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Birth Collapse and Long-Acting Reversible Contraceptive Policies

Rodrigo Ceni[*] Cecilia Parada [†] Ivone Perazzo [‡] Eliana Sena[§]

Resumen

En este trabajo estimamos el impacto cuantitativo de la política de anticonceptivos reversibles de larga duración en la fuerte caída observada de la Tasa Global de Fecundidad en los últimos años en Uruguay. A partir del cronograma escalonado de implementación de la política de acceso a implantes subcutáneos en hospitales públicos de todo el país, aplicamos un estudio de eventos con el fin de capturar los efectos causales de esta política sobre los nacimientos. Utilizando los datos de los registros administrativos detallados de nacimientos durante los últimos 20 años, los despachos de implantes desde los depósitos centrales y las afiliadas al subbsistema de salud público, estimamos una reducción promedio del 3% en la tasa de nacimientos en los hospitales públicos durante los dos años posteriores a la implementación de la política. Estos efectos se concentraron principalmente entre las mujeres más jóvenes y, en particular, entre las adolescentes, donde la disminución alcanzó al 5,5%. En el contexto de una caída del 20% de los nacimientos a lo largo de tres años, la disponibilidad de implantes subdérmicos puede explicar una tercera parte de la reducción de la natalidad en los hospitales públicos. Finalmente, este efecto es mayor en los primeros nacimientos respecto a los nacimientos de órdenes superiores, pero no se encuentra ningún efecto sobre la calidad del embarazo como el peso al nacer o las semanas de gestación.

Keywords: Anticonceptivo reversible de acción prolongada . Fecundidad . Fecundidad adolescente. Política pública . Caída en los nacimientos

JEL codes: H42, H75, I12, J13

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Abstract

We estimate the quantitative impact of a long-acting reversible contraceptive (LARCs) policy on the unexpected recent collapse of the Total Fertility Rate (TFR) in Uruguay. We exploit, first, the expansion schedule of a large-scale policy of access to sub-dermal implants in public hospitals across the country, through an event study to capture causal effects, and second, detailed birth administrative records for the last 20 years. We document an average reduction of 3% in the birth rate in public hospitals across the two years after the policy was implemented. These effects were concentrated among teens, with a decrease of 5.5%, and this decrease affects mainly the first birth. In the context of a reduction of 20% in births in three years, the use of implants can explain one-third of the reduction in births in public hospitals. We also document a more significant effect on first births and no effect on pregnancy outcomes such as childbirth weight or weeks of gestation.

Keywords: Long-acting reversible contraceptive . Fertility . Adolescent fertility . Public policy . Birth collapse

JEL codes: H42, H75, I12, J13

1 Introduction

Fertility rates have been declining worldwide in the last few decades, especially in low and middle-income countries. In Uruguay, these rates have been historically low; Total Fertility Rate (TFR) has been below 3 children per woman since the 1960s and crossed the replacement threshold of 2.1 in the first years of the 2000s (Cabella et al., 2019; Nathan et al., 2016). However, this aggregate trend hides heterogeneity across socioeconomic groups and the life-cycle. Indeed, the age of the first birth shows a bimodal pattern, with less-educated women experiencing their firth birth in their early twenties and highly-educated women in their early thirties (Nathan and Pardo, 2019; Pardo and Cabella, 2018; Lima et al., 2018). Furthermore, adolescent fertility has been a matter of concern for policymakers in the last several decades. Since the late 1960s and until 2014, as the TFR fell from 3 to 2 children per woman, the adolescent fertility rate remained stagnant at about 65‰of births. Moreover, an estimation for Uruguay from administrative records and the National Childbearing Survey shows that almost half of all pregnancies in 2012 were unintended, and among teens, this number rises to 65%; 42% of teenagers who had an unplanned pregnancy had not been using any contraceptive method before becoming pregnant (Brunet et al., 2020; Cabella et al., 2015).[1]

Since 2006, the government has enacted a set of education and contraceptive policies, introducing a centralized sexual education program at all educational levels, even in private catholic schools. Also, every institution in the National Health System must provide universal essential sexual and reproductive services (Ferre et al., 2011). In 2012, the parliament passed a law legalizing Voluntary Termination of Pregnancy (VTP) but this law was a regularization of an habitual practice in the country and the number of pregnancy terminations per year has been stable since.

The most impressive change in fertility trends was between 2016 and 2018, when the number of total births experienced a steep decline of almost 20%. The TFR was 1.96 in 2015 and decreased to 1.59 in 2018, and the birth rate decreased from 14.1‰to 11.4‰, the sharpest falls in the last half-century. The group who lead this decrease is teenagers, whose fertility rate in 2018 (36‰) was almost half that of five years ago. This fall not only occurred after 10 years of stagnation in adolescent fertility, but it is the lowest level for the country since 1961 (first record available) (Cabella et al., 2019).

The timing of this change coincides with the implementation of a new contraception policy. Indeed, in 2014, a national program began providing long-acting reversible contraceptives (LARCs) in public hospitals, reaching 60 thousand women by 2018. LARCs include both sub-dermal and intrauterine

[1]In Figure A.1, we show the TFR and the adolescent fertility rate from 1960 to 2019.

devices that are remarkably effective at preventing pregnancy. Whereas birth control pills, injectables, patches, rings, and condoms have failure rates between 6% and 18%, the rate for LARCs is about 0.1%, mainly because they do not require any particular procedure for at least three years (Lindo and Packham, 2017). In this paper, we measure the quantitative impact of this massive LARC policy on births. To identify causal effects, we exploit the time heterogeneity in the distribution of the stock of LARCs by administrative divisions in Uruguay through an event study methodology using detailed administrative data of birth certificates for the period 1998-2018.[2]

Improvement in the accessibility of contraceptive methods reduces economic and psychological costs for women, but evidence of empirical performance is mixed depending on countries, methods, and selected outcomes(Gertler and Molyneaux, 1994; Sinha, 2005; Phillips et al., 2006; Desai and Tarozzi, 2011; Ashraf et al., 2014; Kagesten et al., 2014; Strupat, 2017; Branson and Byker, 2018). If public policy focuses on teenagers' pregnancies, it will be geared toward reducing not only the costs on the teen but also their family, friends, and communities. These costs are not internalized ex-ante and are disproportionately high in terms of social welfare (Lindo and Packham, 2017; Ashcraft et al., 2013). Additionally, as unintended pregnancies are more prevalent among teenagers, there is room for a wide variety of comprehensive programs (Kearney and Levine, 2009; Finer, 2010). Despite the fact that there is no consensus in the evidence about the sign or the quantitative impact of contraceptive policies, there is evidence that sexual abstinence-based policies have no effect, or even a positive effect, on the teen birth rate , as well as an additional positive effect on teen sexually transmitted disease rates in some cases(Galárraga and Harris, 2019; Carr and Packham, 2017).

In this paper, we find a negative and significant effect on the birth rate of the LARC program 14 months after its implementation. This effect is more significant and starts among teenagers. We estimate an average reduction of 3% in the birth rate, reaching about 5.5% among teenagers. In the medium run, this policy explains one-third of the reduction in births at public hospitals. We also document a more significant effect on first births and no effect on pregnancy outcomes such as childbirth weight or weeks of gestation.

We make three contributions to the literature. First, we perform a causal estimation, in which we can measure the quantitative impact of a particular policy focused on the most deprived population. Secondly, we use twenty years of administrative data, which detail the birth certificate and some measurements of the newborn. These data allow us to work with only the targeted population, to

[2]There is an increasing trend toward the increased use of LARCs around the world. However, the percentage is still below 10% (de Leon et al., 2019; Finer et al., 2012). Adopting these methods (sub-dermal implants, intrauterine devices) carries a relevant increase in contraceptive effectiveness.

provide robust estimation, and to explore heterogeneities. Finally, our results provide relevant insights to policymakers to evaluate the results of a campaign of contraceptive access.

2 Fertility evolution and use of contraceptive methods in Uruguay

Uruguay is a middle-income country that has had a traditionally low fertility rate since the middle of the last century. This low rate was rare in the Latin-American context, where on average women had six children, while in Uruguay, this number was less than three. This downward trend has continued since then, although younger cohorts with low levels of education continued stagnate at the same rates until the first decade of the 21st century. Then, as highly educated women began to delay the age of their first birth until their thirties, more deprived women experience their first birth in their early twenties. These trends produced a bimodal pattern in the fertility profile(Lima et al., 2018; Pardo and Cabella, 2018; Nathan et al., 2016; Varela, 2008)

In the recent years, Uruguay has experienced a sharp decrease in births, with the TFR decreasing 23.5% between 2016 and 2019, reaching a very low fertility threshold (1.5 children per woman). For the number of births, there were 11,500 fewer in 2019 than in 2015. In particular, the adolescent fertility rate collapsed to 32‰in 2019, after 45 years at rates above 60‰. This level is below the world average (46.5‰) and the Latin American average (66.6‰), although it is still above the developed country average(Cabella et al., 2019).

The birth control methods used most extensively among individuals between 15 and 44 years of age are male condoms and contraceptive pills, with a cumulative use rate of 75%. However, there are well-known differences between men and women, as well as by education levels. In 2015, 54% of men declared the male condom as their most used method, while the most common method used among women at those ages was contraceptive pills at 43%. Only 3.7% of men and 8.9% of women declared the use of other methods: the calendar method, removal or interruption of the sexual act, contraceptive injection, female condom, female and male sterilization, emergency contraception, and the lactation method. There are differences in usage by educative levels, with 10 points higher percentage use rates in the main methods among those with higher levels of education. Finally, there is relatively high percentage that declares they do not use any contraceptive method, 16% and 13% among men and women, respectively. Among those who had low education levels, this percentage rises to 23% (INE-UNFPA, 2017). Note that the gender and socioeconomic differences in the use of contraceptive methods also imply differences in who has responsibility for the correct usage of the method.

We also observe this gender and socioeconomic gap in the differences between the average number of desired children and the number of children that people actually had at 40-44 years old. There is no difference in the optimal number of children among women by educative levels, but only women with low education levels have more than their optimum (0.3 children more)(INE-UNFPA, 2017).

Since 2006, a series of educational programs have been implemented in the country and more recently, in 2012, the parliament passed a law legalizing VTP. The law provides for and regulates medical abortion in the whole National Health System. This law has not produced significant changes in total births, and there have been no significant changes in the number of abortions since the implementation of the LARC program. [3] This legislation did produce a reduction in the number of unplanned pregnancies of about 8% but did not produce any effect on adolescent fertility (Antón et al., 2016, 2018; López Gómez et al., 2019).

In 2014, the government launched a program to offer LARCs to those women who use public health services, and there were not many changes in the offer of other contraceptive methods in public hospitals. In Uruguay, there are two ways to access health care: one is through a compulsory insurance system for formal workers (and pensioners) and their families, while those in the informal sector can access public hospitals and receive completely free of charge health care. Those in the compulsory insurance system have to choose between using a private or a public hospital. In both, the insured have to pay medical and prescription co-payments. Private hospitals have a wide variety of prices, but are generally much more expensive than public ones.[4] This paper explores the possible effect of greater availability of a highly effective contraceptive method, sub-dermal implants.

Uruguay is divided into 19 administrative areas (Departments). All Departments have available public health services in which women can request a LARC. The program started in some public hospitals in some regions, and in the subsequent 30 months, it was expanded to the whole country, as is shown in Table A.2. Hospitals offer sub-dermal implants, which consist of a matchstick-sized rod that releases etonogestrel. The rod is inserted sub-dermally in the non-dominant upper arm, and it acts with 99.9% effectiveness for up to five years. A health practitioner must do both the insertion and extraction, and these implants are available only to those who are registered as public health users.[5] There were no significant side-effects in the literature, but minor side effects in the first

[3] The number of voluntary abortions performed tends to stabilize at around 10,000 per year in the 2015-2017 period, half of them in public hospitals, see Table A.1. Likewise, among the abortions that occurred, the percentage of those performed on women under the age of twenty has remained stable in the range of 15% to 17%.

[4] A payroll tax finances the health system; the government collects this specific tax, and then makes money transfers to the public and private health providers by gender and age. This mechanism ensures that a single person cannot attend two different hospitals at the same time. Almost 100% of the population is active in one hospital; about two-thirds use private hospitals and one-third use public ones. Of those, two-thirds are free of charge users and one-third are insured users.

[5] The sub-dermal implants are available in the market, but are quite expensive ($150, one hundred and fifty US dollars), so their use should not be expected to spread significantly beyond the public policy.

months included disruption of regular menstruation, breast and abdominal pain, weight gain, or acne. Despite these side-effects, only 8% had the sub-dermal implants removed (Aguirre et al., 2017).

The implementation of the program coincided with a steep decrease in total births, as shown in Figure 1. In 2018, the stock of sub-dermal implants in the system reached 60 thousand across the country.[6]

3 Data

We use data from three administrative records in this paper. First, we use data from birth certificates issued between 2003 and 2018 where we have information about any single birth, and where we can distinguish whether the hospital is public or private, the geographical area, and the mother's age at childbirth.[7] Additionally, physicians collect data containing administrative information, parental characteristics, prenatal care, and birth outcomes such as weight and APGAR scores. We use administrative records from the MSP by month that allow us to compute the number of women that receive health care in the private and public hospitals by a single age.[8]

Finally, we use data regarding the number of sub-dermal implants delivered to every public hospital in the country. We did not have any information available at the individual level; more specifically, we lack information about who received the sub-dermal implant and whether they decide to have the implant removed afterwards. For these reasons, we had to work with aggregated data by Department, identifying the arrival date of the contraceptive shipments across the country. The first shipment of these LARCs was in May 2014, then each Department was receiving its first shipment over the following two and a half years, and finally, the last region received its first shipment in December 2016. In 2014, there was a total stock of less of 2.5 thousand sub-dermal implants available in public hospital pharmacies, and by 2018, the stock of sub-dermal implants (inserted or available in public hospital pharmacies) was about of 60 thousand.

In Figure 1, we show the annual number of births that occurred in private and public hospitals, and the total number of sub-dermal implants that were shipped to public hospitals. We consider only births to women between 15 and 29 years of age because 70% of sub-dermal implants were inserted in this age group.[9] Before the introduction of the sub-dermal implant policy, the trend of birth occurrence

[6]This figure takes into account the whole population, but in this paper we will consider only births to women between 15 and 29 years-old; for those women, there was a drop of about 6 thousand births in three years (Figure 1).

[7]These records are known as Birth Certificates (CNV, in Spanish Certificado de Nacido Vivo) and are collected by the Ministry of Public Health (MSP, in Spanish Ministerio de Salud Pública).

[8]In Spanish Ministerio de Salud Pública, MSP and these records are known as Formal Health Coverage Records (RUCAF, in Spanish Registro Único de Cobertura de Asistencia Formal)

[9]We compute this figure from a sub-sample of the administrative records regarding those sub-dermal implants inserted

in public hospitals was stable, and it started to decrease in 2016.

In Figure 2, we show that the monthly time series of births by Department exhibit high volatility; because of the small size of the country, there are less than 4000 births per month in the whole country, and the population is distributed very unevenly across the country.[10] We perform a set of strategies to smooth the series: first, we use quarterly data for the period 2000-2018; secondly, we perform both a moving average with the previous twelve months and a Kalman filter. In our estimations, moving averages and the Kalman filter give us very similar trend series in the estimation, so we present only the moving average smoothing. All the series present a strong seasonality, see Figure A.2.[11]

As regions have very different population sizes and numbers of births, we define our main variable as the rate of the (smoothed) number of births in public hospitals over the number of women who access public hospitals in region i (Figure 3). The observed trends in both Figures 2 and 3 are decreasing, especially in the birth rate.

4 Methodology

We exploit the time heterogeneity of the onset of sub-dermal implant access in each region, combined with the fact that the policy is only available in the public hospitals, to implement an event study. We set the zero time to when the first shipment of sub-dermal implants arrives; after that the region becomes treated and we compare the performance of the result variable with respect to the past. Then, in the robustness analysis, we set the zero time to when the stock sub-dermal implants shipped was enough to cover the 5% of reproductive-age women who are users of public hospitals. Our main outcome (Y_{it}) is the ratio between the number of births from mothers between 15 and 29 years old in public hospitals in department i and month (or quarter) t and the number of women between 15 and 29 years old who are public hospital users in department i and month (or quarter) t.

$$Y_{it} = \frac{\#\,\text{Birth in public hospitals}_{it}}{\#\,\text{Women users of public hospitals}_{it}} \tag{1}$$

In the first approach, we consider the average effect after the policy in comparison to the situation prior to the start of the policy. Again, we expect a negative coefficient if the sub-dermal implants are effective in the decreasing births.

$$Y_{it} = \beta D_{it} + \alpha_i + \lambda_t + \epsilon_{it} \tag{2}$$

in the capital city with the age of who received it.

[10] Uruguay has a population of 3 and a half million in nineteen regions (Departments); 40% of the population is in the capital city, and there are regions with about ten monthly births on average during the period.

[11] We also perform a Hodrick-Prescott filter, but because of the fact the trends are linear we discard it.

The dependent variable Y_{it} is the birth rate in public hospitals in region i and month t by age group, and the independent variables are D_{it} which takes a value of zero up to the time that the the first shipment arrives to the region i, and takes a value of one after that. Finally, α_i gives region fixed effects and λ_t gives time fixed effects.

In the second approach, we consider the dynamic effect with respect to the month before the policy begin ($t = -1$). Our main variable is the birth rate and the number of women who receive health care in public hospitals by age and region. If access to sub-dermal implants is relevant in the fall of the birth rate, we expect a decrease after the ninth month, and no effect before the event and in the short run (less than nine months). As there are differences in the zero moment by region, we are capturing the effect of any change that occurs contemporaneous with the first implant shipment.

$$Y_{it} = \sum_{k \neq -1} \gamma_k I(K_{it} = k) + \alpha_i + \lambda_t + \epsilon_{it} \tag{3}$$

The dependent variable Y_{it} is the birth rate in public hospitals in region i and month t by age group. The key variables of the treatment are $I(K_{it} = k)$, an indicator function, where K_{it} is the month with respect to the event E_i, which is the moment when the first shipment of sub-dermal implants arrived in each region ($K_{it} = t - E_i$). Therefore, coefficients γ_k compare each moment after and before this first shipment with respect to $K_{it} = -1$. The coefficients γ_k for $K_{it} < 0$ correspond to pre-policy adoption trends, and for $K_{it} \geq 0$ to the dynamic effects k months after the adoption of the policy. Finally, α_i region fixed effects and λ_t time fixed effects. In our estimates (Equation 4), we consider the thirteen months before and the twenty-three months after the first shipment.

$$Y_{it} = \sum_{k=-14}^{k=-2} \gamma_k I(K_{it} = k) + \sum_{k=0}^{k=24} \gamma_k I(K_{it} = k) + \alpha_i + \lambda_t + \epsilon_{it} \tag{4}$$

5 Results

Firstly, in Table 1 we show the average effect of the sub-dermal implants on the birth rate after the event (coefficient β in the Equation 2), and for different time frames: very short-run (up to 8 months), short-run (between 9 and 16 months) and medium-run (between 17 and 24 months). Note the sub-dermal implant should not be active in the very short run, and as we expected, we do not find any effect in this time frame. We find a negative effect on the average birth rate of women aged 15-19 years old; there is a reduction of 1.7% in the whole latter period of the treatment. We also find a negative effect in the medium run for all the births from mothers between 15 and 29 years old and each age group, but the magnitude of the coefficients is 75% bigger among the youngest group.

Secondly, we present the results of the dynamic effect in Figures 4 and 5. We plot the estimated monthly coefficients of the dynamic specification compared with the benchmark in time -1 (γ_k in the Equation 3). Each point on the graph identifies the estimated coefficient accompanied by a 90% confidence interval. If the interval crosses zero, it implies that the coefficient is not statistically different from zero. To identify the effects of the policy, the estimated coefficients corresponding to the subsequent months or quarters after $t = -1$ should be statistically significant. In this case, it is expected that before the implementation of the policy and until the nine months after ($t = 9$), all coefficients should be statistically insignificant.

We show the monthly dynamic event study effect in Figure 4. The first panel presents the impact on the birth rate of women between 15 and 29 years old, and panels 2 to 4 present the results by age groups (15 to 19, 20 to 24 and 25 to 29 years old). The coefficients in our whole sample are zero before the event and up to the thirteenth month after the deployment of the program. From the fourteenth month onwards, the coefficient becomes negative and increasing in magnitude. These effects are explained by the behavior of young groups (15-19 years old); their fertility rates start to decrease at month 12 and continue to do so. The 25 to 29-year-old group recorded significant effects only from month 21.

Additionally, for the last estimation with the smoothed series, we also perform a quarterly dynamic event study estimation. Figure 5 shows the same trend as that observed for the monthly estimate. In this case, the fall in the birth rate for women aged 15 to 29 starts in the fourth quarter after the policy deployment. The panels with results by age groups show the effect start in the fourth quarter for those age groups below 25, and in the sixth quarter for the older group.

We documented a causal effect of the sub-dermal implants on birth rates, and now we want to disentangle the role of the policy in the fertility decision. Using the birth certificates issued to women, we can distinguish the order of births for those aged below 24. We have enough information in the records from 2003, so it is possible to know with high certainty the reproductive history of women who are between 15 and 24 years old after 2012. For this group of women, we can assess the birth order (we classify if it is the first birth or the second or later birth). Figure 6 shows that the monthly effect starts earlier in births of the first order, and there are higher in magnitudes in the decrease of births. This result provides evidence that the policy has more impact on young and childless women and gives insight into how their reproductive behavior is changing. Furthermore, these results can move to the right the bimodal distribution in the age of first birth, eliminating the first mode, reducing the current

TFR and the expected TFR in the medium-run.[12]

We expect that the reduction in the number of births would be accompanied by improvements in other outcomes related to pregnancies' quality, such as birth weight and weeks of gestation. We perform this analysis with four outcomes: birth weight in grams, a dummy variable that takes the value one if the baby weighs up to 1500 grams at birth, weeks of gestation and a dummy variable that takes the value one if the baby born premature (between 21 and 37 weeks of pregnancy). Figure 7 shows the results for the group of women between 15 and 29 years of age (the results for the different age groups can be found in the annex: Figures A.4- A.6). In this case, there are no significant effects of the policy observed for any of the variables analyzed, but due to the small magnitude of the effects found in the main estimates and the rigidity that is usually shown by outcomes such as those analyzed here, the results found should not be surprising.[13]

We perform the analysis using some alternative specifications of the event study model. First, we define the event $t = 0$ as when the stock of sub-dermal implants shipped to each region was enough to cover 5% of women between 15 and 45 years old (see Table A.2). Figure A.7 shows the results in this specification, and there is a particular negative trend in the birth rate before the new moment event zero. That result is reasonable because the implants had already arrived at the department and the policy was already underway.

Secondly, we estimate the same event study in the benchmark, but we consider as the outcome variable the gross number of births instead of rates. As we work with raw birth numbers, we do not contemplate any differences in each region's population structures. However, precisely because of that, it reduces possible noise in the data and allows us to verify that the results obtained are robust. In Figure A.8, we show an effect only in the youngest group.

Finally, we propose two placebo exercises. For the first one, as the sub-dermal implants were available for free use only for public hospital users, we should not find any effect on the number of births observed in the private hospitals. Figure 8 shows the results of the main model considering private hospital users. The non-occurrence of policy effects in this sector, where implants were not yet available, can be observed.

Additionally, a placebo was constructed by setting the event ($t = 0$) nine months before the start of the policy (Figure 9). As can be seen, if assumed that the policy began nine months earlier, there are no effects on birth rates. Therefore, as mentioned, all exercises report results consistent with the

[12]The quarterly effects have similar figures and trends (see Figure A.3).

[13]In (Antón et al., 2018) found that Voluntary Termination Law reduced by 8% the unplanned pregnancy among more educated mothers between 20 and 34 years old and improved pregnancy quality.

main findings of the work.

6 Conclusions

During recent decades in Uruguay, a low TFR has coexisted with relatively high adolescent fertility rates. In the last lustrum, these two rates have started a quick decline that has lead the TFR to a very low fertility threshold and has cut adolescent fertility to half of its historical rate. In this paper, we quantified the causal impact of a contraceptive policy on the birth rates in public hospitals.

As we examined the policy timing implementation through an event study model, we were able to test the causal effect of this policy. We documented the significant impact of a LARCs policy on the decline of fertility in Uruguay between 2015-2018, and we provided evidence that this policy was relevant in reducing births among adolescent women, as well as postponing first births. As we exploit the heterogeneity in the timing of subdermal implant shipments, all the causal effects come from the arrival of this contraceptive method and everything that accompanied this arrival, such as the health practitioners' training in contraceptive methods and sexual health. However, in this paper, we do not find any effect on the quality of the pregnancy nor the incidence of sexually transmitted diseases.

Our estimates document a reduction of 3.3% in the birth rate in the medium run, between 16 to 23 months, after the policy was implemented. This reduction is 5.5% for adolescent fertility (15 to 19 years old) and the average figures for the rest of our sample were 3.5% (20 to 24 years old) and 3.2% (25 to 29 years old). These figures are a bit lower than those found by Lindo and Packham (2017) with a reduction of 6% in the adolescent fertility rate across five years in Colorado, between 2009 and 2013.[14]

These effects imply that the program prevented around 900 births between months 9 and 24 after the program's implementation. This reduction represents one-third of the total decrease in births over those sixteen months for our population.[15] Again, this number is comparable with the reduction of 1500 births reported by Lindo and Packham (2017). These results lead to the belief that the policy of access to LARCs has a more significant effect on decreasing the adolescent fertility rate, especially among the most deprived population.

Finally, this paper brings information to policymakers about the effectiveness of a contraceptive policy among the most deprived population. As we also find that these effects are bigger for the first

[14]Note the definition of birth rate in each paper is different, but these figures are comparable.

[15]We consider the impact on births, computing the number of births among women using public hospitals in $t = -1$, and then computing the reduction through the coefficient γ_k. Then in those 16 months, there is a reduction in public hospitals of 2750 births, if we compare the total births in those months and a contractual number if those months are similar to $t = -1$.

birth and for the youngest group of women, we can expect a postponement in the time of the first birth, and a movement of the first mode in the fertility pattern from the early twenties to the right in the distribution. The subdermal implants policy is effective in preventing unintended pregnancies, especially among teenagers, and as we document, the reduction of births provides critical insights for policymakers to invest in contraceptive methods. However, birth collapse is a multi-causal phenomenon in which LARCs also play an important role. In further studies, there is an open question about how many years women are postponing their first birth and the medium-term effect on employment, education, and well-being.

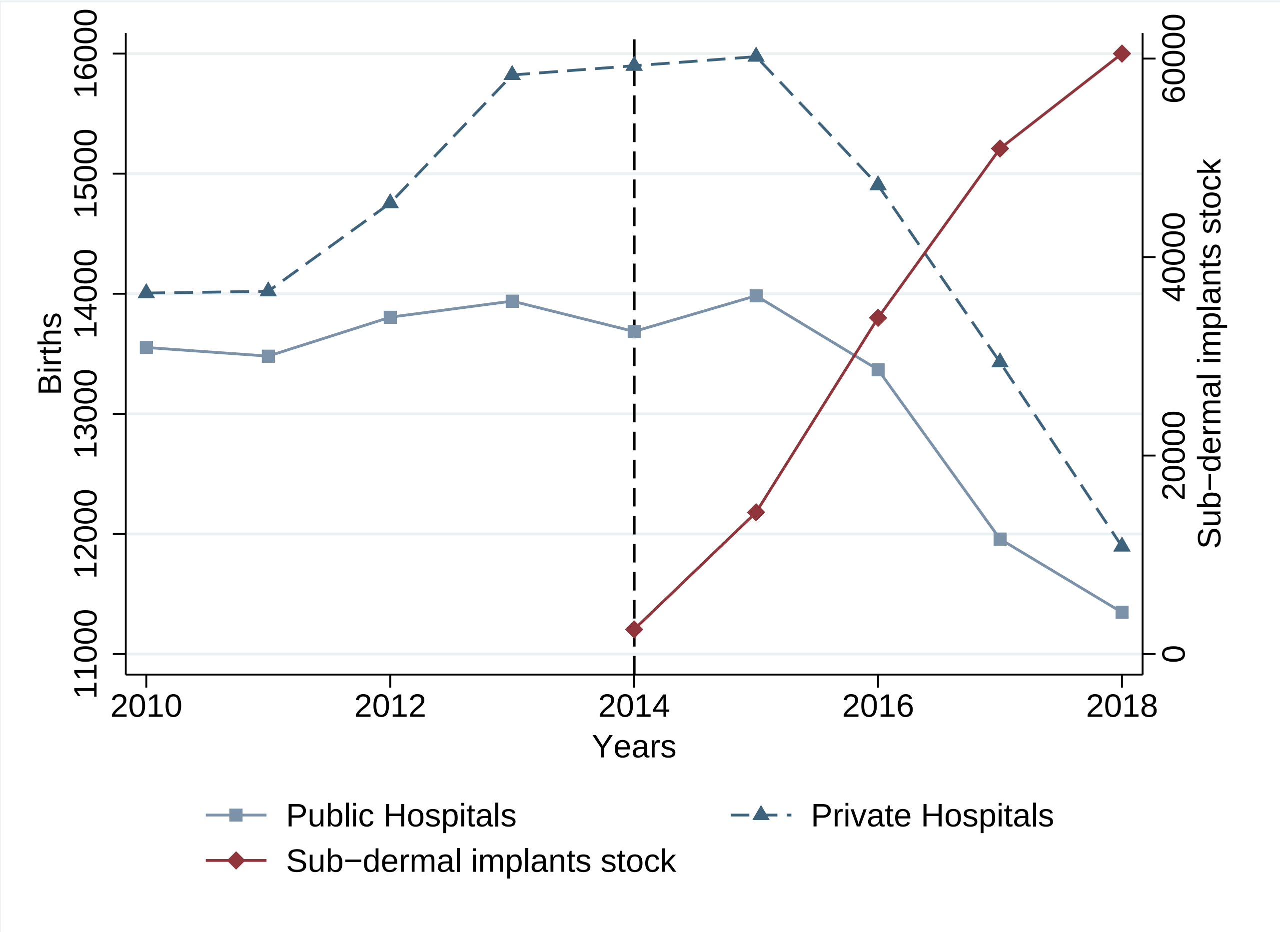
Tables

Table 1: Average birth rate effects between by age groups

	15 -29	15 -19	20 -24	25 -29
Average effect	-0.00001	-0.00011	-0.000045	-0.000012
	(0.27)	(2.46)*	(0.84)	(0.21)
Very Short Run: 0 to 8 months	-0.0000027	-0.000058	-0.000023	0.0000095
	(0.07)	(1.34)	(0.43)	(0.17)
Short Run: 9 to 16 months	-0.00008	-0.00020	-0.00012	-0.000018
	(1.62)	(3.49)**	(1.74)	(0.25)
Medium Run: 17 to 24 months	-0.00024	-0.00035	-0.00032	-0.00020
	(4.08)**	(5.29)**	(3.94)**	(2.45)*
Observations	627	627	627	627
Average Birth Rate Pre-Policy	0.0072	0.0064	0.009	0.0063

Source: CNV, MSP and RUCAF. We perform the average effects on the birth rate by age groups with region fixed effects. Balanced panel. Heteroskedasticity across panels and autocorrelation within panels.
* $p < 0.05$; ** $p < 0.01$

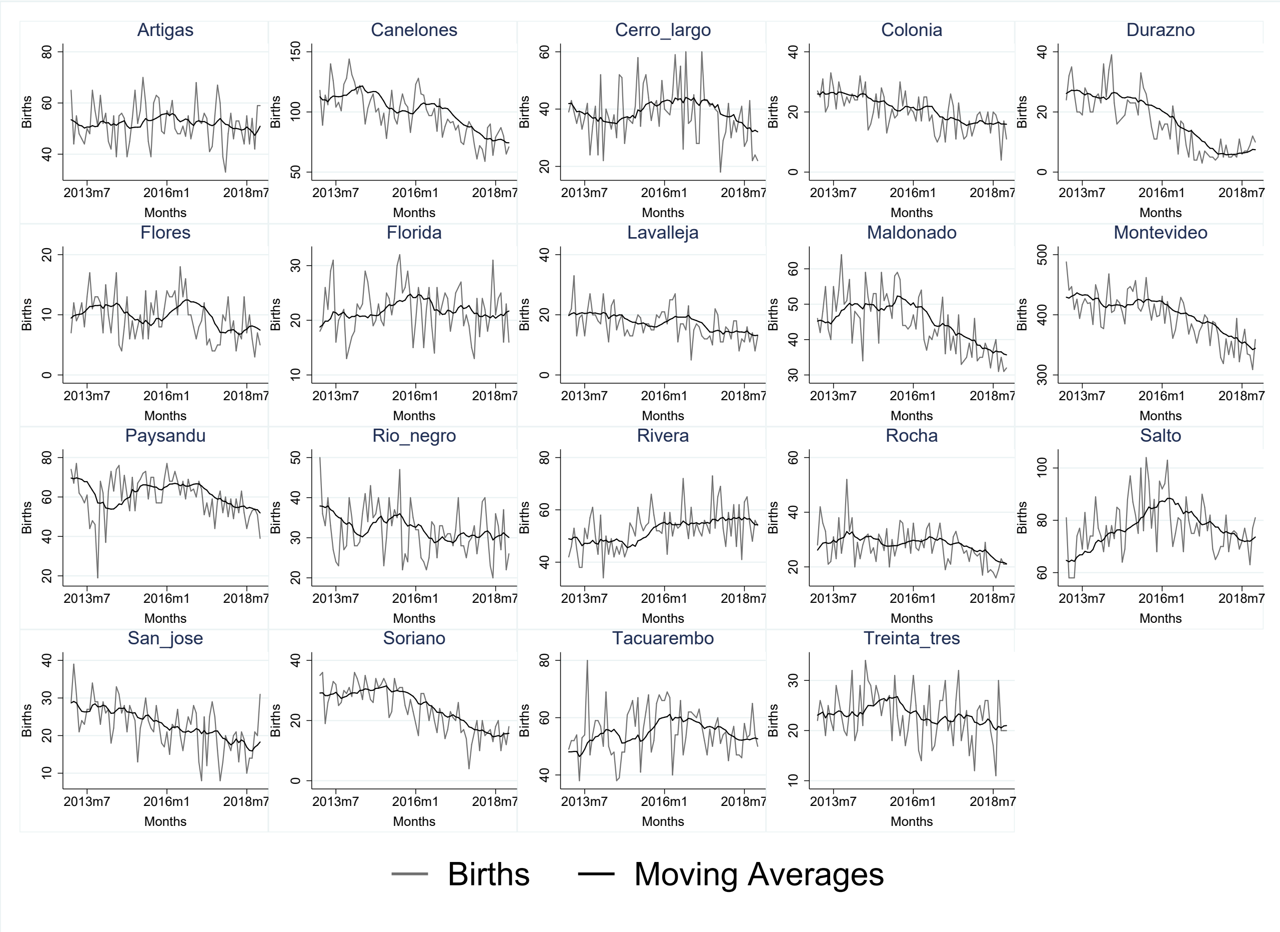
Figure 1: Total annual births and sub-dermal implants stock 2010-2018



Source: CNV and MSP.
We consider the total annual number of births in public and private hospitals for women between 15 and 29 years old, and the total stock of sub-dermal implant shipments (insertions or available in the hospital pharmacy).

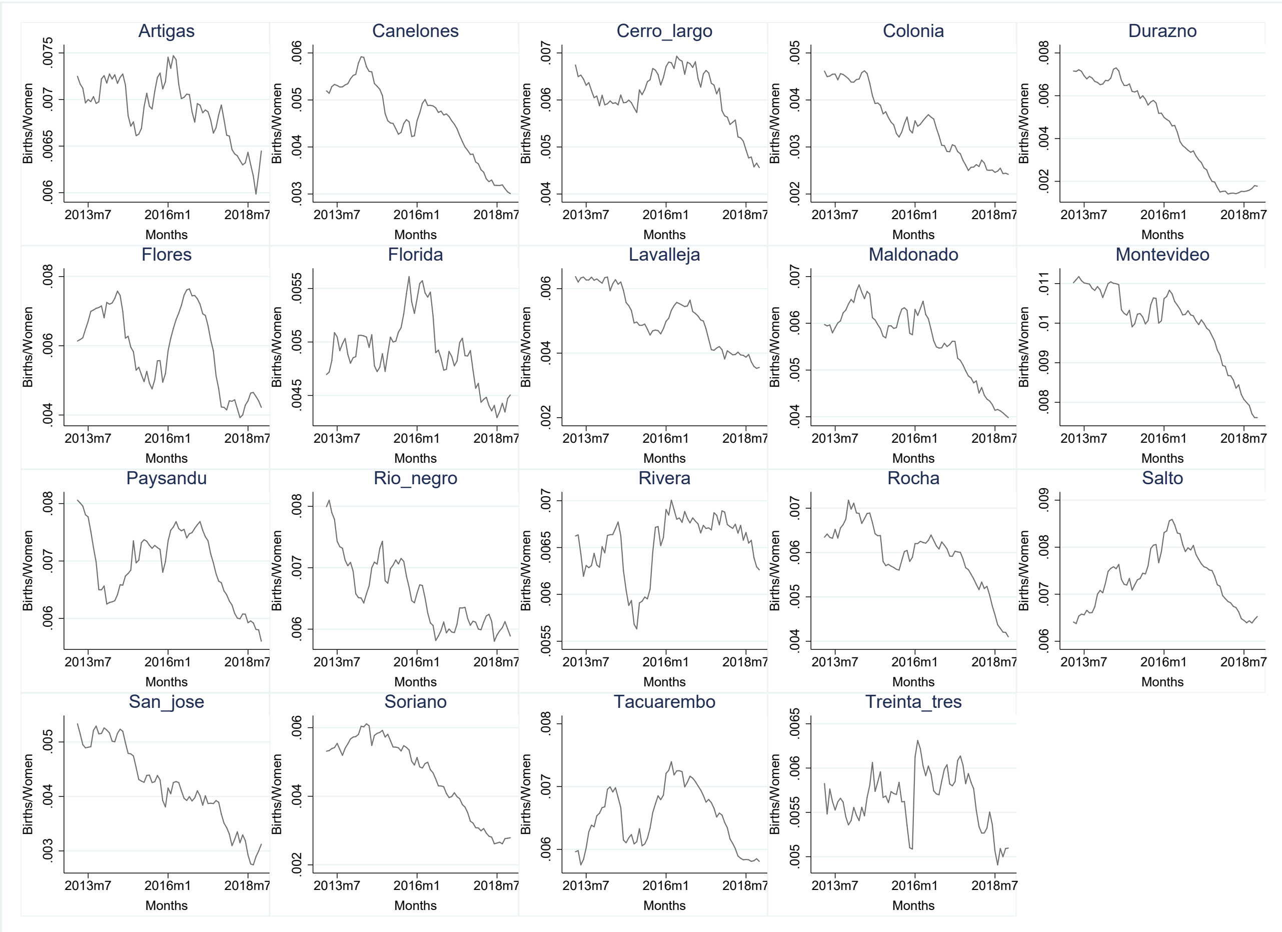
Figures

Figure 2: Monthly births from mothers between 15 and 29 years old with moving averages estimation 2013-2018



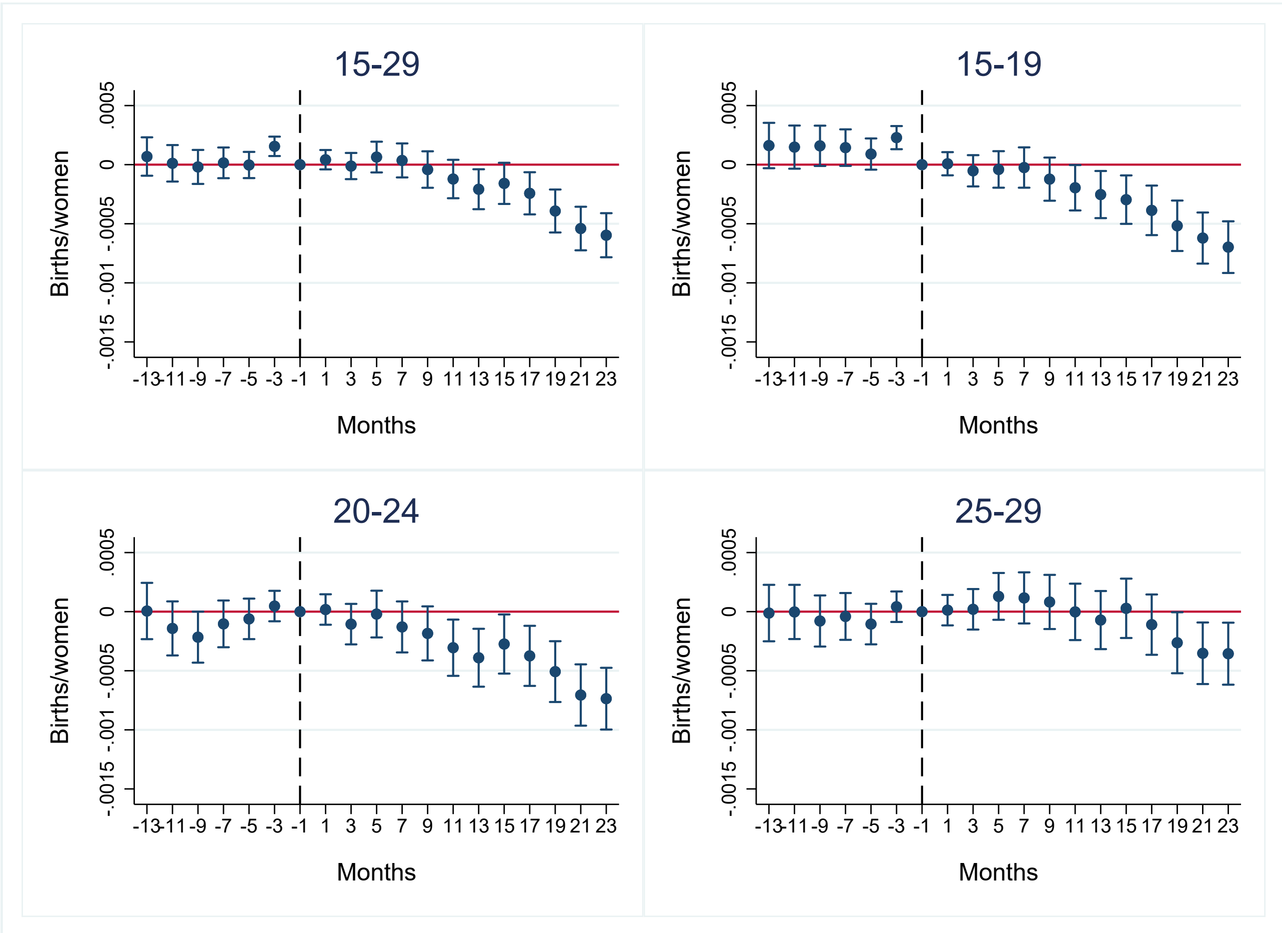
Source: CNV.
There are considered monthly births registered in the public sector from women between 15 and 29 years old. The moving averages are a smoothed series using the previous twelve months of each moment.

Figure 3: Monthly number of births/number women who attended public hospitals between 15 and 29 years old by region



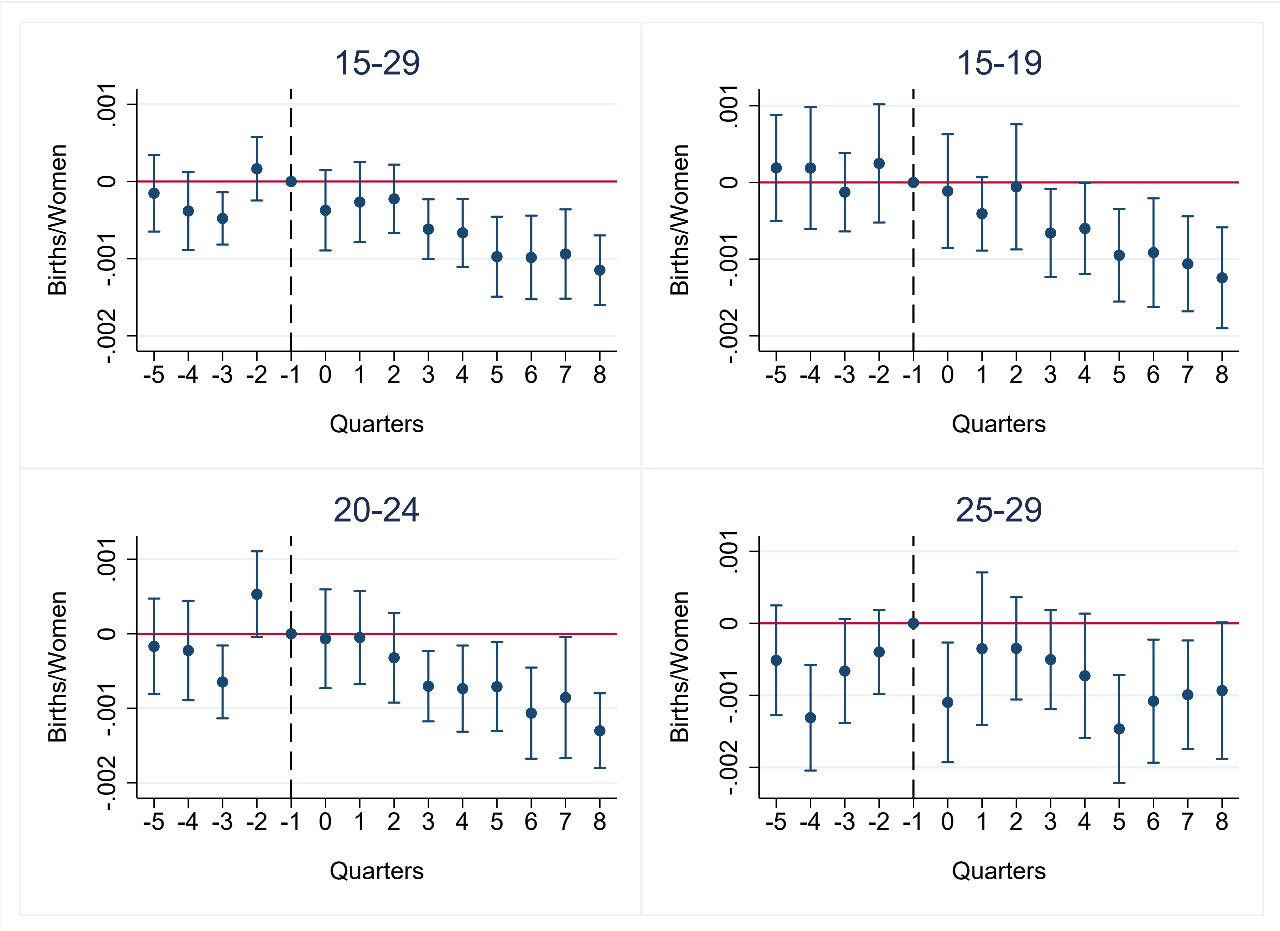
Source: CNV and RUCAF.
The birth series are smoothed using a moving average with the previous twelve months.

Figure 4: Monthly birth rate effects by mother age group



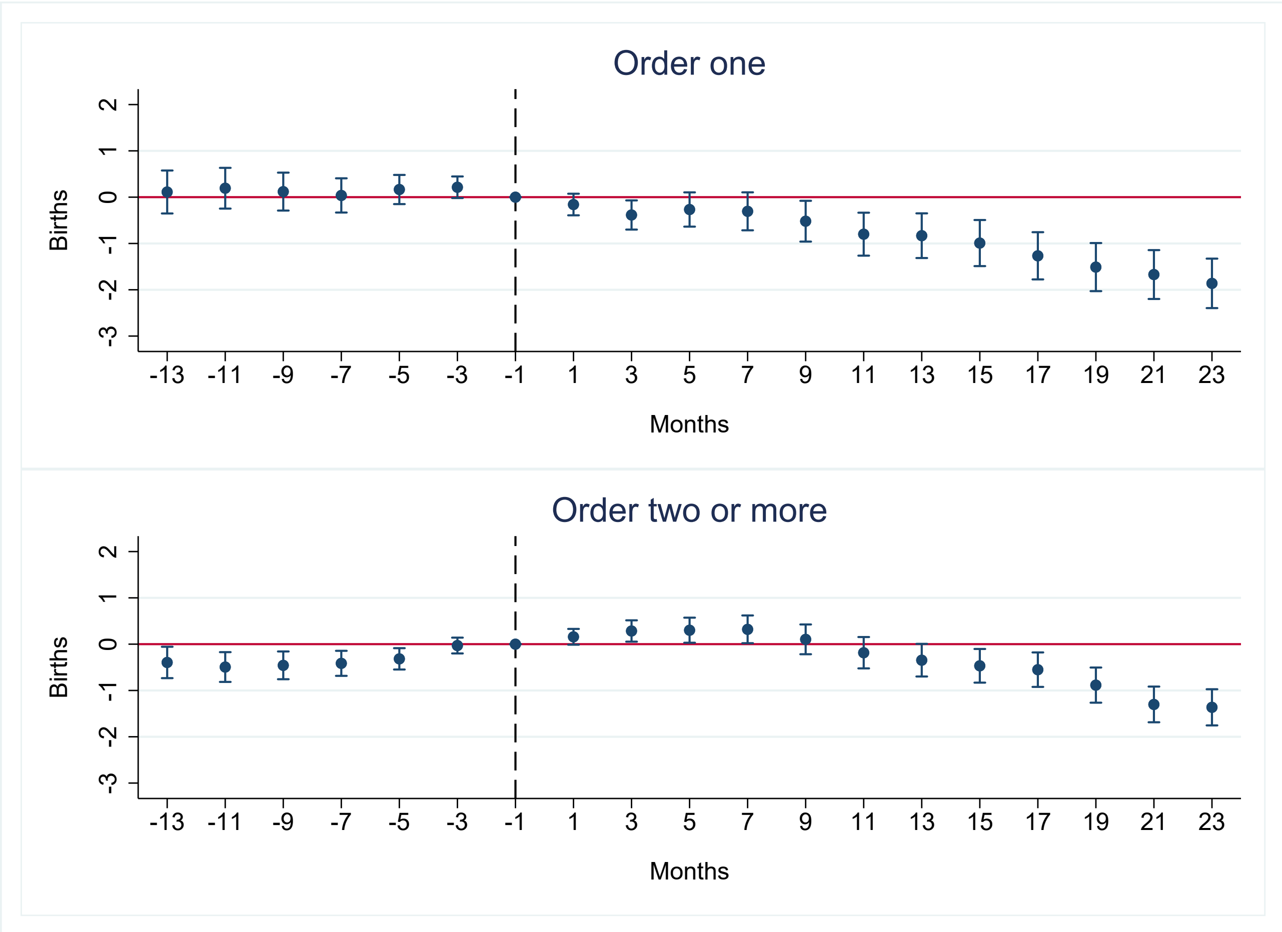
Source: CNV, RUCAF and MSP.
Each point on the graph identifies the estimated coefficient accompanied by a 90% confidence interval. If the interval crosses zero, it implies that the coefficient is not statistically different from zero. Results of monthly dynamic event study with fixed effects by department considering women who attended public hospitals between 15 and 29 years old. Balanced panel, with heteroskedasticity across panels and autocorrelation within panels.

Figure 5: Quarterly birth rate effects by mother age group



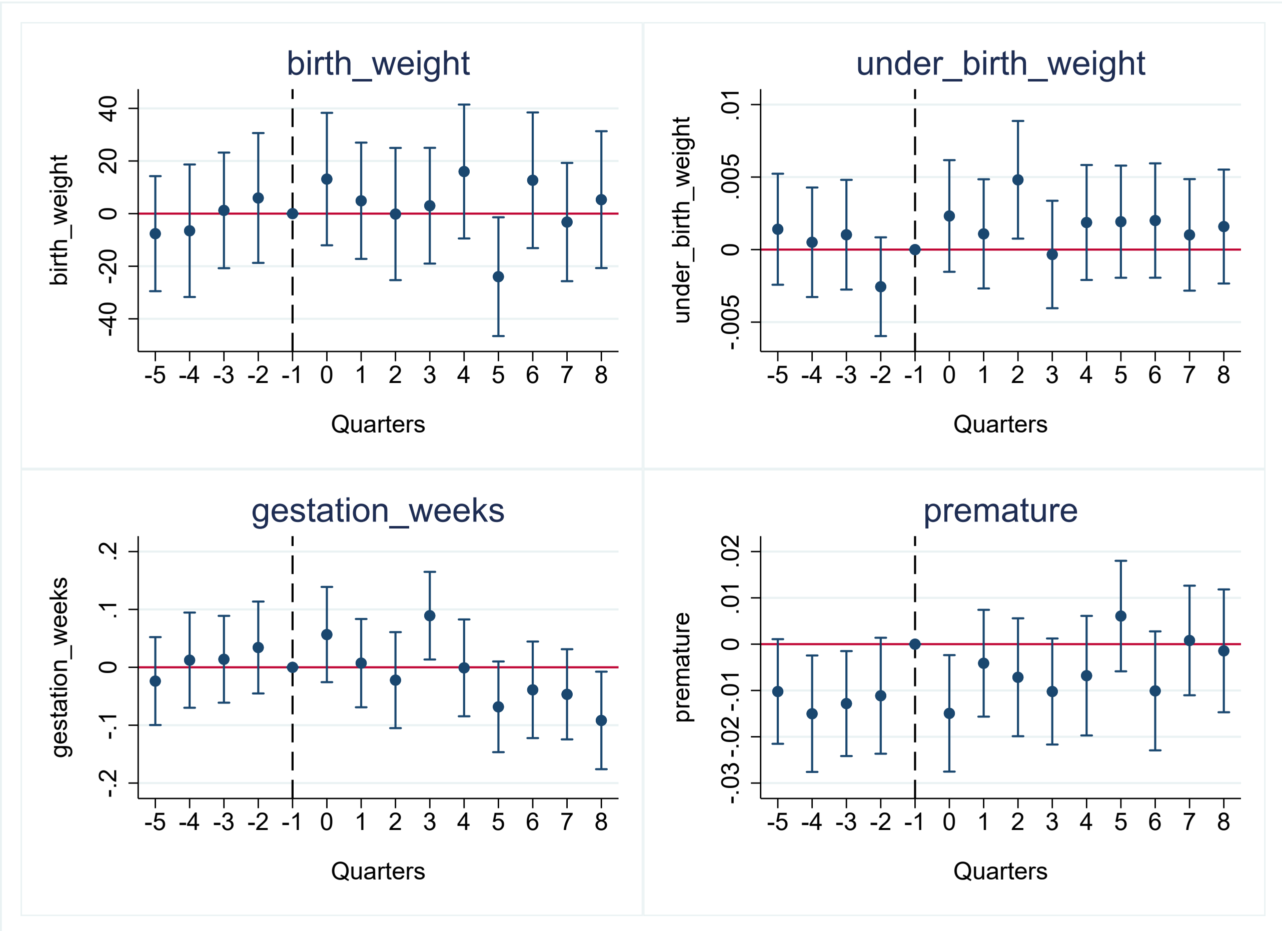
Source: CNV, RUCAF and MSP.
Each point on the graph identifies the estimated coefficient accompanied by a 90% confidence interval. If the interval crosses zero, it implies that the coefficient is not statistically different from zero. Results of quarterly dynamic event study with fixed effects by department and quarter considering women who attended public hospitals between 15 and 29 years old. Balanced panel. Robust standard errors.

Figure 6: Monthly births effects by birth order



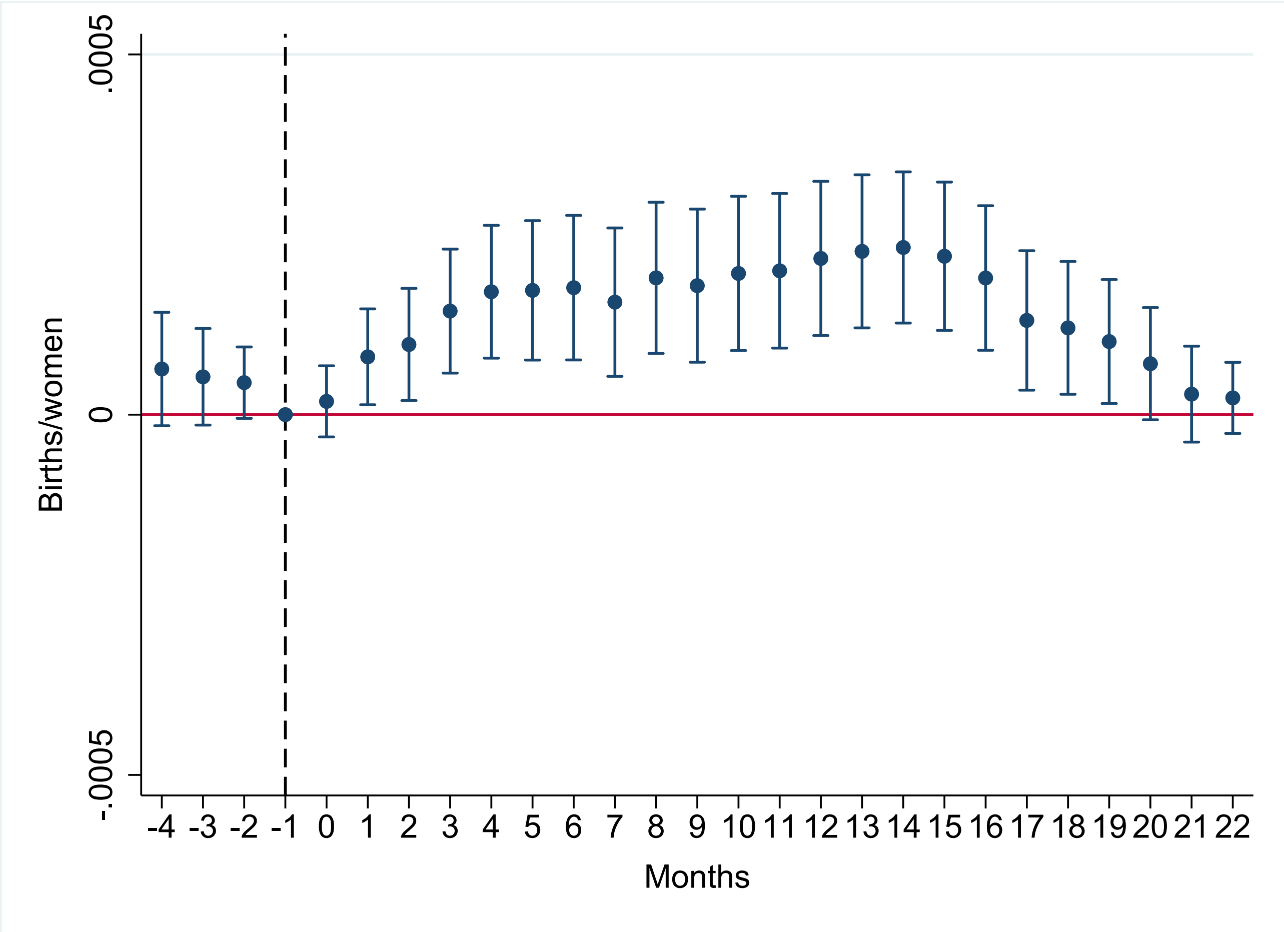
Source: CNV, RUCAF and MSP.
Each point in the graph identifies the estimated coefficient accompanied by a 90% confidence interval. If the interval crosses zero, it implies that the coefficient is not statistically different from zero. This result is based in the sample of women who attended public hospitals between 15 and 24 years old. Results of monthly dynamic event study with region fixed effects. Balanced panel. Heteroskedasticity across panels and autocorrelation within panels.

Figure 7: Quarterly effects for different births outcomes



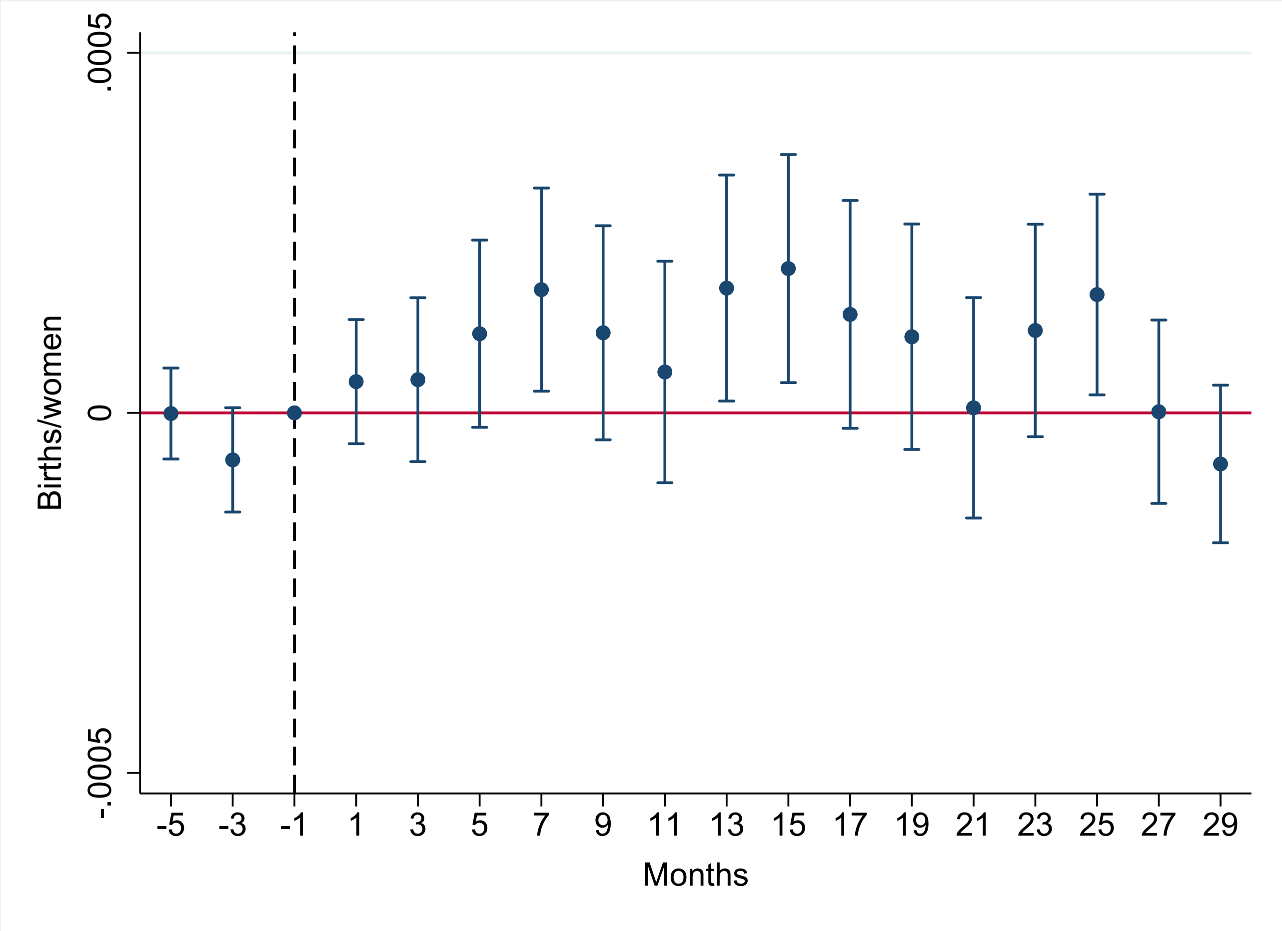
Source: CNV.
Each point in the graph identifies the estimated coefficient accompanied by a 90% confidence interval. If the interval crosses zero, it implies that the coefficient is not statistically different from zero. Results of quarterly dynamic event study with region and quarter fixed effects considering women who attended public hospitals between 15 and 29 years old. Balanced panel. Robust standard errors.

Figure 8: Placebo event. Monthly births effects for women between 15 and 29 years old. Private hospitals.



Source: CNV and MSP.
Each point in the graph identifies the estimated coefficient accompanied by a 90% confidence interval. If the interval crosses zero, it implies that the coefficient is not statistically different from zero. Results of monthly dynamic event study with region fixed effects considering women who attended private hospitals between 15 and 29 years old. Balanced panel. Heteroskedasticity across panels and autocorrelation within panels.

Figure 9: PLACEBO EVENT WITH $t = 0$ AT THE PREVIOUS NINE MONTHS OF IMPLEMENTATION.



Source: RUCAF, CNV and MSP.
Each point in the graph identifies the estimated coefficient accompanied by a 90% confidence interval. If the interval crosses zero, it implies that the coefficient is not statistically different from zero. Results of monthly dynamic event study with region fixed effects considering women who attended public hospitals between 15 and 29 years old. Balanced panel. Heteroskedasticity across panels and autocorrelation within panels.

References

Aguirre, R., Gorgoroso, M., Píriz, G., Cambre, L., Alegretti, M., Cardozo, S., Díaz, J., and Ramos, V. (2017). IIntroducción de implantes anticonceptivos sub-dérmicos en Uruguay: estudio piloto sobre aceptación y desempeño clínico de los implantes utilizados en servicios de salud del área metropolitana de Montevideo. Working paper, MSP-ASSE-UNFPA.

Antón, J.-I., Ferre, Z., and Triunfo, P. (2016). Evolution of adolescent fertility after decriminalization of abortion in montevideo, uruguay. *International Journal of Gynecology & Obstetrics*, 134:S24–S27.

Antón, J.-I., Ferre, Z., and Triunfo, P. (2018). The impact of the legalisation of abortion on birth outcomes in uruguay. *Health economics*, 27(7):1103–1119.

Ashcraft, A., Fernández-Val, I., and Lang, K. (2013). The consequences of teenage childbearing: Consistent estimates when abortion makes miscarriage non-random. *The Economic Journal*, 123(571):875–905.

Ashraf, N., Field, E., and Lee, J. (2014). Household bargaining and excess fertility: an experimental study in zambia. *American Economic Review*, 104(7):2210–37.

Branson, N. and Byker, T. (2018). Causes and consequences of teen childbearing: Evidence from a reproductive health intervention in South Africa. *Journal of Health Economics*, 57:221 – 235.

Brunet, N., Cabella, W., Marroig, A., Nathan, M., Pardo, I., and Zoppolo, G. (2020). Intenciones de embarazo y cuidados prenatales en Uruguay. Working paper, FCS.

Cabella, W., De Rosa, M., Failache, E., Fitermann, P., Katzkowicz, N., Medina, M., Mila, J., Nathan, M., Nocetto, A., Pardo, I., et al. (2015). *Salud, nutrición y desarrollo en la primera infancia en Uruguay: primeros resultados de la ENDIS.* INE.

Cabella, W., Nathan, M., and Pardo, I. (2019). La caída de la fecundidad en Uruguay entre 2015 y 2018. Working paper, UNFPA-MSP-UdelaR.

Carr, J. B. and Packham, A. (2017). The effects of state-mandated abstinence-based sex education on teen health outcomes. *Health economics*, 26(4):403–420.

de Leon, R. G. P., Ewerling, F., Serruya, S. J., Silveira, M. F., Sanhueza, A., Moazzam, A., Becerra-Posada, F., Coll, C. V., Hellwig, F., Victora, C. G., et al. (2019). Contraceptive use in latin america and the caribbean with a focus on long-acting reversible contraceptives: prevalence and inequalities in 23 countries. *The Lancet Global Health*, 7(2):e227–e235.

Desai, J. and Tarozzi, A. (2011). Microcredit, Family Planning Programs, and Contraceptive Behavior: Evidence From a Field Experiment in Ethiopia. *Demography*, 48(2):749–782.

Ferre, Z., Gerstenbluth, M., Rossi, M., and Triunfo, P. (2011). Sexual initiation decisions among adolescent women: The uruguayan case. *Sexuality Research and Social Policy*, 8(2):103–111.

Finer, L. B. (2010). Unintended pregnancy among us adolescents: accounting for sexual activity. *Journal of Adolescent Health*, 47(3):312–314.

Finer, L. B., Jerman, J., and Kavanaugh, M. L. (2012). Changes in use of long-acting contraceptive methods in the united states, 2007–2009. *Fertility and sterility*, 98(4):893–897.

Galárraga, O. and Harris, J. E. (2019). Effect of an Abrupt Change in Sexual and Reproductive Health Policy on Adolescent Birth Rates in Ecuador, 2008-2017. Working Paper 26044, National Bureau of Economic Research.

Gertler, P. J. and Molyneaux, J. W. (1994). How Economic Development and Family Planning Programs Combined to Reduce Indonesian Fertility. *Demography*, 31(1):33–63.

INE-UNFPA (2017). Encuesta Nacional de Comportamientos Reproductivos, Uruguay. Working paper, MIDES-INE-UNFPA-MSP-UdelaR.

Kagesten, A., Parekh, J., Tunï¿½alp, z., Turke, S., and Blum, R. W. (2014). Comprehensive Adolescent Health Programs That Include Sexual and Reproductive Health Services: A Systematic Review. *American Journal of Public Health*, 104(12):e23–e36. PMID: 25320876.

Kearney, M. S. and Levine, P. B. (2009). Subsidized contraception, fertility, and sexual behavior. *The review of economics and statistics*, 91(1):137–151.

Lima, E. E. C., Zeman, K., Sobotka, T., Nathan, M., and Castro, R. (2018). The Emergence of Bimodal Fertility Profiles in Latin America. *Population and Development Review*, 44(4):723–743.

Lindo, J. M. and Packham, A. (2017). How Much Can Expanding Access to Long-Acting Reversible Contraceptives Reduce Teen Birth Rates? *American Economic Journal: Economic Policy*, 9(3):348–376.

López Gómez, A., Brunet, N., and Couto, M. (2019). Estudio sobre descenso de la fecundidad y factores explicativos en Uruguay 2015-2017: políticas públicas implementadas en el período analizado. Working paper, UNFPA-MSP-UdelaR.

Nathan, M. and Pardo, I. (2019). Fertility Postponement and Regional Patterns of Dispersion in Age at First Birth: Descriptive Findings and Interpretations. *Comparative Population Studies*, 44:37–60.

Nathan, M., Pardo, I., and Cabella, W. (2016). Diverging patterns of fertility decline in Uruguay. *Demographic Research*, 34(20):563–586.

Pardo, I. and Cabella, W. (2018). A Bimodal Pattern in Age at First Birth in Southern Cone Countries? *Population Review*, 57(2).

Phillips, J. F., Bawah, A. A., and Binka, F. N. (2006). Accelerating reproductive and child health programme impact with community-based services: the Navrongo experiment in Ghana. *Bulletin of the World Health Organization*, 84(12):949 – 955.

Sinha, N. (2005). Fertility, Child Work, and Schooling Consequences of Family Planning Programs: Evidence from an Experiment in Rural Bangladesh. *Economic Development and Cultural Change*, 54(1):97–128.

Strupat, C. (2017). Do Targeted Reproductive Health Services Matter? The Impact of a Midwife Program in Indonesia. *Health Economics*, 26(12):1667–1681.

Varela, C. (2008). *Demografía de una sociedad en transición. La población uruguaya a inicios del Siglo XXI.* UNFPA.

7 Appendices

Table A.1: Voluntary termination of pregnancy by age groups

	2013	2014	2015	2016	2017	2018	2019
Under 15 years-old	74	69	94	74	64	53	35
15 to 19 years-old	1200	1404	1603	1597	1476	1421	1324
Above 19 years-old	5897	7064	7664	8048	8290	8899	8868
Total	7171	8537	9362	9719	9830	10373	10227

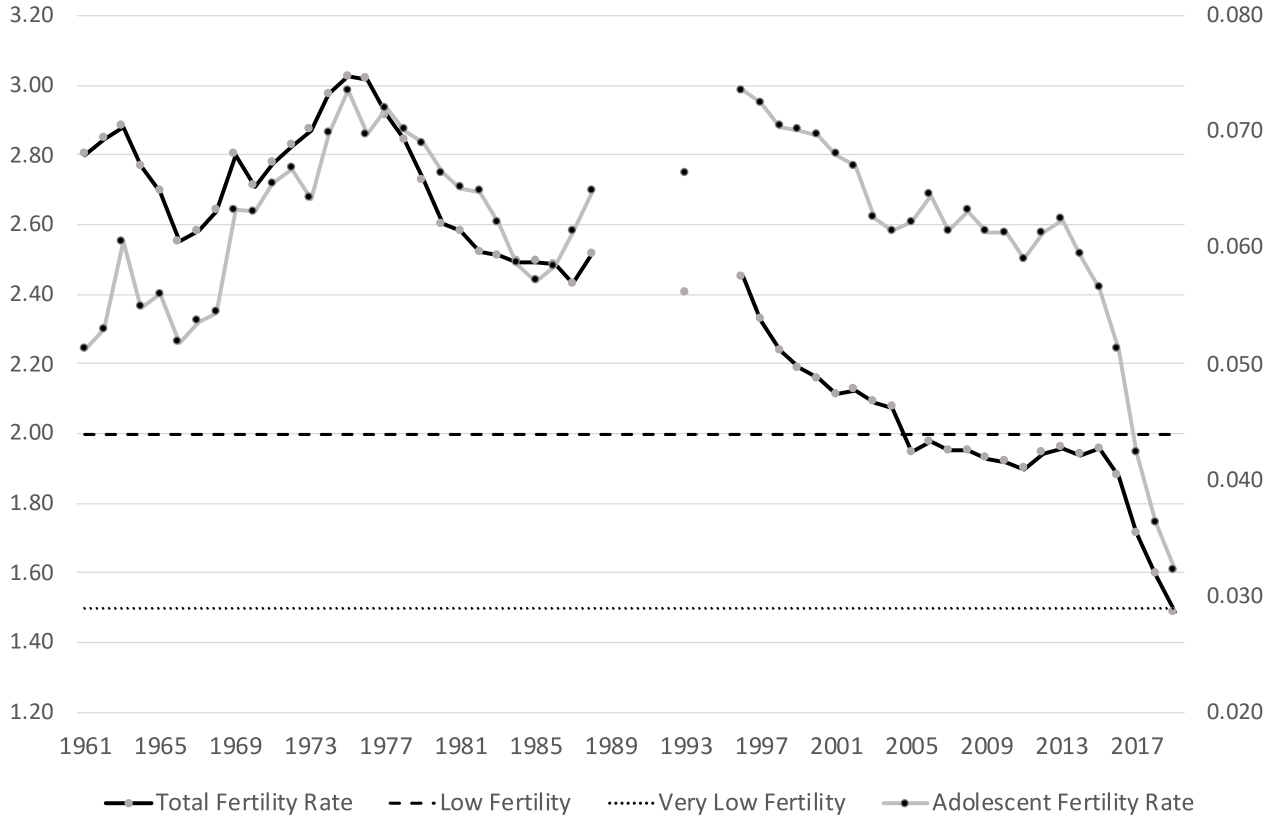
Source: MSP.

Table A.2: Sub-dermal implant shipments by region

Region	**First shipment**		**Threshold 5%**		**Total shipments (2018)**
Canelones	May	2014	May	2015	8018
Montevideo	June	2014	February	2015	23465
Artigas	November	2014	June	2016	900
Cerro Largo	November	2014	April	2015	1606
Florida	November	2014	March	2015	1953
Río Negro	November	2014	October	2015	1500
Rivera	November	2014	June	2015	1813
Paysandú	December	2014	October	2015	2623
Maldonado	February	2015	July	2015	3040
Tacuarembó	May	2015	July	2016	2337
Soriano	October	2015	December	2015	1947
Treinta y Tres	October	2015	January	2016	1100
Durazno	November	2015	January	2016	1600
Salto	November	2015	October	2016	1714
Rocha	December	2015	March	2016	1444
Colonia	January	2016	March	2016	2401
Flores	January	2016	January	2016	1100
San José	November	2016	May	2017	930
Lavalleja	December	2016	January	2017	1013

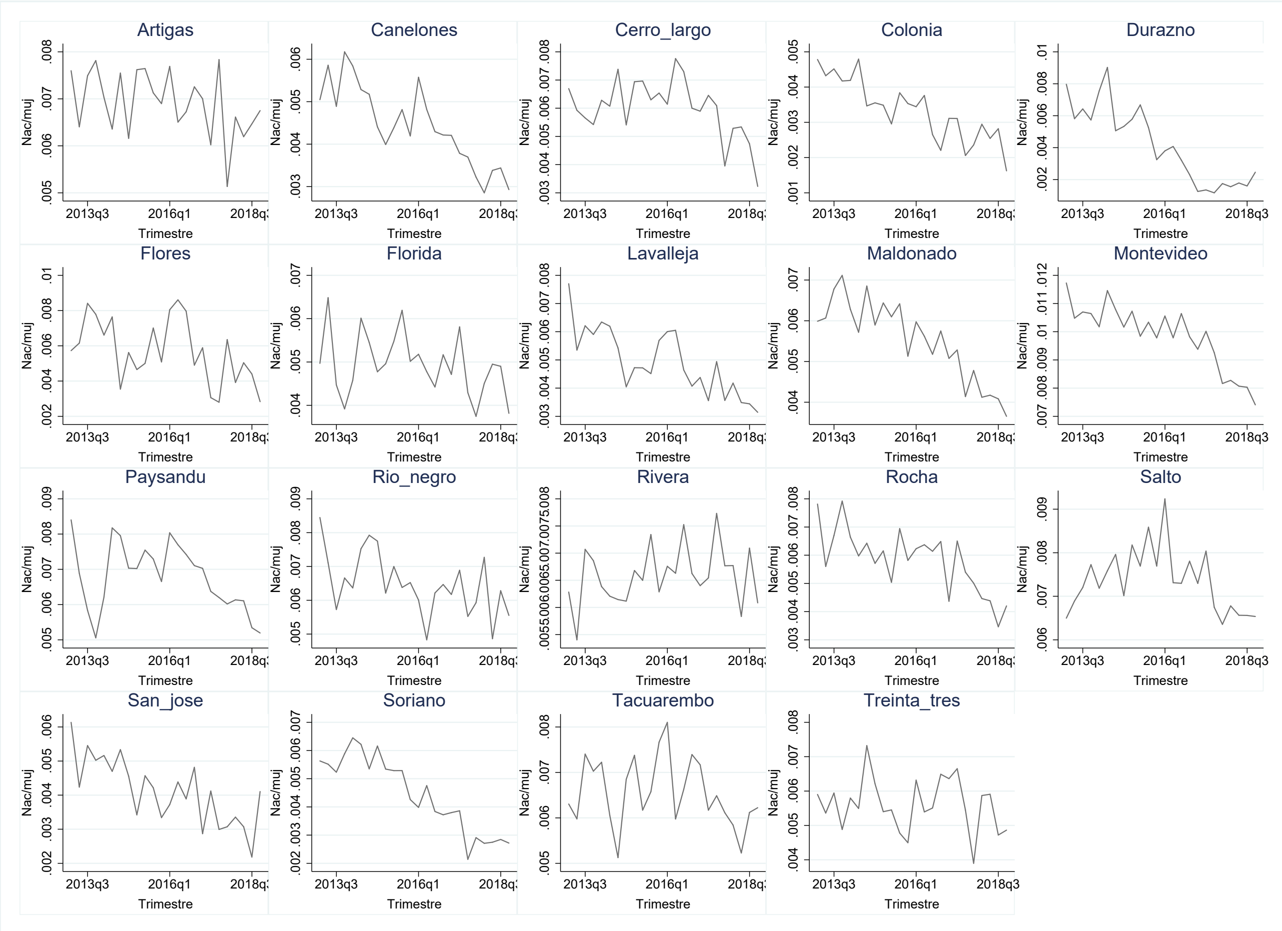
Source: MSP. We consider the first shipment form the Ministry of Public Health for one hospital in each region. The threshold of 5% is computed using the number of sub-dermal implants shipped and the total number of women in reproductive ages in each region. Last column shows the total number of sub-dermal implants inserted or available in public hospital pharmacies by region.

Figure A.1: Total fertility rate and Adolescent fertility rate, 1960-2019



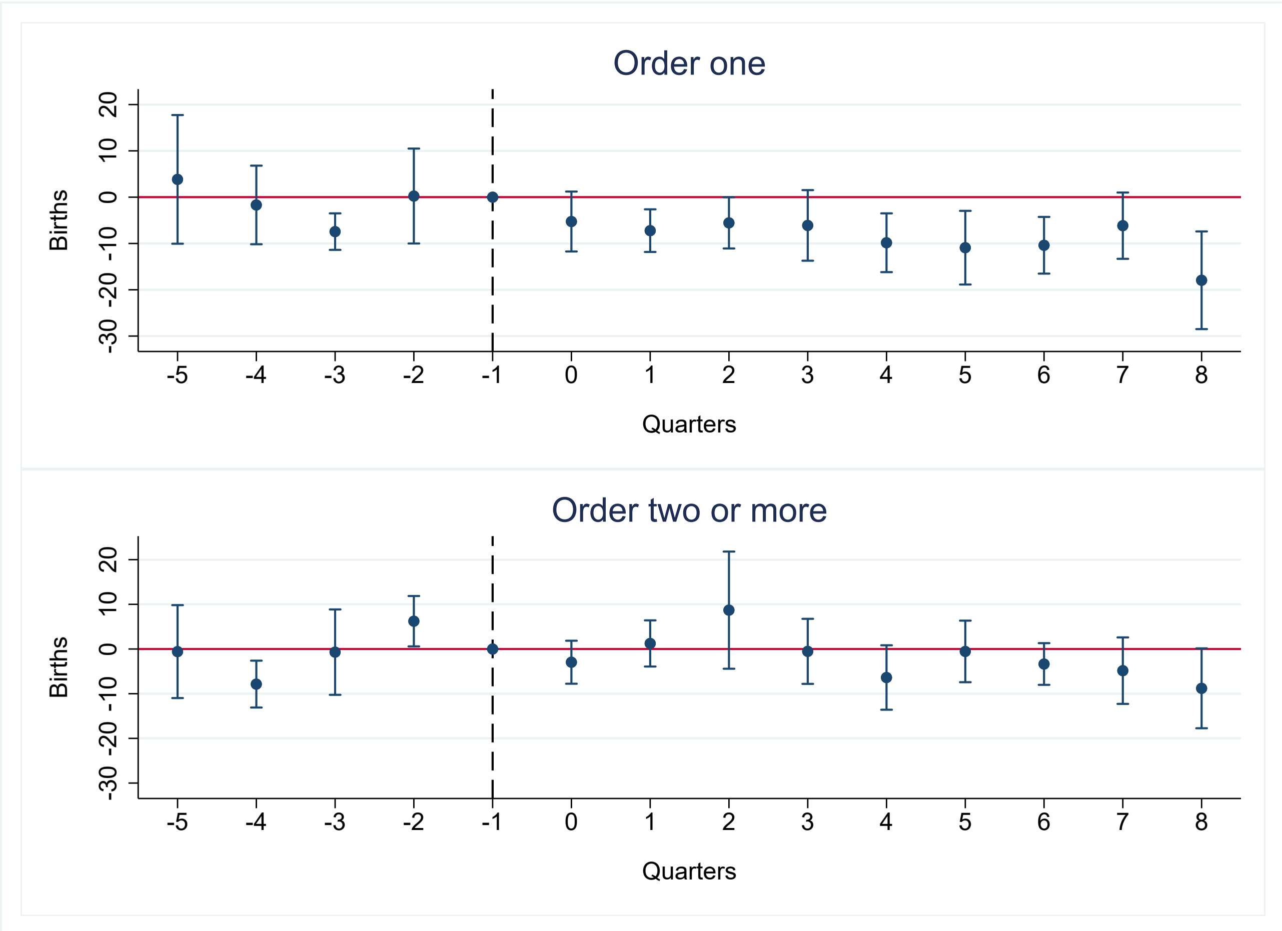
Source: CNV.

Figure A.2: Quartely rate birth-women public hospitals users between 15 and 29 years old by region



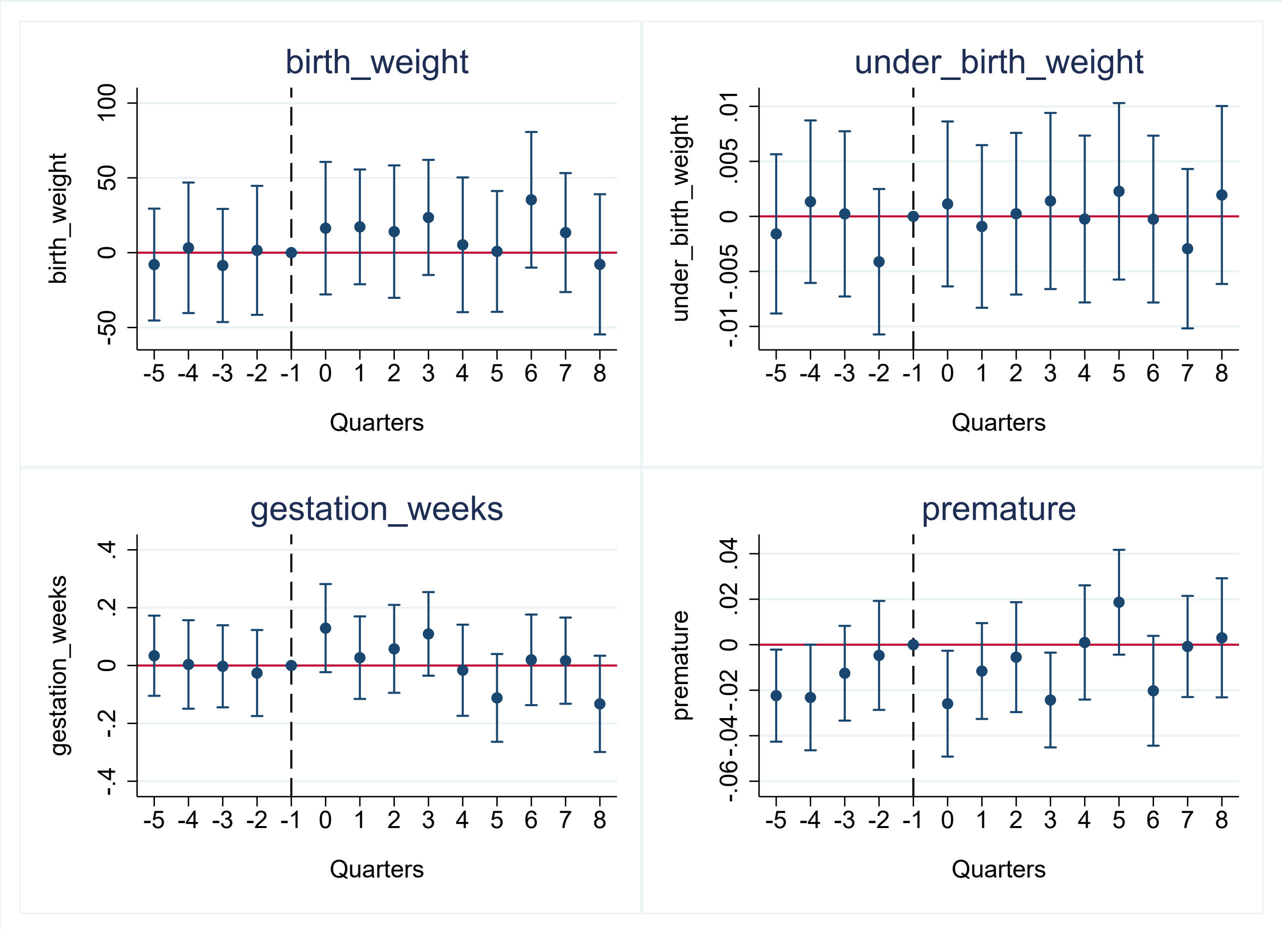
Source: CNV.

Figure A.3: Quarterly births effects for different birth order



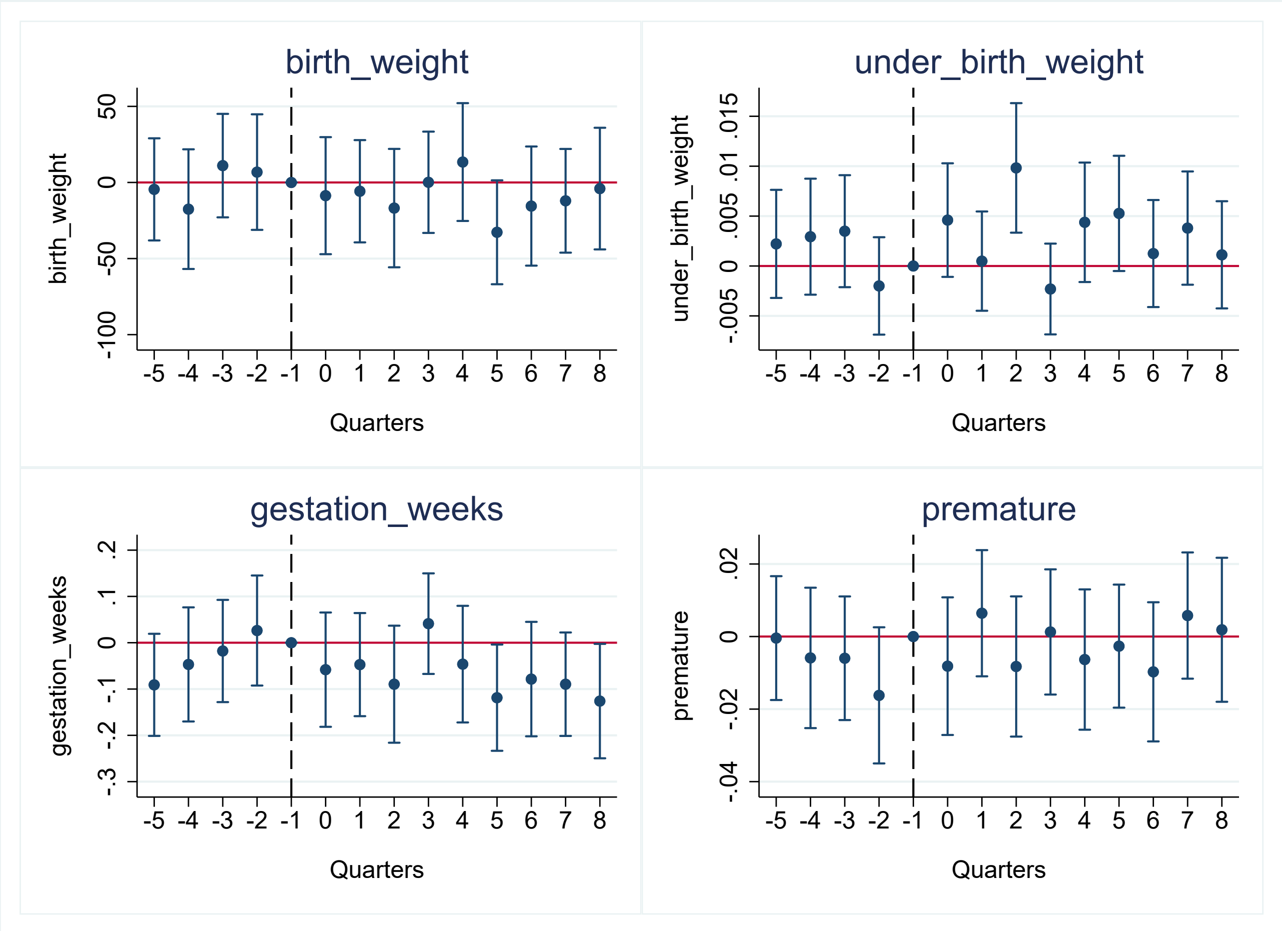
Source: RUCAF, CNV y MSP.
Each point in the graph identifies the estimated coefficient accompanied by a 90% confidence interval. If the interval crosses zero, it implies that the coefficient is not statistically different from zero. This result is based on the sample of women who attended public hospitals between 15 and 24 years old. Results of quarterly dynamic event study with region and quarter fixed effects. Balanced panel. Robust standard errors.

Figure A.4: Quarterly effects for different births outcomes: women between 15 and 19 years old



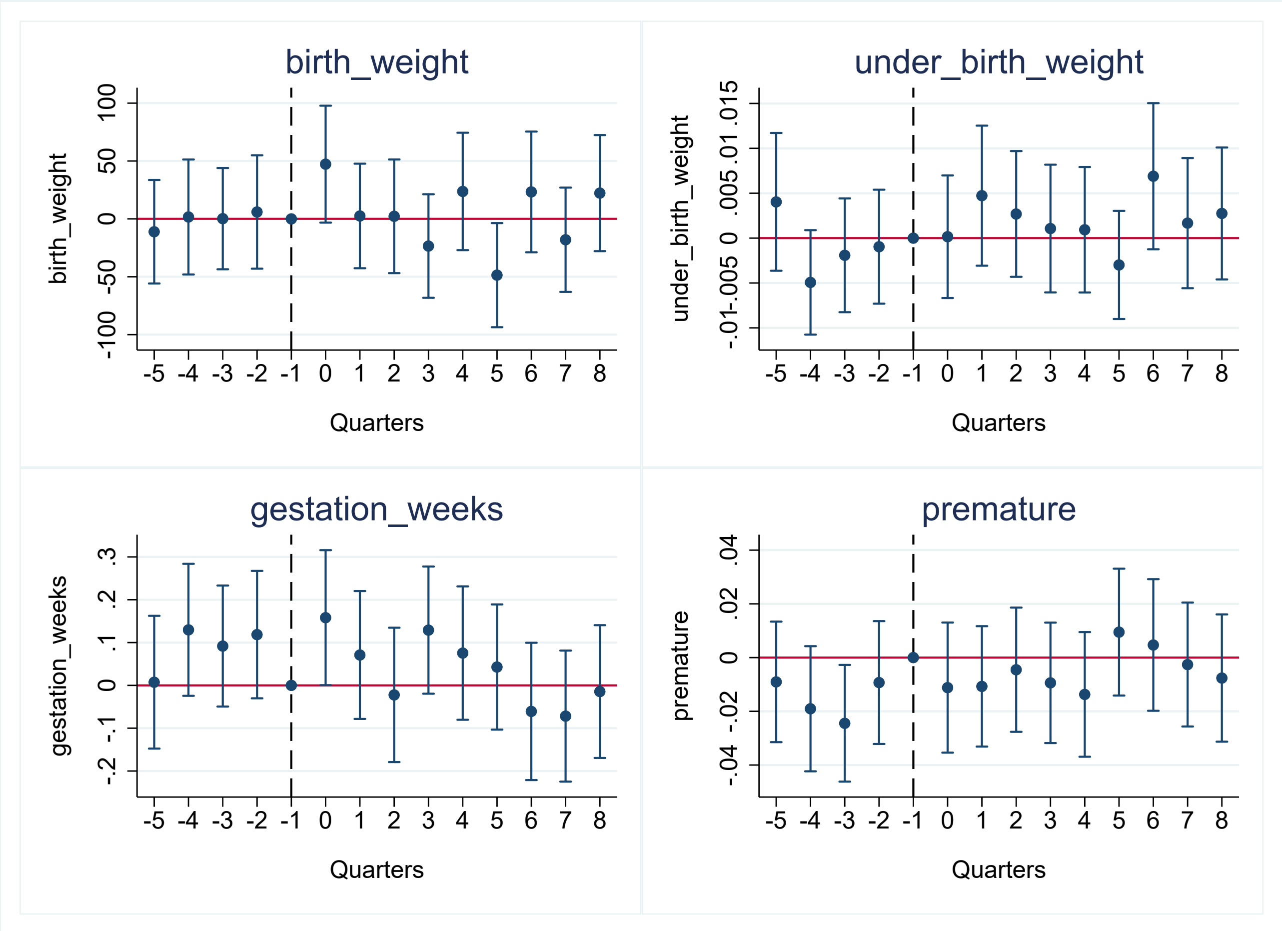
Source: CNV.
Each point in the graph identifies the estimated coefficient accompanied by a 90% confidence interval. If the interval crosses zero, it implies that the coefficient is not statistically different from zero. Results of dynamic study of quarterly event with fixed effects by department and quarter. We consider only births to women between 15 and 19 years old and in public hospitals. Robust standard errors.

Figure A.5: Quarterly effects for different births outcomes: women between 20 and 24 years old



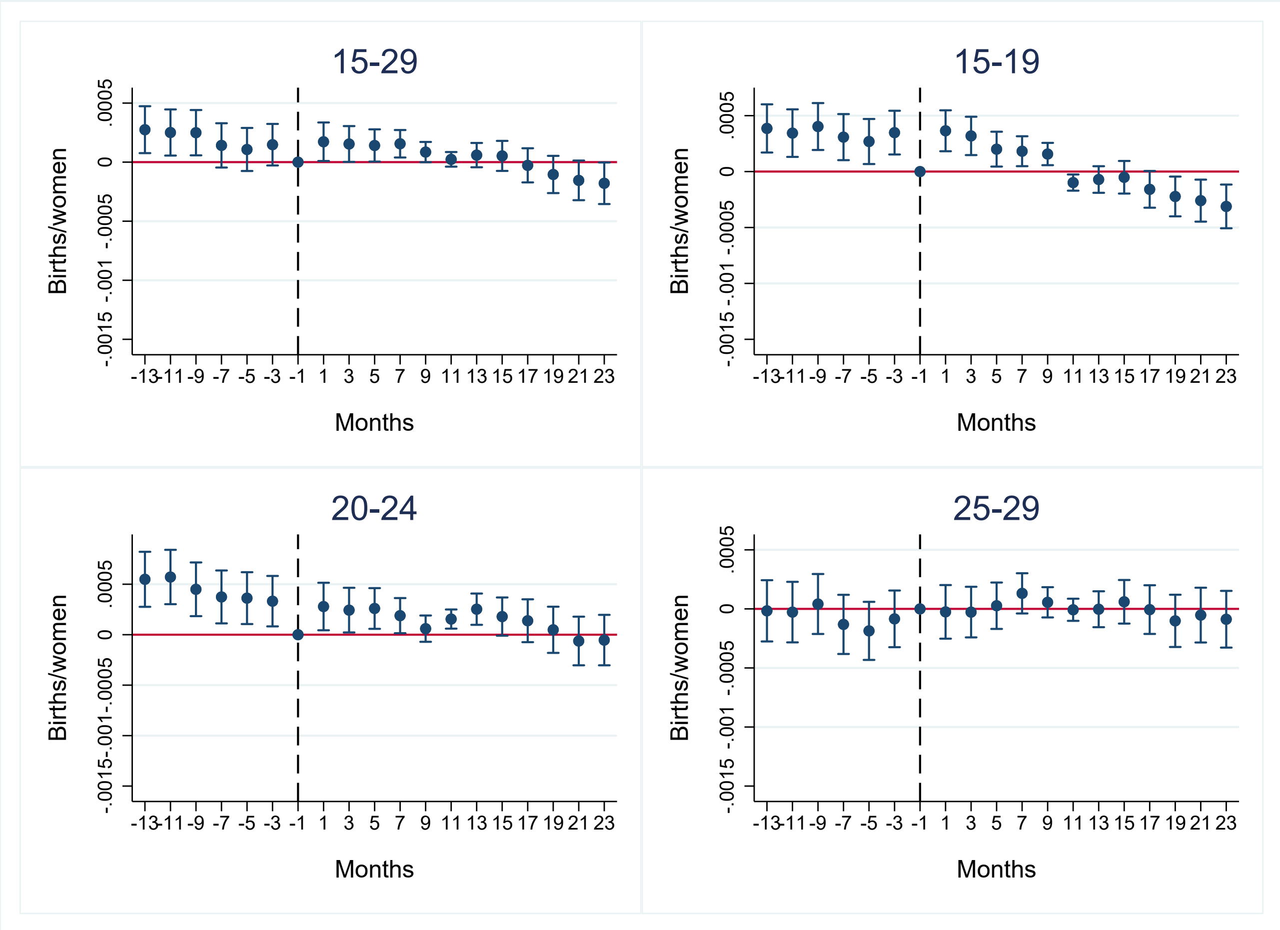
Source: CNV.
Each point in the graph identifies the estimated coefficient accompanied by a 90% confidence interval. If the interval crosses zero, it implies that the coefficient is not statistically different from zero. Results of dynamic study of quarterly event with fixed effects by department and quarter. We consider only births to women between 20 and 24 years old and in public hospitals. Robust standard errors.

Figure A.6: Quarterly effects for different births outcomes: women between 25 and 29 years old



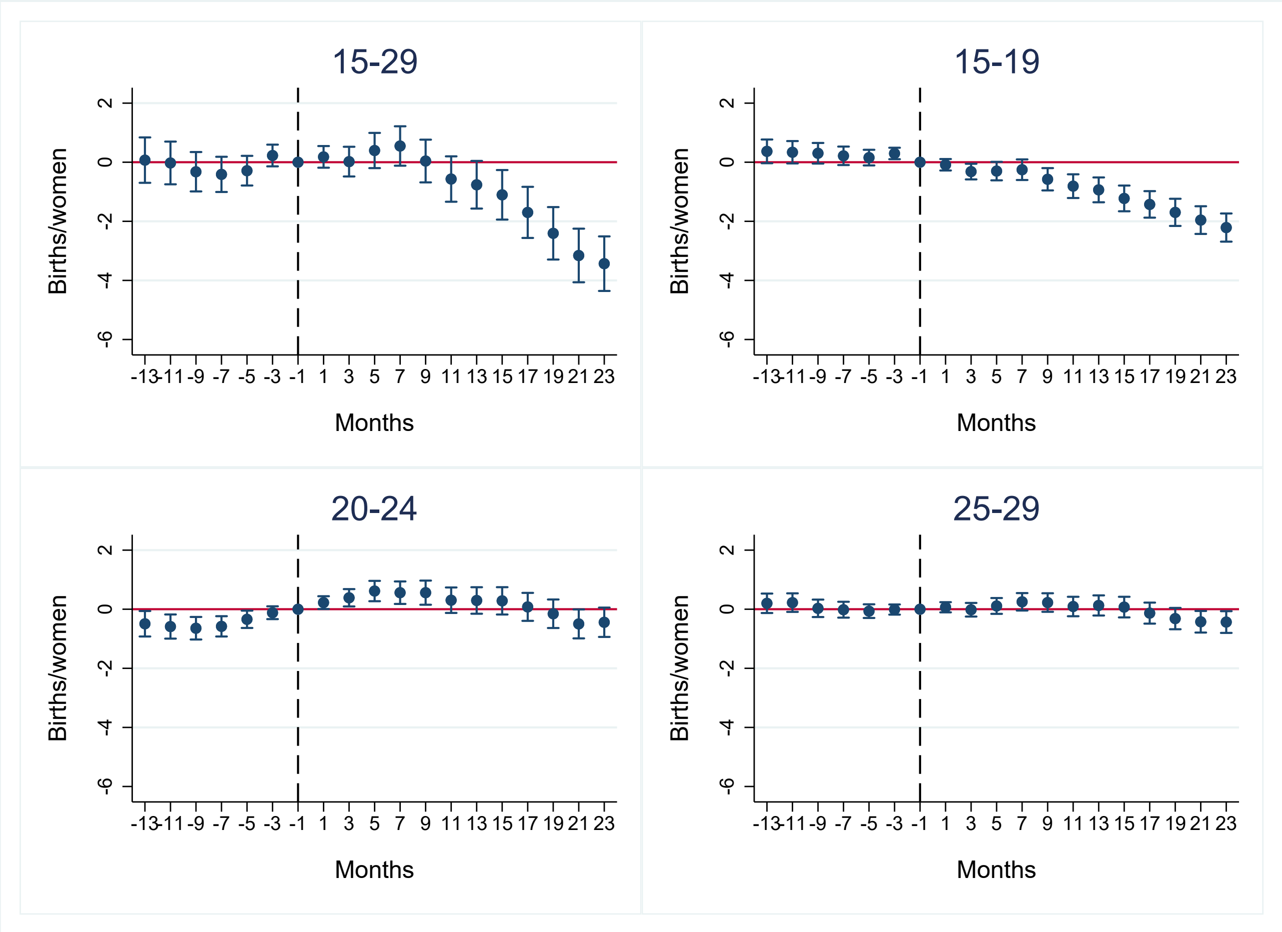
Source: CNV.
Each point in the graph identifies the estimated coefficient accompanied by a 90% confidence interval. If the interval crosses zero, it implies that the coefficient is not statistically different from zero. Results of dynamic study of quarterly event with fixed effects by department and quarter. We consider only births to women between 25 and 29 years old and in public hospitals. Robust standard errors.

Figure A.7: Monthly births effects for different age groups of women when policy reaches 5% of users



Source: RUCAF, CNV and MSP.
Each point in the graph identifies the estimated coefficient accompanied by a 90% confidence interval. If the interval crosses zero, it implies that the coefficient is not statistically different from zero. Results of dynamic study of monthly event with fixed effects by department. We consider only births in public hospitals. Heteroskedasticity across panels and autocorrelation within panels.

Figure A.8: Monthly births effects for different age groups of women considering gross births



Source: RUCAF, CNV and MSP.
Each point in the graph identifies the estimated coefficient accompanied by a 90% confidence interval. If the interval crosses zero, it implies that the coefficient is not statistically different from zero. Results of dynamic study of monthly event with fixed effects by department. We consider only births in public hospitals. Heteroskedasticity across panels and autocorrelation within panels.