Effect of Emergency Contraception on the Maternal Morbidity of Adolescents in Chile

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I. Introduction

In this study we examine the impact of the availability of the emergency contraceptive (EC) pill on maternal health outcomes of adolescents in Chile. We focus on the roll-out of the EC pill in the country between 2008 and 2011, taking advantage of the unique features of EC provision in Chile in this period. We argue that the variation in time- and municipal-availability of the EC pill provide an ideal set-up for the identification of the causal effects of the contraceptive technology on women's health. We focus on two particular indicators of maternal health: abortion-related morbidity and hemorrhage in early pregnancy. We estimate difference-in-difference models, using municipal variation in EC pill availability, and high-quality micro-level administrative data capturing all-cases of morbidity in the country between 2001 and 2016.

II. Previous Research

Maternal Health

Maternal health has received much less attention in the demographic and economic literature analysis than maternal mortality. Morbidity and mortality are evidently related, inasmuch as women die as a result of complications in their pregnancies, at delivery or postpartum. This implies that the large decrease in indicators of maternal mortality worldwide –between 1990 and 2015 maternal mortality dropped by more than 40 percent (WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division, 2015)—was likely accompanied by improvements in indicators of women's health. An example of the link between maternal morbidity and mortality is the concept of "near miss", which has been developed to refer to severe acute maternal morbidity, "defined as a very ill pregnant or recently delivered woman who would

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have died had it not been that luck and good care was on her side" (Say, Pattinson, & Gülmezoglu, 2004, p. 1)

Even though maternal mortality has declined, it is still high in developing countries, for women living in rural areas or in poorer communities. Adolescents face a higher risk of death as a result of a pregnancy, as well as higher risks of complications during their pregnancies (WHO, 2018). Consequently, maternal health should be worst for those women.

The association between contraceptive use and the reduction of maternal mortality is known. Cleland and colleagues estimated that the use of contraceptives in developing countries reduced the maternal mortality ratio (number of maternal deaths per 100,000 live births) by 26 percent between 1986 and 2009. It did so by reducing the fertility rate of women with a higher risk of death when pregnant, namely, women younger than 18 or older than 34 years, women with more than three children and women whose births are closely spaced. The authors argue that increasing the use of contraceptives could further reduce the maternal deaths due to unsafe abortions, given than those abortions are avoidable with proper contraceptive use (Cleland, Conde-Agudelo, Peterson, Ross, & Tsui, 2012). The effect of contraceptives on maternal health has, heretofore, not been studied in great depth, and particularly not based on within-country, plausibly exogenous, variation in contraceptive provision over time. We focus in one particular type of contraception, emergency contraception, and its effect on the maternal health of adolescents in Chile. As said, the risk of complications during pregnancies is higher in developing countries and for adolescents. Chile is not only a developing country, but also a country in which the historical provision of emergency contraception set unique conditions for the evaluation of the impact of this method on maternal health.

Emergency Contraception

The emergency contraceptive pill is a hormonal treatment which can be used up to five days of unprotected sex to reduce the probability of conception. It is composed of progestin levonogesrel, or a combination of oestrogen and progestin. Typically EC is taken either as a single or two pills in a 12 hours period (von Hertzen et al., 2002), even though the high dose of hormones these pills contain can obtained by combining large amounts of normal birth control pills (Ellertson, Blanchard, Bigrigg, & Haskell, 1998). The effectiveness of EC, based on typical usage, is

estimated to be 75-85 percent, depending on the method used. EC is more effective when taken soon after unprotected sex: even though it can prevent conception up to 120 hours after intercourse, it is the most effective when taken within 12 hours (von Hertzen et al., 2002). This is why widespread and quick access to EC are important for reducing unwanted pregnancies. Even though EC has been of clinical interest since the late 1960s, access it is still not universal, worldwide. The first countries that made EC available did it in the mid 1980s and many countries made it available only in this millennium (Bentancor & Clarke, 2016). There have been several studies of EC use in adolescents, looking at changes in sexual behaviors. They generally conclude that EC is not associated with more unprotected intercourse or less condom or hormonal contraceptive use (Gold, Wolford, Smith, & Parker, 2004). There have also been studies of the impact of EC on pregnancy and abortion rates, most of which find no effects on a population level (Durrance, 2012; Gross, Lafortune, & Low, 2013; Raymond, Trussell, & Polis, 2007). On the contrary, a study conducted in Chile found that EC reduces the general fertility rate by 1.6 percent and early-term fetal deaths (which are considered to reflect illegal abortions) by 40 percent among adolescents. The authors argue that previous studies have found no effects because of the analysis typically focus in the U.S., where abortion is legal. However, in a context in which access to abortion is restricted, the EC pill actually impacts both birth and abortion rates, which implies that the EC pill and abortion act as substitutes (Bentancor & Clarke, 2016).

In Chile, the introduction of EC was complex. As with many other legislation initiatives related to either reproductive health or marriage, conservative sectors blocked the action of more progressive sectors. In the particular case of EC, the first discussions and administrative inquires took place in 2001, but only in 2005 the Supreme Court determined that it was not unconstitutional to include an EC drug in the pharmaceutical register. Detractors quickly challenged this decision, presenting cases both before ordinary and Constitutional Tribunal (Casas Becerra, 2008). After that, meanwhile litigation and legislative efforts were happening, during several years the EC was sporadically available, sometimes at no cost from state clinics or by purchase in private pharmacies. However, these periods were typically short-lived and the EC pill not consistently stocked (Bentancor & Clarke, 2016), meaning that access was never complete. In 2008, the country's Constitutional Tribunal made expressly illegal for the centralized health system to distribute the EC (as a response to a demand placed by conservative representatives). As a consequence, none of the health centers under direct administration of the Ministry of Health could

provide EC, but all municipality-level centers and hospitals have freedom to decide whether or not to distribute the EC pill. These centers depend directly on the major of each municipality, meaning that the availability of EC in a given municipality depended entirely on the major's will (Dides, Benavente, & Moran, 2009; Dides, Benavente, & Saez, 2010; Dides, Benavente, Saez, Nicholls, & Correa, 2011). In practice, about half of the Chilean municipalities distributed the EC pill freely and the other half refused to distribute it or distribute it under very restrictive conditions. This situation lasted for about four years, until a law, operational in May 2013, mandated that the EC pill should be available to all women requesting it. During those four years, whether or not women have access to the EC pill did not depend on their preferences or any other individual variable, but it was completely exogenously determined (Bentancor & Clarke, 2016). Up to this point, abortion was completely illegal in Chile, even though in 2017 a law was passed allowing abortion in cases of rape during the first 12 weeks of pregnancy, severe risk to mother's life or when the fetus is unviable, that is to say, it will not survive the pregnancy. EC was then, and to a certain extent still is, the only legal way to avoid an unwanted pregnancy after unprotected intercourse.

Adolescent fertility in Chile shares many features with adolescent fertility in other Latin American countries. Even though it has decreased from its highest historic values, in the 1960s, the decline has been slower than the decline of the total fertility rate and adolescent fertility not follow a monotonic trend in time (Rodríguez & Mariachiara, 2010). After several years of decline, it increased for over a decade (1987-1999), it declined again between 1999 and 2004, it increased again between 2005 and 2009 and it has finally been declining since 2010. Currently, the age-specific fertility rate in the 15-19 age group is relative large, reaching 39.3 per thousand women.

Therefore, we ask about the impact of EC on the maternal health of adolescent in Chile in a period in which abortion was completely illegal in the country and there was ample variability in access to EC at the municipal level. Because of the previous findings of the effect of EC on birth rates and fetal deaths in Chile (Bentancor & Clarke, 2016) we focus on health issues that are related to abortion, assuming that the EC pill and abortion act as substitutes, and we hypothesize that greater access to the EC pill reduce issues of maternal morbidity related to abortions. In order to explore whether the effects of the EC pill go beyond abortion, we also include indicators of two of the other main health-related problems during the pregnancy in Chile, namely, hypertensive disorders and diabetes in pregnancy. In particular, we believe this is important as it allows for us to consider

both direct effects of the contraceptive technology on maternal health outcomes, as well as possible selection effects on cohorts of mothers giving birth before and after the arrival of the EC pill.

III. Methodology

We use administrative data, from the Department of Health Statistics and Information (DEIS, *Departamento de Estadísticas e Información de Salud*), which depends on the Ministry of Health. The coverage of birth-related vital statistics in Chile is about 99 percent (Bharadwaj et al, 2013). DEIS provides discharge statistics, classified according to the International Classification of Disease code (ICD 10), from which we obtain our indicators of maternal health. These figures are recorded according to the age and sex of the patient, allowing us to identify maternal health issues affecting adolescents. We aggregate these numbers at the municipal level. We also use data from an independent survey conducted in 2009, 2010, and 2011, which asked health workers in each municipality of the country whether they could prescribe the EC and to list the circumstances under which they could prescribe it (Dides et al., 2009, 2010, 2011).[3]

In order to examine the impact of the EC pill on women's health outcomes, we begin by estimating the following difference-in-differences (DD) specification:

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

Here *Health* refers to average rates of morbidity in municipality *c* at time *t*, and *EC Pill* refers to the availability of the emergency contraceptive pill in the same municipality and time period.

Our parameter of interest, β, captures the impact of the availability of the EC pill on maternal health (under the assumption laid out below). We include state and year fixed effects as ϕ_c and μ_t respectively, and examine stability to the inclusion of the time-varying controls X_{st} capturing socio-political characteristics of each municipality. There are 346 municipalities in Chile, and the availability of the EC pill is determined at the level of each municipality. In order to account for the possibility of unobserved correlations of outcomes for women within a municipality, standard

[3] Additionally, we have compiled administrative data on the disbursement of EC pills by the Ministry of Health in Chile, allowing us to consider actual usage, as well as availability.

errors are clustered by municipality (Bertrand et al., 2004). The quantity of clusters in this setting exceeds typical 'rule-of-thumb' type minimum cluster sizes (by as much as an order of magnitude) for the asymptotic validity of standard errors (Cameron and Miller, 2015).

We focus on two particular morbidity classes when examining the impact of the availability of the EC pill on female health outcomes. These are abortion-related causes, and hemorrhage early in pregnancy. The first outcome is typically examined when considering the impacts of unsafe abortion on women's health in the medical and public health literature. It includes all forms of morbidity classified in ICD-10 codes O02-O08. A full discussion of this coding is provided in Singh and Maddow-Zimet (1999). We additionally consider the impact of abortion reform on hemorrhage in early pregnancy. This is classified as hemorrhage prior to 20 weeks of gestation, and is coded from ICD-10 code O20. We focus on this outcome given that hemorrhage (along with incomplete abortion) are one of the two most common complications of unsafe abortion (World Health Organization, 2018; Gerdts et al., 2013), and given the widespread use of misoprostol as an abortifacient agent in clandestine abortions prior to the availability of the EC pill in Chile. While bleeding is a normal side-effect of misoprostol use as an abortive agent, when taken in unsupervised settings misoprostol can lead to heavy bleeding and hemorrhage (Pourette et al., 2018)[4].

For difference-in-difference estimates to capture the causal effects of the rollout of the EC pill, we require a parallel trend assumption to hold, or that outcomes in each of the municipalities having available the EC pill and those not having the EC pill would have evolved similarly in the absence of abortion reforms. We provide a partial test of this, and additionally quantify any dynamic reform effects by estimating the following DD event-study specification:

$$Health_{ct} = \alpha_0 + \sum_{j=-8}^{8} \delta_{-j} \Delta \text{EC Pill}_{c,t+j} + X'_{ct}\Gamma + \phi_c + \mu_t + \varepsilon_{ct}$$

[4] Accounts of self-administered abortion in a case study in Brazil described in Grimes et al. (2006), suggest that even though the use of Misoprostol as an abortifacient increased safety, hospitalization due to hemorrhage was the outcome in cases of complications. They state: "Women would self-administer the drug orally and then seek medical assistance if the uterine bleeding did not stop" (Grimes et al., 2006, p. 1916).

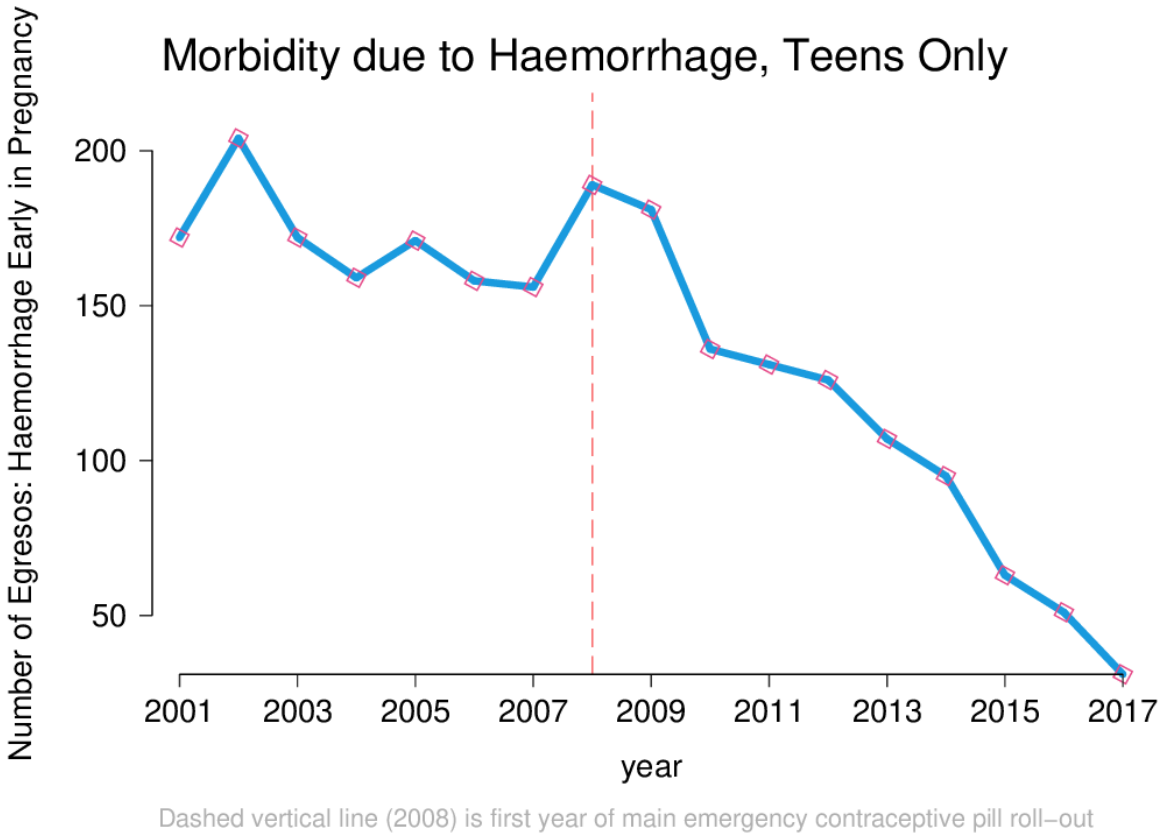
we normalize δ by setting $\delta_1 = 0$. These event-study specifications are increasingly common in DD settings, and here we adopt the notation of Freyaldenhoven et al. (2018). In this specification, we are interested in the leads and the lags of the policy change, where leads capture any prevailing trends prior to the reform in treated versus untreated municipalities, and lags show the change in health outcomes following the availability of the EC pill. In specification 2, we include a full set of 8 yearly leads and lags to capture the full dynamic impacts of the reform. These are the longest set of lags and leads possible with the range of years of data. As in specification 1, year and state fixed effects absorb time-invariant and state-invariant factors, and standard errors are clustered by municipality. As well as capturing any dynamic impacts of the reform, for example any technology diffusion over time, specification 2 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.

IV. Preliminary Results

The municipality-level dataset is currently being constructed, but country-level data suggest that the legal reform that made EC fully available to women in Chile is associated whit a steep decline in hemorrhage early in pregnancy among adolescents, as seen in Figure 1 (2008, the year of the reform, is marked with a vertical red line). The sharp increase in the disbursement of pills following the contraceptive reform began in 2009-2011, the years in which the steepest decline in hemorrhage early in pregnancy is observed.

Figure 1: Hemorraghe in Early Pregnancy, Chile 2001-2017,

Women 15-19 Years Old



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