(0.007)	(0.029)	(0.033)	(0.047)	(0.058)
$r \in [10, 12]$	–	–	–	-0.076***	-0.082***	-0.094***	-0.098**
				(0.019)	(0.026)	(0.034)	(0.042)
$r \in [13, 15]$	–	–	–	–	-0.046**	-0.102***	-0.074**
					(0.021)	(0.030)	(0.037)
$r \in [16, 18]$	–	–	–	–	–	-0.101***	-0.098**
						(0.028)	(0.039)
$r \in [19, 21]$	–	–	–	–	–	–	-0.139***
							(0.037)
3rd childbirth							
$r \in [1, \min(t, 12)]$	–	–	-0.010	-0.019	-0.075	-0.065	-0.136
			(0.020)	(0.041)	(0.059)	(0.081)	(0.097)
$r \in [13, 15]$	–	–	–	–	-0.044	-0.026	0.026
					(0.043)	(0.064)	(0.069)
$r \in [16, \min(t, 21)]$	–	–	–	–	–	-0.163***	-0.154***
						(0.052)	(0.053)

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%. Standard errors are in parentheses.

Figure D.2: Impact on yearly fraction of days spent at work of the 1st birth occurring 0-3, 4-6, or 10-12 years after school completion without UH (a) and with time-varying UH (b)



Notes: The vertical segments crossing the dots are 95% confidence intervals.

Table D.3: Estimated coefficients of the covariates of the labor market outcome equations with time-varying UH

	labor earnings			Fraction of days spent in employment		
	Coeff.		Std. Err.	Coeff.		Std. Err.
Age at school completion/10[§]	4,961.08	***	328.74	-0.002		0.006
Education - Reference: Lower secondary or less						
Higher secondary	538.99	***	95.72	0.011	***	0.002
Tertiary	1,260.88	***	125.78	0.012	***	0.003
Fraction of days worked one year before school completion	-38.85		96.06	0.005		0.004
Age of respondent's mother at respondent's birth/10[§]	34.02		50.30	-0.001		0.001
Age of respondent's mother at respondent's birth is missing	250.13	**	116.23	0.001		0.003
Number of siblings at 14 if IT-SILC wave is 2005/10	-702.77	**	278.87	-0.006		0.006
Number of siblings at 14 if IT-SILC wave is 2011/10	829.97	**	388.17	0.000		0.010
IT-SILC wave 2011	125.05		87.04	-0.003		0.002
Respondent's mother has at least secondary education	643.18	***	54.47	-0.004	***	0.002
Respondent's mother was employed when respondent was 14	69.27		53.00	0.003	*	0.001
Quarter of birth - Reference: January, February, March						
April, May, June	-286.46	***	68.93	-0.001		0.002
July, August, September	81.96		65.81	0.001		0.002
October, November, December	-253.80	***	71.66	-0.001		0.002
Regional unemployment rate at t	-2,881.46		2,126.80	-0.048		0.040
Regional employment rate at t	6,965.54	***	1,270.24	0.101	***	0.025
Regional fertility rate at t	3,637.19	***	213.94	-0.014	***	0.005
Year of birth/10 (normalized to its minimum)	-596.18	*	318.03	-0.005		0.005
Geographical area at t - Reference: North-West						
North-East	-138.75	**	65.33	0.004	**	0.002
Center	-1,193.57	***	70.33	0.005	**	0.002
South	-2,259.90	***	148.28	-0.001		0.004
Islands (Sardinia and Sicily)	-1,638.93	***	199.68	0.001		0.004
Calendar year of t - Reference: After 2005						
Before 1985	-406.02		852.22	-0.011		0.012
Between 1986 and 1990	277.84		676.59	-0.013		0.010
Between 1990 and 1995	639.00		523.99	-0.020	**	0.008
Between 1996 and 2000	119.10		357.77	-0.014	**	0.006
Between 2001 and 2005	7.49		219.56	-0.007	*	0.004
Constant at $t = 3$	4,245.84	***	1,317.46	0.873	***	0.022
$\ln(\sigma_3^2)^‡$	-1.13	***	0.01	-4.854	***	0.017
Constant at $t = 6$	-6,481.39	***	1,264.24	0.119	***	0.022
$\ln(\sigma_6^2)^‡$	-0.80	***	0.01	-4.374	***	0.020
Constant at $t = 9$	7,853.14	***	1,190.50	0.908	***	0.022
$\ln(\sigma_9^2)^‡$	-0.53	***	0.01	-4.527	***	0.019
Constant at $t = 12$	6,247.72	***	1,183.20	0.766	***	0.028
$\ln(\sigma_{12}^2)^‡$	-0.10	***	0.01	-2.205	***	0.041
Constant at $t = 15$	5,794.33	***	1,196.83	0.729	***	0.032
$\ln(\sigma_{15}^2)^‡$	-0.02		0.01	-2.083	***	0.048
Constant at $t = 18$	6,648.34	***	1,136.88	0.756	***	0.031
$\ln(\sigma_{18}^2)^‡$	0.09	***	0.01	-1.915	***	0.052
Constant at $t = 21$	7,357.31	***	1,139.24	0.770	***	0.034
$\ln(\sigma_{21}^2)^‡$	0.11	***	0.02	-1.797	***	0.055

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%.

§ Normalized to zero.

‡ We estimated the model using labor earnings divided by 10,000 to reduce numerical problems. Then, we multiplied all the estimated coefficients by 10,000 before reporting them in the tables with estimations results, apart from the natural logarithms of the variances of the underlying normal distributions. Hence, the latter must be interpreted as the log of the variance of the normal distribution of labor earnings divided by 10,000, i.e. $\ln(\sigma_t^2 \cdot 10,000)$.

Table D.4: Estimated coefficients of the measurement equations with time-varying UH

	Employment 1 year before school completion			Number of siblings at 14		
	Coeff.		Std. Err.	Coeff.		Std. Err.
Age of respondent's mother at respondent's birth/10[§]	-0.035		0.040	-0.045	*	0.024
Age of respondent's mother at respondent's birth is missing	0.107		0.091	-0.033		0.055
Number of siblings at 14 if IT-SILC wave is 2005/10	0.354		0.222	–		–
Number of siblings at 14 if IT-SILC wave is 2011/10	1.187	***	0.309	–		–
IT-SILC wave 2011	-0.095		0.066	-0.546	***	0.032
Respondent's mother has at least secondary education	-0.074		0.046	-0.171	***	0.034
Respondent's mother was employed when respondent was 14	-0.033		0.045	-0.125	***	0.031
Quarter of birth - Reference: January, February, March						
April, May, June	-0.015		0.055	0.051		0.034
July, August, September	-0.103	*	0.056	-0.028		0.035
October, November, December	-0.140	**	0.059	-0.066	*	0.037
Regional unemployment rate at birth	-1.081		1.174	-1.753	***	0.578
Regional employment rate at birth	1.128		0.753	-1.566	***	0.434
Regional fertility rate at birth	0.052		0.126	0.823	***	0.061
Year of birth/10 (normalized to its minimum)	-0.964	***	0.063	-0.045		0.030
Geographical area at birth - Reference: North-West						
North-East	0.231	***	0.056	0.134	***	0.040
Center	-0.036		0.062	-0.109	**	0.046
South	-0.024		0.119	0.180	**	0.070
Islands (Sardinia and Sicily)	0.013		0.145	0.346	***	0.077
Calendar year of t - Reference: After 2001						
Before 1981	-2.811	***	0.153	–		–
Between 1982 and 1986	-2.293	***	0.129	–		–
Between 1987 and 1991	-1.593	***	0.107	–		–
Between 1992 and 1996	-1.240	***	0.097	–		–
Between 1997 and 2001	-0.740	***	0.088	–		–
Constant	1.025	*	0.547	1.683	***	0.302
$\ln(\sigma^2)$	–		–	0.340	***	0.009

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%.
[§] Normalized to zero.

Table D.5: Estimated coefficients of the (ordered probit) equations for the timing of childbirth with time-varying UH

	Coeff.		Std. Err.		Coeff.		Std. Err.
(a) Variables with common effect for all the childbirth equations				***(b) Ordered probit thresholds specific to each childbirth equation***			
Age at school completion/10[§]	-0.618	***	0.045	*(b.1) Ordered probit thresholds of 1st childbirth equation*			
Education - Reference: Lower secondary or less				δ_1^1 (birth in $[1, 3]$)	-2.772	***	0.219
Higher secondary	0.041		0.028	$\ln(\delta_2^1 - \delta_1^1)$ (birth in $[4, 6]$)	-0.080	**	0.032
Tertiary	0.059		0.046	$\ln(\delta_3^1 - \delta_2^1)$ (birth in $[7, 9]$)	-1.050	***	0.059
Fraction of days worked one year before school completion	-0.162	***	0.046	$\ln(\delta_4^1 - \delta_3^1)$ (birth in $[10, 12]$)	-0.624	***	0.028
Age of respondent's mother at respondent's birth/10[§]	0.077	***	0.018	$\ln(\delta_5^1 - \delta_4^1)$ (birth in $[13, 15]$)	-1.282	***	0.050
Age of respondent's mother at respondent's birth is missing	0.000		0.040	$\ln(\delta_6^1 - \delta_5^1)$ (birth in $[16, 18]$)	-1.040	***	0.047
Number of siblings at 14 if IT-SILC wave is 2005/10	-0.319	***	0.087	$\ln(\delta_7^1 - \delta_6^1)$ (birth in $[19, 21]$)	-1.860	***	0.074
Number of siblings at 14 if IT-SILC wave is 2011/10	-0.616	***	0.131	*(b.2) Ordered probit thresholds of 2nd childbirth equation*			
IT-SILC wave 2011	0.028		0.030	δ_1^2 (birth in $[1, 6]$)	-1.605	***	0.227
Respondent's mother has at least secondary education	0.048	**	0.023	$\ln(\delta_2^2 - \delta_1^2)$ (birth in $[7, 9]$)	0.031		0.042
Respondent's mother was employed when respondent was 14	-0.051	**	0.021	$\ln(\delta_3^2 - \delta_2^2)$ (birth in $[10, 12]$)	-0.102	***	0.036
Quarter of birth - Reference: January, February, March				$\ln(\delta_4^2 - \delta_3^2)$ (birth in $[13, 15]$)	-0.333	***	0.035
April, May, June	-0.020		0.025	$\ln(\delta_5^2 - \delta_4^2)$ (birth in $[16, 18]$)	-0.674	***	0.042
July, August, September	0.043	*	0.025	$\ln(\delta_6^2 - \delta_5^2)$ (birth in $[19, 21]$)	-1.108	***	0.057
October, November, December	0.080	***	0.026	*(b.3) Ordered probit thresholds of 3rd childbirth equation*			
Regional unemployment rate at birth	0.132		0.435	δ_1^3 (birth in $[1, 12]$)	-1.242	***	0.247
Regional employment rate at birth	-0.267		0.313	$\ln(\delta_2^3 - \delta_1^3)$ (birth in $[13, 15]$)	-0.584	***	0.104
Regional fertility rate at birth	-0.368	***	0.051	$\ln(\delta_3^3 - \delta_2^3)$ (birth in $[16, 21]$)	-0.332	***	0.073
Year of birth/10 (normalized to its minimum)	-0.045	*	0.023	***(c) Variables only included in the 2nd childbirth equation***			
Geographical area at birth - Reference: North-West				Time until 1st childbirth	2.107	***	0.048
North-East	-0.071	***	0.027	Twins in the 1st childbirth	-1.668	***	0.295
Center	-0.021		0.029	***(d) Variables only included in the 3rd childbirth equation***			
South	-0.088	*	0.051	Time until 1st childbirth	1.317	***	0.117
Islands (Sardinia and Sicily)	-0.017		0.061	Spacing between 1st and 2nd childbirth	2.222	***	0.169
				First 2 kids of the same gender	-0.127	**	0.064

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%.
[§] Normalized to zero.

Table D.6: Estimated distribution of the discrete time-varying UH with $H = 10$ support points

	$t=3$	$t=6$	$t=9$	$t=12$	$t=15$	$t=18 \vee t=21$	Logistic weight of the probability masses (ρ^h)	Resulting probabilities (p^h)
$\boldsymbol{\theta}^1$	0.00	0.00	0.00	0.00	0.00	0.00	-0.383***	0.033
							(0.082)	
$\boldsymbol{\theta}^2$	-13,266.27***	13,204.39***	577.47***	1,674.92***	1,821.98***	815.64**	1.056***	0.141
	(173.60)	(235.20)	(111.01)	(366.56)	(466.91)	(337.78)	(0.060)	
$\boldsymbol{\theta}^3$	-13,263.37***	-1,696.48***	-15,290.21***	-12,160.21***	-10,630.48***	-9,219.04***	1.219***	0.166
	(178.65)	(108.54)	(344.72)	(703.61)	(810.65)	(554.45)	(0.062)	
$\boldsymbol{\theta}^4$	-13,290.51***	-1,665.27***	-14,836.41***	-2,675.19***	3,269.21***	4,125.17***	0.454***	0.077
	(185.70)	(119.98)	(334.38)	(373.13)	(544.17)	(411.96)	(0.072)	
$\boldsymbol{\theta}^5$	-12,564.76***	12,495.54***	-14,295.47***	-7,687.91***	-5,435.92***	-3,842.54***	-0.155	0.042
	(171.14)	(233.15)	(325.93)	(543.31)	(598.48)	(412.71)	(0.078)	
$\boldsymbol{\theta}^6$	1,265.36***	14,040.96***	857.43***	3,050.61***	3,785.14***	2,278.74***	1.821***	0.303
	(64.15)	(242.42)	(109.85)	(362.74)	(476.74)	(329.97)	(0.058)	
$\boldsymbol{\theta}^7$	610.31***	12,982.32***	-14,145.12***	-5,600.35***	-4,245.72***	-4,183.45***	-0.159**	0.042
	(72.65)	(241.92)	(319.56)	(467.87)	(592.60)	(422.85)	(0.080)	
$\boldsymbol{\theta}^8$	-13,234.34***	-892.56***	54.00	-62.94	745.24	-463.78	0.794***	0.109
	(176.05)	(87.93)	(107.09)	(359.42)	(465.77)	(335.60)	(0.063)	
$\boldsymbol{\theta}^9$	-365.90***	-1,007.77***	-15,058.78***	-8,725.41***	-5,594.61***	-6,460.93***	-0.247***	0.038
	(65.43)	(116.99)	(347.43)	(582.57)	(626.15)	(489.67)	(0.080)	
$\boldsymbol{\theta}^{10}$	-5,971.61***	13,183.09***	536.59***	1,926.79***	2,419.68***	1,543.40***	0.000	0.049
	(101.03)	(239.69)	(135.82)	(445.56)	(570.61)	(406.54)		

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%. Standard errors are reported in parentheses. Since the loading factors of the earnings equations are normalized to 1, all the figures are in 2014 Euro. The normalisation $\boldsymbol{\theta}^1 = \mathbf{0}$ is innocuous: all the support points are indeed in deviation from the time-varying constant terms displayed in the last part of Table D.3.

Table D.7: Covariance matrix of the discrete time-varying UH distribution

	$t=3$	$t=6$	$t=9$	$t=12$	$t=15$	$t=18 \vee t=21$
$t=3$	0.4710	–	–	–	–	–
	(0.0116)	–	–	–	–	–
$t=6$	0.2797	0.5420	–	–	–	–
	(0.0073)	(0.0181)	–	–	–	–
$t=9$	0.1994	0.3365	0.5592	–	–	–
	(0.0080)	(0.0104)	(0.0241)	–	–	–
$t=12$	0.1810	0.2797	0.3837	0.3170	–	–
	(0.0107)	(0.0149)	(0.0181)	(0.0307)	–	–
$t=15$	0.1546	0.2245	0.3073	0.2855	0.2764	–
	(0.0112)	(0.0151)	(0.0194)	(0.0197)	(0.0331)	–
$t=18 \vee t=21$	0.1091	0.1730	0.2297	0.2277	0.2276	0.1924
	(0.0077)	(0.0107)	(0.0133)	(0.0149)	(0.0151)	(0.0180)

Notes: Before computing the covariance matrix the support points displayed in Table D.6 were divided by 10,000 for the sake of readability. Standard errors in parentheses. All coefficients are statistically significant at the 1% level.

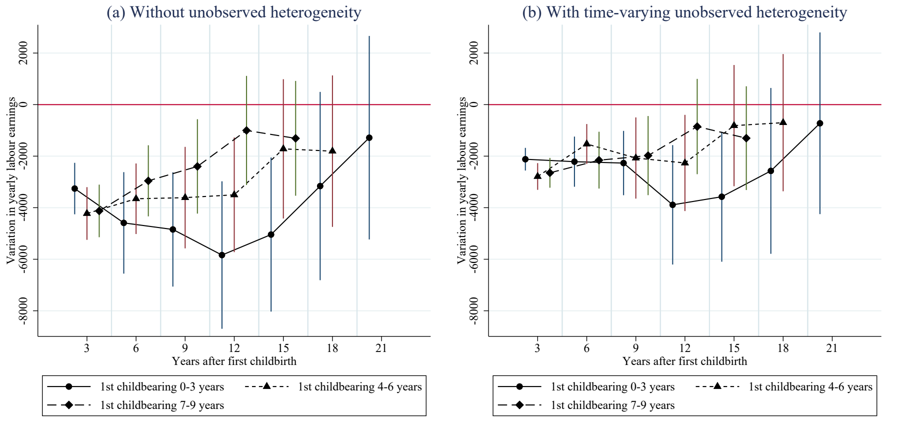
Table D.8: Estimated loading factors

Equations	Loading factor		Std. Err.
Measurement equations			
Employment 1 year before school completion	0.408	***	0.033
Number of siblings when 14 years old	0.006		0.021
Selection into treatment equations			
1st pregnancy	-0.149	***	0.013
2nd pregnancy	-0.078	***	0.027
3rd pregnancy	0.011		0.050
Equations for the fraction of time at work			
3 years after school completion	0.649	***	0.009
6 years after school completion	0.598	***	0.012
9 years after school completion	0.581	***	0.014
12 years after school completion	0.517	***	0.037
15 years after school completion	0.493	***	0.045
18 or 21 years after school completion	0.464	***	0.037

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%.

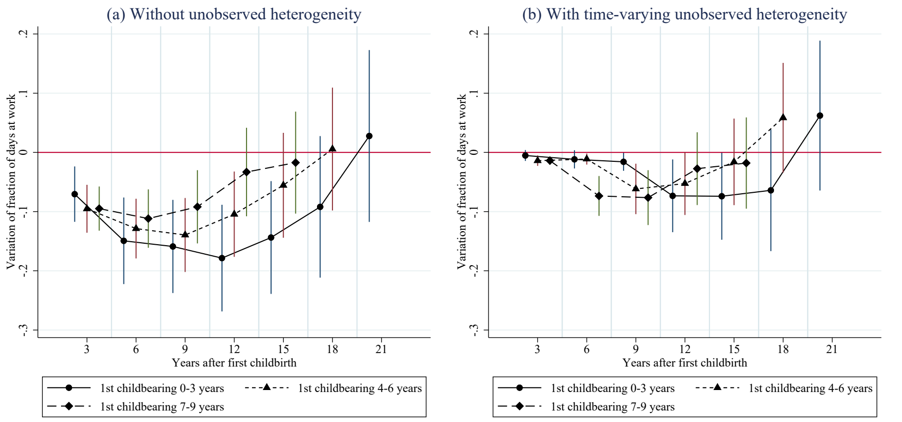
§ The loading factors of the labor earnings equations are normalized to 1.

Figure D.3: The impact on labor earnings of the 1st childbirth occurring 0-3, 4-6, or 7-9 years after school completion over time after the first childbirth



Notes: The vertical segments crossing the dots are 95% confidence intervals.

Figure D.4: The impact on the yearly fraction of days spent in employment of the 1st childbirth occurring 0-3, 4-6, or 10-12 years after school completion over time after the first childbirth



Notes: The vertical segments crossing the dots are 95% confidence intervals.

E Full Set of Estimation Results for the Model with Time-Constant UH, Discrete Distribution with 10 Support Points

Table E.1: Estimated coefficients of the impact of childbirth and birth timing on yearly labor earnings (€)§ with time-constant UH (discrete distribution with 10 support points)

Years since school completion	$t = 3$	$t = 6$	$t = 9$	$t = 12$	$t = 15$	$t = 18$	$t = 21$
1st childbirth							
$r \in [0, 3]$	-3,360.72***	-5,196.35***	-5,166.56***	-6,126.59***	-5,515.24***	-4,013.34***	-2,360.47*
	(428.87)	(686.28)	(706.41)	(756.66)	(871.46)	(1,136.33)	(1,370.28)
$r \in [4, 6]$	–	-5,373.93***	-5,025.22***	-5,288.05***	-5,269.29***	-3,654.09***	-3,500.51***
		(376.67)	(428.37)	(494.61)	(611.68)	(782.61)	(1,000.29)
$r \in [7, 9]$	–	–	-5,365.2***	-4,649.43***	-4,349.55***	-2,867.21***	-3,166.45***
			(289.95)	(336.60)	(478.40)	(627.52)	(776.85)
$r \in [10, 12]$	–	–	–	-5,791.22***	-4,507.01***	-3,370.53***	-3,824.65***
				(263.12)	(390.96)	(613.67)	(686.49)
$r \in [13, 15]$	–	–	–	–	-5,582.77***	-3,786.59***	-3,841.98***
					(343.64)	(548.96)	(710.81)
$r \in [16, 18]$	–	–	–	–	–	-6,675.04***	-4,954.51***
						(656.65)	(813.93)
$r \in [19, 21]$	–	–	–	–	–	–	-6,860.34***
							(928.25)
2nd childbirth							
$r \in [1, 6]$	–	-1,789.76**	-1,631.81*	-245.31	-522.47	-314.14	-1,835.62
		(834.66)	(892.24)	(888.11)	(1,361.86)	(1,657.25)	(2,226.38)
$r \in [7, 9]$	–	–	-2,432.48***	-1,397.37**	-1,060.88	-2,167.78**	-2,026.78
			(480.44)	(587.38)	(700.04)	(1,009.02)	(1,344.58)
$r \in [10, 12]$	–	–	–	-2,971.3***	-2,311.94***	-2,564.94***	-2,799.9***
				(358.79)	(536.39)	(720.31)	(901.44)
$r \in [13, 15]$	–	–	–	–	-2,504.18***	-2,188.27***	-1,700.43**
					(402.42)	(609.62)	(750.32)
$r \in [16, 18]$	–	–	–	–	–	-3,788.36***	-2,733.11***
						(592.47)	(814.12)
$r \in [19, 21]$	–	–	–	–	–	–	-3,909.21***
							(745.53)
3rd childbirth							
$r \in [1, \min(t, 12)]$	–	–	626.15	-1,210.54*	-2,833.72*	-3,500.67*	-3,173.46
			(1,034.65)	(669.9)	(1,501.74)	(1,859.45)	(2,701.4)
$r \in [13, 15]$	–	–	–	–	-1,411.9	-1,456.37	-265.57
					(919.87)	(1,297.23)	(1,503.04)
$r \in [16, \min(t, 21)]$	–	–	–	–	–	-2,427.57*	-1,944.76
						(1,321.04)	(1,296.11)

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%. Standard errors are in parentheses.
§ Yearly labor earnings are in 2014 prices and deflated by the ISTAT consumer price index.

Table E.2: Estimated coefficients of the impact of childbirth and birth timing on yearly fraction of days spent in employment with time-constant UH (discrete distribution with 10 support points)

Years since school completion	$t = 3$	$t = 6$	$t = 9$	$t = 12$	$t = 15$	$t = 18$	$t = 21$
1st childbirth							
$r \in [0, 3]$	-0.073***	-0.166***	-0.167***	-0.181***	-0.159***	-0.117***	0.0003
	(0.021)	(0.029)	(0.029)	(0.031)	(0.033)	(0.044)	(0.055)
$r \in [4, 6]$	–	-0.131***	-0.169***	-0.187***	-0.159***	-0.115***	-0.044
		(0.017)	(0.018)	(0.020)	(0.024)	(0.031)	(0.040)
$r \in [7, 9]$	–	–	-0.131***	-0.161***	-0.151***	-0.090***	-0.073**
			(0.014)	(0.016)	(0.020)	(0.026)	(0.033)
$r \in [10, 12]$	–	–	–	-0.131***	-0.158***	-0.109***	-0.125***
				(0.012)	(0.017)	(0.024)	(0.030)
$r \in [13, 15]$	–	–	–	–	-0.137***	-0.115***	-0.128***
					(0.016)	(0.024)	(0.031)
$r \in [16, 18]$	–	–	–	–	–	-0.144***	-0.129***
						(0.024)	(0.032)
$r \in [19, 21]$	–	–	–	–	–	–	-0.158***
							(0.037)
2nd childbirth							
$r \in [1, 6]$	–	-0.029	-0.072*	-0.030	-0.087*	-0.081	-0.110
		(0.033)	(0.038)	(0.043)	(0.046)	(0.062)	(0.075)
$r \in [7, 9]$	–	–	-0.081***	-0.079***	-0.073**	-0.074**	-0.058
			(0.022)	(0.027)	(0.028)	(0.038)	(0.048)
$r \in [10, 12]$	–	–	–	-0.079***	-0.092***	-0.096***	-0.095***
				(0.017)	(0.022)	(0.027)	(0.035)
$r \in [13, 15]$	–	–	–	–	-0.039**	-0.084***	-0.056*
					(0.018)	(0.024)	(0.030)
$r \in [16, 18]$	–	–	–	–	–	-0.108***	-0.106***
						(0.023)	(0.032)
$r \in [19, 21]$	–	–	–	–	–	–	-0.123***
							(0.031)
3rd childbirth							
$r \in [1, \min(t, 12)]$	–	–	0.087	0.008	-0.056	-0.048	-0.093
			(0.058)	(0.036)	(0.048)	(0.063)	(0.078)
$r \in [13, 15]$	–	–	–	–	-0.042	-0.045	0.016
					(0.036)	(0.051)	(0.056)
$r \in [16, \min(t, 21)]$	–	–	–	–	–	-0.118***	-0.127***
						(0.041)	(0.043)

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%. Standard errors are in parentheses.

Table E.3: Estimated coefficients of the covariates of the labor market outcome equations with time-constant UH (discrete distribution with 10 support points)

	labor earnings			Fraction of days spent in employment		
	Coeff.		Std. Err.	Coeff.		Std. Err.
Age at school completion/10[§]	4,940.41	***	411.19	0.022		0.018
Education - Reference: Lower secondary or less						
Higher secondary	1,396.73	***	205.71	0.081	***	0.006
Tertiary	1,334.35	***	290.22	0.061	***	0.010
Fraction of days worked one year before school completion	5,449.17	***	289.79	0.247	***	0.010
Age of respondent's mother at respondent's birth/10[§]	-200.87	*	118.59	-0.014	***	0.004
Age of respondent's mother at respondent's birth is missing	-512.30	*	270.19	-0.036	***	0.009
Number of siblings at 14 if IT-SILC wave is 2005/10	2,415.44	***	701.71	0.092	***	0.022
Number of siblings at 14 if IT-SILC wave is 2011/10	4,185.39	***	934.57	0.131	***	0.031
IT-SILC wave 2011	-66.76		196.50	-0.014	**	0.007
Respondent's mother has at least secondary education	-231.53	*	138.84	-0.046	***	0.005
Respondent's mother was employed when respondent was 14	-49.65		129.63	0.005		0.004
Quarter of birth - Reference: January, February, March						
April, May, June	-429.05	**	165.82	-0.013	**	0.005
July, August, September	-296.48	*	162.71	-0.017	***	0.006
October, November, December	-205.30		169.54	0.000		0.006
Regional unemployment rate at t	-12,580.40	***	2,481.23	-0.947	***	0.102
Regional employment rate at t	16,429.20	***	1,632.61	0.633	***	0.064
Regional fertility rate at t	598.05	*	308.21	-0.182	***	0.012
Year of birth/10 (normalized to its minimum)	344.11		352.77	0.065	***	0.016
Geographical area at t- Reference: North-West						
North-East	1,249.43	***	134.82	0.064	***	0.005
Center	-1,272.76	***	139.92	-0.014	***	0.005
South	-3,743.60	***	247.07	-0.076	***	0.008
Islands (Sardinia and Sicily)	-2,826.47	***	325.97	-0.069	***	0.011
Calendar year of t - Reference: After 2005						
Before 1985	-663.68		899.78	0.020		0.042
Between 1986 and 1990	-453.77		692.98	-0.010		0.033
Between 1990 and 1995	-483.70		532.14	-0.052	**	0.025
Between 1996 and 2000	-711.27	*	368.31	-0.043	**	0.018
Between 2001 and 2005	-482.75	**	224.68	-0.015		0.011
Constant at $t = 3$	10,824.50	***	1,513.34	0.859	***	0.070
$\ln(\sigma_3^2)^‡$	-0.67	***	0.02	-1.935	***	0.029
Constant at $t = 6$	21,845.00	***	1,495.79	1.184	***	0.068
$\ln(\sigma_6^2)^‡$	-0.73	***	0.01	-2.067	***	0.027
Constant at $t = 9$	30,046.90	***	1,497.64	1.380	***	0.065
$\ln(\sigma_9^2)^‡$	-0.84	***	0.01	-2.198	***	0.025
Constant at $t = 12$	35,266.10	***	1,491.27	1.562	***	0.064
$\ln(\sigma_{12}^2)^‡$	-0.85	***	0.01	-2.302	***	0.026
Constant at $t = 15$	36,623.40	***	1,480.02	1.591	***	0.063
$\ln(\sigma_{15}^2)^‡$	-0.70	***	0.01	-2.247	***	0.029
Constant at $t = 18$	36,368.60	***	1,513.15	1.606	***	0.065
$\ln(\sigma_{18}^2)^‡$	-0.44	***	0.01	-2.128	***	0.034
Constant at $t = 21$	35,747.70	***	1,489.28	1.554	***	0.073
$\ln(\sigma_{21}^2)^‡$	-0.31	***	0.02	-1.990	***	0.042

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%.

§ Normalized to zero.

‡ We estimated the model using labor earnings divided by 10,000 to reduce numerical problems. Then, we multiplied all the estimated coefficients by 10,000 before reporting them in the tables with estimations results, apart from the natural logarithms of the variances of the underlying normal distributions. Hence, the latter must be interpreted as the log of the variance of the normal distribution of labor earnings divided by 10,000, i.e. $\ln(\sigma_t^2 \cdot 10,000)$.

Table E.4: Estimated coefficients of the measurement equations with time-constant UH (discrete distribution with 10 support points)

	Employment 1 year before school completion			Number of siblings at 14		
	Coeff.		Std. Err.	Coeff.		Std. Err.
Age of respondent's mother at respondent's birth/10§	-0.049		0.040	-0.044	*	0.024
Age of respondent's mother at respondent's birth is missing	0.081		0.090	-0.028		0.055
Number of siblings at 14 if IT-SILC wave is 2005/10	0.265		0.215	–		–
Number of siblings at 14 if IT-SILC wave is 2011/10	1.162	***	0.305	–		–
IT-SILC wave 2011	-0.106		0.065	-0.543	***	0.031
Respondent's mother has at least secondary education	-0.083	*	0.046	-0.161	***	0.034
Respondent's mother was employed when respondent was 14	-0.038		0.045	-0.121	***	0.031
Quarter of birth - Reference: January, February, March						
April, May, June	-0.024		0.054	0.051		0.034
July, August, September	-0.096	*	0.055	-0.026		0.035
October, November, December	-0.111	*	0.057	-0.064	*	0.037
Regional unemployment rate at birth	-1.091		1.116	-1.722	***	0.576
Regional employment rate at birth	1.543	**	0.728	-1.465	***	0.431
Regional fertility rate at birth	0.025		0.125	0.809	***	0.061
Year of birth/10 (normalized to its minimum)	-1.029	***	0.062	-0.054	*	0.030
Geographical area at birth - Reference: North-West						
North-East	0.240	***	0.055	0.127	***	0.040
Center	-0.113	*	0.061	-0.112	**	0.046
South	-0.122		0.118	0.194	***	0.070
Islands (Sardinia and Sicily)	-0.103		0.140	0.355	***	0.076
Calendar year of t - Reference: After 2001						
Before 1981	-3.035	***	0.152	–		–
Between 1982 and 1986	-2.475	***	0.128	–		–
Between 1987 and 1991	-1.757	***	0.106	–		–
Between 1992 and 1996	-1.345	***	0.095	–		–
Between 1997 and 2001	-0.771	***	0.087	–		–
Constant	0.543		0.538	1.439	***	0.304
$\ln(\sigma^2)$	–		–	0.337	***	0.010

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%.
§ Normalized to zero.

Table E.5: Estimated coefficients of the (ordered probit) equations for the timing of childbirth with time-constant UH (discrete distribution with 10 support points)

	Coeff.		Std. Err.		Coeff.		Std. Err.
(a) Variables with common effect for all the childbirth equations				***(b) Ordered probit thresholds specific to each childbirth equation***			
Age at school completion/10§	-0.572	***	0.045	*(b.1) Ordered probit thresholds of 1st childbirth equation*			
Education - Reference: Lower secondary or less				δ_1^1 (birth in $[1, 3]$)	-2.367	***	0.222
Higher secondary	0.044		0.028	$\ln(\delta_2^1 - \delta_1^1)$ (birth in $[4, 6]$)	-0.176	***	0.032
Tertiary	0.076	*	0.046	$\ln(\delta_3^1 - \delta_2^1)$ (birth in $[7, 9]$)	-0.460	***	0.031
Fraction of days worked one year before school completion	-0.181	***	0.046	$\ln(\delta_4^1 - \delta_3^1)$ (birth in $[10, 12]$)	-0.602	***	0.031
Age of respondent's mother at respondent's birth/10§	0.077	***	0.017	$\ln(\delta_5^1 - \delta_4^1)$ (birth in $[13, 15]$)	-1.388	***	0.057
Age of respondent's mother at respondent's birth is missing	-0.001		0.040	$\ln(\delta_6^1 - \delta_5^1)$ (birth in $[16, 18]$)	-0.983	***	0.054
Number of siblings at 14 if IT-SILC wave is 2005/10	-0.367	***	0.088	$\ln(\delta_7^1 - \delta_6^1)$ (birth in $[19, 21]$)	-1.994	***	0.151
Number of siblings at 14 if IT-SILC wave is 2011/10	-0.647	***	0.132	*(b.2) Ordered probit thresholds of 2nd childbirth equation*			
IT-SILC wave 2011	0.021		0.030	δ_1^2 (birth in $[1, 6]$)	-1.433	***	0.229
Respondent's mother has at least secondary education	0.054	**	0.023	$\ln(\delta_2^2 - \delta_1^2)$ (birth in $[7, 9]$)	0.062		0.047
Respondent's mother was employed when respondent was 14	-0.047	**	0.021	$\ln(\delta_3^2 - \delta_2^2)$ (birth in $[10, 12]$)	-0.124	***	0.036
Quarter of birth - Reference: January, February, March				$\ln(\delta_4^2 - \delta_3^2)$ (birth in $[13, 15]$)	-0.349	***	0.035
April, May, June	-0.023		0.025	$\ln(\delta_5^2 - \delta_4^2)$ (birth in $[16, 18]$)	-0.673	***	0.041
July, August, September	0.043	*	0.025	$\ln(\delta_6^2 - \delta_5^2)$ (birth in $[19, 21]$)	-1.120	***	0.059
October, November, December	0.079	***	0.026	*(b.3) Ordered probit thresholds of 3rd childbirth equation*			
Regional unemployment rate at birth	0.040		0.437	δ_1^3 (birth in $[1, 12]$)	-1.244	***	0.252
Regional employment rate at birth	-0.143		0.313	$\ln(\delta_2^3 - \delta_1^3)$ (birth in $[13, 15]$)	-0.778	***	0.189
Regional fertility rate at birth	-0.379	***	0.051	$\ln(\delta_3^3 - \delta_2^3)$ (birth in $[16, 21]$)	-0.342	***	0.073
Year of birth/10 (normalized to its minimum)	-0.036		0.023	***(c) Variables only included in the 2nd childbirth equation***			
Geographical area at birth - Reference: North-West				Time until 1st childbirth	2.129	***	0.047
North-East	-0.074	***	0.027	Twins in the 1st childbirth	-1.672	***	0.300
Center	-0.037		0.029	***(d) Variables only included in the 3rd childbirth equation***			
South	-0.101	**	0.052	Time until 1st childbirth	1.343	***	0.117
Islands (Sardinia and Sicily)	-0.042		0.062	Spacing between 1st and 2nd childbirth	2.256	***	0.171
				First 2 kids of the same gender	-0.128	**	0.064

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%.
§ Normalized to zero.

Table E.6: Estimated distribution of the discrete time-constant UH with $H = 10$ support points

	Location of the mass	Logistic weight of the probability masses (ρ^h)	Resulting probabilities (p^h)
θ^1	0.00	1.720***	0.007
		(0.568)	
θ^2	6,641.95***	0.800	0.003
	(562.54)	(0.543)	
θ^3	-7,731.14***	3.865***	0.060
	(382.84)	(0.566)	
θ^4	-10,888.30***	4.957***	0.178
	(431.74)	(0.576)	
θ^5	-13,065.40***	5.148***	0.216
	(469.19)	(0.567)	
θ^6	-18,900.00***	4.963***	0.179
	(489.90)	(0.562)	
θ^7	-15,855.00***	5.407***	0.279
	(459.69)	(0.560)	
θ^8	-3,947.12***	2.777***	0.020
	(317.49)	(0.562)	
θ^9	-22,532.20***	3.803***	0.056
	(556.74)	(0.571)	
θ^{10}	-16,790.90***	0.000	0.001
	(633.87)		

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%. Standard errors are reported in parentheses. Since the loading factors of the earnings equations are normalized to 1, all the figures are in 2014 Euro.

Table E.7: Estimated loading factors with time-constant UH (discrete distribution with 10 support points)

Equations	Loading factor		Std. Err.
Measurement equations			
Employment 1 year before school completion	-0.248	***	0.059
Number of siblings when 14 years old	-0.140	***	0.040
Selection into treatment equations			
1st pregnancy	0.170	***	0.019
2nd pregnancy	0.029		0.021
3rd pregnancy	-0.061		0.044
Equations for yearly labor earnings			
3 years after school completion	1.000		–
6 years after school completion	1.506	***	0.041
9 years after school completion	1.900	***	0.042
12 years after school completion	2.149	***	0.047
15 years after school completion	2.193	***	0.045
18 years after school completion	2.148	***	0.059
21 years after school completion	2.063	***	0.062
Equations for the fraction of time at work			
3 years after school completion	0.366	***	0.020
6 years after school completion	0.490	***	0.016
9 years after school completion	0.567	***	0.016
12 years after school completion	0.659	***	0.020
15 years after school completion	0.662	***	0.022
18 years after school completion	0.668	***	0.025
21 years after school completion	0.626	***	0.031

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%.

F Full Set of Estimation Results for the Model with Time-Constant UH, Mixture of 3 Normal Distributions

Table F.1: Estimated coefficients of the impact of childbirth and birth timing on yearly labor earnings (€)[§] with time-constant UH (mixture of 3 normals)

Years since school completion	$t = 3$	$t = 6$	$t = 9$	$t = 12$	$t = 15$	$t = 18$	$t = 21$
1st childbirth							
$r \in [0, 3]$	-3,428.22***	-5,187.01***	-5,097.01***	-5,953.19***	-5,353.52***	-3,817.08***	-2,153.23
	(442.8)	(698.64)	(712.0)	(767.11)	(860.26)	(1,168.34)	(1,366.45)
$r \in [4, 6]$	–	-5,329.87***	-4,920.08***	-5,117.02***	-5,114.46***	-3,483.33***	-3,338.6***
		(374.97)	(433.06)	(501.9)	(607.82)	(777.6)	(999.01)
$r \in [7, 9]$	–	–	-5,386.77***	-4,629.99***	-4,340.06***	-2,876.98***	-3,161.36***
			(290.68)	(335.32)	(477.8)	(618.0)	(768.06)
$r \in [10, 12]$	–	–	–	-5,42.62***	-4,357.81***	-3,279.53***	-3,719.52***
				(263.67)	(382.48)	(602.42)	(677.49)
$r \in [13, 15]$	–	–	–	–	-5,813.62***	-3,994.98***	-4,049.17***
					(341.95)	(538.1)	(701.36)
$r \in [16, 18]$	–	–	–	–	–	-6,467.34***	-4,747.96***
						(635.67)	(803.99)
$r \in [19, 21]$	–	–	–	–	–	–	-6,812.01***
							(916.7)
2nd childbirth							
$r \in [1, 6]$	–	-1,889.26**	-1,774.34**	-482.47	-728.66	-662.17	-2,141.17
		(828.67)	(876.67)	(889.4)	(1,298.69)	(1,677.74)	(2,172.67)
$r \in [7, 9]$	–	–	-2,477.47***	-1,460.41**	-1,060.96	-2,170.59**	-2,019.25
			(477.93)	(587.21)	(690.83)	(986.86)	(1,327.49)
$r \in [10, 12]$	–	–	–	-3,025.13***	-2,340.51***	-2,583.97***	-2,808.61***
				(358.64)	(533.02)	(707.95)	(891.61)
$r \in [13, 15]$	–	–	–	–	-2,477.99***	-2,126.39***	-1,577.2**
					(399.28)	(600.72)	(740.52)
$r \in [16, 18]$	–	–	–	–	–	-3,830.7***	-2,774.19***
						(579.07)	(803.28)
$r \in [19, 21]$	–	–	–	–	–	–	-3,867.73***
							(736.06)
3rd childbirth							
$r \in [1, \min(t, 12)]$	–	–	544.1	-1,212.64*	-2,871.41*	-3,552.99*	-3,210.17
			(1,044.74)	(663.85)	(1,500.16)	(1,831.11)	(2,625.95)
$r \in [13, 15]$	–	–	–	–	-1,680.32*	-1,816.43	-650.54
					(911.7)	(1,277.62)	(1,495.57)
$r \in [16, \min(t, 21)]$	–	–	–	–	–	-2,598.8**	-2,100.03
						(1,292.45)	(1,276.76)

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%. Standard errors are in parentheses.

[§] Yearly labor earnings are in 2014 prices and deflated by the ISTAT consumer price index.

Table F.2: Estimated coefficients of the impact of childbirth and birth timing on yearly fraction of days spent in employment with time-constant UH (mixture of 3 normals)

Years since school completion	$t = 3$	$t = 6$	$t = 9$	$t = 12$	$t = 15$	$t = 18$	$t = 21$
1st childbirth							
$r \in [0, 3]$	-0.075***	-0.166***	-0.166***	-0.176***	-0.155***	-0.111***	0.006
	(0.021)	(0.029)	(0.029)	(0.031)	(0.034)	(0.042)	(0.056)
$r \in [4, 6]$	–	-0.129***	-0.166***	-0.181***	-0.156***	-0.109***	-0.039
		(0.017)	(0.019)	(0.020)	(0.024)	(0.031)	(0.039)
$r \in [7, 9]$	–	–	-0.132***	-0.161***	-0.152***	-0.090***	-0.073**
			(0.014)	(0.016)	(0.020)	(0.025)	(0.032)
$r \in [10, 12]$	–	–	–	-0.126***	-0.155***	-0.106***	-0.122***
				(0.012)	(0.017)	(0.023)	(0.030)
$r \in [13, 15]$	–	–	–	–	-0.145***	-0.122***	-0.136***
					(0.016)	(0.023)	(0.031)
$r \in [16, 18]$	–	–	–	–	–	-0.138***	-0.123***
						(0.023)	(0.032)
$r \in [19, 21]$	–	–	–	–	–	–	-0.156***
							(0.036)
2nd childbirth							
$r \in [1, 6]$	–	-0.032	-0.075**	-0.035	-0.092**	-0.088	-0.118
		(0.033)	(0.038)	(0.042)	(0.047)	(0.060)	(0.076)
$r \in [7, 9]$	–	–	-0.083***	-0.081***	-0.074***	-0.074**	-0.059
			(0.022)	(0.027)	(0.028)	(0.037)	(0.047)
$r \in [10, 12]$	–	–	–	-0.08***	-0.093***	-0.096***	-0.095***
				(0.017)	(0.022)	(0.027)	(0.034)
$r \in [13, 15]$	–	–	–	–	-0.038**	-0.083***	-0.053*
					(0.018)	(0.024)	(0.030)
$r \in [16, 18]$	–	–	–	–	–	-0.108***	-0.105***
						(0.023)	(0.032)
$r \in [19, 21]$	–	–	–	–	–	–	-0.122***
							(0.031)
3rd childbirth							
$r \in [1, \min(t, 12)]$	–	–	0.085	0.006	-0.058	-0.05	-0.096
			(0.058)	(0.036)	(0.048)	(0.063)	(0.077)
$r \in [13, 15]$	–	–	–	–	-0.05	-0.057	0.003
					(0.036)	(0.051)	(0.056)
$r \in [16, \min(t, 21)]$	–	–	–	–	–	-0.124***	-0.132***
						(0.041)	(0.043)

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%. Standard errors are in parentheses.

Table F.3: Estimated coefficients of the covariates of the labor market outcome equations with time-constant UH (mixture of 3 normals)

	labor earnings			Fraction of days spent in employment		
	Coeff.		Std. Err.	Coeff.		Std. Err.
Age at school completion/10[§]	5,310.89	***	412.76	0.034	*	0.018
Education - Reference: Lower secondary or less						
Higher secondary	1,192.43	***	213.94	0.074	***	0.007
Tertiary	1,161.26	***	294.79	0.055	***	0.010
Fraction of days worked one year before school completion	5,541.79	***	324.01	0.250	***	0.011
Age of respondent's mother at respondent's birth/10[§]	-252.67	**	120.37	-0.016	***	0.004
Age of respondent's mother at respondent's birth is missing	-583.81	**	274.33	-0.038	***	0.009
Number of siblings at 14 if IT-SILC wave is 2005/10	3,139.96	***	738.35	0.116	***	0.023
Number of siblings at 14 if IT-SILC wave is 2011/10	4,399.16	***	1,017.11	0.138	***	0.034
IT-SILC wave 2011	118.07		197.56	-0.007		0.007
Respondent's mother has at least secondary education	-332.47	**	139.41	-0.049	***	0.005
Respondent's mother was employed when respondent was 14	-117.33		132.18	0.002		0.005
Quarter of birth - Reference: January, February, March						
April, May, June	-397.41	**	167.94	-0.012	**	0.006
July, August, September	-288.28	*	165.40	-0.017	***	0.006
October, November, December	-238.76		174.86	-0.001		0.006
Regional unemployment rate at t	-11,880.00	***	2,468.30	-0.923	***	0.101
Regional employment rate at t	16,410.20	***	1,620.14	0.632	***	0.064
Regional fertility rate at t	654.75	**	306.77	-0.180	***	0.012
Year of birth/10 (normalized to its minimum)	220.30		348.99	0.060	***	0.016
Geographical area at t- Reference: North-West						
North-East	1,312.23	***	137.09	0.067	***	0.005
Center	-1,318.00	***	140.89	-0.016	***	0.005
South	-3,641.00	***	248.88	-0.072	***	0.008
Islands (Sardinia and Sicily)	-2,818.88	***	328.27	-0.069	***	0.011
Calendar year of t - Reference: After 2005						
Before 1985	-701.77		896.39	0.018		0.042
Between 1986 and 1990	-489.42		689.81	-0.011		0.033
Between 1990 and 1995	-494.17		529.56	-0.052	**	0.025
Between 1996 and 2000	-720.44	**	365.99	-0.043	**	0.018
Between 2001 and 2005	-477.56	**	223.55	-0.015		0.011
Constant at $t = 3$	-3,569.72	**	1,464.12	0.334	***	0.065
$\ln(\sigma_3^2)^\ddagger$	-0.668	***	0.017	-1.936	***	0.030
Constant at $t = 6$	221.23		1,400.41	0.481	***	0.062
$\ln(\sigma_6^2)^\ddagger$	-0.725	***	0.014	-2.066	***	0.027
Constant at $t = 9$	2,798.03	**	1,343.26	0.567	***	0.059
$\ln(\sigma_9^2)^\ddagger$	-0.830	***	0.013	-2.196	***	0.025
Constant at $t = 12$	4,420.83	***	1,297.98	0.616	***	0.056
$\ln(\sigma_{12}^2)^\ddagger$	-0.843	***	0.014	-2.305	***	0.026
Constant at $t = 15$	5,174.52	***	1,260.40	0.643	***	0.054
$\ln(\sigma_{15}^2)^\ddagger$	-0.697	***	0.013	-2.253	***	0.028
Constant at $t = 18$	5,557.66	***	1,229.49	0.648	***	0.052
$\ln(\sigma_{18}^2)^\ddagger$	-0.461	***	0.010	-2.136	***	0.033
Constant at $t = 21$	6,129.68	***	1,224.71	0.656	***	0.051
$\ln(\sigma_{21}^2)^\ddagger$	-0.327	***	0.017	-1.998	***	0.042

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%.

§ Normalized to zero.

‡ We estimated the model using labor earnings divided by 10,000 to reduce numerical problems. Then, we multiplied all the estimated coefficients by 10,000 before reporting them in the tables with estimations results, apart from the natural logarithms of the variances of the underlying normal distributions. Hence, the latter must be interpreted as the log of the variance of the normal distribution of labor earnings divided by 10,000, i.e. $\ln(\sigma_t^2 \cdot 10,000)$.

Table F.4: Estimated coefficients of the measurement equations with time-constant UH (mixture of 3 normals)

	Employment 1 year before school completion			Number of siblings at 14		
	Coeff.		Std. Err.	Coeff.		Std. Err.
Age of respondent's mother at respondent's birth/10§	-0.049		0.040	-0.044	*	0.024
Age of respondent's mother at respondent's birth is missing	0.080		0.090	-0.027		0.055
Number of siblings at 14 if IT-SILC wave is 2005/10	0.270		0.215	–		–
Number of siblings at 14 if IT-SILC wave is 2011/10	1.173	***	0.305	–		–
IT-SILC wave 2011	-0.108	*	0.065	-0.544	***	0.031
Respondent's mother has at least secondary education	-0.081	*	0.046	-0.159	***	0.034
Respondent's mother was employed when respondent was 14	-0.036		0.045	-0.120	***	0.031
Quarter of birth - Reference: January, February, March						
April, May, June	-0.024		0.054	0.050		0.034
July, August, September	-0.096	*	0.055	-0.025		0.035
October, November, December	-0.110	*	0.057	-0.063	*	0.037
Regional unemployment rate at birth	-0.972		1.115	-1.730	***	0.576
Regional employment rate at birth	1.655	**	0.727	-1.461	***	0.431
Regional fertility rate at birth	0.029		0.125	0.805	***	0.061
Year of birth/10 (normalized to its minimum)	-1.025	***	0.062	-0.054	*	0.030
Geographical area at birth - Reference: North-West						
North-East	0.239	***	0.055	0.126	***	0.039
Center	-0.111	*	0.061	-0.112	**	0.046
South	-0.127		0.118	0.196	***	0.070
Islands (Sardinia and Sicily)	-0.103		0.140	0.356	***	0.076
Calendar year of t - Reference: After 2001						
Before 1981	-3.024	***	0.151	–		–
Between 1982 and 1986	-2.466	***	0.128	–		–
Between 1987 and 1991	-1.750	***	0.106	–		–
Between 1992 and 1996	-1.340	***	0.095	–		–
Between 1997 and 2001	-0.770	***	0.087	–		–
Constant	0.808		0.530	1.641	***	0.299
$\ln(\sigma^2)$	–		–	0.337	***	0.010

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%.
§ Normalized to zero.

Table F.5: Estimated coefficients of the (ordered probit) equations for the timing of childbirth with time-constant UH (mixture of 3 normals)

	Coeff.		Std. Err.		Coeff.		Std. Err.
(a) Variables with common effect for all the childbirth equations				***(b) Ordered probit thresholds specific to each childbirth equation***			
Age at school completion/10§	-0.585	***	0.044	*(b.1) Ordered probit thresholds of 1st childbirth equation*			
Education - Reference: Lower secondary or less				δ_1^1 (birth in $[1, 3]$)	-2.581	***	0.219
Higher secondary	0.050	*	0.028	$\ln(\delta_2^1 - \delta_1^1)$ (birth in $[4, 6]$)	-0.330	***	0.030
Tertiary	0.080	*	0.046	$\ln(\delta_3^1 - \delta_2^1)$ (birth in $[7, 9]$)	-0.623	***	0.027
Fraction of days worked one year before school completion	-0.178	***	0.046	$\ln(\delta_4^1 - \delta_3^1)$ (birth in $[10, 12]$)	-0.719	***	0.027
Age of respondent's mother at respondent's birth/10§	0.079	***	0.017	$\ln(\delta_5^1 - \delta_4^1)$ (birth in $[13, 15]$)	-1.045	***	0.034
Age of respondent's mother at respondent's birth is missing	0.004		0.039	$\ln(\delta_6^1 - \delta_5^1)$ (birth in $[16, 18]$)	-1.391	***	0.048
Number of siblings at 14 if IT-SILC wave is 2005/10	-0.381	***	0.088	$\ln(\delta_7^1 - \delta_6^1)$ (birth in $[19, 21]$)	-1.841	***	0.074
Number of siblings at 14 if IT-SILC wave is 2011/10	-0.657	***	0.132	*(b.2) Ordered probit thresholds of 2nd childbirth equation*			
IT-SILC wave 2011	0.016		0.030	δ_1^2 (birth in $[1, 6]$)	-1.449	***	0.226
Respondent's mother has at least secondary education	0.055	**	0.023	$\ln(\delta_2^2 - \delta_1^2)$ (birth in $[7, 9]$)	0.029		0.042
Respondent's mother was employed when respondent was 14	-0.045	**	0.021	$\ln(\delta_3^2 - \delta_2^2)$ (birth in $[10, 12]$)	-0.134	***	0.035
Quarter of birth - Reference: January, February, March				$\ln(\delta_4^2 - \delta_3^2)$ (birth in $[13, 15]$)	-0.350	***	0.035
April, May, June	-0.020		0.025	$\ln(\delta_5^2 - \delta_4^2)$ (birth in $[16, 18]$)	-0.669	***	0.041
July, August, September	0.047	*	0.025	$\ln(\delta_6^2 - \delta_5^2)$ (birth in $[19, 21]$)	-1.110	***	0.057
October, November, December	0.084	***	0.026	*(b.3) Ordered probit thresholds of 3rd childbirth equation*			
Regional unemployment rate at birth	0.077		0.437	δ_1^3 (birth in $[1, 12]$)	-1.136	***	0.244
Regional employment rate at birth	-0.097		0.313	$\ln(\delta_2^3 - \delta_1^3)$ (birth in $[13, 15]$)	-0.579	***	0.094
Regional fertility rate at birth	-0.383	***	0.051	$\ln(\delta_3^3 - \delta_2^3)$ (birth in $[16, 21]$)	-0.347	***	0.073
Year of birth/10 (normalized to its minimum)	-0.033		0.023	***(c) Variables only included in the 2nd childbirth equation***			
Geographical area at birth - Reference: North-West				Time until 1st childbirth	2.128	***	0.047
North-East	-0.073	***	0.027	Twins in the 1st childbirth	-1.672	***	0.299
Center	-0.030		0.029	***(d) Variables only included in the 3rd childbirth equation***			
South	-0.100	*	0.051	Time until 1st childbirth	1.339	***	0.116
Islands (Sardinia and Sicily)	-0.034		0.061	Spacing between 1st and 2nd childbirth	2.251	***	0.170
				First 2 kids of the same gender	-0.128	**	0.064

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%.
§ Normalized to zero.

Table F.6: Estimated distribution of the time-constant UH with mixture of 3 normals

	Coeff.		Std. Err.
Means and standard deviations of the 3 mixing normal distributions			
Mean of the 1st normal distribution (μ_1)	0.041	***	0.011
$\ln(\sigma_1)$ of the 1st normal distribution	-1.030	***	0.024
Mean of the 2nd normal distribution (μ_2)	-0.042	***	0.006
$\ln(\sigma)$ of the 2nd normal distribution	-1.799	***	0.026
Mean of the 3rd normal distribution (μ_3)§	1.540		–
$\ln(\sigma)$ of the 3rd normal distribution	-0.502	***	0.064
Logistic weights of the probabilities of the mixing distribution			
Logistic weight 1	2.989	***	0.240
Logistic weight 2	4.039	***	0.239
Logistic weight 3	0.000		–
Resulting probability masses of the mixing distribution			
Probability mass 1 (P_1)	0.256		
Probability mass 2 (P_2)	0.731		
Probability mass 3 (P_3)	0.013		

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%. Standard errors are reported in parentheses. Since the loading factors of the earnings equations are normalized to 1, all the figures are in 2014 Euro (divided by 10,000).

§ The means of the 3 normal distributions are normalized so that their weighted mean (weighted by the probabilities of the mixing distribution) is equal to 0. Hence $\mu_3 = (-P_1\mu_1 - P_2\mu_2)/P_3$

Table F.7: Estimated loading factors with time-constant UH (mixture of 3 normals)

Equations	Loading factor		Std. Err.
Measurement equations			
Employment 1 year before school completion	-0.251	***	0.059
Number of siblings when 14 years old	-0.164	***	0.042
Selection into treatment equations			
1st pregnancy	0.156	***	0.019
2nd pregnancy	0.042	*	0.023
3rd pregnancy	-0.046		0.045
Equations for yearly labor earnings			
3 years after school completion	1.000		–
6 years after school completion	1.509	***	0.042
9 years after school completion	1.903	***	0.043
12 years after school completion	2.170	***	0.046
15 years after school completion	2.167	***	0.045
18 years after school completion	2.187	***	0.059
21 years after school completion	2.080	***	0.063
Equations for the fraction of time at work			
3 years after school completion	0.365	***	0.019
6 years after school completion	0.491	***	0.016
9 years after school completion	0.567	***	0.015
12 years after school completion	0.664	***	0.020
15 years after school completion	0.669	***	0.022
18 years after school completion	0.677	***	0.025
21 years after school completion	0.634	***	0.032

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%.

G Sensitivity Analysis: Estimated Motherhood Penalties

In a first sensitivity analysis, we considered the treatment as starting 9 months before the delivery date, instead of 3. The drawback of bringing forward so much the timing of the treatment is that in the treated group at time t there might be women who deliver in the first 9 months of year $t+1$ but have yet to be affected by their pregnancy at time t. This is the case, for example, if they realize late they are pregnant or in cases of preterm births occurring in $t+1$. This measurement error could generate a bias toward zero in the motherhood penalty. As shown in Tables G.1 and G.2, the short-term motherhood effects from this sensitivity analysis are indeed closer to zero, although very much in line with the ones from the benchmark model.

Second, we included among the regressors of the outcome equations the accumulated work experience up to the previous period in which earnings and the fraction of time spent in employment are measured. Although the accumulated work experience is a regressor with a strong explanatory power, it cannot be safely introduced in the model. It is indeed an endogenous time-varying variable, very likely to be jointly determined with the fertility episodes. This is the main reason why in the benchmark model we do not use it. If we do not include it in the outcome equations, this time-varying component ends up into the time-varying UH. If we are properly modeling the presence of time-varying UH correlated across outcome and fertility equations, the motherhood effects should not be sensitive to its inclusion. Tables G.3 and G.4 show that the motherhood penalties are not sensitive to the inclusion of the accumulated work experience, providing evidence that our benchmark model is able to accommodate the time-varying unobserved determinants of the modeled endogenous processes.

Third, we re-estimated the benchmark model under different combinations of exclusion restrictions. In the baseline model, there are three main sets of exclusion restrictions:

- The dummies for the geographical area of residence at birth are only included in the measurement and treatment (childbirth) equations and excluded from the outcome equations.
- The regional fertility, employment, and unemployment rates at birth are only included in the measurement and treatment (childbirth) equations and excluded from the outcome equations.
- In the three childbirth equations we have exclusion restrictions which naturally arise from

the time sequence of the events. For example, the equation for timing of the 2nd childbirth is explained by an indicator for a twin birth at the first delivery, which do not obviously enter the equation for the time elapsed to the 1st childbirth.

In this sensitivity analysis, we included the dummies for geographical area at birth and/or the regional rates at birth in the outcome equations. The results are reported in Tables G.5–G.10 and are very much in line with the ones of the benchmark model. On top of that, we also removed the exclusion restrictions in the equations for the timing of the different childbirths. Tables G.11 and G.12 confirm that the estimated benchmark effects are not sensitive to those exclusion restrictions.

Fourth, we replicated the estimation only on those women who exited school between 17 and 20 years of age with a secondary school diploma. The sample size shrank from 9,387 to 3,690 women. Because of our sample construction, women from older cohorts and with lower education are likely to have more weight in the identification of the effects for large t and, therefore, for longer-lasting effects, since they are more likely to stay up to the 21st year after school completion in our sample. One may wonder indeed whether women from older cohorts and with lower education could be differently affected by motherhood and partly explain the estimated profiles of the motherhood penalty. By focusing on women with the same education attained at similar age, we retain a much more homogeneous subsample that is less affected by the changing composition of the sample across different follow-up horizons. Tables G.13 and G.14 suggest that the point estimates of the parameters of interest are in most cases very close to those from the benchmark model displayed in Tables D.1 and D.2. The standard errors are much larger, since we removed more than 60% of the initial sample. This should be taken into account when comparing these estimation results with those from the baseline sample.

Fifth, with women in our sample born between 1960 and 1985, we check the existence of cohort effects by splitting the sample in those born in the 1960s and those born in the 1970s-1980s.[37] The results are reported in Tables G.15-G.18. Both groups of women show similar estimated parameters, with however some differences. Women born in the 1970s-1980s suffer somewhat larger motherhood penalties compared to women born in the 1960s, especially for early

[37]Table A.5 reports the number of observations and summary statistics of the distribution of the age at school completion by birth decade. It shows that the distribution of years of education did not change much across birth decades.

deliveries. This might be explained by the reduction in the employment protection legislation in Italy started in 1997 with the introduction of atypical job contracts. The reduced job protection for new entrants might indeed have prolonged the time needed to get a stable position allowing to reduce the motherhood penalties.

Lastly, we assessed whether the estimated parameter vector could be a local optimum. We run two checks in this direction. First, we re-started the maximization process using the final estimated parameters as initial values, while reducing by 1,000 times the termination tolerances for convergence. Second, we re-started 100 times the maximization process, each time using the final vector with each coefficient affected by a random deviation drawn from a uniform distribution centered at 0 with interval of size 0.001. We attained convergence always at the same parameter vector.

G.1 Treatment as Starting 9 Months before the Delivery Date

Table G.1: Estimated coefficients of the impact of childbirth and birth timing on yearly labor earnings (€)[§] with time-varying UH, if treatments start 9 months before the delivery date (instead of 3)

Years since school completion	$t = 3$	$t = 6$	$t = 9$	$t = 12$	$t = 15$	$t = 18$	$t = 21$
1st childbirth							
$r \in [0, 3]$	-1646.00***	-2205.11***	-2203.39***	-3143.64***	-2904.84**	-2040.12	-1225.41
	(189.13)	(448.26)	(591.23)	(1024.12)	(1265.96)	(1513.77)	(1648.06)
$r \in [4, 6]$	–	-2281.19***	-1407.24***	-2031.26***	-2061.37**	-1274.28	-592.70
		(234.24)	(415.46)	(768.76)	(927.08)	(1143.77)	(1316.86)
$r \in [7, 9]$	–	–	-2234.57***	-2340.96***	-2257.22***	-1553.08*	-1889.26*
			(293.79)	(578.19)	(739.62)	(932.96)	(1025.71)
$r \in [10, 12]$	–	–	–	-4473.24***	-3443.36***	-2287.55**	-2961.99***
				(468.39)	(655.68)	(889.07)	(972.34)
$r \in [13, 15]$	–	–	–	–	-4930.03***	-3672.64***	-3734.34***
					(636.01)	(901.59)	(1015.15)
$r \in [16, 18]$	–	–	–	–	–	-5152.14***	-4731.78***
						(1026.30)	(1173.92)
$r \in [19, 21]$	–	–	–	–	–	–	-5754.66***
							(1608.37)
2nd childbirth							
$r \in [1, 6]$	–	-1129.94**	-30.38	1266.79	876.61	1708.86	1426.29
		(488.32)	(785.86)	(1355.73)	(1724.68)	(2144.65)	(2367.08)
$r \in [7, 9]$	–	–	-423.30	2.98	521.03	-353.60	-622.60
			(444.95)	(938.95)	(1120.04)	(1309.84)	(1658.25)
$r \in [10, 12]$	–	–	–	-2526.87***	-1648.20*	-1532.84	-2247.16*
				(601.43)	(881.56)	(1015.77)	(1150.73)
$r \in [13, 15]$	–	–	–	–	-2376.24***	-2420.55**	-1684.81
					(735.52)	(987.87)	(1076.20)
$r \in [16, 18]$	–	–	–	–	–	-3397.62***	-2527.42**
						(898.18)	(1188.08)
$r \in [19, 21]$	–	–	–	–	–	–	-3303.98***
							(1221.45)
3rd childbirth							
$r \in [1, \min(t, 12)]$	–	–	-1680.70*	-1967.27	-3450.89	-4556.58	-4786.14
			(933.55)	(1224.21)	(2478.09)	(2790.00)	(3477.89)
$r \in [13, 15]$	–	–	–	–	-1578.85	-1205.80	-479.70
					(1577.36)	(1994.76)	(1935.56)
$r \in [16, \min(t, 21)]$	–	–	–	–	–	-2410.62	-1925.04
						(2022.28)	(1568.16)

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%. Standard errors are reported in parentheses.

[§] Yearly labor earnings are in 2014 prices. They are deflated by using the consumer price index gathered by ISTAT.

Table G.2: Estimated coefficients of the impact of childbirth and birth timing on yearly fraction of days spent in employment with time-varying UH, if treatments start 9 months before the delivery date (instead of 3)

Years since school completion	$t=3$	$t=6$	$t=9$	$t=12$	$t=15$	$t=18$	$t=21$
1st childbirth							
$r \in [0,3]$	-0.003	-0.014**	-0.016**	-0.050*	-0.070*	-0.071	0.040
	(0.004)	(0.007)	(0.007)	(0.028)	(0.037)	(0.048)	(0.059)
$r \in [4,6]$	–	-0.011**	-0.011**	-0.039*	-0.058**	-0.024	0.062
		(0.004)	(0.005)	(0.021)	(0.028)	(0.036)	(0.044)
$r \in [7,9]$	–	–	-0.012***	-0.080***	-0.089***	-0.052*	-0.033
			(0.004)	(0.017)	(0.023)	(0.031)	(0.040)
$r \in [10,12]$	–	–	–	-0.099***	-0.143***	-0.091***	-0.120***
				(0.014)	(0.021)	(0.029)	(0.037)
$r \in [13,15]$	–	–	–	–	-0.118***	-0.131***	-0.137***
					(0.020)	(0.030)	(0.039)
$r \in [16,18]$	–	–	–	–	–	-0.112***	-0.165***
						(0.031)	(0.040)
$r \in [19,21]$	–	–	–	–	–	–	-0.095*
							(0.049)
2nd childbirth							
$r \in [1,6]$	–	-0.009	0.001	0.038	0.015	0.033	0.016
		(0.009)	(0.010)	(0.041)	(0.053)	(0.070)	(0.083)
$r \in [7,9]$	–	–	-0.001	-0.045*	-0.019	-0.035	-0.040
			(0.007)	(0.027)	(0.033)	(0.044)	(0.053)
$r \in [10,12]$	–	–	–	-0.088***	-0.082***	-0.085***	-0.113***
				(0.018)	(0.026)	(0.033)	(0.041)
$r \in [13,15]$	–	–	–	–	-0.029	-0.101***	-0.063*
					(0.021)	(0.030)	(0.037)
$r \in [16,18]$	–	–	–	–	–	-0.093***	-0.110***
						(0.029)	(0.041)
$r \in [19,21]$	–	–	–	–	–	–	-0.071*
							(0.040)
3rd childbirth							
$r \in [1,\min(t,12)]$	–	–	-0.014	-0.032	-0.091	-0.085	-0.140
			(0.017)	(0.040)	(0.058)	(0.078)	(0.090)
$r \in [13,15]$	–	–	–	–	-0.045	-0.066	-0.039
					(0.041)	(0.061)	(0.066)
$r \in [16,\min(t,21)]$	–	–	–	–	–	-0.110**	-0.119**
						(0.051)	(0.053)

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%. Standard errors are reported in parentheses.

G.2 Accumulated Work Experience Among the Regressors of the Outcome Equations

Table G.3: Estimated coefficients of the impact of childbirth and birth timing on yearly labor earnings (€)[§] with time-varying UH, if accumulated work experience is included in the outcome equations

Years since school completion	$t = 3$	$t = 6$	$t = 9$	$t = 12$	$t = 15$	$t = 18$	$t = 21$
1st childbirth							
$r \in [0, 3]$	-2113.49***	-2345.34***	-1970.06***	-3314.07***	-2680.58**	-1868.58	-29.60
	(219.75)	(492.45)	(630.05)	(1132.95)	(1164.77)	(1459.83)	(1527.85)
$r \in [4, 6]$	–	-3017.70***	-1586.92***	-1912.96**	-1787.03**	-154.66	56.79
		(259.04)	(393.58)	(776.17)	(875.74)	(1067.79)	(1136.17)
$r \in [7, 9]$	–	–	-2973.82***	-2126.04***	-1499.82**	18.36	-229.24
			(289.15)	(542.25)	(716.65)	(839.54)	(890.49)
$r \in [10, 12]$	–	–	–	-4673.16***	-2619.35***	-814.12	-1065.44
				(449.32)	(578.24)	(801.77)	(805.27)
$r \in [13, 15]$	–	–	–	–	-5163.88***	-2778.41***	-2176.56***
					(554.08)	(766.18)	(840.39)
$r \in [16, 18]$	–	–	–	–	–	-6037.48***	-3633.42***
						(912.61)	(989.32)
$r \in [19, 21]$	–	–	–	–	–	–	-5903.16***
							(1118.50)
2nd childbirth							
$r \in [1, 6]$	–	-1580.35***	-175.33	1815.60	1602.95	1594.62	1251.43
		(562.57)	(852.96)	(1387.06)	(1762.51)	(2047.93)	(2273.32)
$r \in [7, 9]$	–	–	-811.66*	313.95	829.78	-811.10	-207.55
			(417.98)	(995.01)	(1085.90)	(1315.01)	(1530.54)
$r \in [10, 12]$	–	–	–	-2636.95***	-1375.39*	-1493.67	-1189.39
				(612.86)	(830.52)	(983.73)	(1046.26)
$r \in [13, 15]$	–	–	–	–	-2433.23***	-1976.59**	-836.50
					(625.80)	(827.41)	(873.67)
$r \in [16, 18]$	–	–	–	–	–	-3618.39***	-2155.42**
						(792.44)	(955.30)
$r \in [19, 21]$	–	–	–	–	–	–	-3957.49***
							(900.24)
3rd childbirth							
$r \in [1, \min(t, 12)]$	–	–	-957.76	-1864.15	-3374.71	-3823.86	-3461.97
			(961.04)	(1177.11)	(2300.86)	(2451.14)	(2939.07)
$r \in [13, 15]$	–	–	–	–	-1670.16	-1178.15	-68.51
					(1448.13)	(1748.85)	(1692.08)
$r \in [16, \min(t, 21)]$	–	–	–	–	–	-2664.35	-1572.26
						(1778.73)	(1450.84)

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%. Standard errors are reported in parentheses.

[§] Yearly labor earnings are in 2014 prices. They are deflated by using the consumer price index gathered by ISTAT.

Table G.4: Estimated coefficients of the impact of childbirth and birth timing on yearly fraction of days spent in employment with time-varying UH, if accumulated work experience is included in the outcome equations

Years since school completion	$t=3$	$t=6$	$t=9$	$t=12$	$t=15$	$t=18$	$t=21$
1st childbirth							
$r \in [0,3]$	-0.003	-0.017**	-0.011	-0.064**	-0.058*	-0.044	0.083*
	(0.004)	(0.008)	(0.008)	(0.029)	(0.032)	(0.042)	(0.050)
$r \in [4,6]$		-0.014***	-0.009*	-0.058***	-0.041*	0.001	0.077**
		(0.004)	(0.005)	(0.021)	(0.023)	(0.031)	(0.036)
$r \in [7,9]$			-0.013***	-0.065***	-0.053***	0.004	0.022
			(0.004)	(0.016)	(0.020)	(0.026)	(0.030)
$r \in [10,12]$				-0.103***	-0.103***	-0.028	-0.037
				(0.012)	(0.017)	(0.024)	(0.028)
$r \in [13,15]$					-0.129***	-0.082***	-0.072**
					(0.017)	(0.024)	(0.029)
$r \in [16,18]$						-0.134***	-0.092***
						(0.024)	(0.030)
$r \in [19,21]$							-0.138***
							(0.034)
2nd childbirth							
$r \in [1,6]$		-0.010	0.001	0.040	-0.026	-0.032	-0.035
		(0.010)	(0.012)	(0.042)	(0.047)	(0.060)	(0.070)
$r \in [7,9]$			-0.005	-0.018	-0.023	-0.057	-0.025
			(0.007)	(0.027)	(0.029)	(0.038)	(0.044)
$r \in [10,12]$				-0.077***	-0.073***	-0.079***	-0.059*
				(0.018)	(0.022)	(0.028)	(0.032)
$r \in [13,15]$					-0.045**	-0.094***	-0.043
					(0.018)	(0.025)	(0.028)
$r \in [16,18]$						-0.112***	-0.094***
						(0.023)	(0.030)
$r \in [19,21]$							-0.137***
							(0.029)
3rd childbirth							
$r \in [1,\min(t,12)]$			0.001	-0.018	-0.067	-0.055	-0.103
			(0.022)	(0.039)	(0.051)	(0.065)	(0.072)
$r \in [13,15]$					-0.056	-0.041	0.017
					(0.037)	(0.053)	(0.053)
$r \in [16,\min(t,21)]$						-0.135***	-0.123***
						(0.043)	(0.041)

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%. Standard errors are reported in parentheses.

G.3 Estimation Results with Different Sets of Exclusion Restrictions

In this subsection we report the estimation results of the effect of the timing of childbirths on the outcomes (yearly labor earnings and fraction of time spent at work) under different combinations of exclusion restrictions. In the baseline model, there are 3 main sets of exclusion restrictions:

- Dummies for the geographical area of residence at birth are only included in the measurement and treatment (childbirth) equations and excluded from the outcome equations. In the outcome equations we indeed only control for geographical area in the year of observation.
- The regional fertility, employment, and unemployment rates at birth are only included in the measurement and treatment (childbirth) equations and excluded from the outcome equations. In the outcome equations we only control for regional rates in the year of observation.
- The equation for the 2nd childbirth is explained by the timing to the first childbirth and by the dummy for twin birth. Similarly the equation for the 3rd childbirth is explained by the timing to the previous births and by the gender composition of the previous children. Hence, in the three childbirth equations we have exclusion restrictions that naturally arise from the time sequence of the events.

In what follows, we report in:

I. Tables G.5 and G.6 the results if we include the geographical area at birth in the outcome equations;

II. Tables G.7 and G.8 the results if we include the regional fertility, employment, and unemployment rates at birth in the outcome equations;

III. Tables G.9 and G.10 the results if we include both the geographical area at birth and the regional rates at birth in the outcome equations;

IV. Tables G.11 and G.12 the results if we include both the geographical area at birth and the regional rates at birth in the outcome equations and the childbirth equations have the same set of explanatory variables, i.e. we removed from the set of regressors of the 2nd and 3rd childbirths information on the previous births.

I. Including Geographical Area at Birth in the Outcome Equations

Table G.5: Estimated coefficients of the impact of childbirth and birth timing on yearly labor earnings (€)§ with time-varying UH and by including geographical area at birth in the outcome equations

Years since school completion	$t = 3$	$t = 6$	$t = 9$	$t = 12$	$t = 15$	$t = 18$	$t = 21$
1st childbirth							
$r \in [0, 3]$	-2119.49***	-2207.73***	-2252.42***	-3870.08***	-3544.02***	-2561.80	-734.06
	(224.24)	(496.42)	(637.49)	(1184.94)	(1288.09)	(1642.33)	(1802.79)
$r \in [4, 6]$	–	-2789.02***	-1546.41***	-2070.54**	-2258.71**	-816.41	-699.20
		(264.11)	(405.24)	(808.34)	(953.40)	(1199.79)	(1362.85)
$r \in [7, 9]$	–	–	-2643.97***	-2145.52***	-1971.06**	-855.94	-1302.44
			(295.20)	(563.65)	(784.36)	(943.90)	(1029.80)
$r \in [10, 12]$	–	–	–	-4585.67***	-3038.55***	-2000.88**	-2707.43***
				(467.76)	(628.35)	(902.15)	(943.46)
$r \in [13, 15]$	–	–	–	–	-5263.93***	-3634.69***	-3508.47***
					(608.63)	(870.49)	(983.15)
$r \in [16, 18]$	–	–	–	–	–	-5978.15***	-4296.65***
						(1046.90)	(1169.77)
$r \in [19, 21]$	–	–	–	–	–	–	-6557.42***
							(1358.69)
2nd childbirth							
$r \in [1, 6]$	–	-1622.87***	-118.39	1875.75	1651.09	1687.72	1042.56
		(569.23)	(855.52)	(1451.24)	(1860.95)	(2228.59)	(2693.42)
$r \in [7, 9]$	–	–	-605.88	398.60	733.18	-940.33	-809.09
			(432.60)	(1027.99)	(1175.89)	(1477.51)	(1792.24)
$r \in [10, 12]$	–	–	–	-2653.78***	-1732.77*	-2077.04*	-2437.10**
				(644.38)	(907.58)	(1103.21)	(1225.39)
$r \in [13, 15]$	–	–	–	–	-2624.31***	-2293.24**	-1790.56*
					(697.37)	(932.71)	(1022.19)
$r \in [16, 18]$	–	–	–	–	–	-3564.40***	-2527.93**
						(895.53)	(1150.06)
$r \in [19, 21]$	–	–	–	–	–	–	-3912.61***
							(1111.80)
3rd childbirth							
$r \in [1, \min(t, 12)]$	–	–	-1279.95	-1828.26	-3473.01	-4202.91	-4280.98
			(970.32)	(1250.76)	(2581.31)	(2847.36)	(3660.56)
$r \in [13, 15]$	–	–	–	–	-1475.04	-814.27	20.08
					(1625.36)	(1989.71)	(1934.75)
$r \in [16, \min(t, 21)]$	–	–	–	–	–	-3315.37	-2464.83
						(2104.26)	(1864.74)

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%. Standard errors are in parentheses.

§ Yearly labor earnings are in 2014 prices and deflated by the ISTAT consumer price index.

Table G.6: Estimated coefficients of the impact of childbirth and birth timing on yearly fraction of days spent in employment with time-varying UH and by including geographical area at birth in the outcome equations

Years since school completion	$t=3$	$t=6$	$t=9$	$t=12$	$t=15$	$t=18$	$t=21$
1st childbirth							
$r \in [0,3]$	-0.006	-0.011	-0.015**	-0.073**	-0.074**	-0.064	0.062
	(0.005)	(0.008)	(0.008)	(0.031)	(0.037)	(0.052)	(0.065)
$r \in [4,6]$	–	-0.013***	-0.011**	-0.061***	-0.052*	-0.016	0.059
		(0.005)	(0.005)	(0.022)	(0.027)	(0.037)	(0.047)
$r \in [7,9]$	–	–	-0.013***	-0.073***	-0.076***	-0.028	-0.018
			(0.004)	(0.017)	(0.024)	(0.031)	(0.039)
$r \in [10,12]$	–	–	–	-0.105***	-0.126***	-0.077***	-0.106***
				(0.014)	(0.020)	(0.029)	(0.036)
$r \in [13,15]$	–	–	–	–	-0.141***	-0.123***	-0.131***
					(0.020)	(0.029)	(0.038)
$r \in [16,18]$	–	–	–	–	–	-0.143***	-0.126***
						(0.030)	(0.039)
$r \in [19,21]$	–	–	–	–	–	–	-0.169***
							(0.044)
2nd childbirth							
$r \in [1,6]$	–	-0.013	-0.001	0.048	-0.007	-0.007	-0.026
		(0.011)	(0.013)	(0.045)	(0.054)	(0.073)	(0.093)
$r \in [7,9]$	–	–	-0.003	-0.014	-0.016	-0.047	-0.032
			(0.007)	(0.029)	(0.033)	(0.047)	(0.058)
$r \in [10,12]$	–	–	–	-0.076***	-0.082***	-0.094***	-0.098**
				(0.019)	(0.026)	(0.034)	(0.042)
$r \in [13,15]$	–	–	–	–	-0.046**	-0.102***	-0.075**
					(0.021)	(0.030)	(0.037)
$r \in [16,18]$	–	–	–	–	–	-0.101***	-0.098**
						(0.028)	(0.039)
$r \in [19,21]$	–	–	–	–	–	–	-0.139***
							(0.037)
3rd childbirth							
$r \in [1,\min(t,12)]$	–	–	-0.009	-0.018	-0.074	-0.066	-0.136
			(0.020)	(0.041)	(0.058)	(0.081)	(0.092)
$r \in [13,15]$	–	–	–	–	-0.045	-0.027	0.025
					(0.043)	(0.064)	(0.069)
$r \in [16,\min(t,21)]$	–	–	–	–	–	-0.162***	-0.153***
						(0.052)	(0.053)

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%. Standard errors are in parentheses.

II. Including Regional Rates at Birth in the Outcome Equations

Table G.7: Estimated coefficients of the impact of childbirth and birth timing on yearly labor earnings (€)§ with time-varying UH and by including regional rates in the outcome equations

Years since school completion	$t=3$	$t=6$	$t=9$	$t=12$	$t=15$	$t=18$	$t=21$
1st childbirth							
$r \in [0,3]$	-2088.66***	-2216.98***	-2285.71***	-3898.00***	-3591.42***	-2548.46	-731.1084
	(224.22)	(497.35)	(638.39)	(1176.63)	(1283.64)	(1635.48)	(1795.65)
$r \in [4,6]$	–	-2804.13***	-1569.34***	-2071.04***	-2259.55**	-795.5119	-675.873
		(264.86)	(400.11)	(801.94)	(950.54)	(1194.58)	(1358.23)
$r \in [7,9]$	–	–	-2653.87***	-2147.70***	-1953.42**	-810.5735	-1269.472
			(295.85)	(560.39)	(782.04)	(938.32)	(1025.74)
$r \in [10,12]$	–	–	–	-4572.54***	-3023.89***	-1978.44**	-2641.21***
				(465.13)	(626.43)	(897.31)	(942.16)
$r \in [13,15]$	–	–	–	–	-5257.64***	-3617.62***	-3496.78***
					(607.39)	(864.21)	(980.17)
$r \in [16,18]$	–	–	–	–	–	-5960.67***	-4276.80***
						(1039.17)	(1164.36)
$r \in [19,21]$	–	–	–	–	–	–	-6476.77***
							(1347.12)
2nd childbirth							
$r \in [1,6]$	–	-1615.29***	-83.25	1975.46	1815.50	1810.36	1186.19
		(569.81)	(855.10)	(1443.37)	(1853.20)	(2219.27)	(2686.46)
$r \in [7,9]$	–	–	-581.00	400.76	759.23	-880.74	-662.55
			(425.47)	(1021.49)	(1170.42)	(1468.68)	(1787.51)
$r \in [10,12]$	–	–	–	-2649.10***	-1716.03*	-2066.62*	-2368.63*
				(640.49)	(904.97)	(1097.47)	(1220.95)
$r \in [13,15]$	–	–	–	–	-2623.13***	-2278.97**	-1743.63*
					(695.12)	(927.16)	(1018.88)
$r \in [16,18]$	–	–	–	–	–	-3564.26***	-2517.48**
						(888.99)	(1145.79)
$r \in [19,21]$	–	–	–	–	–	–	-3886.37***
							(1106.86)
3rd childbirth							
$r \in [1, \min(t,12)]$	–	–	-1335.35	-1917.11	-3568.86	-4254.32	-4283.84
			(973.55)	(1242.23)	(2571.20)	(2834.72)	(3637.27)
$r \in [13,15]$	–	–	–	–	-1467.27	-792.26	49.51
					(1620.45)	(1979.65)	(1932.17)
$r \in [16, \min(t,21)]$	–	–	–	–	–	-3269.30	-2424.40
						(2084.25)	(1848.96)

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%. Standard errors are in parentheses.
§ Yearly labor earnings are in 2014 prices and deflated by the ISTAT consumer price index.

Table G.8: Estimated coefficients of the impact of childbirth and birth timing on yearly fraction of days spent in employment with time-varying UH and by including regional rates at birth in the outcome equations

Years since school completion	$t=3$	$t=6$	$t=9$	$t=12$	$t=15$	$t=18$	$t=21$
1st childbirth							
$r \in [0,3]$	-0.005	-0.012	-0.016**	-0.074**	-0.074**	-0.064	0.062
	(0.005)	(0.008)	(0.008)	(0.031)	(0.037)	(0.052)	(0.064)
$r \in [4,6]$	–	-0.014***	-0.011**	-0.062***	-0.053*	-0.016	0.059
		(0.005)	(0.005)	(0.022)	(0.027)	(0.037)	(0.047)
$r \in [7,9]$	–	–	-0.013***	-0.073***	-0.076***	-0.027	-0.017
			(0.004)	(0.017)	(0.024)	(0.031)	(0.039)
$r \in [10,12]$	–	–	–	-0.104***	-0.126***	-0.077***	-0.104***
				(0.014)	(0.020)	(0.029)	(0.036)
$r \in [13,15]$	–	–	–	–	-0.140***	-0.123***	-0.130***
					(0.020)	(0.029)	(0.038)
$r \in [16,18]$	–	–	–	–	–	-0.144***	-0.126***
						(0.030)	(0.039)
$r \in [19,21]$	–	–	–	–	–	–	-0.166***
							(0.044)
2nd childbirth							
$r \in [1,6]$	–	-0.013	-0.001	0.049	-0.007	-0.007	-0.024
		(0.010)	(0.013)	(0.045)	(0.054)	(0.073)	(0.092)
$r \in [7,9]$	–	–	-0.003	-0.014	-0.015	-0.046	-0.030
			(0.007)	(0.029)	(0.033)	(0.047)	(0.057)
$r \in [10,12]$	–	–	–	-0.076***	-0.082***	-0.094***	-0.098**
				(0.019)	(0.026)	(0.034)	(0.042)
$r \in [13,15]$	–	–	–	–	-0.046**	-0.10***	-0.073**
					(0.021)	(0.030)	(0.037)
$r \in [16,18]$	–	–	–	–	–	-0.101***	-0.098**
						(0.028)	(0.039)
$r \in [19,21]$	–	–	–	–	–	–	-0.139***
							(0.037)
3rd childbirth							
$r \in [1,\min(t,12)]$	–	–	-0.010	-0.019	-0.075	-0.066	-0.135
			(0.020)	(0.041)	(0.058)	(0.081)	(0.097)
$r \in [13,15]$	–	–	–	–	-0.043	-0.024	0.027
					(0.043)	(0.064)	(0.069)
$r \in [16,\min(t,21)]$	–	–	–	–	–	-0.161***	-0.152***
						(0.052)	(0.053)

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%. Standard errors are in parentheses.

III. Including Geographical Area and Regional Rates at Birth in the Outcome Equations

Table G.9: Estimated coefficients of the impact of childbirth and birth timing on yearly labor earnings (€)[§] with time-varying UH and by including regional rates at birth in the outcome equations

Years since school completion	$t = 3$	$t = 6$	$t = 9$	$t = 12$	$t = 15$	$t = 18$	$t = 21$
1st childbirth							
$r \in [0, 3]$	-2086.05***	-2210.31***	-2289.15***	-3889.05***	-3582.09***	-2550.20	-733.14
	(224.48)	(496.63)	(638.62)	(1179.12)	(1283.37)	(1633.99)	(1795.73)
$r \in [4, 6]$	–	-2794.96***	-1589.87***	-2056.78**	-2246.26**	-771.30	-654.13
		(264.37)	(408.66)	(806.33)	(950.81)	(1192.66)	(1361.12)
$r \in [7, 9]$	–	–	-2638.19***	-2124.73***	-1939.67**	-806.60	-1259.79
			(295.66)	(562.06)	(782.82)	(937.54)	(1027.55)
$r \in [10, 12]$	–	–	–	-4566.34***	-3008.71***	-1977.04**	-2642.88***
				(466.28)	(626.58)	(896.84)	(943.72)
$r \in [13, 15]$	–	–	–	–	-5262.92***	-3630.38***	-3521.73***
					(607.13)	(864.62)	(981.58)
$r \in [16, 18]$	–	–	–	–	–	-5962.54***	-4298.34***
						(1039.52)	(1166.22)
$r \in [19, 21]$	–	–	–	–	–	–	-6512.49***
							(1346.45)
2nd childbirth							
$r \in [1, 6]$	–	-1604.16***	-92.67	1941.96	1792.67	1806.27	1200.42
		(570.63)	(856.09)	(1447.79)	(1855.61)	(2217.52)	(2685.79)
$r \in [7, 9]$	–	–	-580.36	386.80	745.86	-879.86	-690.63
			(434.69)	(1024.79)	(1171.73)	(1470.16)	(1789.89)
$r \in [10, 12]$	–	–	–	-2651.57***	-1716.21*	-2057.46*	-2390.19*
				(642.45)	(904.46)	(1097.81)	(1223.34)
$r \in [13, 15]$	–	–	–	–	-2632.10***	-2289.16**	-1764.81*
					(695.89)	(926.42)	(1019.95)
$r \in [16, 18]$	–	–	–	–	–	-3578.68***	-2538.47**
						(888.83)	(1146.80)
$r \in [19, 21]$	–	–	–	–	–	–	-3861.67***
							(1107.15)
3rd childbirth							
$r \in [1, \min(t, 12)]$	–	–	-1289.45	-1885.65	-3548.07	-4308.39	-4319.26
			(971.78)	(1246.63)	(2570.34)	(2842.05)	(3634.43)
$r \in [13, 15]$	–	–	–	–	-1466.17	-790.99	78.39
					(1618.06)	(1976.23)	(1933.89)
$r \in [16, \min(t, 21)]$	–	–	–	–	–	-3248.80	-2387.10
						(2076.79)	(1849.32)

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%. Standard errors are in parentheses.
[§] Yearly labor earnings are in 2014 prices and deflated by the ISTAT consumer price index.

Table G.10: Estimated coefficients of the impact of childbirth and birth timing on yearly fraction of days spent in employment with time-varying UH and by including regional rates at birth in the outcome equations

Years since school completion	$t=3$	$t=6$	$t=9$	$t=12$	$t=15$	$t=18$	$t=21$
1st childbirth							
$r \in [0,3]$	-0.005	-0.011	-0.015**	-0.073**	-0.074**	-0.064	0.061
	(0.005)	(0.008)	(0.008)	(0.031)	(0.037)	(0.052)	(0.064)
$r \in [4,6]$	–	-0.013***	-0.011**	-0.061***	-0.053*	-0.016	0.058
		(0.005)	(0.005)	(0.022)	(0.027)	(0.037)	(0.047)
$r \in [7,9]$	–	–	-0.013***	-0.073***	-0.076***	-0.027	-0.018
			(0.004)	(0.017)	(0.024)	(0.031)	(0.039)
$r \in [10,12]$	–	–	–	-0.104***	-0.126***	-0.077***	-0.104***
				(0.014)	(0.020)	(0.029)	(0.036)
$r \in [13,15]$	–	–	–	–	-0.141***	-0.124***	-0.132***
					(0.020)	(0.029)	(0.038)
$r \in [16,18]$	–	–	–	–	–	-0.143***	-0.127***
						(0.030)	(0.039)
$r \in [19,21]$	–	–	–	–	–	–	-0.167***
							(0.044)
2nd childbirth							
$r \in [1,6]$	–	-0.013	-0.001	0.048	-0.008	-0.007	-0.024
		(0.011)	(0.013)	(0.045)	(0.054)	(0.073)	(0.092)
$r \in [7,9]$	–	–	-0.004	-0.014	-0.016	-0.045	-0.029
			(0.007)	(0.029)	(0.033)	(0.047)	(0.057)
$r \in [10,12]$	–	–	–	-0.076***	-0.082***	-0.093***	-0.097**
				(0.019)	(0.026)	(0.034)	(0.042)
$r \in [13,15]$	–	–	–	–	-0.046**	-0.101***	-0.073**
					(0.021)	(0.030)	(0.037)
$r \in [16,18]$	–	–	–	–	–	-0.101***	-0.097**
						(0.028)	(0.039)
$r \in [19,21]$	–	–	–	–	–	–	-0.138***
							(0.037)
3rd childbirth							
$r \in [1,\min(t,12)]$	–	–	-0.009	-0.018	-0.075	-0.067	-0.137
			(0.020)	(0.041)	(0.058)	(0.080)	(0.097)
$r \in [13,15]$	–	–	–	–	-0.043	-0.024	0.027
					(0.043)	(0.063)	(0.069)
$r \in [16,\min(t,21)]$	–	–	–	–	–	-0.160***	-0.151***
						(0.052)	(0.053)

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%. Standard errors are in parentheses.

IV. Including Geographical Area and Regional Rates at Birth in the Outcome Equations and Having the Same Regressors in the three Childbirth Equations

Table G.11: Estimated coefficients of the impact of childbirth and birth timing on yearly labor earnings (€)[§] with time-varying UH, by including regional rates at birth in the outcome equations, and with the same regressors in the three childbirth equations

Years since school completion	$t = 3$	$t = 6$	$t = 9$	$t = 12$	$t = 15$	$t = 18$	$t = 21$
1st childbirth							
$r \in [0, 3]$	-2118.07***	-2216.92***	-2282.30***	-3877.48***	-3556.40***	-2490.35	-684.30
	(228.28)	(501.70)	(645.18)	(1181.61)	(1281.07)	(1640.88)	(1795.94)
$r \in [4, 6]$	–	-2773.40***	-1531.47***	-2017.24**	-2206.23**	-739.18	-627.28
		(266.92)	(412.22)	(808.15)	(948.92)	(1195.43)	(1362.17)
$r \in [7, 9]$	–	–	-2626.22***	-2093.94***	-1929.66**	-788.95	-1234.23
			(298.31)	(563.38)	(782.34)	(941.90)	(1027.81)
$r \in [10, 12]$	–	–	–	-4566.73***	-3029.14***	-1978.85**	-2667.70***
				(467.23)	(626.05)	(900.64)	(944.50)
$r \in [13, 15]$	–	–	–	–	-5255.73***	-3622.78***	-3512.06***
					(606.51)	(867.78)	(982.34)
$r \in [16, 18]$	–	–	–	–	–	-5972.08***	-4301.31***
						(1044.23)	(1167.19)
$r \in [19, 21]$	–	–	–	–	–	–	-6517.18***
							(1345.45)
2nd childbirth							
$r \in [1, 6]$	–	-1620.45***	-130.55	1875.73	1695.03	1712.45	1171.57
		(576.10)	(861.36)	(1449.54)	(1847.66)	(2215.14)	(2683.11)
$r \in [7, 9]$	–	–	-604.19	384.49	762.98	-861.12	-666.12
			(439.22)	(1025.40)	(1169.11)	(1475.88)	(1791.08)
$r \in [10, 12]$	–	–	–	-2648.55***	-1683.15*	-1995.76*	-2321.69*
				(644.04)	(903.54)	(1102.04)	(1223.88)
$r \in [13, 15]$	–	–	–	–	-2576.99***	-2223.78**	-1687.92*
					(696.93)	(930.93)	(1020.23)
$r \in [16, 18]$	–	–	–	–	–	-3549.30***	-2498.44**
						(893.26)	(1146.60)
$r \in [19, 21]$	–	–	–	–	–	–	-3851.18***
							(1106.29)
3rd childbirth							
$r \in [1, \min(t, 12)]$	–	–	-1285.23	-1855.34	-3532.35	-4296.38	-4319.25
			(978.12)	(1246.71)	(2568.65)	(2855.67)	(3621.04)
$r \in [13, 15]$	–	–	–	–	-1408.14	-742.14	139.08
					(1615.61)	(1976.02)	(1933.02)
$r \in [16, \min(t, 21)]$	–	–	–	–	–	-3284.78	-2375.06
						(2076.90)	(1841.19)

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%. Standard errors are in parentheses.

[§] Yearly labor earnings are in 2014 prices and deflated by the ISTAT consumer price index.

Table G.12: Estimated coefficients of the impact of childbirth and birth timing on yearly fraction of days spent in employment with time-varying UH, by including regional rates in the outcome equations, and with the same regressors in the three childbirth equations

Years since school completion	$t = 3$	$t = 6$	$t = 9$	$t = 12$	$t = 15$	$t = 18$	$t = 21$
1st childbirth							
$r \in [0, 3]$	-0.005	-0.011	-0.016**	-0.072**	-0.073*	-0.062	0.063
	(0.005)	(0.008)	(0.008)	(0.031)	(0.037)	(0.052)	(0.064)
$r \in [4, 6]$	–	-0.013***	-0.011**	-0.060***	-0.051*	-0.014	0.059
		(0.005)	(0.005)	(0.022)	(0.027)	(0.037)	(0.047)
$r \in [7, 9]$	–	–	-0.013***	-0.071***	-0.076***	-0.026	-0.017
			(0.004)	(0.017)	(0.024)	(0.031)	(0.039)
$r \in [10, 12]$	–	–	–	-0.104***	-0.127***	-0.077***	-0.106***
				(0.014)	(0.020)	(0.029)	(0.036)
$r \in [13, 15]$	–	–	–	–	-0.141***	-0.124***	-0.132***
					(0.020)	(0.029)	(0.038)
$r \in [16, 18]$	–	–	–	–	–	-0.144***	-0.127***
						(0.030)	(0.039)
$r \in [19, 21]$	–	–	–	–	–	–	-0.169***
							(0.044)
2nd childbirth							
$r \in [1, 6]$	–	-0.013	-0.001	0.047	-0.009	-0.008	-0.024
		(0.011)	(0.013)	(0.044)	(0.054)	(0.073)	(0.092)
$r \in [7, 9]$	–	–	-0.003	-0.015	-0.016	-0.046	-0.029
			(0.007)	(0.029)	(0.033)	(0.047)	(0.057)
$r \in [10, 12]$	–	–	–	-0.076***	-0.081***	-0.091***	-0.095**
				(0.019)	(0.026)	(0.034)	(0.041)
$r \in [13, 15]$	–	–	–	–	-0.044**	-0.099***	-0.072*
					(0.021)	(0.030)	(0.037)
$r \in [16, 18]$	–	–	–	–	–	-0.100***	-0.097**
						(0.028)	(0.039)
$r \in [19, 21]$	–	–	–	–	–	–	-0.137***
							(0.036)
3rd childbirth							
$r \in [1, \min(t, 12)]$	–	–	-0.008	-0.018	-0.075	-0.067	-0.137
			(0.020)	(0.041)	(0.058)	(0.080)	(0.096)
$r \in [13, 15]$	–	–	–	–	-0.041	-0.024	0.028
					(0.043)	(0.063)	(0.068)
$r \in [16, \min(t, 21)]$	–	–	–	–	–	-0.161***	-0.150***
						(0.051)	(0.053)

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%. Standard errors are in parentheses.

G.4 Estimating the Model Using only Women Who Exited School with a Secondary School Diploma when 17–20 Years Old

Table G.13: Estimated coefficients of the impact of childbirth and birth timing on yearly labor earnings (€)[§] with time-varying UH using only women who exited school with a secondary school diploma when 17–20 years old

Years since school completion	$t = 3$	$t = 6$	$t = 9$	$t = 12$	$t = 15$	$t = 18$	$t = 21$
1st childbirth							
$r \in [0, 3]$	-971.46**	-2201.05**	-2813.61***	-3857.26	-4600.66*	-3549.68	-2040.88
	(442.80)	(862.85)	(1051.83)	(2510.01)	(2450.99)	(3465.66)	(3460.90)
$r \in [4, 6]$	–	-3010.24***	-2540.84***	-3585.27**	-4153.37**	-2390.43	-2596.64
		(426.39)	(723.09)	(1561.54)	(2053.04)	(2131.53)	(2698.16)
$r \in [7, 9]$	–	–	-2971.02***	-2357.11***	-2828.49**	-1370.27	-2065.49
			(419.34)	(912.69)	(1355.75)	(1733.06)	(1916.78)
$r \in [10, 12]$	–	–	–	-5166.63***	-4218.37***	-2591.79	-3122.12
				(687.36)	(1177.44)	(1653.11)	(1911.89)
$r \in [13, 15]$	–	–	–	–	-5614.22***	-2565.68	-3322.33*
					(1006.97)	(1580.16)	(1893.39)
$r \in [16, 18]$	–	–	–	–	–	-6483.37***	-3397.18
						(1880.33)	(2278.72)
$r \in [19, 21]$	–	–	–	–	–	–	-7189.54***
							(2688.21)
2nd childbirth							
$r \in [1, 6]$	–	-603.54	592.51	-19.79	1221.46	1739.57	1414.04
		(936.20)	(1579.49)	(3367.80)	(4163.16)	(5421.88)	(6032.69)
$r \in [7, 9]$	–	–	-421.67	119.22	587.87	-1341.72	-1072.87
			(928.64)	(1883.35)	(2530.71)	(3156.43)	(3961.11)
$r \in [10, 12]$	–	–	–	-2555.00**	-1355.51	-2452.43	-2464.49
				(1033.55)	(1781.99)	(2100.49)	(2381.83)
$r \in [13, 15]$	–	–	–	–	-2482.94**	-2972.84*	-2175.02
					(1186.08)	(1775.15)	(2179.36)
$r \in [16, 18]$	–	–	–	–	–	-4936.56***	-2006.57
						(1630.87)	(2226.77)
$r \in [19, 21]$	–	–	–	–	–	–	-1190.42
							(2220.45)
3rd childbirth							
$r \in [1, \min(t, 12)]$	–	–	-1429.81	820.88	-1491.01	-3106.99	-3281.33
			(2031.12)	(1777.58)	(4556.56)	(6992.54)	(7640.99)
$r \in [13, 15]$	–	–	–	–	-4966.15*	-4126.65	-1088.61
					(2929.10)	(4496.13)	(4244.35)
$r \in [16, \min(t, 21)]$	–	–	–	–	–	-3297.31	-3338.78
						(3872.55)	(4368.35)

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%. Standard errors are in parentheses. When selecting only women that exited school between 17 and 20 years of age with a secondary school diploma, the sample size shrinks from 9,387 to 3,690 women.

[§] Yearly labor earnings are in 2014 prices and deflated by the ISTAT consumer price index.

Table G.14: Estimated coefficients of the impact of childbirth and birth timing on yearly fraction of days spent in employment with time-varying UH using only women who exited school with a secondary school diploma when 17–20 years old

Years since school completion	$t=3$	$t=6$	$t=9$	$t=12$	$t=15$	$t=18$	$t=21$
1st childbirth							
$r \in [0,3]$	-0.005	-0.010	-0.020*	-0.077	-0.036	-0.076	0.062
	(0.010)	(0.013)	(0.012)	(0.055)	(0.058)	(0.080)	(0.090)
$r \in [4,6]$	–	-0.009	-0.013*	-0.080**	-0.052	-0.009	0.026
		(0.008)	(0.007)	(0.035)	(0.045)	(0.056)	(0.073)
$r \in [7,9]$	–	–	-0.015***	-0.089***	-0.091**	-0.041	-0.05
			(0.005)	(0.026)	(0.038)	(0.048)	(0.057)
$r \in [10,12]$	–	–	–	-0.106***	-0.121***	-0.034	-0.066
				(0.021)	(0.033)	(0.045)	(0.055)
$r \in [13,15]$	–	–	–	–	-0.115***	-0.013	-0.054
					(0.031)	(0.048)	(0.061)
$r \in [16,18]$	–	–	–	–	–	-0.06	-0.017
						(0.051)	(0.069)
$r \in [19,21]$	–	–	–	–	–	–	-0.12
							(0.080)
2nd childbirth							
$r \in [1,6]$	–	-0.015	0.015	0.003	-0.077	0.001	-0.030
		(0.019)	(0.023)	(0.078)	(0.093)	(0.114)	(0.134)
$r \in [7,9]$	–	–	0.011	-0.007	-0.032	-0.065	-0.017
			(0.010)	(0.046)	(0.056)	(0.074)	(0.090)
$r \in [10,12]$	–	–	–	-0.066**	-0.073*	-0.090*	-0.077
				(0.028)	(0.041)	(0.051)	(0.062)
$r \in [13,15]$	–	–	–	–	-0.053	-0.128***	-0.063
					(0.033)	(0.049)	(0.058)
$r \in [16,18]$	–	–	–	–	–	-0.119***	-0.016
						(0.045)	(0.064)
$r \in [19,21]$	–	–	–	–	–	–	-0.063
							(0.066)
3rd childbirth							
$r \in [1,\min(t,12)]$	–	–	0.001	0.026	-0.031	-0.084	-0.089
			(0.044)	(0.062)	(0.089)	(0.131)	(0.137)
$r \in [13,15]$	–	–	–	–	-0.095	-0.107	0.062
					(0.063)	(0.110)	(0.120)
$r \in [16,\min(t,21)]$	–	–	–	–	–	-0.239***	-0.172*
						(0.083)	(0.098)

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%. Standard errors are in parentheses. When selecting only women that exited school between 17 and 20 years of age with a secondary school diploma, the sample size shrinks from 9,387 to 3,690 women.

G.5 Estimating the Model Using only Women Born in the 1960s

Table G.15: Estimated coefficients of the impact of childbirth and birth timing on yearly labor earnings (€)§ with time-varying UH using only women born in the 1960s

Years since school completion	$t=3$	$t=6$	$t=9$	$t=12$	$t=15$	$t=18$	$t=21$
1st childbirth							
$r \in [0,3]$	-2376.79***	-1819.64**	-2277.95***	-4142.49**	-3192.42*	-2277.778	-715.132
	(356.28)	(772.99)	(829.25)	(1654.20)	(1758.02)	(2121.88)	(2140.68)
$r \in [4,6]$	–	-1714.12***	-832.00	-1935.38	-2192.33	-419.24	-546.09
		(416.74)	(601.51)	(1211.28)	(1333.85)	(1519.20)	(1581.81)
$r \in [7,9]$	–	–	-2101.16***	-2175.39**	-2207.79*	-797.55	-1283.07
			(467.36)	(843.77)	(1142.78)	(1235.36)	(1252.36)
$r \in [10,12]$	–	–	–	-4163.68***	-3252.14***	-2123.82*	-3024.07***
				(728.64)	(930.63)	(1222.16)	(1150.92)
$r \in [13,15]$	–	–	–	–	-5425.99***	-3172.75***	-3548.36***
					(908.95)	(1148.07)	(1197.35)
$r \in [16,18]$	–	–	–	–	–	-6065.60***	-4294.09***
						(1433.01)	(1486.60)
$r \in [19,21]$	–	–	–	–	–	–	-5815.17***
							(1680.24)
2nd childbirth							
$r \in [1,6]$	–	-2070.76**	39.48	3087.49	1758.53	1665.27	1297.94
		(892.12)	(1113.33)	(1889.60)	(2777.17)	(3150.42)	(3294.61)
$r \in [7,9]$	–	–	-95.72	691.99	1016.17	-1157.75	-1000.70
			(629.72)	(1469.78)	(1660.40)	(1849.92)	(2140.38)
$r \in [10,12]$	–	–	–	-1832.69*	-1499.36	-2352.03*	-2561.10*
				(1055.28)	(1330.47)	(1416.73)	(1465.13)
$r \in [13,15]$	–	–	–	–	-1835.37*	-1673.28	-1233.38
					(1011.93)	(1228.49)	(1245.43)
$r \in [16,18]$	–	–	–	–	–	-4263.53***	-2619.48*
						(1244.90)	(1496.30)
$r \in [19,21]$	–	–	–	–	–	–	-3771.06***
							(1355.62)
3rd childbirth							
$r \in [1,\min(t,12)]$	–	–	-666.82	-3522.62	-4431.26	-5293.53	-4418.54
			(1359.19)	(2591.90)	(3633.14)	(3820.20)	(4229.70)
$r \in [13,15]$	–	–	–	–	-1290.12	-468.43	779.41
					(2853.22)	(2656.64)	(2270.35)
$r \in [16,\min(t,21)]$	–	–	–	–	–	-2790.18	-2528.55
						(2998.08)	(2467.78)

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%. Standard errors are in parentheses. When selecting only women born in the 1960s, the sample size shrinks from 9,387 to 3,887 women.

§ Yearly labor earnings are in 2014 prices and deflated by the ISTAT consumer price index.

Table G.16: Estimated coefficients of the impact of childbirth and birth timing on yearly fraction of days spent in employment with time-varying UH using only women born in the 1960s

Years since school completion	$t = 3$	$t = 6$	$t = 9$	$t = 12$	$t = 15$	$t = 18$	$t = 21$
1st childbirth							
$r \in [0, 3]$	-0.007	-0.015	-0.016	-0.101**	-0.062	-0.060	0.063
	(0.008)	(0.012)	(0.012)	(0.044)	(0.048)	(0.062)	(0.072)
$r \in [4, 6]$	–	-0.005	-0.010	-0.071**	-0.052	-0.015	0.060
		(0.007)	(0.007)	(0.032)	(0.037)	(0.046)	(0.054)
$r \in [7, 9]$	–	–	-0.008	-0.089***	-0.086**	-0.015	-0.019
			(0.005)	(0.025)	(0.033)	(0.041)	(0.047)
$r \in [10, 12]$	–	–	–	-0.103***	-0.127***	-0.090**	-0.117***
				(0.022)	(0.029)	(0.038)	(0.043)
$r \in [13, 15]$	–	–	–	–	-0.134***	-0.106***	-0.110**
					(0.028)	(0.038)	(0.045)
$r \in [16, 18]$	–	–	–	–	–	-0.170***	-0.104**
						(0.040)	(0.046)
$r \in [19, 21]$	–	–	–	–	–	–	-0.118**
							(0.054)
2nd childbirth							
$r \in [1, 6]$	–	-0.012	-0.002	0.105*	-0.012	-0.033	-0.055
		(0.016)	(0.019)	(0.062)	(0.077)	(0.097)	(0.114)
$r \in [7, 9]$	–	–	-0.004	-0.012	-0.010	-0.063	-0.030
			(0.009)	(0.041)	(0.043)	(0.055)	(0.064)
$r \in [10, 12]$	–	–	–	-0.054*	-0.084**	-0.108***	-0.103**
				(0.030)	(0.036)	(0.042)	(0.049)
$r \in [13, 15]$	–	–	–	–	-0.033	-0.096**	-0.063
					(0.030)	(0.040)	(0.044)
$r \in [16, 18]$	–	–	–	–	–	-0.116***	-0.090*
						(0.037)	(0.048)
$r \in [19, 21]$	–	–	–	–	–	–	-0.175***
							(0.045)
3rd childbirth							
$r \in [1, \min(t, 12)]$	–	–	-0.005	-0.012	-0.039	-0.046	-0.094
			(0.039)	(0.064)	(0.081)	(0.104)	(0.109)
$r \in [13, 15]$	–	–	–	–	-0.013	0.009	0.076
					(0.066)	(0.077)	(0.077)
$r \in [16, \min(t, 21)]$	–	–	–	–	–	-0.170**	-0.176***
						(0.072)	(0.068)

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%. Standard errors are in parentheses. When selecting only women born in the 1960s, the sample size shrinks from 9,387 to 3,887 women.

G.6 Estimating the Model Using only Women Born in the 1970s-1980s

Table G.17: Estimated coefficients of the impact of childbirth and birth timing on yearly labor earnings (€)[§] with time-varying UH using only women born in the 1970s-1980s

Years since school completion	$t=3$	$t=6$	$t=9$	$t=12$	$t=15$	$t=18$	$t=21$
1st childbirth							
$r \in [0,3]$	-1837.26***	-2297.38***	-2072.38*	-3884.81*	-4922.24**	-5084.02*	-2327.54
	(310.22)	(684.14)	(1065.07)	(1982.98)	(2333.20)	(2762.58)	(4645.63)
$r \in [4,6]$	–	-3736.39***	-2222.04***	-2283.02*	-2805.37*	-2855.29	-2399.06
		(364.66)	(630.75)	(1214.67)	(1516.16)	(2504.72)	(4072.57)
$r \in [7,9]$	–	–	-3227.88***	-2061.59**	-1897.42	-1652.34	-2016.25
			(414.86)	(836.54)	(1179.49)	(1454.96)	(1821.66)
$r \in [10,12]$	–	–	–	-5019.61***	-2842.43***	-1790.99	-1604.54
				(629.99)	(825.69)	(1250.08)	(1531.66)
$r \in [13,15]$	–	–	–	–	-5167.92***	-4343.42***	-3451.61**
					(768.39)	(1200.37)	(1585.93)
$r \in [16,18]$	–	–	–	–	–	-5463.81***	-3908.70**
						(1296.09)	(1619.78)
$r \in [19,21]$	–	–	–	–	–	–	-6959.42***
							(1933.24)
2nd childbirth							
$r \in [1,6]$	–	-1506.87*	-982.37	-73.34	958.00	1507.33	1716.81
		(825.52)	(1521.68)	(3336.18)	(3276.42)	(4224.30)	(7464.97)
$r \in [7,9]$	–	–	-1257.71*	185.73	625.55	749.70	2420.23
			(668.80)	(1605.23)	(1817.02)	(3413.00)	(3914.55)
$r \in [10,12]$	–	–	–	-3607.99***	-1775.12	-616.10	-816.94
				(884.11)	(1323.07)	(1822.12)	(2302.55)
$r \in [13,15]$	–	–	–	–	-3697.26***	-3439.19**	-3285.75*
					(960.96)	(1394.64)	(1815.96)
$r \in [16,18]$	–	–	–	–	–	-2371.87**	-2049.17
						(1193.96)	(1625.89)
$r \in [19,21]$	–	–	–	–	–	–	-3481.46*
							(1796.67)
3rd childbirth							
$r \in [1, \min(t,12)]$	–	–	-1843.67	713.51	-1952.89	-1650.74	-5540.01
			(1749.91)	(1843.08)	(4024.78)	(5342.83)	(9038.08)
$r \in [13,15]$	–	–	–	–	-1878.64	-2477.23	-4779.70
					(1877.08)	(6735.37)	(7387.46)
$r \in [16, \min(t,21)]$	–	–	–	–	–	-4757.70	-1764.17
						(3487.48)	(2633.61)

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%. Standard errors are in parentheses. When selecting only women born in the 1960s, the sample size shrinks from 9,387 to 5,500 women.

[§] Yearly labor earnings are in 2014 prices and deflated by the ISTAT consumer price index.

Table G.18: Estimated coefficients of the impact of childbirth and birth timing on yearly fraction of days spent in employment with time-varying UH using only women born in the 1970s-1980s

Years since school completion	$t = 3$	$t = 6$	$t = 9$	$t = 12$	$t = 15$	$t = 18$	$t = 21$
1st childbirth							
$r \in [0, 3]$	-0.009	-0.001	-0.013	-0.031	-0.076	-0.061	0.083
	(0.007)	(0.011)	(0.012)	(0.052)	(0.077)	(0.151)	(0.241)
$r \in [4, 6]$	–	-0.023***	-0.013*	-0.041	-0.042	-0.014	0.041
		(0.006)	(0.007)	(0.033)	(0.047)	(0.079)	(0.141)
$r \in [7, 9]$	–	–	-0.022***	-0.046*	-0.048	-0.063	-0.009
			(0.005)	(0.025)	(0.037)	(0.053)	(0.082)
$r \in [10, 12]$	–	–	–	-0.105***	-0.126***	-0.042	-0.057
				(0.019)	(0.030)	(0.047)	(0.073)
$r \in [13, 15]$	–	–	–	–	-0.153***	-0.151***	-0.188**
					(0.029)	(0.048)	(0.078)
$r \in [16, 18]$	–	–	–	–	–	-0.103**	-0.193**
						(0.047)	(0.079)
$r \in [19, 21]$	–	–	–	–	–	–	-0.259***
							(0.079)
2nd childbirth							
$r \in [1, 6]$	–	-0.020	-0.002	-0.032	-0.002	0.063	0.073
		(0.014)	(0.020)	(0.077)	(0.094)	(0.164)	(0.227)
$r \in [7, 9]$	–	–	-0.001	-0.011	-0.020	0.013	-0.056
			(0.010)	(0.046)	(0.063)	(0.117)	(0.184)
$r \in [10, 12]$	–	–	–	-0.104***	-0.074*	-0.040	-0.072
				(0.027)	(0.041)	(0.065)	(0.094)
$r \in [13, 15]$	–	–	–	–	-0.069**	-0.121**	-0.113
					(0.032)	(0.050)	(0.076)
$r \in [16, 18]$	–	–	–	–	–	-0.071	-0.109
						(0.045)	(0.072)
$r \in [19, 21]$	–	–	–	–	–	–	-0.044
							(0.075)
3rd childbirth							
$r \in [1, \min(t, 12)]$	–	–	-0.015	-0.041	-0.172	-0.157	-0.366
			(0.027)	(0.072)	(0.112)	(0.181)	(0.342)
$r \in [13, 15]$	–	–	–	–	-0.122*	-0.182	-0.225
					(0.066)	(0.230)	(0.292)
$r \in [16, \min(t, 21)]$	–	–	–	–	–	-0.152*	-0.054
						(0.086)	(0.102)

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%. Standard errors are in parentheses. When selecting only women born in the 1960s, the sample size shrinks from 9,387 to 5,500 women.