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Abstract

Mental health consequences of abortions have recently been the subject of public discussions surrounding abortion legislation in several countries. Yet, it is unclear whether the positive association commonly found in the literature reflects a causal effect or whether the main driver is selection. Using administrative records from both in- and outpatient data among a population of Swedish women aged 16-35 in the region of Skåne, we illustrate that there are substantial differences in the rate of diagnoses of mental health disorders and risky health behavior between women who experienced an abortion and those who did not. We show that there is a positive association between abortion and different mental health outcomes (as diagnosed by a medical provider), even when including various controls and individual fixed effects. To examine possible causality, we then use quasi-experimental control group- and event study methods and find no causal effect of abortion. We interpret the remaining association from the OLS specification as a selection effect and consequently are interested in characterizing what drives observed differences in mental health status between women with and without abortions. Recognizing that even small differences in innate mental health might drive risky health behaviors leading to abortions, we hypothesize that earlier abortions indicate different future mental health profiles. Our preliminary results suggest that there are slope differences depending on the age of abortion for future mental health curves. To formalize this notion we are planning on implementing an estimator using group-fixed effects first proposed by Bonhomme and Manresa (2015).

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1 Introduction

There is an ongoing debate in policy about how abortions are related to mental health and claims of negative mental health effects of abortion are still used to justify restrictions on the access and execution of abortions. Such misinformation has initiated the legislation to create waiting times, or disclosures that abortions cause depression, substance abuse or suicide (see e.g. Coleman (2011) or Stotland and Shrestha (2018) for an overview). However, no matter on whether these studies found positive and negative associations between abortions and measures on mental health they almost all undergo a number of methodological issues, ranging from non-random samples, under-reporting of abortions or imprecise measures of mental health, to threats of identification due to endogenous selection and other sources of unobserved heterogeneity Abel et al. (2012).

This study investigates the impact of having an abortion on the incidence of mental health conditions and risky health behavior in the form of alcohol abuse. We postulate that an naive comparison of women who had an abortion and women who did not have an abortion reveals a positive association with the incidence of mental health condition cross-sectional as well as over time. In the next step of our empirical analysis we then explicitly address the question whether this positive association reflects a selection effect, or whether abortion has a causal treatment effect on mental health measures. The former effect arises if women who are more vulnerable to mental health issues are also more likely to experience unwanted pregnancies and subsequent abortions. As a consequence, differences in mental health conditions are attributed to the abortion event. The latter can be interpreted as a causal effect of abortion on mental health if there are no unobserved factors left that increase the probability of abortion as well as the risk of being diagnosed with mental health conditions. We attempt to disentangle these two effects by contrasting the onset of various mental health diagnoses from the date of the abortion. While it is true that women who have experienced an abortion are more likely to be diagnosed with a mental health issue at some time after the abortion, we would observe a jump/kink/change of slope in the diagnosis rate directly following an abortion (once we control for selection). Once we have established that there is no causal effect of abortions on mental health, we examine the selection effect in more detail.

To address our research question we follow two types of empirical strategies. To recover the treatment effect of abortion on mental health we combine a traditional event-study approach with a quasi-experimental matching research design, obtaining a dynamic difference-in-difference estimator. Second, we investigate endogenous selection by analyzing the unobserved heterogeneity using different types of fixed effects estimators. This allows us to explore whether endogenous selection is static expressed by differences in permanent unobserved heterogeneity (e.g. innate health or other endowments), or whether endogenous selection is dynamic. Time-constant individual-specific unobserved heterogeneity is obtained from the dynamic difference-in-difference model which we use to estimate the treatment effect. Time-varying individual-specific unobserved heterogeneity is addressed by allowing for clustered time patterns of unobserved heterogeneity that are common within groups of individuals. This so called grouped fixed effects estimator was proposed by Bonhomme and Manresa (2015) and it works well is the number of individual time patterns of unobserved heterogeneity is small. To document selection into abortion we first examine the relationship between unobserved heterogeneity and observed individual characteristics, and then investigate how unobserved heterogeneity is distributed among women with an abortive event and women without an abortive event.

Currently, only two studies in Psychiatry address a large number of the methodological issues mentioned before, both using administrative population registers on healthcare in Denmark. Munk-Olsen et al. (2011) analyze data for girls and women with no record of mental disorders during the 1995–2007 period who had a first-trimester induced abortion or a first childbirth during that period. They do not find any supportive evidence of an increased risk of mental disorders after a first-trimester induced abortion. The second study by Steinberg et al. (2018) use women from 14 consecutive birth cohorts from the Danish population register to examine whether the first-trimester first abortion or first childbirth is associated with an increase in women's probability of using prescribed

antidepressants for the first time. While they find evidence that those women who had an abortion had a higher rate of antidepressant use compared to those who did not have an abortion, they conclude that this association is driven by risk factors for depression among women who had an abortion rather than by the abortion itself. While these two studies reveal credible findings on the association between having an abortion and mental health, the issue of identification and a causal interpretation of the results remains.

While mental health consequences of abortions have been mostly investigated in the medical literature, the economics literature has focused on the impact of the (legal) availability of abortion on fertility, education and labor market outcomes as well as on child-specific outcomes (see for instance Gruber et al. (1999); Pop-Eleches (2006); Ananat et al. (2004); Ananat et al. (2009); Pop-Eleches (2009); Mølland (2016); Bailey et al. (2017); Myers (2017). By exploiting regional or temporal differences in the access of abortion, these studies find that a better access to abortions delays marriage and motherhood, increases childlessness among women with abortions, and increases educational attainment of mothers. Relaxing abortion restrictions moreover has benefits for children born after such policy changes, ranging from reductions in poverty and welfare receipt, higher test scores and higher educational attainment, substance use or teenage pregnancy. The studies conclude that these positive consequences operate through selection on mother's socioeconomic status. The availability of abortion leads to better outcomes because poorer or less-prepared mothers are more likely to have abortions (Mølland (2016)).

Our study adds to the psychiatric literature on mental health effects of abortions and to the economics literature on abortion availability in several ways. First, instead of using prescriptions on antidepressant drugs we use measures of mental health that were derived from ICD-10 diagnosis codes, recorded in the outpatient and inpatients registers on the population of Skåne. This allows us to consider several dimensions of mental health. Second, we apply identification strategies that explicitly aim to disentangle endogenous selection and treatment effect, thus giving our results a causal interpretation. Third, our data cover a period of 10 years, allowing us to examine more than short-term effects of abortion on mental health. Having observations over a period of 10 years moreover provides to opportunity to employ a quasi-experimental design that exploits potential randomness of the timing of an unwanted pregnancy/ abortion within a short period of time. Finally, we study women in Sweden in 1999–2008, a period in which different types of contraceptive methods are accessible to all women, and the emergency pill is available over the counter[1].

Regarding the literature in economics, we are the first empirically analyzing the effects of abortion on mental health. While studies have investigated selective fertility or economic outcomes in the light of abortion, mental health consequences have been completely understudied by economists. Yet, researchers have recognized the importance of mental health for understanding patterns in individual labor market and earnings trajectories. A recent paper by Biasi et al. (2018) examines the effects of mental health disorders on earnings using psychiatric register data from Denmark. The authors find immense earnings penalties, leading 35-74% less earnings for people with mental health conditions compared to the population. A paper by LayaRd (2017) shows that close to 50% of all disability benefits in OECD countries directly are due to mental illness. By combining output losses through non-employment, absenteeism, and presenteeism (less effectiveness) in the UK as a consequence of mental health conditions, his analysis reveals a reduction in the national income (gross national product) of 7%. It thus is of major importance to understand which factors, such as abortions, contribute to these numbers.

By showing that positive associations between abortions and mental health disorders are spurious and do not hold up a causal interpretation, we would like to shut down this line of argument in the public debate. Our findings will moreover reveal factors that make women vulnerable to abortions. Our results implies that policy makers should rather promote the reduction of unequal economic and social resources among women rather than limiting the access to abortion.

[1]Contraceptive counseling is free. However, the price for the different contraceptive methods vary. Some counties subsidize contraceptives for young people under 25 years of age.

2 Data

2.1 Description of different data registers

Our empirical analysis is based on a unique set of population register data from the county[2] of Skåne. It includes individual-level merged longitudinal records from the intergenerational register, the inhabitant register, the income tax register, the medical birth register, the in-patient register and the out-patient register. The in-patient and out-patient registers are from the "patient administrative register systems" from Skåne, administrated by the Regional Council of Skåne. They contain detailed records of all occurrences of in-patient and out-patient care for all inhabitants of the region, covering over one million of individuals for 1999–2008.[3] These registers have previously been used by Tertilt and Van Den Berg (2015). In the next subsection we discuss their contents in detail.

The health care registers are collected at the county level because they determine the monetary streams from the county to the various health care centers and hospitals. At the same time these register data are collected on the national level as part of the so-called "National eHealth" endeavor to improve efficiency in health care. Here, institutional variation in the health care systems across counties is used for "natural experiments" in the analysis of the connection between health care diagnoses and treatments and health outcomes. For this reason, the national health authorities place great value in the collection of reliable health-care diagnosis records.

We now turn to the other registers. In Sweden, each individual has a unique identifier which is used to record all contacts with the health care system as well as the general public administration, tax boards, employment offices and so on. We use this to match the above-mentioned health care registers to individual information on socio-economic and demographic conditions. Specifically, we merge the health care registers to a dataset that itself consists of a number of different registers. This dataset has been used before by Meghir and Palme (2005) and covers all persons born in Sweden between 1940 and 1985, their parents, and all their children. It includes variables from the annual LISA register which in turn builds on the income tax register. For individuals aged 16 and above, it includes employment status, incomes by type, level of education and marital status. This dataset is annual in the sense that each variable is only recorded once per year. It covers the years 1992–2002 and 2004–2006.[4]

As individual unemployment durations are often much shorter than a year, these data only allow for a limited characterization of the whether an individual is unemployed in a given calendar year. Following Ekstrand et al. (2009) , we use two sources of information. First, we observe whether the individual is employed in November of a year. Secondly, we observe total annual income from labor and the total amounts of sickness absence benefits, parental leave benefits, disability benefits, and unemployment benefits, received in a year. Accordingly, we define an individual to be unemployed in a year if one of the following two conditions applies. First, the individual receives no labor income, sickness absence benefits, disability benefits or parental leave benefits but does receive unemployment benefits. Secondly, the individual is not employed in November but receives labor income, sickness absence benefits, disability benefits or parental leave benefits during the year.

The dataset also includes the inhabitant register, which we use to obtain detailed residence information for the population in Skåne. Further, the intergenerational register allows for linkage of women to their children and to their mothers. The intersection of the health care registers and the Meghir and Palme (2005) dataset contains about 1 million individuals, which is the vast majority of inhabitants of Skåne in 1999–2008.

From all this we construct a panel data set which comprises all women born between 1964–1994 and living in the

[2]The terms county, province and region are used interchangeably. The same applies to the terms municipality and community. The latter range from a collection of neighboring villages to a single city.

[3]A small number of health care providers (notably dentists) are private. The patient registers are organized by the public/private distinction. PASiS register contains all publicly provided in-patient and out-patient care, whereas PRIVA contains all privately provided care. The information in PASiS and PRIVA includes dates of admission and discharges, as well as detailed diagnoses and DRG-based costs.

[4]The LISA registers for the years 2007 and 2008 were not available at the time at which we applied for and received the data. Variables from the LISA register for the year 2003 are not provided to us. See SCB (2009) for a detailed description of the variables in the LISA register.

region of Skåne between 1999–2008. We restrict the number of women to all for which information on parents can be linked. This reduces the sample size by about 40,000 women over the observation period. Our final sample consists of 1,688,458 yearly observations, covering 229,005 women at ages 14–44.[5]

2.2 Diagnosis variables & abortions

We define measures for mental health and abortions using ICD–10 diagnoses codes are available on a daily level for each individual. Chapter five of the ICD-10 catalogue comprises codes that are used to diagnose mental and behavioral disorders. The chapter is divided in 11 subchapters which classify diagnoses into forms of organic mental disorders, shizophrenia, affective, somatoform disorders, behavioral or developmental mental disorders. We pick four major outcome measures to map several dimensions of mental health problems:

- anxiety disorders (ICD F400-F419P): women who are diagnosed with anxiety disorders can have phobic anxiety disorder, panic disorders, or anxiety mixed with other disorders e.g. neurotics or stress-related conditions.
- depression (ICD F320-F329): These women are typically diagnosed with mild, moderate, or severe depressive episodes with typical symptoms such as a reduced energy, interest, enjoyment, self-esteem and self-confidence.
- stress reaction (ICD F4300-F439P): diagnoses of stress reaction include post-traumatic stress and adjustment disorders as well as acute and severe stress disorders.
- affective disorders (F30-F39): Besides depression, this category also covers diagnoses on manic episodes, biploar affective disorders, and persistent mood disorders.

Additionally, as a measure for risky health behavior, we examine whether a women is diagnosed with alcohol abuse (ICD F100-F109). This measure does not necessarily indicate that a woman was diagnosed with alcohol addiction, but rather that she came into contact with a medical provider because of some alcohol related problem (such as alcohol poisoning and acute intoxication).
Table 1 provides an overview on our mental health measures over the observation period. As mentioned before we include all women of age 14–44 in the period 1999–2008. Since we cannot link the medical birth register for birth cohorts born before 1964, our sample is not stable over time but increases across calendar year because in each year a new cohort enters our sample. One consequence is that the average age of women in the sample increases over time.

year	number women	age	mood disorders	anxiety disorders	depression	stress reaction	alcohol abuse
1999	138,590	24.99	0.0045	0.0039	0.0035	0.0036	0.0021
2000	144,629	25.48	0.0049	0.0037	0.0039	0.0039	0.0019
2001	151,173	25.96	0.0063	0.0041	0.0053	0.0048	0.0020
2002	158,436	26.40	0.0076	0.0052	0.0063	0.0057	0.0018
2003	166,066	26.85	0.0158	0.0115	0.0124	0.0107	0.0025
2004	172,431	27.27	0.0261	0.0176	0.0218	0.0189	0.0023
2005	179,439	27.72	0.0274	0.0201	0.0231	0.0185	0.0027
2006	186,115	28.18	0.0312	0.0236	0.0261	0.023	0.0031
2007	192,689	28.66	0.0330	0.0254	0.0279	0.0196	0.0029
2008	198,890	29.17	0.0327	0.0255	0.0272	0.0193	0.0029

Table 1: Annual numbers on different dimension of mental health, 1999–2007

[5]Note that women enter and leave the observation period at different ages according to their month and year of birth. Thus the panel data set is unbalanced across ages.

Columns (4)–(8) of Table 2 show the numbers on mental health disorders. While numbers moderately increase in the years 1999–2002, they suddenly double in 2003 for all mental health measure except for alcohol abuse. While part of the explanation on this increase is the increase in sample age it cannot fully explain the jump in 2003[6].
To measure abortions we make use of a number of pregnancy-related codes. The codes O00-O08 refer to pregnancies with abortive outcomes with spontaneous and medical abortions being subchapters. According to ICD-10 codes, all abortions can be complete or incomplete and with or without complications. We will not distinguish between these different categories but use the entire universe of codes within the abortion categories. The measures we are constructing contains information on whether a woman had an abortion in a given calendar year.

- Medical abortion: Any type of medical intervention, i.e. surgical extractions and medical interventions, includes voluntary legal abortions above and unwanted miscarriages that did not result in a spontaneous abortion. Women with medical abortions receive the diagnosis code O04.

- Spontaneous abortion: In colloquial terms miscarriages. These will include some women who would have had an abortion but had a miscarriage first, as well as women who would have carried a pregnancy to term. The respective ICD-10 code is O03.

- Legal abortions: What is colloquially referred to as abortion, i.e. voluntary termination of an otherwise viable, unwanted pregnancy. Women with legal abortions are diagnosed with an unwanted pregnancy (ICD Z640) together with a medical abortion (ICD O04).

- Unwanted pregnancies: Women who had an unwanted pregnancy received the diagnosis code ICD Z640. This includes women who later on have an abortion, women who carried the pregnancy to term or women who had a spontaneous abortion.

In medical terms, an abortion refers to any type of termination of pregnancy. We look at four different events that are partially overlapping and define our own terms so as not to confuse the reader.

year	number women	children born	medical abortions	spontaneous abortions	unwanted pregnancies
1999	138,590	7,835	0.0158	0.0049	0.0112
2000	144,629	8,382	0.0160	0.0055	0.0162
2001	151,173	8,589	0.0163	0.0058	0.0166
2002	158,436	9,222	0.0164	0.0063	0.0179
2003	166,066	9,683	0.0167	0.0062	0.0183
2004	172,431	9,835	0.0154	0.0061	0.0179
2005	179,439	9,034	0.0146	0.0059	0.0176
2006	186,115	10,043	0.0145	0.0064	0.0179
2007	192,689	9,699	0.0148	0.0063	0.0179

Table 2: Annual numbers for women, children born, abortions and unwanted pregnancies, 1999–2007

Table 2 displays the annual numbers on children born, abortions and unwanted pregnancies for the sample period. We find that in 1999 women aged 14-44 gave birth to 7,835 children in our sample. The number remains remarkably stable over time. Turning to the number on abortions, column shows the fraction of women with a medical abortion. About 1.58% of women in our age group had an abortion in 1999. This number slightly increases and peaks at a number of 1.67% in 2003. In later years the number of abortions relative to the number of women decrease again. This suggests that women do not have more abortions over time. Compared to medical abortions, spontaneous abortions increases slightly over time, from 0.49% in 1999 to 0.63% in 2008. One reason for this upwards trend could

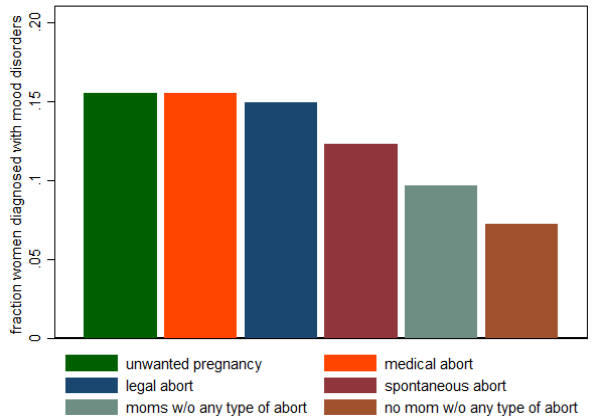
[6]Nevertheless, our identification strategy will take account of this increase in diagnoses by including calendar year fixed effect. WE NEED TO FIND OUT WHAT THE ISSUE IS? CODING???s

be that our sample gets older over time and older potential moms are more prone to miscarriages and spontaneous abortions. The final column shows the number of unwanted pregnancies among women in Skåne. Unwanted pregnancies slightly increase until 2003 and then decrease again. While the number of unwanted pregnancies in 2008 is slightly higher than in 1999, there numbers do not show a clear upward trend. Altogether, the numbers in Table 2 are remarkably stable. This pattern is pretty much in line with official statistics on birth rates and abortions provided by statistics Sweden. The total number of abortions in Skåne ranges between around 18 to 20 per 1000 women of all age groups (see Socialstyrelsens Statistiekdatabas, accessed 12-02-2019).

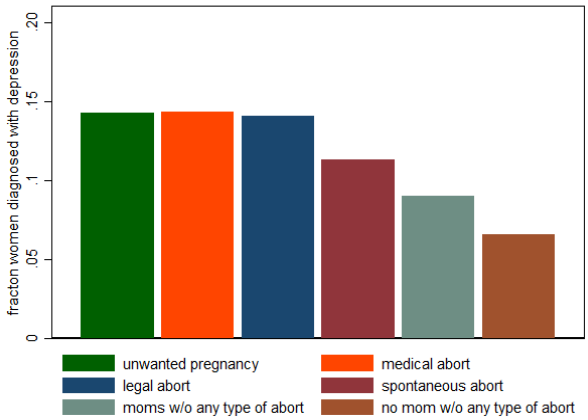
We next would like to show how mental health diagnoses relate to different types of abortion and unwanted pregnancy. To this end, we categorize women in six groups of abortion experience (according to the coding above): Women that ever had a) a medical abortion; b) a spontaneous abortion; c) a legal abortion; and d) an unwanted pregnancy. All women who never experienced such an event are then distinguished by whether they ever had been mothers or not. The latter two groups serve as the control group. For these six groups we then compute the annual average for different measures of mental health. Figure 1 shows the relationship between the different abortion categories and different mental health diagnoses among women. In all figures we find quite some variation in the probability of having been diagnosed with mental health disorders. The fraction is highest among women who had unwanted pregnancies and abortions, followed by women who experienced miscarriages/spontaneous abortions and moms who had an abortive event. About 12–15% of women with unwanted pregnancies and abortive events are diagnosed with such mental health conditions. The fraction of mothers without any abortive events ranges between about 8% for anxiety disorders and 11% for stress reactions. Mental health diagnoses are least prevalent among childless women who never had an abortive outcome (about 5–7%). This pattern is quite consistent across all dimensions of mental health, including alcohol abuse. For the latter, the fraction of women who was diagnosed with is much smaller, ranging from about 3% for women with abortive outcomes to less than 1% for moms. Overall, figure 1 shows quite some level differences between women who had an abortive event and women who did not have such an experience. Thus, just looking at these numbers suggests that unwanted pregnancies and abortions are positively associated with mental health problems.

In the next step we would like to assess whether having an abortion is associated with an increase in mental health diagnoses. To do so we plot the mental health diagnoses against the time measured in calendar years abortive events happened for the first time. Figure 3 shows that the number of health diagnoses steadily increases over time. This linear time trend is most prevalent for mood disorders, depression and anxiety disorders (Figures 3(a)-3(c)). For diagnoses on stress reaction the we find a small hump around the time of the abortive, suggesting a temporary increase in the number of diagnoses (Figure 3(d)). The diagnoses on alcohol abuse are relatively constant around the event. Regarding the different abortive events, women with spontaneous aborts shows the lowest incidence of mental health diagnosis. One exception are diagnoses on stress reaction in Figure 3(d) where the group of women with spontaneous aborts experiences the most distinct hump around the event. For this group of women we also find a much lower fraction who is diagnosed with alcohol abuse.

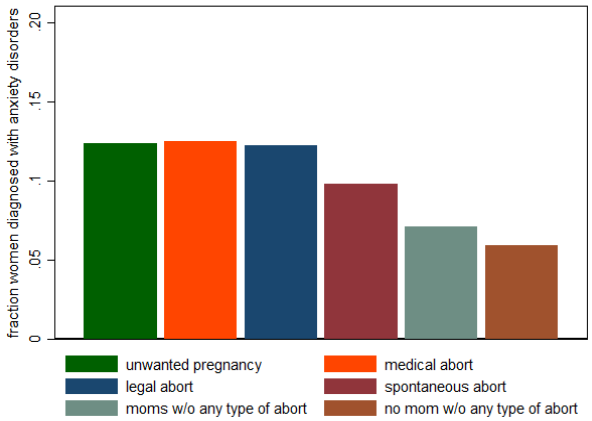
Overall the pattern suggests that there is not a strong correlation between the abortive event and different mental health diagnoses. One exception are diagnoses on stress disorders for which the group of women with spontaneous abortions have show the strongest reaction. However, this is not surprising given that spontaneous abortions are rather considered as unexpected shocks to women who would like to have children than an active decision on fertility. Given the similar patterns we get for legal abortions, medical abortions and unwanted pregnancies, we focus on medical abortions in the empirical analysis and consider spontaneous abortions separately.



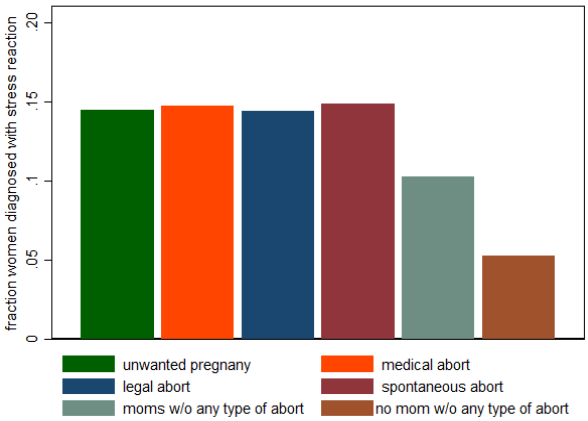
(a) Ever been diagnosed with mood disorders



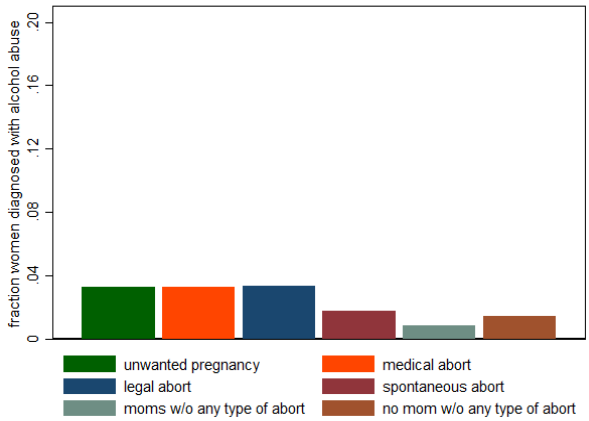
(b) Ever been diagnosed with depression



(c) Ever been diagnosed with anxiety disorders

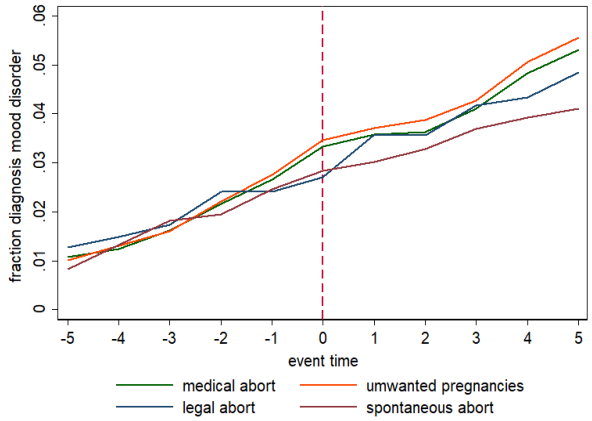


(d) Ever been diagnosed with stress reaction

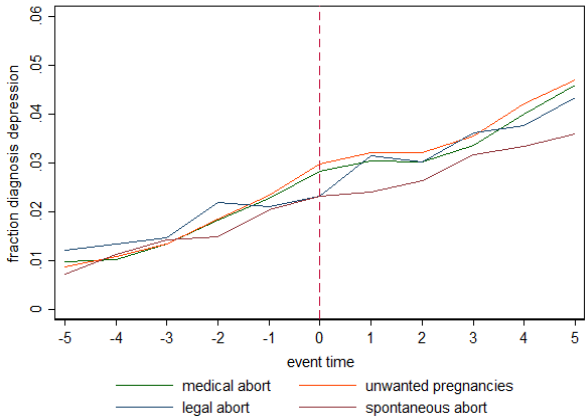


(e) Ever been diagnosed with alcohol abuse

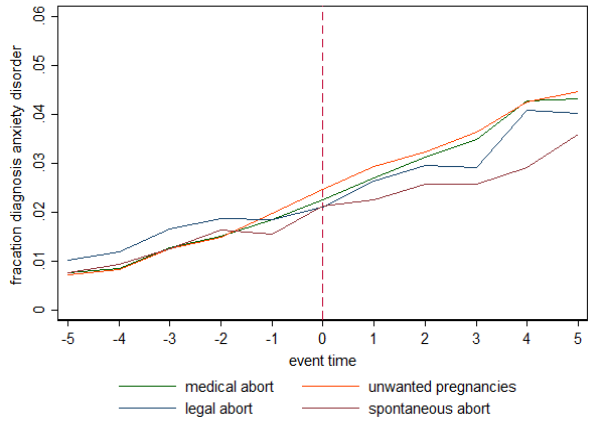
Figure 1: Mental health diagnoses by abortion events



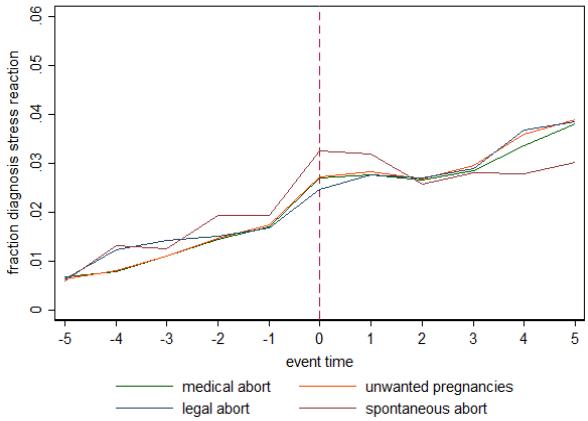
(a) Mood disorder diagnosis around time of abortive event



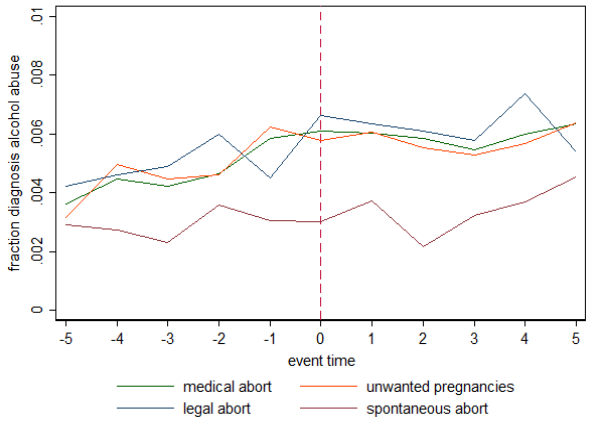
(b) Depression diagnosis around time of abortive event



(c) Anxiety disorder diagnosis around time of abortive event

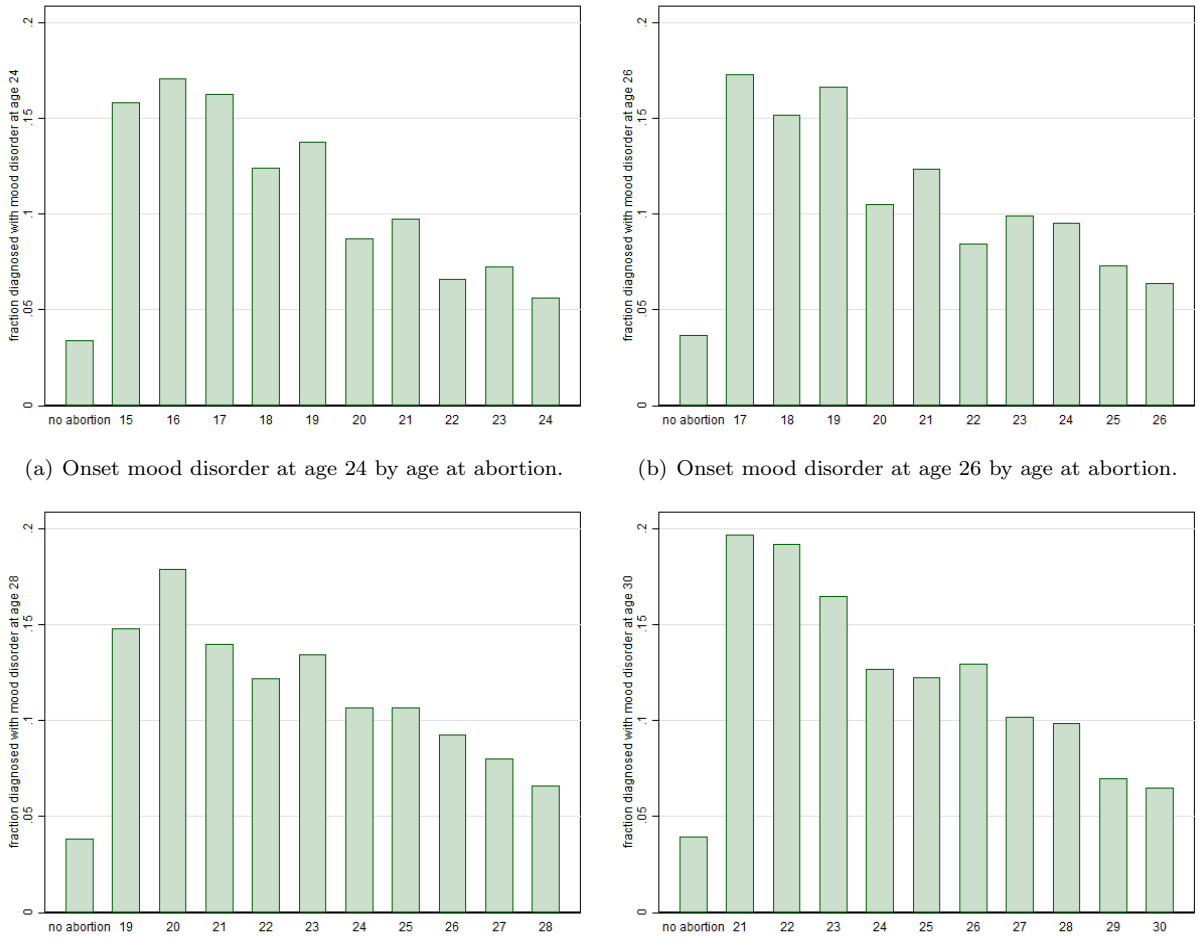


(d) Stress reaction diagnosis around time of abortive event



(e) Alcohol abuse diagnosis around time of abortive event

Figure 2: Mental health diagnoses by abortion events



(a) Onset mood disorder at age 24 by age at abortion.

(b) Onset mood disorder at age 26 by age at abortion.

(c) Onset mood disorder at age 28 by age at abortion.

(d) Onset mood disorder at age 30 by age at abortion.

Figure 3: Onset affective mood disorder at different ages by age at abortion.

3 Empirical strategy

To identify the treatment effect of the abortive event on mental health we start off with a simple linear probability model that links the mental health diagnosis to medical abortions and covariates.

$$MH_{it} = \alpha_i + \beta MA_{it} + \gamma X_{it} + \tau_t + \mu_m + \epsilon_{it} \tag{1}$$

where X_{it} comprises a rich set of covariates for the individual and the parents, α_i is an individual fixed effect, τ_t is a calendar year fixed effect and μ_m is a municipality fixed effect. The parameter of interest is β which provides us with a measure of the association of having a medical abortion and a particular mental health diagnosis.
We expand Equation (1) by incorporating dynamics of the treatment effect MA_{it}. The dynamic specification adds leads and lags of treatments to the above specification, leading to a linear two-way FE specification.

$$MH_{it} = \alpha_i + \sum_{l=-T}^{T} \beta_l MA_{it}^l + \gamma X_{it} + \tau_t + \mu_m + \epsilon_{it} \tag{2}$$

where MA_{it}^l is an indicator for being l time periods relative to i's initial treatment ($l = 0$ is the year of initial

treatment). Due to potential multicollinearities between fixed effects and relative time indicators and the linear relationship between calendar time, cohort and relative time we must exclude at least two relative time indicators. In practice, we will exclude all leads that are smaller than $l = -5$ and all lags that are greater than $l = 5$[7].

As pointed out by Borusyak and Jaravel (2017) and Abraham and Sun (2018), estimating Equation (2) suffers from a fundamental identification problem. The individual fixed effect α_i subsumes linear terms in the initial treatment period (such as linear cohort effects), arising a similar issue as the well-known age-cohort-time problem. The calendar year t is equal to the to year in which the event happens for unit i plus the relative time l. The consequence is a perfect linear relationship between these effects. The linear trend in the causal path of $\{\beta_l\}_{l=-T}^{T}$ is not identified because one cannot disentangle the paths of of relative time l and absolute time t in the presence of individual fixed effects.

One solution to this identification problem is the availability of a control group because it pins down the year fixed effects. In our setting a natural control group would be women without any abortions. However, women with abortions and women without abortions may be very different with respect to their mental health trajectories before the actual event. To mitigate the problem of non-parallel trends, we therefore construct a control group following Fadlon and Nielsen (2015). The main idea is to find a control group with the same expectations over the distribution of future paths, but with different realizations of the abortion event. More specifically, we construct a counterfactual to women with abortions by using women from the same cohorts that experience an abortion as well but a few years in the future.

In the model as specified above in Equation (1), we assume that the effect of innate mental health/the individual unobserved heterogeneity is age-invariant. However, it is very likely that good or bad innate mental health maps into small differences in observed health early in late adolescence (that lead to differences in risky behaviors/abortion) get magnified as one ages. The effect of such differing health profiles are (for illustrative purposes) sketched in 4, where the individual fixed effect, i.e. innate health is sketched as a function of age. In this example, small initial differences in mental health that lead into selection into abortion are amplified over time, leading to very different mental health profiles over time, depending on the age at abortion. To examine this, we aim to estimate a different fixed effect specification introduced by Bonhomme and Manresa (2015)

$$MA_{it} = \alpha\left(a_{it}, \eta_{g(i)}\right) + \beta\left(a_{it}\right) MA_{it} + \mathbf{x}_{it}'\gamma + \varepsilon_{it} \tag{3}$$

for $i \in \{1, \ldots, N\}$ and $t \in \{1, \ldots, T\}$ where now $\alpha\left(a, \eta_g\right)$ is the having aborted health curve for type $-g \in \{1, \ldots, G\}$ individuals, with $G < N$, and $\alpha\left(a, \eta_g\right) + \beta(a)$ is the curve for having aborted ones. The g in this example represent age-groups. Thus, Equation 3 allows for age-dependent unobserved heterogeneity that shapes the entire health curves through $\alpha\left(a, \eta_g\right)$, which we can estimate non-parametrically. In the specification above, we would define abortion as an absorbing state in the sense that MA_{it} does not turn to zero again.

4 Results and Discussion

Here, we outline the results of the empirical strategy (except for the group-fixed effects estimator) introduced above for one of the health outcomes we are most interested in, affective mood disorder, which includes depression. In Table (3) we present the results from estimating Equation (1), sequentially adding controls, the final specification including the individual fixed effect is presented in column (4). The effect of abortion on the probability of a diagnosis of affective mood disorder is smaller in size when fixed effects are included, but still significant, suggesting that abortion is associated with mental health. Table (4) shows the results for the event study regression; the first column estimates the raw treatment effect including controls and shows a significant effect of abortion, that persists

[7] The decision to exclude all relative time periods beyond these cut-off is mainly data driven. The number of observations decreases with moving away from the event.

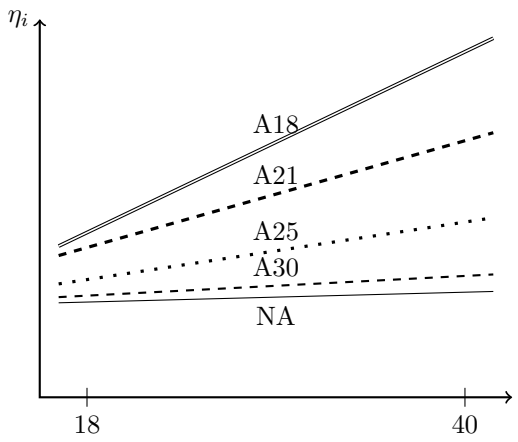


Figure 4: An illustrative example sketching different mental health profiles between the ages of 18–40 for women with no abortion (NA), an abortion at age 18, 21, 25 and 30.

VARIABLES	(1) Pr(affective mood disorder)	(2) Pr(amd)	(3) Pr(amd)	(4) Pr(amd)
Abortion (ICD O04)	0.0190*** [0.001]	0.0145*** [0.001]	0.0139*** [0.002]	0.0038** [0.001]
Constant	0.0101*** [0.002]	0.0610*** [0.003]	-0.0279** [0.013]	0.0129* [0.007]
Fixed effects	Yes	Yes	Yes	Yes
Individual level controls	No	Yes	Yes	Yes
Parental controls	No	No	Yes	Yes
Individual FE	No	No	No	Yes
Observations	1,688,458	1,597,376	1,035,416	1,035,416
R-squared	0.010	0.017	0.016	0.011
N				130,110

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table 3: OLS Regression of probability of being diagnosed with an affective mood disorder on having an abortion.

once we include lags in column two. However, once we include a full set of leads in column three, the effect is much smaller and is no longer significant. This confirms our suspicions that the positive association above is a result of selection. As a final test, we estimate the quasi-experimental design by Fadlon and Nielsen (2015). We compare women who had an abortion with women of the same cohort who have an abortion two years into the future. Table (7) shows the results by year of abortion. The coefficients have unexpected signs and are almost all insignificant. From these results we conclude that abortion does not have a causal effect on the mental health outcomes studied here. Figure 3 depicts the onset of affective mood disorder at age (a) 24, (b) 26, (c) 28 and (d) 30 by the age at abortion, the first bar representing the results for all women with no abortion. There is a clear age profile in the probability of onset at these ages, with women who experience an abortion when they are older being the most similar to women who never experience an abortion. This motivates the use of the group-fixed effects estimator by Bonhomme and Manresa (2015) in order to estimate different fixed effects by age group and therefore different mental health profile curves for different age groups. Implementing this estimator will be the next step in our analysis, as well as extending our analysis to the other mental health disorders described above.

VARIABLES	(1) Pr(affective mood disorder)	(2) Pr(amd)	(3) Pr(amd)	(4) Pr(amd)
$t-4$			-0.0050***	-0.0040**
			[0.002]	[0.002]
$t-3$			-0.0035**	-0.0024
			[0.002]	[0.002]
$t-2$			-0.0011	
			[0.002]	
$t-1$			0.0004	0.0015
			[0.002]	[0.002]
t	**0.0029****	**0.0029***	**0.0014**	**0.0025**
	[0.001]	[0.002]	[0.002]	[0.002]
$t+1$		0.0042**	0.0027	0.0038*
		[0.002]	[0.002]	[0.002]
$t+2$		-0.0014	-0.0028	-0.0017
		[0.002]	[0.003]	[0.003]
$t+3$		-0.0024	-0.0038	-0.0027
		[0.003]	[0.003]	[0.003]
$t+4$		-0.0011	-0.0025	-0.0014
		[0.003]	[0.004]	[0.003]
$t+5$		-0.0020	-0.0033	-0.0022
		[0.004]	[0.004]	[0.004]
Constant	-0.0306	-0.0298	-0.0283	-0.0294
	[0.024]	[0.024]	[0.024]	[0.024]
Observations	96,777	96,777	96,777	96,777
R-squared	0.025	0.025	0.025	0.025

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table 4: Event Study regression of probability of being diagnosed with an affective mood disorder on having an abortion.

VARIABLES	(1) Pr(affective mood disorder)	(2) Pr(amd)	(3) Pr(amd)	(4) Pr(amd)	(5) Pr(amd)	(6) Pr(amd)	(7) Pr(amd)
Abortion in 2000	-0.0054						
	[0.005]						
Abortion in 2001		0.0035					
		[0.005]					
Abortion in 2002			-0.0040				
			[0.006]				
Abortion in 2003				0.0069			
				[0.010]			
Abortion in 2004					-0.0050		
					[0.011]		
Abortion in 2005						0.0080	
						[0.012]	
Abortion in 2006							0.0025
							[0.014]
Constant	0.1300*	0.0534	0.0942	0.0800	0.0499	-0.2288	-0.0033
	[0.069]	[0.074]	[0.059]	[0.155]	[0.148]	[0.157]	[0.188]
Observations	1,556	1,549	1,523	1,499	1,484	1,451	1,407
R-squared	0.075	0.136	0.058	0.103	0.096	0.109	0.101

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table 5: Quasi-Experimental control group regression of probability of being diagnosed with an affective mood disorder on having an abortion.

VARIABLES	(1) Pr(affective mood disorder)	(2) Pr(amd)	(3) Pr(amd)	(4) Pr(amd)	(5) Pr(amd)	(6) Pr(amd)	(7) Pr(amd)
Abortion in 2000	0.0019						
	[0.006]						
Abortion in 2001		-0.0031					
		[0.006]					
Abortion in 2002			-0.0110				
			[0.007]				
Abortion in 2003				-0.0103			
				[0.007]			
Abortion in 2004					-0.0050		
					[0.008]		
Abortion in 2005						-0.0094	
						[0.009]	
Abortion in 2006							-0.0058
							[0.010]
Constant	-0.0299	0.0605	-0.0528	0.2047***	-0.0640	0.0222	-0.1415*
	[0.049]	[0.068]	[0.045]	[0.064]	[0.065]	[0.080]	[0.082]
Observations	13,622	13,345	13,365	12,398	11,921	10,829	9,007
R-squared	0.040	0.042	0.041	0.045	0.049	0.052	0.051

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table 6:

VARIABLES	(1) Pr(affective mood disorder)	(2) Pr(amd)	(3) Pr(amd)	(4) Pr(amd)	(5) Pr(amd)	(6) Pr(amd)	(7) Pr(amd)
Abortion in 2000	-0.0002						
	[0.006]						
Abortion in 2001		-0.0005					
		[0.006]					
Abortion in 2002			-0.0145*				
			[0.008]				
Abortion in 2003				-0.0059			
				[0.008]			
Abortion in 2004					0.0022		
					[0.009]		
Abortion in 2005						-0.0065	
						[0.011]	
Abortion in 2006							-0.0091
							[0.011]
Constant	-0.0038	0.0293	0.0138	-0.0030	-0.0149	-0.0516	0.0225
	[0.044]	[0.072]	[0.044]	[0.079]	[0.063]	[0.072]	[0.149]
Observations	13,622	13,345	13,365	12,398	11,921	10,829	9,007
R-squared	0.022	0.023	0.022	0.020	0.023	0.022	0.021
N	1,824	1,800	1,809	1,714	1,760	1,710	1,572

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table 7: Quasi-Experimental control group regression of probability of being diagnosed with an affective mood disorder on having an abortion including individual fixed-effects.

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