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Access to the Emergency Contraceptive Pill and Women's Reproductive Health: Evidence From Public Reform in Chile

Damian Clarke and Viviana Salinas

ABSTRACT We examine the sharp expansion in availability of the emergency contraceptive pill in Chile following legalized access through municipal public health care centers. We study the period 2002–2016 and a broad rollout of the emergency contraceptive pill occurring between 2008 and 2011. By combining a number of administrative data sets on health outcomes and pharmaceutical use, and using event-study and difference-in-differences methods, we document that this expansion improved certain classes of women's reproductive health outcomes, notably reducing rates of abortion-related morbidity. These improvements were greater in areas of the country where the rollout of the emergency contraceptive pill was more extensive. We also document some evidence that refusal to provide the emergency contraceptive pill upon a women's request was linked with a worsening in reproductive health outcomes. These results point to the importance of contraceptive access as a determinant of women's reproductive health and well-being and relates to a growing body of work documenting the importance of women's autonomy as a determinant of health.

KEYWORDS Emergency contraceptives • Maternal morbidity • Abortion • Event studies • Public health

Introduction

This study examines whether publicly subsidized access to the emergency contraceptive (EC) pill can impact maternal health. Contraceptive use has been linked with an improvement in maternal health indicators, at least when considering survival (Cleland et al. 2012; Stover and Ross 2010).[1] Bongaarts and Westoff (2000) had proposed that increasing contraceptive use could reduce abortion incidence, an idea that more recently has been supported by the work of Miller and Valente (2016), who point to modern contraceptives acting as substitutes for abortion. In addition, there

[1] Maternal mortality has received considerably more attention in the literature (Loudon 1992) than maternal morbidity and is often referred to as the "tip of the iceberg." For every woman who dies from causes related to childbirth, 20–30 more experience events that induce chronic morbidity with ongoing sequelae (Firoz et al. 2013; Reichenheim et al. 2009). In this study, we focus principally on morbidity outcomes.

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is clear evidence that unsafe abortion significantly impacts maternal health and survival (Ganatra et al. 2017; Grimes et al. 2006; Say et al. 2014), as well as evidence in the medical literature that abortive agents bought on the black market[2] are used in the absence of legal alternatives (see Grimes et al. 2006). Thus, a causal chain could plausibly exist: the availability of the EC pill reduces clandestine abortions, which in turn improves health outcomes.

To empirically test for a link between EC pill access and maternal health, we focus on the sharp expansion in availability of the EC pill in Chile over the first two decades of the twenty-first century. We seek to determine whether this availability resulted in reductions in key maternal morbidity events by examining legislative reform that made the EC pill available for free to any women enrolled in the public health system. During the entire study period, abortion was completely illegal in Chile, and our working hypothesis is that EC provides an alternative postcoital contraceptive option for women, potentially allowing them to avoid clandestine and unsafe abortions. In line with this, our key maternal health measures are those caused by unsafe abortion—in particular, inpatient visits classified as abortion-related morbidity. We also discuss the impact on other outcomes such as hemorrhage in early pregnancy. We focus on the large number of nonmortal hospital visits (i.e., morbidity), although we additionally document effects on mortality.

Although we aim to continue a line of research that considers the impact of modern contraceptives on women's health, to our knowledge, this study is the first to examine the impact of access to the EC pill on maternal health. We take advantage of universal microdata on full inpatient visits, as well as variation in the availability of the EC pill over time by municipalities within Chile, to provide a credible estimate of the impact of the EC pill. Using recent advances in difference-in-differences models and event-study methods, we can control for all fixed characteristics at the level of municipalities and time, while also controlling for additional potential confounders, namely, political characteristics of each municipality and availability of other contraceptives. Our estimates suggest that when the EC pill became available, municipalities that disbursed it saw improvements in maternal health outcomes (specifically, abortion-related morbidity) compared with municipalities that had not yet provided the EC pill. We observe that this effect is most marked in municipalities where there was particularly high demand for and provision of the EC pill. We additionally observe some suggestive evidence of the opposite result when EC requests are refused: conditional on fixed municipal and time characteristics, abortion-related morbidity is higher when a municipality denies requests for the EC pill.

The rollout of the EC pill in the Chilean public health system was notable, given that there was subnational variation in availability over several years and an absence of alternative legal[3] postcoital reproductive-control outcomes in the country. This article joins a small number of studies that have examined the EC pill in Chile, including recent work by Nuevo-Chiquero and Pino (2019) that considerably updated and extended earlier

[2] Agents may also be bought over the counter in the case of misoprostol, which is used to treat stomach ulcers but has an off-label use of inducing abortion in pregnant women.

[3] We note that the absence of legal options does not imply a lack of informal access to abortion. The work of Drovetta (2015) and Palma Manríquez et al. (2018) provides detail about access to medical abortion and information about this procedure in Chile during the study period. We return to discuss how this interacts with our estimation strategy and results in subsequent sections.

work of Bentancor and Clarke (2017), as well as a number of studies that examined the EC pill's impact in the United States, United Kingdom, and other countries (Durrance 2013; Girma and Paton 2006, 2011; Gross et al. 2014; Hu et al. 2005; Moreau et al. 2009; Mulligan 2015). These earlier studies have not analyzed maternal morbidity, however, and instead have focused on the impact of the EC pill on fertility rates, abortion rates, rates of unplanned pregnancy, and the prevalence of sexually transmitted infections.

In the following sections, we provide some background on the nature of the expansion of the EC pill in Chile, and then describe the various sources of administrative data used in this study and the estimation methodology, before presenting the results and a brief discussion.

The EC Pill and Its Rollout in Chile

The EC pill is a postcoital contraceptive that can be taken following unprotected sexual intercourse to reduce the likelihood of conception (von Hertzen et al. 2002). In Chile, the rollout of the EC pill followed a lengthy legislative process that resulted in periods of subnational (municipal) variation in availability of the medication. Abortion was illegal in Chile for the entire period of interest of this study, being legalized in 2017 in cases involving three limited circumstances.[4] A full discussion of the rollout is provided in Casas Becerra (2008), Nuevo-Chiquero and Pino (2019), and Bentancor and Clarke (2017) (whose empirical strategies we broadly follow). Here, we provide a brief overview of the rollout and the way this interacts with our identification strategy. Interested readers are directed to the online Appendix B, or the aforementioned references, where fuller details are available.

Until 2008, the EC pill was completely unavailable in Chile, or available for only short windows and in limited cases (e.g., rape). A 2008 legal decision implied that mayors in each of the country's 346 municipalities could dictate whether the EC pill could be made available at local primary care clinics (Dides et al. 2009; Dides et al. 2010; Dides et al. 2011). There were subsequent legal challenges to EC pill availability, but in practice, about half of Chilean municipalities reported disbursing the EC pill in the years following the 2008 decision, with the remainder either not providing it or doing so in only very restricted circumstances. This municipal variation in EC pill availability lasted for around three years, during which time there were several legal decisions that gradually opened access to the EC pill to the entire country. For the sake of our analysis, we consider 2009–2011 to be the period of considerable municipality-level variation in EC pill availability. This period ended with the passage of national law 20533, which modified the sanitary code to allow midwives to provide the EC pill.

The fact that midwives were explicitly allowed to provide the EC pill is important given that all provision through the Chilean public health system involves midwives. The EC pill is completely free through Chile's public health system; women are simply required to request the medication at their local primary care clinic. To do so,

[4] A discussion of induced abortion in Chile over this period is provided by Prada and Ball (2016). This report cites figures suggesting anywhere between 60,000 and 300,000 clandestine abortions each year and highlights that there have been few changes in the methods of clandestine abortion used since 1990, apart from the growing use of misoprostol.

they must make an appointment with a midwife at the clinic, because midwives[5] are indicated by law as being responsible for providing sexual health advice and contraceptive access (Congreso Nacional de Chile 2010). The same procedure is necessary to request any publicly provided contraceptive method, including condoms, oral contraceptive pills, or injectable contraceptives (all also provided free).

Since 2011, according to the National Norms of Fertility, all midwives are obliged to provide the EC pill upon request, provided that the sexual encounter occurred within the last five days.[6] Prior to the laws clarifying access (discussed in the online Appendix B), requests were frequently rejected in line with the mayor's decision whether to provide the EC pill in the municipality (Casas Becerra 2008). Subsequently, the only requirement for request is that women should be enrolled in the public health system and associated with a health center in the municipality. In Chile in the period under study, around three quarters of all women of reproductive age were enrolled in the public health system.[7] For the remaining quarter of women with private insurance, access to the EC pill required a prescription and could be purchased in a pharmacy for about US$18 (Casas Becerra 2008). To our knowledge, comprehensive data on private provision of the EC are not available, though anecdotal evidence suggests limited availability in pharmacies around 2008–2009 (Congreso Nacional de Chile 2010:45). It is important to note that while our aim here is to assess the impact of the free public provision of the EC pill, the legal findings do affect private access to the EC pill through pharmacies, as the initial legal finding clarified that pharmacies could, if desired, provide the EC pill (Nuevo-Chiquero and Pino 2019:5).

Data and Methods

Data

We construct a municipality × year data set based on various sources of administrative health records and measures of EC pill availability. We include a number of time-varying controls to capture potential determinants of municipal-level rollout.[8] Our data cover the 15-year period of 2002–2016, which comprises (1) the pre–EC pill period of 2002–2008 used as a baseline; (2) the rollout period of 2009–2011, for

[5] These are known as *matronas/matrones* and play a key role in the provision of reproductive health and contraceptive advice (see Baba et al. (2020) for discussion).

[6] The contents of these norms were confirmed in a structured interview with a midwife.

[7] For example, in 2010, figures from FONASA, the public health insurance system, show there were 3,507,325 women enrolled, and figures from the National Institute of Statistics of Chile estimate the total population of women of reproductive age at 4,574,965. This suggests that 76.7% of women of reproductive age are enrolled in the public health system. On average, users of the public health system in Chile have a lower income, though the system is widely used across income quintiles (Frenz et al. 2013). All costs related to childbirth and prenatal care are covered by the public health system, with users not required to cover out-of-pocket costs, provided they are enrolled in FONASA.

[8] The municipal determinants of the decision to provide the EC pill have been discussed in Bentancor and Clarke (2017). Among a large number of variables considered, EC pill provision was only robustly correlated with mayoral party, with provision less likely where mayors represented "conservative" parties. As we discuss in the Methods subsection, our estimates do not rely on mayor characteristics being unrelated to the decision to provide the EC pill, but they must not be systematically related to when the EC pill was made available or to other investments in maternal health.

which we can measure municipal-level variation in availability; and (3) the full supply period of 2012–2016. In both the "rollout" and "full supply" periods, we observe the number of EC pills disbursed by the Chilean public health system.

Measures of Maternal Health

Our object of interest, maternal morbidity, is measured by two outcomes: the rate of abortion-related morbidity and the rate of hemorrhage early in pregnancy (number of cases per 1,000 women of reproductive age, defined as ages 15–49 inclusive). Abortion-related causes are often examined in the wider literature when considering the impacts of unsafe abortion, and they include all forms of morbidity classified as one of the ICD-10 codes O02–O08 (e.g., spontaneous abortion and complications following induced terminations). This coding is provided in Singh and Maddow Zimet (2016). Second, we consider "hemorrhage prior to 20 weeks of gestation" (IDC-10 code O20). This outcome is of interest (1) given its importance as one of the major complications of unsafe abortions (Gerdts et al. 2013; World Health Organization 2018) and (2) given that it may plausibly be related to the arrival of the EC pill, because of the widespread use of misoprostol in clandestine abortions prior to the availability of the EC pill in Chile. Discussions of the relationship between misoprostol use, clandestine abortion, and hemorrhage are provided in Clarke and Mühlrad (2020), Grimes et al. (2006), and Pourette et al. (2018). The key potential mechanism of action is that safe EC pill usage may crowd out unsupervised and potentially unsafe use of misoprostol, which can result in severe bleeding. Estimates from the medical literature suggest that 22% of deaths due to hemorrhage in the first trimester are caused by abortion (Haeri and Dildy 2012) (similar values are not reported for nonmortal complications), lending plausibility to this suggested link. We generate municipality-level rates of these events from high-quality microdata registers recording all inpatient hospitalizations in the country (in both public and private systems), which are available for 2001–2017. These records consist of an observation for each inpatient stay and include a limited number of covariates, such as patient's sex and age, the ICD-10 code registering the reason for the stay, and the date of entry and exit.[9] Although we capture any hospitalization using this data, we will *not* observe any ambulatory visits to primary care clinics. In general, these visits will be far less serious. It is important, however, to note that all estimates in this study do not account for these cases.[10]

Measures of EC Pill Rollout and Usage

We generate two measures of rollout and usage of the EC pill in Chile, which is our principal independent variable of interest. For the rollout, our first indicator is a

[9] We observe the universe of 26.2 million hospital visits occurring over this period, 99.74% of which are correctly matched to the municipality of residence of the patient. Unfortunately, these data do not include richer covariates, such as religion or ethnicity.

[10] Although we do not have access to microdata for ambulatory visits, macrolevel information shows that there are many such visits in the country each year. For example, nationwide in 2016, there were 755,547 ambulatory visits classified as gynecological checkups, compared with 299,855 hospitalizations

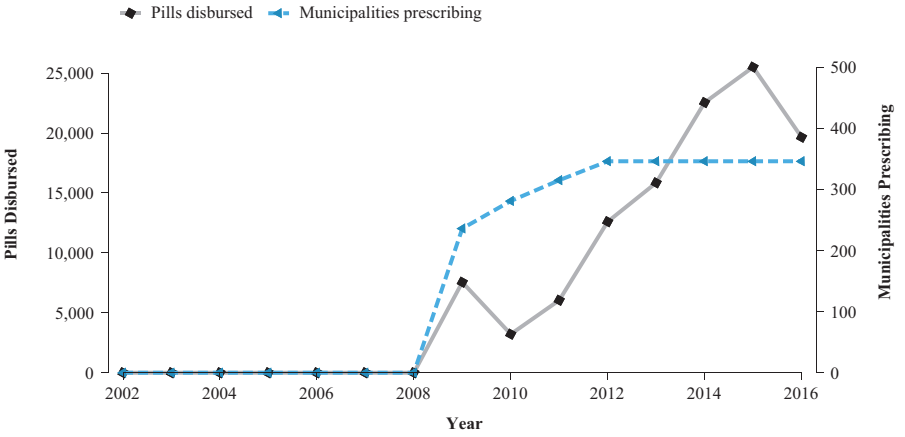

Fig. 1 The rollout of the EC pill in Chile. Administrative data on pill disbursements were obtained from the full Monthly Health Statistics (Resúmen de Estadísticas Mensuales) of the Chilean Ministry of Health; these values were provided in a series of disaggregated online ledgers. Ledgers were transcribed to create a consistent municipal-level register of all EC pills disbursed. A research assistant first transcribed data by hand, and a full audit of the transcription was then conducted; discrepancies were found and corrected in 0.29% of cases.

dummy variable derived from a series of telephone surveys conducted between 2009 and 2011 (Dides et al. 2009; Dides et al. 2010; Dides et al. 2011). In these surveys, local health centers in each municipality were asked whether they prescribe the EC pill and under what circumstances. If the centers responded that they do, the municipality is classified as providing EC. If they reported that they do not or that they only provide it in the limited case of rape, then they are classified as nonpill municipalities. Second, for measuring intensity of use, we generate a rate of pill disbursements and a rate of pill rejections, by harmonizing previously unused administrative data provided by the ministry of health. In the case of rejected pill requests, these began being recorded only in 2010, so data on this are not observed in 2009. Figure 1 shows the number of municipalities recorded to allow EC pill disbursement and the actual disbursements according to ministry of health data. In Table A1 of the online appendix, we document that these sources are in general agreement. We note that in a small number of cases, municipalities that report in telephone surveys that they do not provide the EC pill actually do. In these cases, we update the measure of availability such that these municipalities are correctly recorded as allowing the EC pill.

Other Municipal-Level Records

Finally, we collected or generated several other data sources at the municipal × year level. These are (1) the population of women of reproductive age (provided by the

for reasons related to maternal health. Thus, our microdata capture only one (important) margin of health care utilization. It is worth noting that for both principal morbidity outcomes (hemorrhage and abortion-related causes), a large majority of cases would be expected to be treated in hospital, as laid out in the government's technical treatment guidelines (Ministerio de Salud 2011).

National Statistical Institute); (2) the identity, sex, and party of each municipal mayor and his/her vote share (from the Electoral Service); and (3) administrative records on all other contraceptive disbursements through the public health service, and placebo health outcomes generated from the same administrative health records (male morbidity, and morbidities in the puerperium period).

We combined these data sources into a data set of Chile's 346 municipalities over 15 years, or 5,190 observations/registers. A small number of observations have missing measures in certain periods. In particular, our measure of EC pill availability has 103 missing observations for years in which municipalities did not provide information on their pill disbursement status. Similarly, the measure of refused pills is not available for 2009. We document summary statistics in the following section.

Methods

We exploit the staggered arrival of the EC pill to different municipalities by estimating the following panel event-study specification:

$$Health_{ct} = \alpha_0 + \Sigma_{j=-8}^{9} \delta_{-j} \Delta \text{EC Pill}_{c,t+j} + X'_{ct}\,\Gamma + \phi_c + \mu_t + \varepsilon_{ct}. \quad (1)$$

Here we follow the notation of Freyaldenhoven et al. (2018), where $\delta_{-1} = 0$, so that our reference period is one year prior to adoption in each municipality. We are interested in the nine yearly leads and eight yearly lags of the policy change, where leads capture any prevailing trends prior to the reform in earlier versus later adopting municipalities, and lags show the change in health outcomes following EC pill availability. Given variation in reform timing, initial leads and lags capture differences in treatment status (treated vs. untreated), while later periods capture pure variation in timing. Year and municipal fixed effects μ_t and φ_c absorb time and municipal invariant factors, and standard errors are clustered by Chile's 346 municipalities. As well as capturing any dynamic impacts of the reform (e.g., growing knowledge diffusion), specification (1) provides evidence in favor of parallel (pre)trends if we can reject that each $\delta_j = 0 \; \forall \; j < 0$, given that *prior* to the reform, outcomes in both treated and untreated municipalities were following similar tendencies.

$Health_{ct}$ refers to average rates of morbidity and EC $\text{Pill}_{c,t}$ refers to the availability of the EC pill in municipality c at time t. We include time-varying controls $X_{c,t}$ capturing sociopolitical characteristics of each municipality, as laid out in the Data subsection, although we also show specifications without controls. Observations are consistently weighted by population.[11] It is important to note that in all cases, EC Pill refers to free provision by the public health system. In Chile, following the passage of the EC pill laws, the pill was also sold at private pharmacies. Unlike public data, official data on EC pill usage in the private system are not available (Fernández et al. 2016). Thus, all estimates refer to the impact of the public reform. Although we cannot formally assess the impact of private market provision without data on disbursements, if private provision fills gaps not met by the public health system "spilling

[11] We do, however, document unweighted results, but our preferred estimates always weight by population to ensure that estimates are not driven by municipalities with very few hospitalizations where small total shifts can result in very large proportional changes.

over" to areas not yet treated by the public system, our estimates will understate the actual full effect of EC pill availability (Clarke 2019).

Panel event-study models such as those in Eq. (1) have significant advantages over standard parametric single-coefficient, two-way fixed-effects models of the following form:

$$Health_{ct} = \alpha + \beta \text{EC Pill}_{ct} + X'_{ct}\Gamma + \phi_c + \mu_t + \varepsilon_{ct}, \tag{2}$$

where EC Pill$_{ct}$ is a binary variable indicating that the EC pill is available in municipality c and time t. Specifically, such models take care of recent critiques that single-coefficient models may be biased if effects are heterogeneous over time (Goodman-Bacon 2018). However, recent advances by de Chaisemartin and D'Haultfoeuille (2020) propose an estimator to avoid issues relating to heterogeneous impacts over time and time-varying adoption of policies. We thus follow their proposed DID_M estimator in line with Eq. (2) (full details of this method are included in the online Appendix C).[12] This estimator consists of comparing outcomes between all units that change their EC pill status with those that have not yet changed, around the time that the policy change occurs. This is implemented following de Chaisemartin et al. (2019), where we can observe both immediate changes and changes over the following two years given the variation in treatment adoption. In addition, we estimate mirrored leads as placebo tests, which implement the same comparisons between changing and unchanging units, but in periods entirely before treatment is adopted. Besides allowing for a single summary estimate, this method offers the benefit that all identification is drawn off the time period in which the staggered adoption of the EC pill occurred. We consistently conduct inference using a block-bootstrap procedure allowing for within-municipality correlations over time. We also explore one specification where EC Pill$_{ct}$ is replaced with Pill Rejected$_{ct}$, indicating whether each municipality *refused* to disburse requested EC pills in a given year.

Finally, we propose a series of models to take advantage of the *intensity of use* of the EC pill. The first is a fully interacted event-study specification in which we reestimate Eq. (1), however, we now estimate a series of lags and leads for three municipality types (low/medium/high intensity) based on terciles of EC pill disbursements from official ministry of health disbursement data, specifically,

$$Health_{ct} = \alpha_0 + \Sigma_{i=1}^{3}\Sigma_{j=-8}^{9}\delta_{i,-j}\Delta\left(\text{EC Pill}_{c,t+j} \times \text{Pill Intensity} = i\right) + X'_{ct}\Gamma + \phi_c + \mu_t + \varepsilon_{ct}, \tag{3}$$

where all details follow Eq. (1), yet we now stratify by municipal treatment intensity (indexed with i here). Controls X'_{ct} are included separately for each tercile exposure group.[13] This model extends Eq. (1) to examine whether any health impacts are larger in areas with more intensive usage of the EC pill. Note that here we are simply breaking down average impacts into intensity-specific groups in a single model, allowing for treatment heterogeneity where groups are constant over time. Here, heterogeneity is

[12] We acknowledge an anonymous referee for suggesting this strategy.

[13] The separation into terciles of intensity of EC pill usage is an arbitrary choice. We could present alternative groups; however, this complicates the presentation of results and challenges statistical power, and so we limit results here to three policy-specific exposure groups.

determined by intensity of policy adoption. Such models documenting heterogeneity in a difference-in-differences setting are frequently estimated; see, for example, Bhalotra and Venkataramani (2015) (by race/age) and Myers and Ladd (2020) (by exposure time). Finally, for completeness, we document effects based on a single-coefficient, two-way fixed-effects model, in which the EC Pill indicator from Eq. (2) is replaced with a measure of the rate of pill disbursement in a given municipality per 1,000 women:

$$Health_{ct} = \alpha + \beta \text{Pill Disbursements}_{ct} + X'_{ct}\Gamma + \phi_c + \mu_t + \varepsilon_{ct}. \quad (4)$$

Here, once again, any municipal-specific or time-specific factors are captured by respective fixed effects, and β captures the intensive margin impact of EC pill availability. As in the case of Eq. (2), rather than estimate this model using ordinary least squares, we follow the de Chaisemartin and D'Haultfoeuille (2020) DID_M procedure, in which we also consider one specification where Pill Disbursements$_{ct}$ is replaced by Pill Rejections$_{ct}$ to consider the (extensive margin) impact of rejected EC pill requests. Additional details related to estimation are provided in the online Appendix C.

Results

Descriptive Statistics

Figure 2 presents descriptive plots of the two principal health outcomes over time.[14] Abortion-related morbidity (panel a) shows a slight downward trend from 2002 to 2007, but a clear and sharp reduction following the rollout of the EC pill in 2009. Regarding hemorrhage early in pregnancy (panel b), there is less evidence suggestive of a trend break, with a general reduction in cases observed from 2002 to 2017.

Descriptive statistics of all morbidity and contraceptive measures are provided as municipal-by-year averages in Table 1. We observe that abortion-related morbidity early in pregnancy is considerably more common than hemorrhage, at 5.8 versus 1.4 cases per 1,000 women of reproductive age. The rate of morbidity in the puerperium falls between these two rates, at 3.0 cases per 1,000.[15] On average, each municipality prescribes 22 EC pills per year, though larger municipalities prescribe many more, with a maximum disbursement of 1,029. The number of pills refused is considerably lower, at an average of 2.4 per municipality, though once again, we note that there are municipalities who refuse many requests, with a maximum of 914 per year.

EC Pill Rollout and Morbidity Outcomes

Binary Treatment Measures Capturing EC Rollout

Figure 3 presents main event-study specifications following Eq. (1). We consider a baseline model with time-varying controls, and discuss several alternative specifications—including models without controls—in the following section. Panel a displays

[14] Plots by quinquennial age-group are provided in Figures A1 and A2 in the online appendix.

[15] As discussed later, we will consider this in placebo tests.

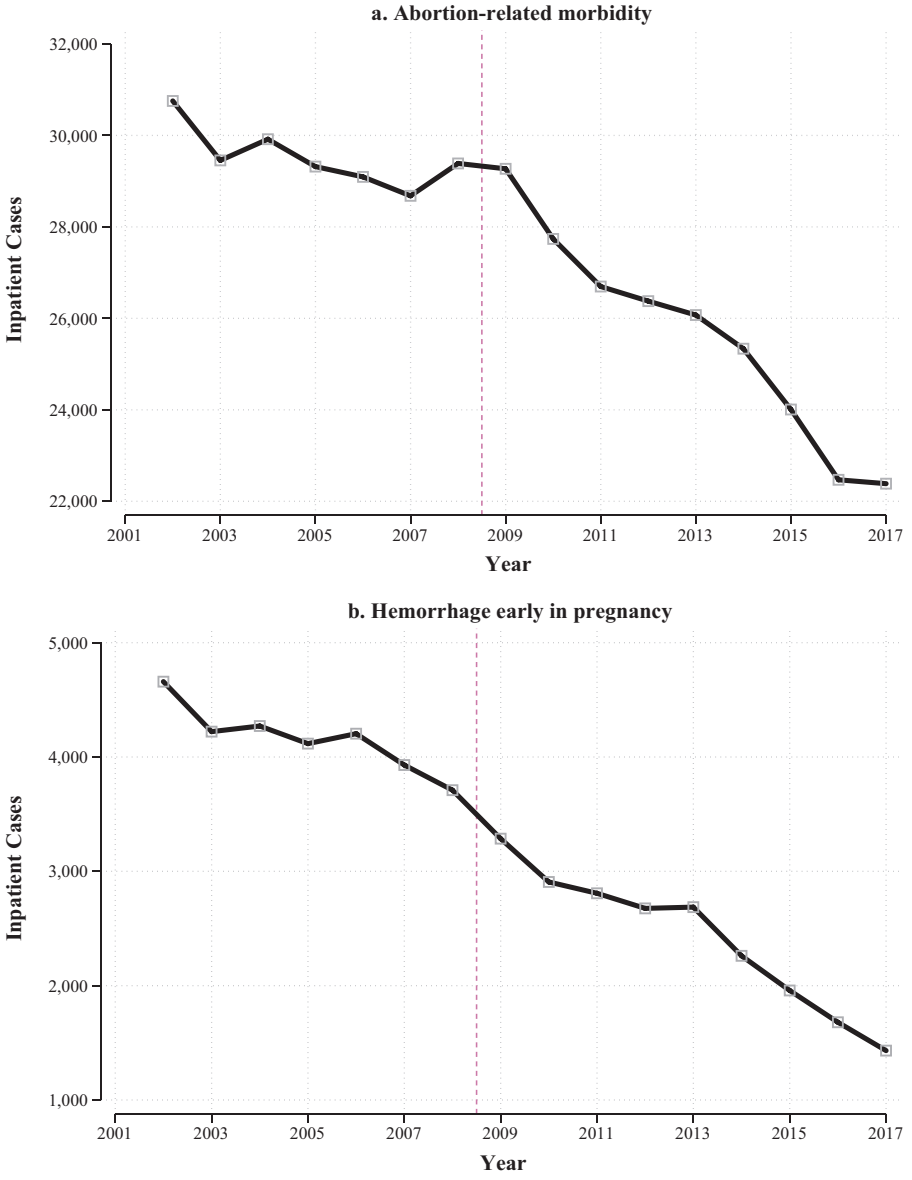

Fig. 2 Trends of abortion-related morbidity and hemorrhage early in pregnancy. All cases were identified from administrative health data on all hospitalizations in the country. Abortion-related morbidity refers to all ICD-10 codes capturing pregnancies with abortive outcomes (O02–O08), and hemorrhage early in pregnancy refers to ICD-10 code O20. Dashed red lines indicate the beginning of the EC rollout.

the event study for rates of abortion-related morbidity. All pre-event pill leads to the left of −1 on the horizontal axis are observed to be close to zero and quite flat, with no significant differences between early and later adopters in the prereform period. In the postreform period, we see a gradual reduction, beginning with a downward movement in the first year of the EC pill's adoption in a given municipality. However, because

Table 1 Summary statistics on morbidity and the availability and provision of the emergency contraceptive pill, among individuals aged 15–49, Chile, 2002–2016

Measure	Observations	Mean	SD	Min.	Max.
No. of Cases of Abortion-Related Morbidity	5,190	79.88	130.93	0	1,037
No. of Cases of Hemorrhage Early in Pregnancy	5,190	9.51	13.22	0	145
No. of Complications Related to the Puerperium	5,170	30.86	50.49	0	1,135
No. of Cases of All-Cause Male Morbidity	5,170	345.93	499.42	0	6,603
Population of Women of Reproductive Age	5,190	13,016.50	21,084.08	10	175,979
Population of Men of Reproductive Age	5,190	13,157.60	20,848.55	68	173,079
Abortion-Related Morbidity per 1,000 Women	5,190	5.81	4.17	0	200
Hemorrhages per 1,000 Women	5,190	1.38	1.87	0	18
Complications Related to the Puerperium per 1,000 Women	5,170	3.00	3.67	0	100
Male Morbidity per 1,000 Men	5,170	30.38	16.53	0	325
Municipality Has Pill Availability	5,190	0.49	0.50	0	1
No. of Pills Disbursed	5,190	21.77	74.58	0	1,029
No. of Pills Refused	4,844	2.43	22.78	0	914
Pills Disbursed per 1,000 Women	5,190	1.92	8.60	0	405
Pill Requests Rejected per 1,000 Women	4,844	0.38	12.55	0	862

Notes: Summary statistics are documented for municipality × year cells, using administrative data on inpatient stays released by the Chilean Ministry of Health and measures of the availability and usage of the emergency contraceptive pill collected by survey and in a municipal health surveillance system. There are 346 municipalities in Chile, so there is a maximum of 346 cells per year. Information on populations is provided by the National Institute of Statistics. As codified in Decree 1671 of the ministry of health, any hospitalizations must be recorded in a standard way; records exist for each visit starting at the administrative point of entry to the hospital, so will capture visits even if they are for less than one day.

the standard errors are quite large, these impacts become significant only around the fourth year post–EC pill adoption. The effect size grows constantly over time, in line with the expanding availability of the EC pill in the country (refer to Tables A2 and A3 in the online appendix). In the first year of EC pill adoption, the point estimate suggests 0.2 fewer cases of abortion-related morbidity per 1,000 women, growing to one fewer case per 1,000 women four years post adoption and slightly more than two fewer cases eight years post adoption.

In panel b of Figure 3, we present results for rates of hemorrhage early in pregnancy, observing no statistically significant change post–EC pill reform. This suggests that health improvements owing to EC pill availability in this context are because of fewer observed cases of abortion-related morbidity in hospitals, rather than a fall in cases classified as hemorrhage early in pregnancy.[16] Although, in general, our preferred specifications are weighted based on the population of women in each municipality, we present unweighted specifications in Figure A3 of the online appendix and observe similar patterns in the case of abortion-related morbidity (a reduction post–EC pill rollout) but with slightly wider confidence intervals and a slight reduction in the case of hemorrhage early in pregnancy when not weighting by

[16] Note from Table 1 that the rate of abortion-related morbidity is more than four times as high as the rate of hemorrhage early in pregnancy.

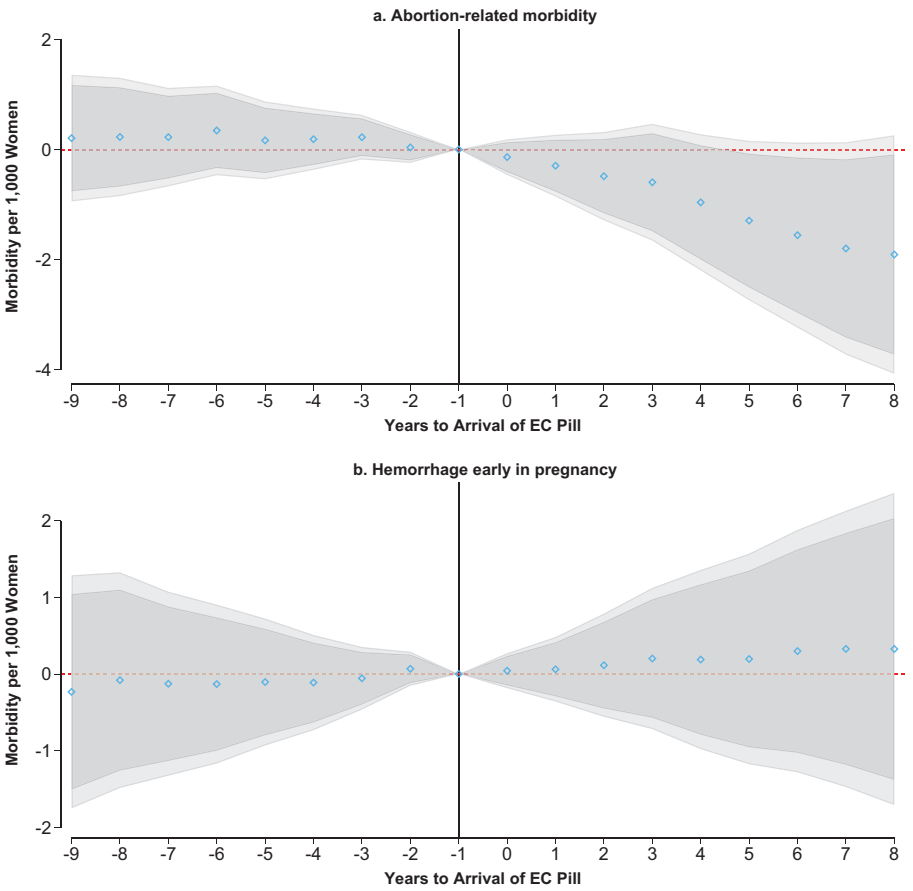

Fig. 3 Event-study tests of the impact of the EC pill on maternal health outcomes. Event studies follow specification (1) and are weighted using the number of women of reproductive age in each municipality; standard errors are clustered by municipality. Unweighted specifications are displayed in Figure A3 in the online appendix. Vertical lines indicate one year prior to the first year in which a municipality disbursed the EC pill. Light and dark shading indicate 95% and 90% CIs, respectively.

the population of women. It is important to note that in the case of hemorrhage early in pregnancy, this is suggestive of impacts observed in smaller municipalities, which receive relatively greater importance in unweighted specifications.

Figure 4 presents alternative DID_M estimates that explicitly contrast municipalities whose EC pill status changes from unavailable to available with municipalities whose EC pill status does not change in the period surrounding the reform. In panels a and c, we present full DID_M dynamic and placebo estimates quantifying the impacts of EC pill availability on abortion-related morbidity and hemorrhage, respectively. Each coefficient compares morbidity rates between municipalities that gained access to the EC pill and those whose status did not change. Pretreatment years (−3, −2, and −1) are placebo estimates given that they compare similar changes in periods *before* the adoption took place. In the case of post treatment lags (0, 1, and 2), estimation

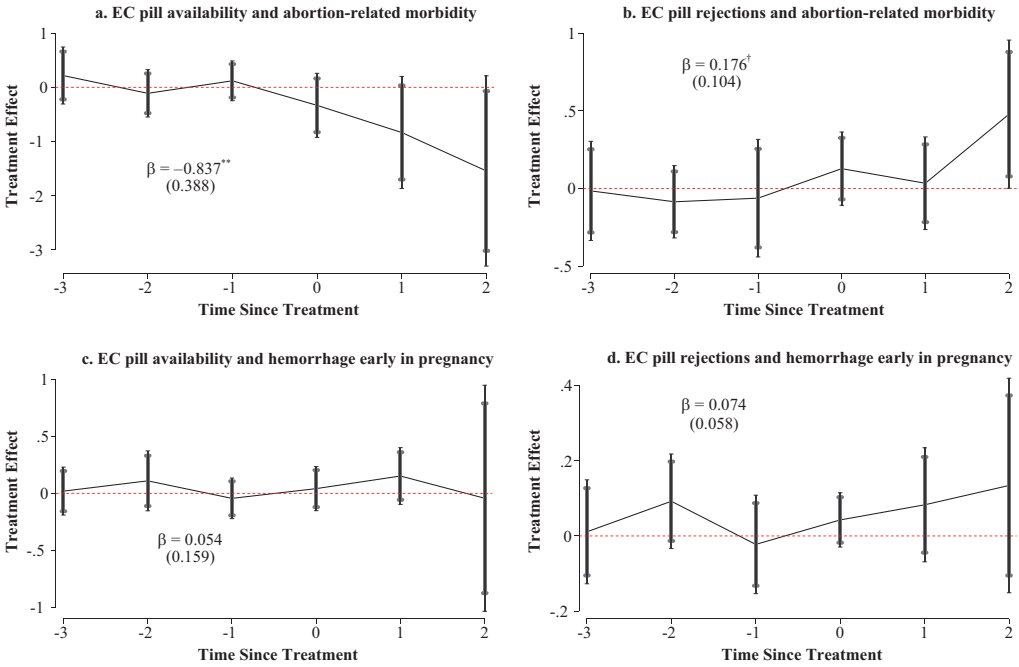

Fig. 4 DID_M estimates of the impact of the EC pill on maternal health outcomes. In all panels, leads −3, −2, and −1 are placebo tests, while lags 0, 1, and 2 are immediate or dynamic effects. The thin black line presents point estimates, the thick gray error bar indicates 90% CIs, and the thinner gray error bar indicates 95% CIs. Panels a and c estimate specification (2) using a binary "EC availability" measure, while panels b and d estimate specification (2) but replace availability with a binary "pill rejected" indicator. All specifications follow de Chaisemartin and D'Haultfoeuille (2020), where flexible year fixed effects and municipal fixed effects are included, along with all control variables described in Figure 3. Inference was conducted using a block-bootstrap by municipality. Global effect sizes for each model (and standard errors in parentheses) are indicated on plots. $^{\dagger}p < .10$; $^{**}p < .01$

is driven by areas in which treatment status remains constant for 1, 2, and 3 years, respectively.[17] For abortion-related morbidity, we observe results that are broadly in line with those documented in event studies. Although preadoption leads are small and centered around zero, an immediate reduction is observed in the year that the EC pill became available, growing to a significant impact of about one fewer case per 1,000 women two years postreform. In this case, the global estimate considering all dynamic leads following de Chaisemartin et al. (2019) is −0.837 fewer cases of abortion per 1,000 women (presented in panel a). Note that this effect is sizable when considering the total number of cases in the population, accounting for slightly more than 12% of inpatient cases relating to abortion in the prereform period. For hemor-

[17] Because identification is drawn entirely by units that *change* treatment status, and changes in treatment status all occur in some period between 2008 and 2011, we cannot estimate greater than three pretreatment and three post treatment indicators.

rhage early in pregnancy, similar patterns are observed to those from event studies, with insignificant placebo and post treatment indicators, once again suggesting no significant change in rates of hemorrhage because of EC pill availability.

In Table A4 of the online appendix, we present total treatment effects for each of these variables (pooling all post treatment indicators) in each quinquennial age-group from 15–19 up to 45–49. Column a presents the global summary of panels a and c of Figure 4. We observe that the global impact of –0.837 in the case of abortion-related morbidity is driven mainly by younger women, with significant impacts among the 15- to 19-year-old population and the 25–29 age-group. In the case of hemorrhage early in pregnancy, in weighted specifications, we observe insignificant estimates across all ages. Table A5 of the appendix presents similar estimates without weighting by municipal populations, and here we observe reductions in abortion-related morbidity and again some evidence suggestive of reductions in hemorrhage when population weights are not applied.

Impact of Rejection of EC Pill Requests on Outcomes

Panels b and d of Figure 4 present data on the role that *rejected* requests for the EC pill play on maternal health outcomes. We employ models identical to those for panels a and c, but rather than considering whether a municipality officially allows EC pill disbursements, we examine the impact of municipalities officially rejecting EC pill requests from women. In the case of abortion-related morbidity, we observe impacts that are opposite to those described based on EC pill *availability*. Where municipalities ever reject EC pill requests, we observe slight increases in the rate of abortion-related morbidity, with a point estimate of 0.176 additional cases in the post-EC period (refer to average estimate presented in panel b). This point estimate accounts for about 3% of the baseline rate of abortion-related morbidity nationwide. In turning to hemorrhage early in pregnancy, a similar effect is observed—0.074 *more* cases following EC pill rejection—but in this case, the effects are not statistically significant.

Combining Binary Treatments With Intensity of EC Pill Usage

Finally, we turn to models that consider the *intensity* of use of the EC pill and the impact of total disbursements on health outcomes. In panel a of Figure 5, we document that high-intensity pill municipalities have the largest reduction in abortion-related morbidity following the introduction of the EC pill. Indeed, when stratifying by the intensity of EC pill rollout, only in this highest intensity group are the effects immediately significant, with point estimates generally being the most negative among all groups. In the first three post–EC pill periods, reductions of 0.8–1.0 fewer cases of abortion-related morbidity are observed per 1,000 women. In medium-intensity areas, significant effects are also observed, though they emerge more gradually, while in low-intensity areas, significant effects are never observed. We replicate these results for hemorrhage early in pregnancy in panel b. In this case, and in line with the fact that we never observe significant impacts in the entire population on rates of hemorrhage early in pregnancy, we observe no significant effects at any point

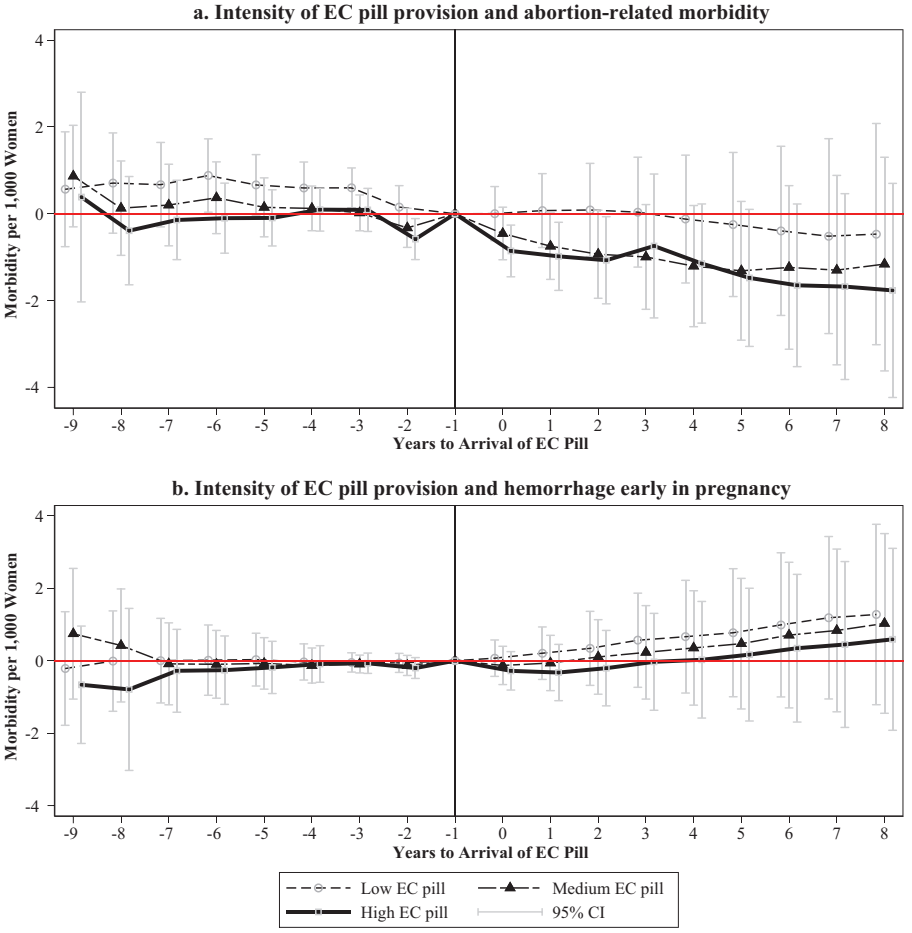

Fig. 5 Event-study tests of the intensity of EC pill provision on maternal health outcomes. Each set of point estimates and 95% confidence intervals refers to the EC pill rollout leads and lags for municipalities with low, medium, and high rates of pill disbursements. These definitions were created using the rate of pill disbursement per municipality, splitting the sample into three evenly sized groups. Coefficients are slightly shifted around the yearly leads and lags to visualize each estimate separately. Vertical lines indicate one year prior to the first year in which a municipality disbursed the EC pill. See Figure 3 for additional details.

(either pre- or post treatment) or in any group—additional evidence suggesting that effects are largely focused on abortion-related morbidity cases.

For completeness, we also present DID_M estimates following Eq. (4) in which our treatment variable is the number of pills disbursed per 1,000 women. Table 2 provides a summary of all DID_M models: for comparison, the binary models discussed earlier (EC pill availability in column 1 and EC pill rejection in column 3), and then using continuous measures (columns 2 and 4). In column 2, we consider the DID_M estimate following de Chaisemartin and D'Haultoeuille (2020) in which instead of a simple binary availability measure, we consider a treatment measure capturing the number of EC pills disbursed per

Table 2 DID_M aggregate estimates and placebo tests for the impact of emergency contraceptive pill availability and pill refusal on abortion-related morbidity and hemorrhage early in pregnancy, using binary and continuous classifications

	Pill Availability		Pill Rejection	
	Model 1	Model 2	Model 3	Model 4
A. Abortion-Related Morbidity				
Binary classification (EC pill)	–0.837**		0.176†	
	(0.388)		(0.104)	
Continuous classification (EC pills per 1,000 women)		–0.062		0.168
		(0.078)		(0.166)
Placebo 1	0.120	0.021	–0.062	–0.045
	(0.187)	(0.098)	(0.193)	(0.110)
Placebo 2	–0.111	0.063	–0.086	–0.044
	(0.223)	(0.115)	(0.119)	(0.111)
Placebo 3	0.218	–0.046	–0.016	–0.016
	(0.268)	(0.095)	(0.163)	(0.200)
No. of observations	5,190	5,190	5,190	5,190
B. Hemorrhage Early in Pregnancy	0.054		0.074	
Binary classification (EC pill)	(0.159)		(0.058)	
Continuous classification (EC pills per 1,000 women)		0.018		0.076
		(0.039)		(0.055)
Placebo 1	–0.044	–0.025	–0.023	–0.012
	(0.091)	(0.034)	(0.067)	(0.031)
Placebo 2	0.110	0.036	0.092	0.068
	(0.134)	(0.032)	(0.064)	(0.062)
Placebo 3	0.020	–0.004	0.011	–0.009
	(0.107)	(0.036)	(0.071)	(0.066)
No. of observations	5,190	5,190	5,190	5,190

Notes: Binary classifications were employed for models 1 and 3 to examine indicators of EC availability or refusal, while continuous classifications were used for models 2 and 4 to examine estimated impacts of the number of pills disbursed or refused per 1,000 women of reproductive age. For other details, see Figure 4 notes. Standard errors are shown in parentheses.

†$p < .10$; **$p < .01$

1,000 women in the municipality. Then, in column 4, we consider a similar model, but rather than EC pill disbursements per 1,000, we use EC pill rejections per 1,000 women.

In column 1 of panel a, we observe the (previously discussed) clear reduction in rates of abortion following EC pill availability. In column 2, we also observe that the point estimate (of −0.062 fewer cases) is suggestive of *larger* reductions in abortion-related morbidity in municipalities with more EC pill disbursements. However, these continuous models are estimated with considerable imprecision, suggesting quite wide confidence intervals that overlap zero. Broadly similar patterns are observed when considering EC pill rejections in columns 3 and 4. There is evidence of a clear and significant (at least at 90%) increase in rates of abortion when municipalities refuse to disburse EC pills, and rates of abortion-related morbidity are estimated to be higher when rates of EC pill rejection are higher, but this latter "continuous" effect is not estimated with sufficient precision to reject a null of no gradient in levels of intensity.

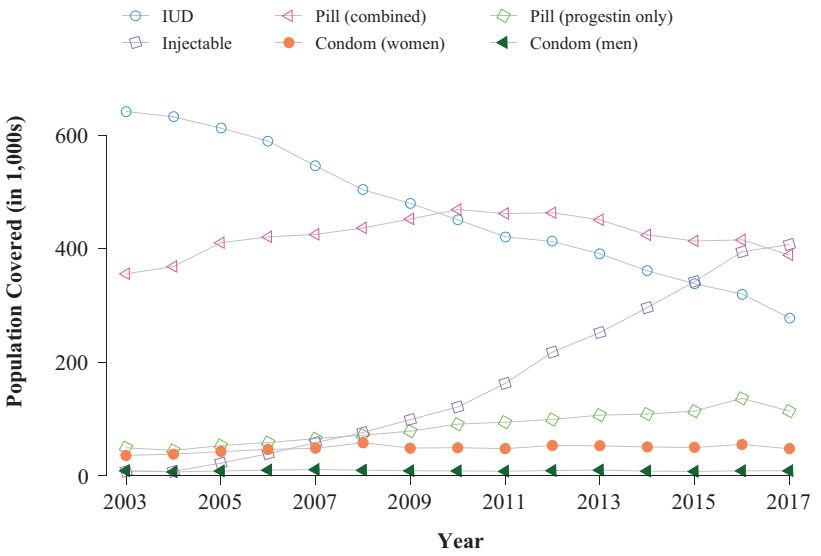

Fig. 6 Coverage of alternative contraceptive methods used in Chile. Administrative data on all contraceptive disbursements provided by the public health system were transcribed (at the health service level) from the full Monthly Health Statistics (Resúmen de Estadísticas Mensuales) of the Chilean Ministry of Health. Data were provided for the copper IUD, the oral pill (both the combined estrogen and progestin pill as well as the progestin-only pill), injectable contraceptives, and condoms (requested by women or men). Trends displayed are for the total population covered by each method in the entirety of the country.

Placebo Outcomes, Alternative Explanations, and Additional Tests

Despite the event-study evidence and lack of pretrends, we are still concerned that these results may be capturing systematic differences in prevailing health outcomes within municipalities. If, for example, at the same time the EC pill was adopted, municipalities engaged in general health-promoting policies or more aggressive contraceptive campaigns, our estimates may capture the effects of these activities, rather than a true EC pill effect. We examine this in several ways. First, in all results presented, we have included controls for a mayor's party, gender, and vote share upon election. Recent work by NuevoChiquero and Pino (2019), which provides a comprehensive analysis of the EC pill rollout and its impacts on contraceptive use, suggests that the EC pill in Chile may have—beyond any direct effect—also had a technological change effect, given that it drove shifts toward more modern contraceptive methods. We have collected and systematized administrative records on the full coverage of contraceptive methods used in Chile for the entire population covered by the public health system. These data include all freely provided contraceptive methods disbursed by the state. In Figure 6, we plot trends in alternative contraceptive methods used in Chile between 2003 and 2017 based on these administrative data. It is interesting to note that there has been a clear and gradual shift in contraceptive methods used within the public health system in the country, in particular, a steady shift away from the copper IUD and toward injectable methods. We have, thus, included

time-varying controls that capture coverage of other modern methods in all the models displayed up to this point in the study.[18]

We do, however, document that our results are not driven by these particular control variables and modeling choices. In Figures A5–A8 of the online appendix, we replicate our analysis of the health impacts of the EC pill unconditional on time-varying controls and observe that, in each case, the documented findings are substantively similar. We also show that the previously documented results are not sensitive to including only political controls (refer to Figures A9–A12 of the online appendix, corresponding to panels a and b of Figures 3 and 5, respectively).

More generally, to provide a test of the idea that these results may be capturing general improvements in health rather than anything related to the EC pill, we conduct several placebo tests. These tests consist of estimating identical specifications following Eq. (1) but now using health outcomes that do not plausibly depend on EC pill availability. The first of these is a pure placebo test in which we consider rates of male morbidity between the ages of 15 and 49. This age range is analogous to that of women when they experience the reproductive health outcomes considered previously. We also consider an alternative placebo test based on morbidity during the puerperium period for women aged 15–49. Although this will not reflect the mechanism discussed earlier in which the EC pill can act as a substitute for clandestine abortion, it is not necessarily a perfect placebo if the EC pill impacts the *composition* of cohorts of mothers.[19]

We present these results in Figure 7. Panel a illustrates the impact of the rollout of the EC pill on all-cause male morbidity. We observe no significant impacts, with results clustered around 0 cases per 1,000 men (the mean for this outcome, given in Table 1, is 30 inpatient visits per 1,000 men per year), suggesting that the findings discussed earlier are not simply proxying generalized improvements in health occurring in municipalities that adopted the EC pill earlier. In panel b, we observe no statistically significant lag or lead terms for complications in the puerperium, although point estimates are slightly noisier. These results again suggest that the reproductive health outcomes seen earlier are not proxying general improvements in health, or even general improvements in maternal health, but are specific to causes early in gestation, consistent with the EC pill acting to prevent unsafe health behaviors early in pregnancy. We note that these placebo tests hold even when considering intensity of use of the EC pill and DID_M models. Identical event studies estimated by different terciles of EC pill use (as presented for the main outcomes in Figure 5) are displayed in Figure A13 of the online appendix, and DID_M models are presented in Figure A14 and Table A6, in all cases with no significant effects.

[18] We note that data that we could harmonize on all contraceptive measures, documented in Figure 6, are only available at the level of each health service in Chile, while our principal regressions are based on data at the level of each municipality. Each health service includes multiple municipalities, and so the rates of birth control coverage refer to average coverage at the level of each health service, rather than each individual municipality. In Figure A4 of the online appendix, we document the correspondence between health services and municipalities within the country.

[19] We note, however, that Bentancor and Clarke (2017) found relatively little evidence for changing composition of mothers following the availability of the EC pill, at least in terms of education and age.

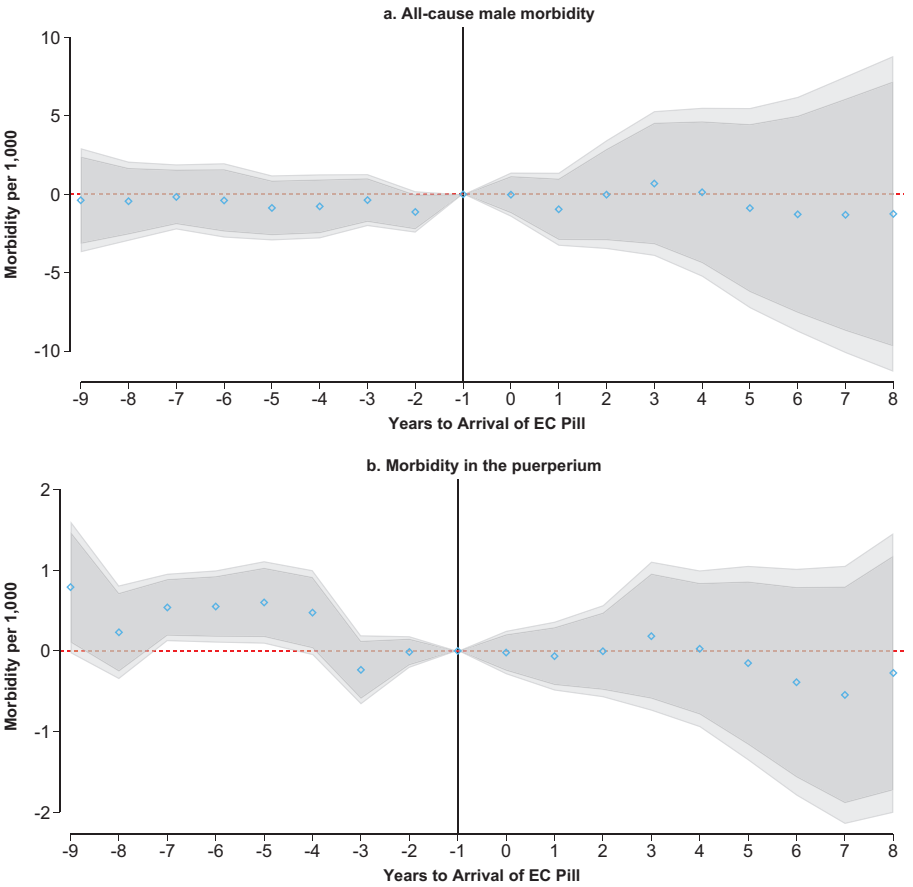

Fig. 7 Placebo tests of the impact of the EC pill using full morbidity records and puerperium health outcomes. Event studies follow specification (1), where the outcome variables are all-cause male morbidity between the ages of 15 and 49 and morbidity owing to complications related to the puerperium period (based on ICD-10 codes O85–O92). Each outcome is per 1,000 residents of the same sex aged 15–49. Specifications are weighted using the number of men and women of reproductive age, respectively, in each municipality; standard errors are clustered by municipality. Vertical lines indicate one year prior to the first year in which a municipality disbursed the EC pill. Light and dark shading indicate 95% and 90% CIs, respectively.

Throughout this paper, our main interest has been considering maternal *morbidity* outcomes. Table A7 and Figures A15 and A16 in the online appendix present estimates using birth rates, which broadly agree with findings from Bentancor and Clarke (2017) (albeit with considerably wider confidence intervals in event-study models), pointing to larger impacts among younger women, with the largest impacts observed among 25- to 29-year-olds in Table A7 (trends are provided in Figure A17). Of particular interest are results from Figure A18 and Table A8, which document the same estimates for maternal *mortality*. In the case of mortality (documented in Figure A18), we do not observe any significant impacts, on average, in line with the idea that

these events represent just a very small "tip of the iceberg" of maternal health outcomes.[20] This underlies the importance of focusing on maternal morbidity outcomes to capture the full weight of reform impacts.

Discussion and Conclusion

In this study, we examined the impact of the EC pill on women's health outcomes by considering the municipal rollout in EC pill availability in Chile's public health system. This is an illustrative case, given that unlike other studies of the rollout of the EC pill, abortion was illegal for the entire period under study. To our knowledge, this work is the first to have full measures of both the intensity of usage of the EC pill in the public health system and of unfulfilled requests, in a setting where there was a sharp expansion in the availability of the EC pill. We document that the availability of the EC pill can have appreciable impacts on women's health outcomes and, in particular, observe that an increased intensity of EC pill disbursement is associated with reductions in rates of abortion-related morbidity. Our evidence suggests that this is the principal morbidity class impacted, with little evidence to suggest an impact on rates of hemorrhage early in pregnancy.

These results are at odds with some previous evaluations of the impact of the EC pill, which often found no or small impacts at the population level. We conducted several robustness checks that indicate that these results are not an artifact or spurious. A potential explanation of these divergent results is context. Unlike research based in the United Kingdom or United States, this study examines a setting where abortion was entirely illegal, and thus growing EC pill availability would have reduced the exposure to health risks inherent in clandestine abortion.[21] Our results are consistent with the EC pill functioning as a substitute for abortion in at least some cases. This finding echoes those in Miller and Valente (2016),[22] providing further evidence based on an expansion in the supply of a particular type of contraceptive method. More importantly, our results indicate that the EC pill can improve women's health in the context where abortion access is severely restricted. Even though access to abortion in at least some circumstances is legal in most countries, restrictions on access are not only common, but have been increasing in recent years, particularly in the United States (Stotland 2018), suggesting a broadening relevance for this study's results.

Our findings suggest that the impact of EC pill availability may be relatively large in Chile. Drawing from the DID_M results estimated here, a back-of-the-envelope calculation suggests that as many as 27,000 cases of hospitalizations related to abortion may have

[20] The magnitude of these outcomes in Chile is small. In 2014, 34 maternal deaths and 252,194 live births occurred in the country, giving a maternal mortality ratio of 13.5 deaths per 100,000 live births. Of the maternal deaths, only three were classified as due to abortion.

[21] Unfortunately, we are not able to directly measure rates of induced abortion, and certainly our outcomes include morbidity related to spontaneous abortion; therefore, this statement is only speculative.

[22] Miller and Valente (2016:979) state: "This finding has important implications for public policy and foreign aid, suggesting that an effective strategy for reducing expensive and potentially unsafe abortions may be to expand the supply of modern contraceptives."

been avoided because of EC pill availability.[23] Regardless of this number, it is worth noting that the wholesale price of an EC pill to the government varied between US$1.50 and US$8.22,[24] while estimates presented by the Chilean Budgetary Department suggest that, on average, a single night of hospitalization costs 43,842 Chilean pesos (Instituto de Administración de Salud 2016) (or around US$60 at current exchange rates). These rough estimates, which include only the direct savings in terms of hospitalization, suggest that the public provision of EC pills may pay for itself many times over.

While the Chilean case offers important lessons and an ideal setting to study the EC pill, we note a number of limitations to this study. Our measures of EC pill and contraceptive use cover only the population using the public health system and do not capture private provision. These results should thus be interpreted with this in mind. Second, the rollout of the EC pill was based on a political calculus—namely, mayoral decisions, which may also be correlated with other prohealth behaviors adopted by mayors. Moreover, while this study found considerable variation in the availability of the EC pill, it is impossible to isolate all such variation given the sporadic availability of the EC pill in the lead-up to the reform, as well as the ability of women to use a high dose of the oral contraceptive pill to act as an emergency contraceptive, even in the absence of legally available EC pills. Finally, we note that while abortion was not legal during the time of the rollout of the EC pill, evidence suggests that information about and usage of (clandestine) medical abortifacients had been on the rise, which should reduce the incidence of medical complications and hospitalizations (Drovetta 2015). This offers a competing explanation for the reduction in rates of hospitalization observed in our aggregate figures; however, to bias our estimates, the usage of such procedures would need to be more intense in early adopting municipalities.

This research relates to an established and growing body of work documenting the importance of women's autonomy as a determinant of health (see Bloom et al. 2001). In particular, we find some evidence that a higher rate of rejected pill requests is associated with higher rates of abortion-related morbidity, possibly because women who have their request unfulfilled may end up using riskier options to terminate their pregnancies. There was a wide range of variation in the rejection of pill requests during the study period, with some municipalities denying several hundred pill requests per month. Certainly some requests are rejected for medical reasons, such as late timing of the request; however, in the particular case of Chile, there is reason to believe that rejections were not only medically based. During the years in which access to the EC pill was contingent on a mayor's will, anecdotal evidence suggests the existence of "ideological rejections." For instance, the mayor of the largest municipality in the country stated that the EC pill violated his moral principles and that he would

[23] Full calculations are provided in an earlier working paper version of this study (Clarke and Salinas 2021: section 4.3). Such back-of-the-envelope calculations should nevertheless be taken as being simply suggestive and illustrative given that the public reform also opened the door for provision of the EC pill by the private sector through pharmacies, and we are unable to observe data on private provision of the EC pill through pharmacies.

[24] These records were compiled from CENABAST (National Centre for Medical Provision) and are available for nine different bulk purchases of the EC pill from five different suppliers between 2015 and 2020. We searched for all purchases using the generic name levonorgestrel, which covers three different brands (Cerciora, Escapel2, and Pregnon).

not allow its disbursement.[25] Our findings suggest that such ideological decisions not only violate the rights of women to make autonomous decisions about their own body and reproductive function, but also threaten women's health. ■

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[25] Such press coverage (in Spanish) can be found, for example, here: https://www.latercera.com/noticia/pildora-del-dia-despues-alcaldes-de-el-bosque-y-puente-alto-discrepan-por-dictamen-de-contraloria/ and https://www.elmostrador.cl/braga/2017/06/13/vecina-de-puente-alto-le-reclama-a-ossandon-que-no-entregan-pildora-del-dia-despues-en-municipios-de-derecha/.

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Damian Clarke (corresponding author)
dclarke@fen.uchile.cl

Clarke • Department of Economics, Universidad de Chile, Santiago, Chile; Institute of Labour Economics, Bonn, Germany; Millennium Nucleus for the Study of Life Course and Vulnerability, Santiago, Chile; https://orcid.org/0000000302977037

Salinas • Institute of Sociology, Pontificia Universidad Católica de Chile, Santiago, Chile; Millennium Nucleus for the Study of Life Course and Vulnerability, Santiago, Chile; https://orcid.org/0000000207682839