Rellstab, Sara; Bakx, Pieter; García-Gómez, Pilar

Working Paper

Human Capital Formation: The Effect of a Miscarriage on Mental Health, Labour Market, and Family Outcomes

Tinbergen Institute Discussion Paper, No. TI 2022-027/V

Provided in Cooperation with:
Tinbergen Institute, Amsterdam and Rotterdam

Suggested Citation: Rellstab, Sara; Bakx, Pieter; García-Gómez, Pilar (2022) : Human Capital Formation: The Effect of a Miscarriage on Mental Health, Labour Market, and Family Outcomes, Tinbergen Institute Discussion Paper, No. TI 2022-027/V, Tinbergen Institute, Amsterdam and Rotterdam

This Version is available at:
https://hdl.handle.net/10419/263947

TI 2022-027/V
Tinbergen Institute Discussion Paper

The Effect of a Miscarriage on Mental Health, Labour Market, and Family Outcomes

Sara Rellstab[1,2]
Pieter Bakx[1]
Pilar Garciá-Gómez[1,3]

1 Erasmus University Rotterdam

2 Università della Svizzera Italiana

3 Tinbergen Institute

The Effect of a Miscarriage on Mental Health, Labour Market, and Family Outcomes

Sara Rellstab*[1,3], Pieter Bakx[2, 4], and Pilar García-Gómez[1, 4, 5]

[1]Erasmus School of Economics, Erasmus University Rotterdam
[2]Erasmus School of Health Policy and Management, Erasmus University Rotterdam
[3]Università della Svizzera Italiana, Lugano
[4]Erasmus Center for Health Economics Rotterdam, Rotterdam, the Netherlands
[5]Tinbergen Institute, Rotterdam, the Netherlands

29th March 2022

Abstract

We investigate the effect of a miscarriage on mental health care use, labour market and family outcomes of women and their partners using Dutch linked administrative data. Miscarriages are common and largely random conditional on age. We estimate event study models using women with a completed pregnancy as a control group. A first miscarriage increases women's use of mental health therapy compared to the control group. These effects disappear over time. Partners are equally likely to use any mental health care as the control group. There are differences in labour market outcomes and probability of living together.

1 Introduction

Around 15% of detected pregnancies end in a miscarriage (Quenby et al., 2021).[1] The high prevalence means that a miscarriage is part of life for many prospective parents (Freidenfelds, 2019). Miscarriages may become even more frequent in the future as an increasing number of couples delay childbirth, and the age of both the mother-to-be and the father-to-be are a risk-factor for miscarriage (Andersen et al., 2000; Kleinhaus et al., 2006).

Despite the high prevalence, there is limited evidence on the effects of a miscarriage on the mental health care use of the woman and her partner, and on potential spillovers

*Acknowledgements: We are grateful to the CBS for providing access to non-public microdata to conduct this study. We would like to thank Annemarie Mulders, Sebastian Tello-Trillo, Vahid Moghani, Fleur Meddens, Bettina Siflinger, colleagues at ESE and ESPHM at Erasmus University Rotterdam, the participants of the V-MESS seminar, the Essen Mental Health care workshop 2020, EALE 2021, and the economics department of the University of Lugano for helpful comments.

[1]A miscarriage is defined as a loss of pregnancy due to a delayed miscarriage or a spontaneous miscarriage in this study. This implies fetal death in the first 20 weeks of gestation (Dulay, 2019) and it is the most prevalent pregnancy complication.

to other aspects of life.[2] Mental health problems caused by a miscarriage may lead to a shift in preferences and expectations; and it may lower productivity on the labour market (Baranov et al., 2020; Biasi et al., 2021). While miscarriages are to a large extent unavoidable, the consequences may be attenuated by appropriate policy responses. Examining the consequences of a miscarriage beyond mental health is thus important as a first step towards defining these responses.

This paper analyses the effect of a miscarriage on mental health care use, labour market and family outcomes using linked administrative data. We identify about 13,000 childless women who went to the hospital for a miscarriage in the Netherlands in 2011-2016. We focus on this group because the mental health effect may be the largest for women who do not have children yet. We link data for these women to their partners, mental health care expenditures, psychotropic drugs prescriptions, labour market, and demographic characteristics, and follow them from two years before the event until two years after.

With our empirical analysis, we leverage that conditional on age, miscarriages are largely random (Quenby et al., 2021). We use the Sun and Abraham (2021) event study framework to estimate the effect of a miscarriage on the women's and their partners' mental health care use, women's labour market outcomes and the probability of a couple staying together. The main threat to our identification strategy is the existence of a pre-trend in the outcomes. This would be the case, for example, if women adjust their behaviour to become pregnant and this adjustment affects the outcomes as well as the probability of having a miscarriage. We overcome this concern using a matched group of women with a completed pregnancy as a control group. This provides a causal estimate as long as women with a miscarriage and matched women with a completed pregnancy adjust their behaviour equally before pregnancy. Our control group provides a relevant counterfactual of what would have happened in the absence of the miscarriage. However, women in the control group also face a life-changing event, as having a baby can impact mental health and labour market outcomes. Therefore, we proceed in two steps. First, we estimate a model comparing the treatment group of women with a miscarriage to the control group of women who complete the pregnancy. Second, we estimate separate event studies for both the treatment and the control group to rule out that the effect estimated at step one stems solely from the effect of having a baby (as experienced by the control group). Furthermore, we complement the causal analysis with a descriptive analysis exploring the role of (subsequent) fertility.

Our results show that in the year of the miscarriage, there is a 1.1 percentage point (or

[2] A miscarriage may lead to a mental health decline for a number of reasons. First, in the Netherlands most pregnancies are wanted or at least welcomed (Rijksinstituut voor Volksgezondheid en Milieu, 2021). A miscarriage may put a sudden end to the anticipation of having a (new member in the) family. Furthermore, the risk of a miscarriage may be underestimated (Banno et al., 2020; Quenby et al., 2021) and thus the loss may come as a shock. Moreover, many women think that the miscarriage is their fault, even though around 70-80% are caused by random non-viable chromosomal anomalities (Banno et al., 2020). These misconceptions are upheld also because it is not common to discuss miscarriages openly and only a minority of women share their experiences with their social environment (Bellhouse et al., 2018). This is slowly changing with social media and the internet. An increasing number of women share their loss online (Freidenfelds, 2019). In addition, technological progress has enabled women to detect pregnancies very early and has "fed the expectation that careful planning and loving care ought to produce perfect pregnancies", leading to the illusion that everything in life is projectable (Freidenfelds, 2019). Finally, despite evolving gender roles, motherhood is widely perceived as a cornerstone of female identity (Bell, 2019; Gillespie, 2003; Wager, 2000).

16%) increase in the probability of seeing a psychologist or a psychiatrist compared to women who complete their pregnancy. This effect does not persist longer than a year. One reason for this may be that many women have a baby relatively soon after the miscarriage - three years after the miscarriage around 70% of women have had their first child. It is unlikely that the effects we find for the year of the miscarriage are for example driven by a higher incidence of postpartum depression in the treatment group, because only 3% of women have a child in the same year as the miscarriage, when we measure the immediate effects. In addition, we find that women with a miscarriage increase the probability of using prescription drugs by 0.7 percentage points (or 10%) compared to the control group. Separate event study estimates for both the treatment and control group reveal that the increased probability of therapy use of women with a miscarriage is driven by an increase in therapy use of women with a miscarriage, and not a reduction in therapy use in the control group. In contrast, the increased use of prescription drugs is entirely driven by women with a completed pregnancy who reduced their use of prescription drugs in the year of the pregnancy. For male partners, we do not find any change in mental health care use after a miscarriage compared to a completed pregnancy. Beyond mental health care use, a miscarriage decreases the probability that a couple lives together by around 2 percentage points compared to women with a completed pregnancy. In addition, a woman's probability of having paid work and her earnings - conditional on paid work - increase after a miscarriage compared to the control group who has a child. However, this increase in mainly driven by a drop in the probability of having paid work and conditional income of the control group. Complementing descriptive evidence shows that women who do not have a child by three years after the miscarriage have the highest and a persisting increases in the probability of using mental health care. They are also the group for which the decrease in the probability to live together is largest and their income from work stagnates in the year of the miscarriage.

This paper contributes to two strands of the literature. First, several studies document that the mental health status of women deteriorates after a miscarriage (Brier, 2008; Broen et al., 2005; deMontigny et al., 2017; Farren et al., 2016; 2018; Nynas et al., 2015; Shreffler et al., 2011).[3] However, these studies provide associations and do not control for important pre-existing risk factors correlated with both the probability of a miscarriage and mental health. An exception is Jacob et al. (2017), who use data from a large group of German gynaecologist to match women with a miscarriage to a control group of women with completed pregnancies using fertility information and other pre-existing characteristics. They find that one year later, women with a miscarriage are 3 percentage points more likely to be diagnosed with depression, anxiety or adjustment disorder. Our setting allows to obtain estimates over a longer time period for a representative sample of the (Dutch) population, to control for pre-existing trends, and to consider spillovers to partners and other outcomes.

In particular, we can follow a large part of Dutch women who had a miscarriage and their partners over a longer time span (i.e. two years before up to two years after the

[3]There is a related literature on the mental health effects of voluntary abortions. Women who are pregnant but do not want a child can get an abortion in many developed countries. These women - and the situations they are in - are on average very different from women who plan to have a child but lose their pregnancy in a miscarriage. It is therefore plausible that abortions do not have the same effect as miscarriages. Janys and Siflinger (2019) evaluate the effect of an abortion on mental health and find no effect for Swedish women. Miller et al. (2020) find that being denied an abortion leads to increased financial distress for US women.

miscarriage) compared to many of the existing articles. This enables us to use an event study framework, where we implement recent advances in event study methods and where we verify the assumptions needed for a causal interpretation of the estimated parameters. This event-study framework also enables us to disentangle the impact of a miscarriage from pre-existing differences and thus produce more valid estimates of the impact.

In a recent series in the Lancet, Quenby et al. (2021) point out that apart from the need of causal studies on miscarriages and their effect on mental health, there is a lack of evidence on long-run economic outcomes. We are, to our knowledge, the first to provide this evidence by examining labour market and couple separation effects of miscarriages.

Furthermore, this is the first study to evaluate the role of subsequent fertility, which can potentially drive some of the mental health effects. This separation is important because the policy implications are different if the worsening in mental health is due to future fertility or lack thereof. Our results suggest that the mental health effects and accompanying labour market repercussions of women are worst among those who do not have a child two years after the miscarriage, while women who complete a pregnancy after a miscarriage are less strongly affected by mental health decline and do not experience labour market effects apart from the ones caused by the arrival of children. Finally, our focus is not only on women, but also the mental health of male partners who are often not considered by other studies.

Second, we contribute to the literature on the economics of grief that studies how bereavement affects economic outcomes. For example, Van den Berg et al. (2017) examine the economic impact of losing a child by estimating the effects on parental (mental) health, labour market and family outcomes. They compare parents who lose a child in an unexpected accident with a control group of parents whose children are in non-fatal accidents. They find significant declines in health, labour market and family outcomes, and put forward grief as the main explanation for this. For Finland and Norway, Breivik and Costa-Ramón (2021) report large earning reductions and mental health declines of parents after losing a child in an event study framework.[4] We contribute to this literature examining economic consequences of grief stemming from a different event that entails a loss for a large share of the adult working-age population. For example, there are about 100 times more miscarriages than fatal car accidents per year in the Netherlands (CBS, 2019a).

Our findings suggest there are women who have mental health problems after a miscarriage. Availability of care for these women is crucial, and since midwifes and gynecologists are not mental health experts, efficient communication and smooth referrals between providers are important to avoid discontinuities in care. Moreover, reducing the taboo around both miscarriage and mental health issues may be important, such that people concerned activate their support network, which may help them to deal with the loss.

[4]The death of the partner is also a distressing event. Becoming a widow is associated with a significant increase in the mental stress score from the general health questionnaire (Gardner and Oswald, 2006), and leads to long-lasting mental health declines (Siflinger, 2017).

2 Background

2.1 Miscarriages

2.1.1 Incidence

Miscarriages occur frequently: roughly 15% of all pregnancies end in a miscarriage (Quenby et al., 2021). This means that there are around 25,000 miscarriages annually in the Netherlands.[5] However, this number is merely a conservative estimate since not all miscarriages are recorded and very early miscarriages may not be detected. Miscarriages are usually detected in either of two ways: (i) a woman experiences abdominal pain or blood loss and sets a meeting with a midwife who may confirm the miscarriage through an ultrasound, or (ii) the midwife detects during an ultrasound that the heart of the fetus is not beating. Improved ultrasound technology and more frequent and early visits to midwifes mean that more miscarriages are detected than in the past (Freidenfelds, 2019). About 5% of couples trying to conceive experience two or more miscarriages (Rai and Regan, 2006). Women with a previous miscarriage are more likely to have another miscarriage than women with a live birth, but there is still a 90% chance to have a healthy baby after a miscarriage.

2.1.2 Causes and risk factors

Around 80% of miscarriages occur during the first trimester of pregnancy (ACOG, 2018; NHG, 2017a). It is estimated that up to 70-80% of miscarriages are due to chromosome abnormalities or a suboptimally functioning placenta (Banno et al., 2020; Kajii et al., 1980; NHS, 2018). While chromosome abnormalities occur at random, medical research suggests that there are several risk factors for miscarriages, including ethnicity (Mukherjee et al., 2013), the age of the mother (Andersen et al., 2000), the age of the father (Slama et al., 2005) and a number of lifestyle-related factors (NHS, 2018): obesity, smoking, high caffeine intake, and alcohol consumption. In addition, there is evidence that some types of medication increase the likelihood of a miscarriage; for many other types of medication, there is no conclusive evidence about reproductive toxicity.[6]

2.2 Health care in the Netherlands

2.2.1 Treatment of miscarriages in the Netherlands

Primary prenatal care is provided by licensed midwives, who may refer a pregnant woman to the gynaecology department of a hospital[7] in the case of a high-risk pregnancy or if complications arise, including if a miscarriage is suspected. Around two-thirds of all miscarriages are treated at the hospital (Verschoor, 2017); the others are not treated medically. After the miscarriage is confirmed at the hospital, the patient has three options for treatment: (i) waiting for a spontaneous miscarriage, (ii) using medication (misoprostol)

[5] There are around 170,000 babies born in the Netherlands annually (CBS, 2019b).

[6] For many types of medication that are unsafe or for which the side effects in humans are unknown, (imperfect) substitutes exist. The Dutch GP guidelines (NHG, 2012) suggest recommending pregnant women not to stop or start taking medication or to switch without consulting a doctor.

[7] There are no independent gynaecologists in the Netherlands and women cannot go to the hospital without a referral, except in case of emergency.

and (iii) removing the fetus surgically (curettage) (Verschoor, 2017).[8]

Treatment for prenatal care and miscarriages is covered by social health insurance in the Netherlands, as is standard medical care for pregnancy and childbirth. Enrolment in a social health insurance plan is mandatory, so all women who experience such a loss are covered under this scheme. Prenatal care visits and treatment of a miscarriage do not fall under the annual deductible of 385 € per year that all social health insurance plans have.[9]

2.2.2 Treatment of mental health problems in the Netherlands

There is no uniform protocol for the mental health follow-up after a miscarriage in the hospital (Verschoor, 2017); the Dutch guidelines for general practitioners (GPs), midwifes and gynecologists for miscarriage treatment recommend scheduling a follow-up meeting 4-6 weeks after the miscarriage (NHG, 2017a; NVOG, 2020).

The first step for getting mental health care is a meeting with the GP, who may decide to treat patients with mild mental health problems in their own practice or refer to a mental health care provider. Treatment by a mental health care provider requires a referral from the GP. Generally, treatment of mild mental health problems consists of therapy, medication or a combination of both (Rijksoverheid, 2020c). While there are no waiting times for GP care, there was an 8-9 weeks average waiting time for treatment of mild mental health problems by a mental health provider in 2018 (V&Z, 2020).

GP care is exempted from the deductible, medication prescribed by the GP and mental health care providers are not exempted. Medication for mild mental health problems is generally cheap (under 1 € per daily dose).

2.3 Sickness, maternity leave and labour market protection

Women with a miscarriage are not entitled to maternity leave when the loss happens before the 24th week of pregnancy (UVW, 2020c). If the woman is reporting sick due to the miscarriage, she is covered by social security (specifically, by the *ziektewet*) and 100% of her salary is paid, capped at a maximum daily salary of 220 € in 2020 (Rijksoverheid, 2020a; UVW, 2020a). These benefits are paid until the woman has recovered, with a maximum of two years (Rijksoverheid, 2020b). She cannot be laid off during this period (UVW, 2020b). There is no information about how often women report sick after a miscarriage.

3 Data

We use hospital data from Statistics Netherlands (CBS) to identify the population of women with a miscarriage treated in the hospital between 2011 to 2016. We then link their

[8] There are no national-level guidelines about which type of treatment is to be preferred. Treatment usually starts in an outpatient or day-care setting; surgery is sometimes done in an inpatient setting. Misoprostol treatment and waiting are more cost-effective than curettage and have a lower risk of complications limiting the women's fertility, but are not always successful; 30% of the misoprostol treatments are followed by curettage (Verschoor, 2017).

[9] Individuals may choose to increase to a maximum of 885 € in return for an insurance premium discount.

Table 1: Number of miscarriages per year treated in a hospital

Year	Miscarriages	Data Set	Births	Estimated number of miscarriages in NL	% of observed miscarriages in the data
2011	8,748	LMR	180,060	$\approx$ 27,000	$\approx$ 35%
2012	5,288	LMR	175,959	$\approx$ 27,000	$\approx$ 22%
2013	7,986	LBZ	171,341	$\approx$ 26,000	$\approx$ 34%
2014	7,442	LBZ	175,181	$\approx$ 26,000	$\approx$ 32%
2015	7,765	LBZ	170,510	$\approx$ 26,000	$\approx$ 35%
2016	7,186	LBZ	172,520	$\approx$ 26,000	$\approx$ 32%

Note: All miscarriages observed in the Dutch administrative data. Two data sets are used: the *LMR (Landelijke Medische Registratie)* hospital data for the years 2011-2012, and the *LBZ (Landelijke Basisregistratie Ziekenhuiszorg)* data for the years 2013-2018. The reason for a declining number of miscarriages in 2012 is hospital attrition from the LMR. The reason for the lower numbers of miscarriages in 2013-2018 is that in these years diagnoses were not reported for some hospital admissions. The number of miscarriages in the Netherlands is calculated based on the estimate that around 15% of all recognised pregnancies end in miscarriage (Quenby et al., 2021). *Source:* Statline (2019); LMR; LBZ.

consumption of mental health care (2009-2018), family links, demographic information, and income (2009-2018) and construct a yearly panel.[10] Table A1 in the Appendix gives an overview of the data sets used in this study. We focus on all women going to the hospital between 2011 and 2016 due to their first miscarriage that we observe, i.e. we drop those observations with a previous recorded miscarriage using the hospital data from 2009. We further select women aged between 20 and 45 without children. We construct a balanced panel in time away from the miscarriage and follow women from two years before their first miscarriage up to 2 years after.

In the hospital data, we can identify all miscarriages treated either as a day care admission or as inpatient care, but we do not observe outpatient visits. We also have precise information on the date of the miscarriage, but not the gestational length or any other information about the pregnancy. Table 1 shows the number of miscarriages treated in the hospital per year and compares this to the number of births in the same year. The last two columns of the table are based on estimates and can therefore only be reported approximately. It is estimated that around 15% of all recognised pregnancies end in miscarrige (Quenby et al., 2021). Using the number of births per year allows us to calculate that there must have been around 26,000-27,000 miscarriages per year during the study period in the Netherlands. This means that the number miscarriages covered by the data as a proportion of the estimated number of total miscarriages in the Netherlands is relatively stable over time and varies between 30-35%. There are fewer miscarriages in the data for the year 2012, as many hospitals did not provide information in that year. Due to concerns about non-random selection of hospitals in 2012, we do not include the 2012 miscarriage cohort in our analysis.

We include two types of miscarriages in our study. The most frequent type of miscarriage in our data is a delayed miscarriage (66%), which indicates a fetal death without

[10]Despite observing the exact date of the hospital treatment for the miscarriage, both mental health care and income data is in yearly format. Therefore, we use yearly data in our analysis.

expulsion (yet) (Dulay, 2019; Farquharson et al., 2005). This is the typical case treated in the hospital, since fetal death has been established, but the miscarriage has still to be completed. The other 33% of women go to the hospital for a spontaneous miscarriage, implying fetal death and (partial) fetal expulsion. Even though we only observe miscarriages that are treated in the hospital in an inpatient setting, this does not imply that these are the more serious or severe cases: the midwife always refers the patient to the hospital when diagnosing an incomplete miscarriage.

In addition to women with a miscarriage, we include a control group of women who give birth to a child. In the municipality registers, we observe all children born in the Netherlands. We link them to their mothers, and select women aged 20 to 45 who are pregnant at the same time as the women with a miscarriage. Some women will experience both a miscarriage and give birth to a child. We classify women in the following way. Women who have a miscarriage only, or who have a miscarriage first and their first child later are in the miscarriage (treatment) group. Women who have children only, or who first have a child and then a miscarriage are in the control group.[11] We do not observe the gestational week for the treatment group, neither the gestational length for the control group. We define the event time as follows. For the treatment group, we use exact month in which the miscarriage occurs. For the control group, we assume a full term, i.e., 9 months, and define event time after the second month of the pregnancy as miscarriages are most likely in the first trimester. Our results do not depend on this exact definition as we use yearly aggregates in all our estimates as the main outcome variables are only observed at the year level.

The outcomes of interest are mental health care use, and labour market and couple separation outcomes. For mental health care use, we use two different data sources. First, we have information on total mental health care expenditures, which mainly include costs of psychologists or psychiatrist visits (not including costs for medication).[12] We construct two variables regarding mental health care costs: i) a binary indicator of having any expenditure for therapy in a year (any therapy); ii) the total annual mental health care expenditures (in inflation adjusted Euros) conditional on any use (conditional therapy costs). Second, we use information on prescriptions for psychotropic medication. At the individual level, we know for every prescribed medication (at the Anatomical Therapeutic Chemical Classification System (ATC) level 4) covered by public health insurance[13] whether it has been dispensed by a pharmacy. We include four types of psychotropic drugs in our analysis: anti-psychotics (ATC code N05A), anxiolytics (N05B), hypnotics and sedatives (N05C), and anti-depressants (N06A).[14] These drugs are used to treat mental illnesses like schizophrenia, bipolar disorder, anxiety, insomnia, chronic pain and depression and must be prescribed by a physician, for example a GP or a psychiatrist. For the main analysis, we combine these four types of drugs into one indicator for taking

[11] Since we do not observe all miscarriages in the Netherlands, some women in the control group may have had a miscarriage in the past. Similarly, we may not observe the first, but a subsequent, miscarriage for some women in the treatment group. Any effects in previous years caused by these miscarriages will be part of the estimated pre-event effects. As long as they are similar for treated and control women, our empirical strategy with a control group will control for those.

[12] This does not include mental health care provided at the GP practice.

[13] The only main category of psychotropic medication that is usually *not* covered by basic health insurance are benzodiazepines.

[14] We can observe if these types of medications were dispensed at least once, but we do not have information about the number of doses.

any psychotropic drugs, but report the disaggregated results in the Appendix (see Figure A1 and A2). Finally, since psychotropic drug use and therapy are not always combined, we construct an indicator for any mental health care use, which is equal to one if the person has mental health care expenditure for therapy *or* uses psychotropic drugs.

A miscarriage may not only affect the woman experiencing the loss, but her partner as well. Men also report grief reactions to miscarriages (Obst et al., 2020; Williams et al., 2019), yet there may be less space for their grief because they are seen as the main supporter for their partner rather than a patient. There is evidence that men also suffer from mental health effects after a miscarriage, but their mental health reaction is less pronounced than for women (Cumming et al., 2007; Volgsten et al., 2018). We define partners based on information on households. Partner can consist of married or registered partners living together with the woman. Furthermore, since not all couples are married or registered, we assume that when a woman lives with one man only that this is her partner. Using this definition, 91% of women have a male[15] partner at the time of the miscarriage. We link information on the mental health care use of these partners and follow them over time as well (independently of whether the couple stays together).

Mental health problems are particularly disabling (Layard, 2017), and can have severe labour market consequences (Biasi et al., 2021). There is evidence that a miscarriage leads to an increase in absenteeism and to a decrease in productivity at work (Lemmers et al., 2018; Petrou et al., 2006). Therefore, we also investigate two labour market outcomes retrieved from tax registers: the probability of having paid work at some point during the calendar year and total income from work conditional on having paid work. We hypothesise that labour market effects would mainly be driven by mental health and grief, as there are usually no long-lasting physical consequences of a miscarriage. Having paid work includes being employed or self-employed, defined as having any income from work. Total conditional income from work includes gross earnings from employment and self-employment for the women who have paid work.

Last, we are interested in the effects on couple separations, because there may be discrepancies in coping style and time spent grieving between partners (Carter et al., 2007), and because worse mental health (or stress) may increase the probability of breaking up with one's partner. We investigate couple dynamics with an indicator for living together in the same household.

Table 2 shows descriptive statistics for the two years before and the year of pregnancy after applying a CEM weighting technique (see Section 4 for details on the weights) that make women who complete the pregnancy comparable to women with a miscarriage in age, calendar year, fertility treatment, employment status and income quintiles.[16] For both two years before and the year of the event, we report weighted averages for both groups and their standardised differences. A standardised difference above 0.1 indicates imbalance in covariates (Stuart et al., 2014). The two groups seem balanced before the event. About 11% (9%) of women with a miscarriage (completed pregnancy) use mental health care. Around 55-60% of these women have mental health care expenditures, indicating at least one visit to a psychologist or psychiatrist. About 5-7% of women use psychotropic

[15] We exclude female partners because there are large differences in mental health care patterns between men and women (Affleck et al., 2018), and the small sample of female partners prevent us from estimating any effects on this group.

[16] The unweighted version of the Table can be found in Table A3.

drugs reimbursed by health insurance, among which the most common drugs are anti-depressants. Before the miscarriage, women in our sample have similar mental health care use pattern as the overall Dutch population of women aged 25-39 (See Table A2 in the Appendix for detailed population summary statistics on women's mental health).[17] Partners are less likely to use mental health care (5-6%), only 3% have expenditure for therapy and 3% use psychotropic drugs. A large majority of women is employed before the miscarriage, with about 37,000 € annual income. About 70% live together with their partner.

Comparing the situation before the miscarriage to the year of the miscarriage, mental health care use stays similar after the miscarriage for almost all measures, for both women and their partner. Income from work increases, and women are slightly more likely to be employed. The proportion of women living with their partners increases to 89%.

4 Empirical strategy

To evaluate the effect of a miscarriage on the outcomes, we compare women with a miscarriage (the treatment group) to women at a similar stage in pregnancy who complete the pregnancy (the control group) in an event study framework. Our data consists of a yearly panel of women that are pregnant at different points in time, forming cohorts. For example, all women who are pregnant in 2013 and either have a miscarriage or have a live birth belong to the 2013 cohort. We balance the panel in event time from two years before the miscarriage up to two years after.[18] As explained above, the event is defined as having a miscarriage for the treatment group and 2-months pregnant for the control group.

Women who will complete their pregnancy are an ideal control group for women with a miscarriage because these women are at the same stage of their pregnancy as the women with the miscarriage, but they do not lose their pregnancy and give birth to a baby. This group exactly depicts the situation of what would have happened had there not been a miscarriage. The disadvantage of this control group is that having a baby is a life-changing event that potentially affects all of our outcomes.[19] For example, women with a baby may suffer from postpartum depression or earnings penalties because of having a child. To determine whether the estimated effects are driven by changes in the treatment group and not only by changes in the control group, we also estimate models for women with a miscarriage and women who will complete their pregnancy separately.

In Equation 1, we regress each of our outcome variables y_{it} on i) time away from the

[17] As a comparison with self-reported health measures, 14% of Dutch women aged 25-45 in 2018/19 report to be in bad mental health (defined as having a Mental Health Inventory score below 60) (Statline, 2020).

[18] If we did not balance the panel in event time, the event time coefficients would not be comparable to each other since they would be based on different cohorts of women. For example, the first and last event time coefficient would be based solely on one cohort of women - the last or the first to be pregnant in our data.

[19] We could also use women with a miscarriage in the future as the control group. However, we believe that this control group is less appropriate. Women who are trying to get pregnant may behave differently from women who do not. This implies that using women who will only try to get pregnant in five years time may behave differently than women who are trying to have a baby now, and hence a control group of women with a future miscarriage may be less comparable in pre-miscarriage unobservable trends than women who will have a baby.

Table 2: Summary statistics before and after the first pregnancy (CEM weighted)

	2 years before the pregnancy			**Year of the pregnancy**		
	Mean miscarriage	Mean completed pregnancy	Std Diff	Mean miscarriage	Mean completed pregnancy	Std Diff
Mental health						
Any MHC	0.11	0.09	0.05	0.11	0.08	0.10
Any therapy	0.07	0.05	0.04	0.08	0.05	0.07
Cond. therapy costs	3,250	3,410	-0.01	2,950	2,931	0.00
Psychotropic drugs	0.07	0.05	0.05	0.06	0.04	0.07
Anti-psychotics (N05A)	0.01	0.01	0.02	0.01	0.01	0.04
Anxiolytics (N05B)	0.01	0.01	0.03	0.01	0.01	0.04
Hypnotics & sedatives (N05C)	0.01	0.00	0.02	0.01	0.00	0.03
Antidepressants (N06A)	0.06	0.04	0.05	0.05	0.03	0.06
Demographics						
Age	28.78	28.78	0.00	30.78	30.78	0.00
Age partner	31.71	31.67	0.01	33.48	33.31	0.02
Lives with partner	0.71	0.69	0.02	0.89	0.89	0.00
Separation	0.05	0.05	0.02	0.03	0.02	0.04
Number of children	0.00	0.00	n.a.	0.03	0.45	-0.79*
Fertility treatment[a]	0.00	0.00	0.00	0.01	0.01	-0.01
Dutch	0.74	0.71	0.04	0.74	0.71	0.04
Surinamese	0.03	0.02	0.00	0.03	0.02	0.00
Antilles/Aruba	0.01	0.01	0.01	0.01	0.01	0.01
Morocan	0.02	0.03	-0.01	0.02	0.03	-0.01
Turkish	0.03	0.03	-0.01	0.03	0.03	-0.01
Western	0.11	0.13	-0.04	0.11	0.13	-0.04
Non-western	0.07	0.07	-0.01	0.07	0.07	-0.01
Labour market						
Employed	0.89	0.88	0.02	0.90	0.88	0.03
Income from work	36,770	37,283	-0.01	39,163	39,515	-0.01
Mental health partner						
Any MHC	0.06	0.05	0.01	0.06	0.05	0.02
Any therapy	0.03	0.03	0.01	0.03	0.03	0.02
Cond. therapy costs	4,174	3,545	0.04	3,927	3,129	0.05
Psychiatric drugs	0.03	0.03	0.01	0.03	0.03	0.01
Anti-psychotics (N05A)	0.01	0.01	0.00	0.01	0.01	0.00
Anxiolytics (N05B)	0.01	0.01	0.01	0.01	0.01	0.01
Hypnotics & sedatives (N05C)	0.00	0.00	0.00	0.00	0.00	0.01
Antidepressants (N06A)	0.02	0.02	0.01	0.03	0.02	0.01
Treatment cohort						
Cohort 2011	0.21	0.21	0.00	0.21	0.21	0.00
Cohort 2013	0.22	0.22	0.00	0.22	0.22	0.00
Cohort 2014	0.19	0.19	0.00	0.19	0.19	0.00
Cohort 2015	0.20	0.20	0.00	0.20	0.20	0.00
Cohort 2016	0.18	0.18	0.00	0.18	0.18	0.00
N	13,347	385,077		13,347	385,077	

Note: Summary statistics two years before and in the year of the first pregnancy using CEM weights that make women who complete the pregnancy comparable in age, year, fertility treatment, employment status at $t-1$, and quintiles of average income in $t-1$ and $t-2$ to women with a miscarriage. * $|\text{StdDiff}| > 0.1$ (Stuart et al., 2014). Standardised difference StdDiff=$\frac{\bar{X}_{G1}-\bar{X}_{G2}}{(\hat{\sigma}^2_{G1}+\hat{\sigma}^2_{G2})^{0.5}}$ where $\bar{X}_{G1}$ corresponds to the group mean of variable X, and $\hat{\sigma}^2$ to the estimated variance.

[a] This variable includes only fertility treatment before the event.

miscarriage $eventtime_{it}$ (set to zero for the control group); ii) calendar year fixed effects $year_{it}$; iii) two years age groups from 18-19 to 46-47 $agegroups_{it}$; and iv) individual fixed effects α_{it}.

$$y_{it} = \alpha_i + \sum_{\substack{k=-2 \\ k\neq -1}}^{2} \beta^k \mathbb{1}[eventtime_{it} = k] + \sum_{l=2010}^{2018} \gamma^l \mathbb{1}[year_{it} = l] + \sum_{\substack{m=1 \\ m\neq 8}}^{15} \delta^m \mathbb{1}[agegroup_{it} = m] + \varepsilon_{it} \tag{1}$$

The event-time coefficients β^k enable us to study the effect of a miscarriage over time compared to the control group and the situation one year before the miscarriage (the base category for event time is -1). Age groups pick up average changes across age groups over event-time. The individual fixed effects capture person-specific unobservables. Together, these two sets of controls allow to capture risk-factors increasing the chance of a miscarriage that potentially also interact with mental health and the other outcomes of interest. Calendar-year fixed effects capture calendar-year effects such as a changing trend in the treatment of miscarriages, mental health problems, or business cycle effects.

Recent econometrics literature points out that two-way fixed effect estimates with variation in treatment timing like in this study can be distorted in the presence of effect heterogeneity by treatment cohort (e.g. Sun and Abraham, 2021). We take this into account by implementing the estimator proposed by Sun and Abraham (2021).[20] This implies that we estimate equation 1 by cohort, and take averages of the coefficients by event time weighted by cohort size. Then, we bootstrap standard errors of this weighted average with 50 replications. In the main text, we only present these aggregated results, but complete results by cohorts can be found in Appendix 6.1.

The two main identifying assumptions are: i) cohort-specific parallel trends in the absence of treatment; and ii) no anticipation of treatment by cohort (Sun and Abraham, 2021). These are partly testable using the pre-trends. If these pre-trends are zero, this is evidence that assumptions i) and ii) are met in the pre-treatment period.[21] It is likely that assumption i) and ii) hold in our application, since miscarriages are largely random conditional on parental age at conception. Therefore, given that women are trying to get pregnant, a miscarriage is exogenous once we control for risk factors that may be related to both the outcomes and a miscarriage. Individual fixed effects allow us to further control for those. We test assumption i) and ii) in pre-treatment periods and check whether there are differences in the trends in the pre-treatment period by treatment cohorts in section 6.1. In case that one or more cohorts violate the assumption, we re-aggregate the results without the cohorts violating the assumptions and show that our results remain similar.

Women with a miscarriage are on average older than women who have a baby. They are also more likely to have undergone fertility treatment. In order to give more weight to

[20] We document this distortion by comparing our results using the Sun and Abraham (2021) estimator to two-way fixed effect estimates in Figures A3-A5. The most relevant estimate for our results, the coefficient for event time zero is often different between the two models, and the largest differences are for labour market and couple dynamics outcomes.

[21] Sun and Abraham (2021) derive the identifying assumptions for a model without covariates. We check the robustness of our results to dropping the age groups indicators as controls and find no difference in results (see Appendix A1.9).

the women in the control group that are similar to women in the treatment group, we use a coarsened exact matching (CEM) procedure (King and Nielsen, 2019). CEM matching is an exact matching algorithm that achieves similar goals as propensity score matching, but is preferable when one has a large data set (or relatively few dimensions to match on). We match on age one year before the event, calendar year, fertility treatment in the year before the event or in the year of the event,[22] employment status one year before the event, and quintiles of the average personal income from work in two and one year before the event.[23] A more detailed description on the implementation of CEM weighting can be found in Rellstab et al. (2020). We apply the CEM weights to all analyses.

An additional empirical challenge is that most women get pregnant relatively quickly after their miscarriage: about 70% of the women in our sample have their first child within 3 years after the miscarriage. Therefore, any effect of a miscarriage that we estimate may also be driven by subsequent fertility and the effects this may have on mental health (postpartum depression) or labour market outcomes (earnings penalties). Comparing the separate results for women with a miscarriage to the results for women who complete their pregnancy will provide insight into what the effect of subsequent fertility may look like. At event time zero, relatively few women who had a miscarriage in the same year already gave birth (3%), so the estimate for this point in time is the most likely to reflect the impact of the miscarriage and not subsequent fertility.

5 Mental health and labour market effects of a miscarriage

5.1 Mental health

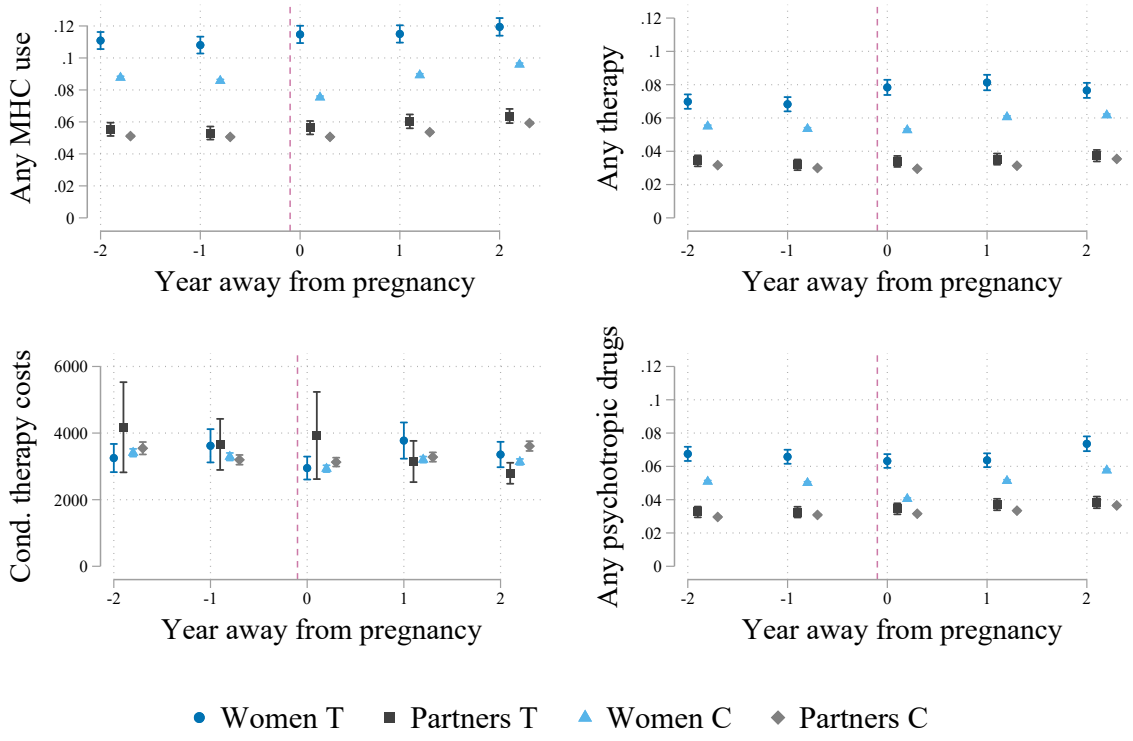
Descriptive results Figure 1 shows mental health care use before and after a pregnancy leading to miscarriage or a baby, for women and their partners. In the two years before the miscarriage, mental health care use is stable, and there is no indication of a trend before the event. From time zero (i.e. at the miscarriage) up to one year after, the probability of using any mental health care increases from 11% to 12%. The proportion of having any therapy increases from 7% to 8% after the miscarriage. Average therapy costs conditional on use remain stable around 300 € with a temporary dip to 3500 € in the year of the miscarriage. The percentage of women using psychotropic drugs is at 7% before the event, decreases to 6% in the year of the miscarriage, and increases back to 7% by two years after. The most widely used psychotropic drugs in the sample are anti-depressants (see Figure A1).

The descriptive trends for women with a completed pregnancy are weighted by CEM weights making them comparable to the women with a miscarriage on the dimensions of age, fertility treatment, calendar year, and pre-event employment and income. The women with a completed pregnancy use on average about 2 percentage point less mental health care, but their trends in the pre-event period are very similar to women who have a

[22] We know the exact date of the miscarriage/birth of the child and the fertility treatment, so we only consider fertility treatment that was administered before the event.

[23] This gives us 26 age categories x 5 calendar year categories x 2 fertility treatment categories x 2 employment categories x 5 income categories, or in total 2600 possible strata. Out of these, 927 contain at least one treated individual. Since our control group is large, only 75 treated individuals are outside the common support. All others can be matched to at least one individual from the control group.

Figure 1: Descriptive trends in mental health care use around a miscarriage (T) or two months pregnant (C)



Note: Descriptive trends of women with a miscarriage and their partners (treatment group T), and women who complete their pregnancy and their partners (control group C). The miscarriage or the 2 month pregnancy mark happens at event time zero. CEM weights are applied, making the women who have a baby comparable to the women with a miscarriage on the dimensions of age, calendar year, fertility treatment, pre-event employment and income quintiles. 95% confidence intervals are depicted. $N_{T(women)} = 13,347$; $N_{C(women)} = 385,077$; $N_{T(partner)} = 11,650$; $N_{C(partner)} = 330,643$.

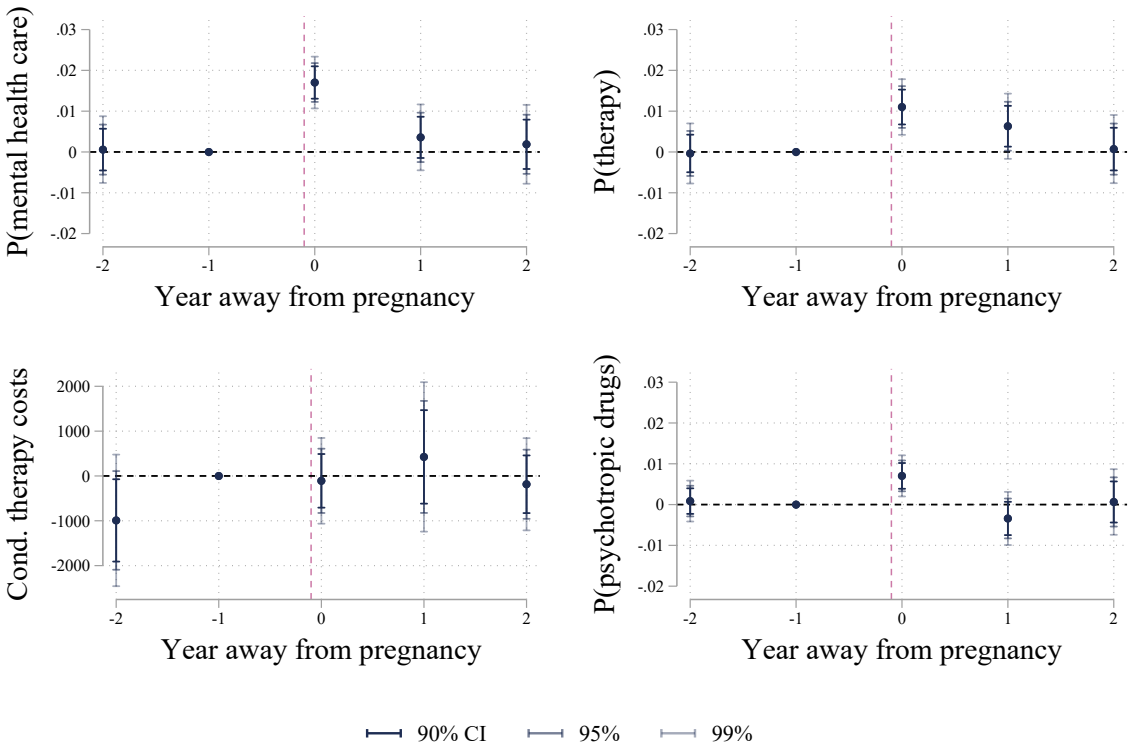
miscarriage. Women with a completed pregnancy experience a decline in the probability of using any mental health care in the year of the pregnancy. This decline is mainly driven by a decrease in the probability to use psychotropic drugs. The probability of using therapy remains stable, and conditional on therapy use, average therapy costs decline in the year of the pregnancy. Two years after the pregnancy, all the mental health care outcomes have restored to initial levels or are even higher than before the pregnancy.

Compared to the women, their partners are less likely to use mental health care. This is in line with the finding that men use mental health services less frequently than women, and that they are less likely to be diagnosed with anxiety or depression (Affleck et al., 2018). The probability of using any mental health care remains stable before their partner's pregnancy, and increases slightly thereafter, and so do the probability of therapy and the probability of using medication. Conditional on mental health care use, average mental health expenditures are similar for men and women in our sample. The year of the miscarriage, partner's mental health care expenditures remain stable, and decrease afterwards. Both groups of partners have a similar mental health care use pattern over time.

Event study results Figure 2 shows the results of the Sun and Abraham (2021) estimator, comparing the mental health care use pattern of women with a miscarriage to women who complete their pregnancy. In the year of the miscarriage, women with a miscarriage are 1.7 percentage points more likely to use any mental health care, 1.1 percentage point more likely to use therapy, and 0.7 percentage points more likely to use psychotropic drugs than women who complete the pregnancy. Since the baseline use of therapy is relatively low, these effects are large when comparing them with the average use in event time -1. The relative use of any mental health care increases by 15%. This relative effect amounts to 16% for therapy, and 10% for the probability of using psychotropic medication. These effects only manifest in the year after the miscarriage and do not persist over time. Therapy costs conditional on having any therapy remain stable after the miscarriage, indicating that therapy intensity does not change after the miscarriage.

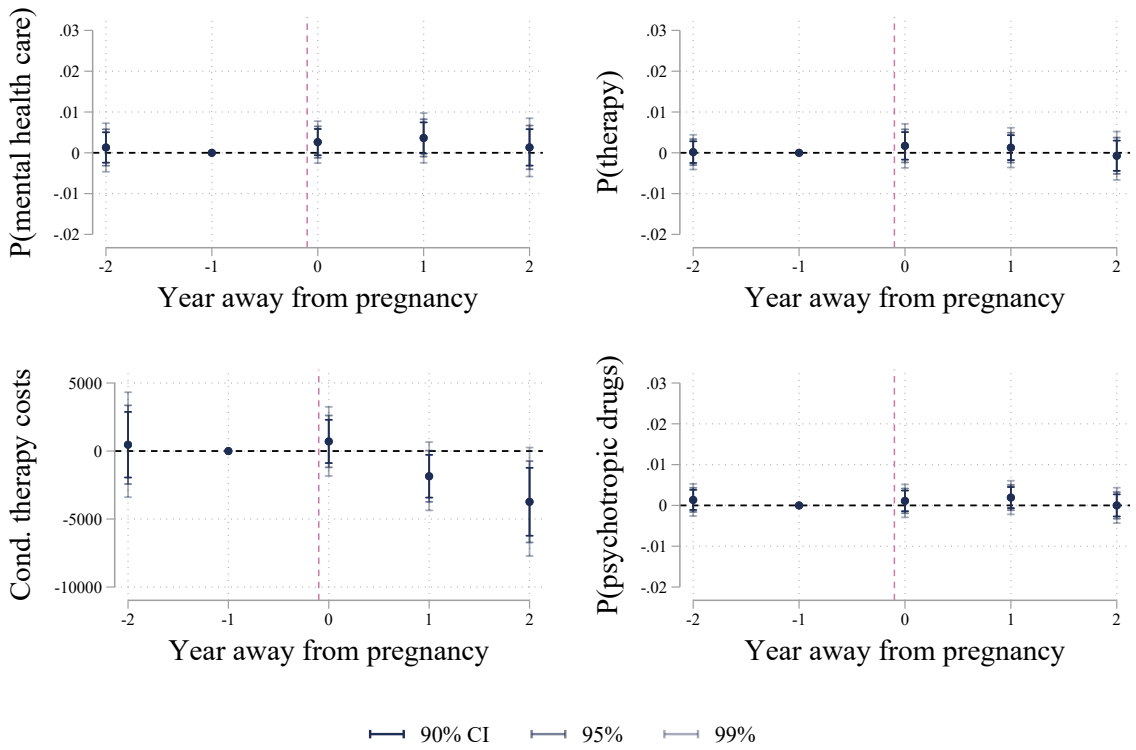
In Figure 2, we compare women with a miscarriage to women with a completed pregnancy. To exclude that the effect we estimate stems from changes in the control group only, Figure A6 shows the results by group. At event time zero, these separate results show that women with a miscarriage increase their mental health care use in this period, and women who complete a pregnancy decrease their use. This finding implies that women with a miscarriage still increase their mental health care use in the year of the miscarriage, even though the results in Figure 2 (with the control group) may partly be driven by a decrease in mental health care use of women who complete their pregnancy. In the years after the event, mental health care use increases for both groups, leading to a point estimate close to zero when comparing both groups in the control group approach. Unfortunately, we cannot disentangle which part of the increase in later years is because having a miscarriage or a baby affects mental health care use and which part is due to changes in other unobserved factors (i.e. an increase that would have happened in the absence of the event). However, the lack of pre-trends before the event for both the treatment and the control group in the separate analysis implies it is unlikely that the increase after a miscarriage or complete pregnancy is driven (exclusively) by other unobserved factors. Hence, the estimates using a control group probably underestimate the true effects of a miscarriage.

Figure 2: The effects of a miscarriage on women's mental health care use



Note: Estimates of β^k (Equation 1) using the reweighting estimator of Sun and Abraham (2021) where women with a completed pregnancy are a control group for the treatment group of women with a miscarriage. The control group is CEM weighted in order to have a comparable age, fertility treatment, calendar year, pre-birth employment and income quintile distribution as the women with a miscarriage. 90, 95, and 99% confidence intervals are reported, and event-time -1 is the reference period.

Figure 3: The effect of a miscarriage on partner's mental health care use

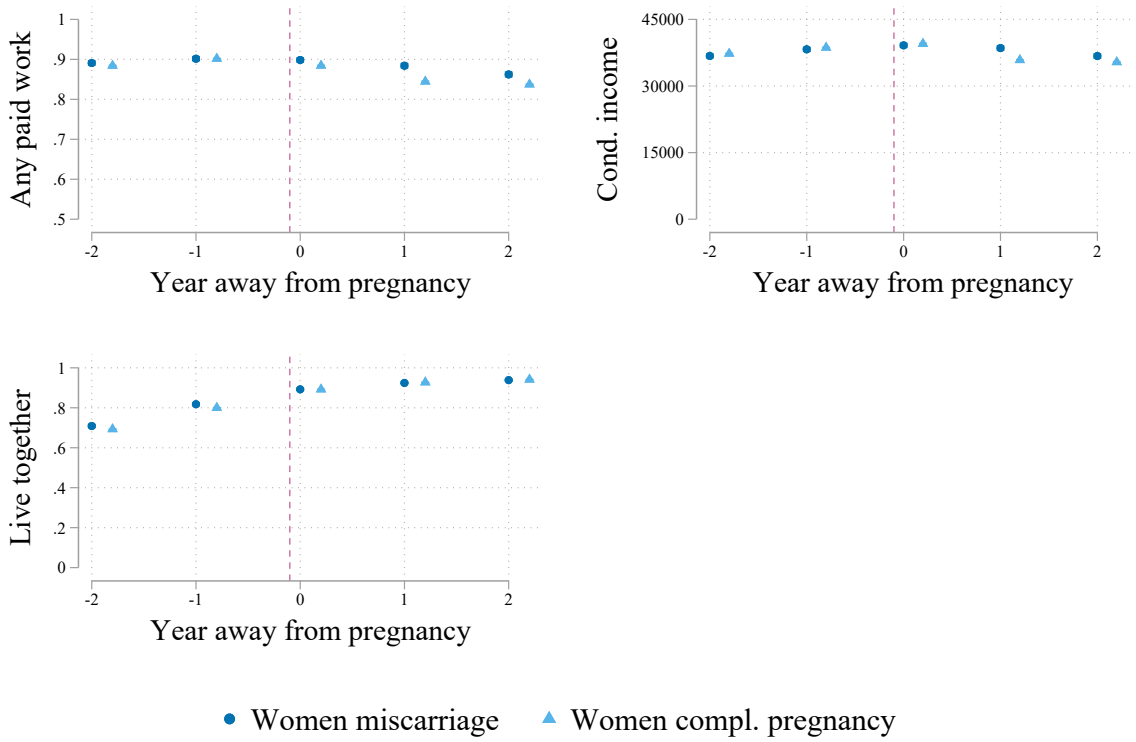


Note: Estimates of β^k (Equation 1) using the reweighting estimator of Sun and Abraham (2021) where women with a completed pregnancy are a control group for the treatment group of women with a miscarriage. The control group is CEM weighted in order to have a comparable age, fertility treatment, calendar year, pre-birth employment and income quintile distribution as the women with a miscarriage. 90, 95, and 99% confidence intervals are reported, and event-time -1 is the reference period.

Examining the components of mental health care use, the estimated effects in any mental health care use at event time zero stem from different sources for the two groups: women with a miscarriage are likely to increase their use of therapy, while women who complete their pregnancy do not change their use of therapy. In contrast, women with a miscarriage do not change their medication use after a miscarriage, while women who complete their pregnancy are less likely to use medication in the year of the pregnancy. Both groups of women are more likely to get therapy in the first and second year after the event, and to use psychotropic drugs in the second year after the event. Therefore, increasing trends in later event times are differenced out in the control group approach. Conditional therapy costs of both groups are negative and develop relatively similarly, leading again to a zero estimate when combining the two groups.

The mental health care use of partners is not affected by a miscarriage when compared to partners having a baby (Figure 3). Figure A7 shows the event time estimates for the two groups of partners separately. The probability of of any mental health care use increases for both groups only one year after the event. This is driven by both probability of therapy and the consumption of prescribed psychotropic drugs for males with a baby, while only the probability of consuming prescribed psychotropic drugs increases for males after a miscarriage. The differences in these patterns are not large, so they cancel each

Figure 4: Descriptive trends in labour market and family outcomes around a miscarriage



Note: Descriptive trends of women with a miscarriage and women who complete their pregnancy. The miscarriage or the 2 month pregnancy mark happens at event time zero. CEM weights are applied, making the women who have a baby comparable to the women with a miscarriage on the dimensions of age, calendar year, fertility treatment, pre-event employment and income quintiles. 95% confidence intervals are depicted. $N_{T(women)} = 13,347$; $N_{C(women)} = 385,077$.

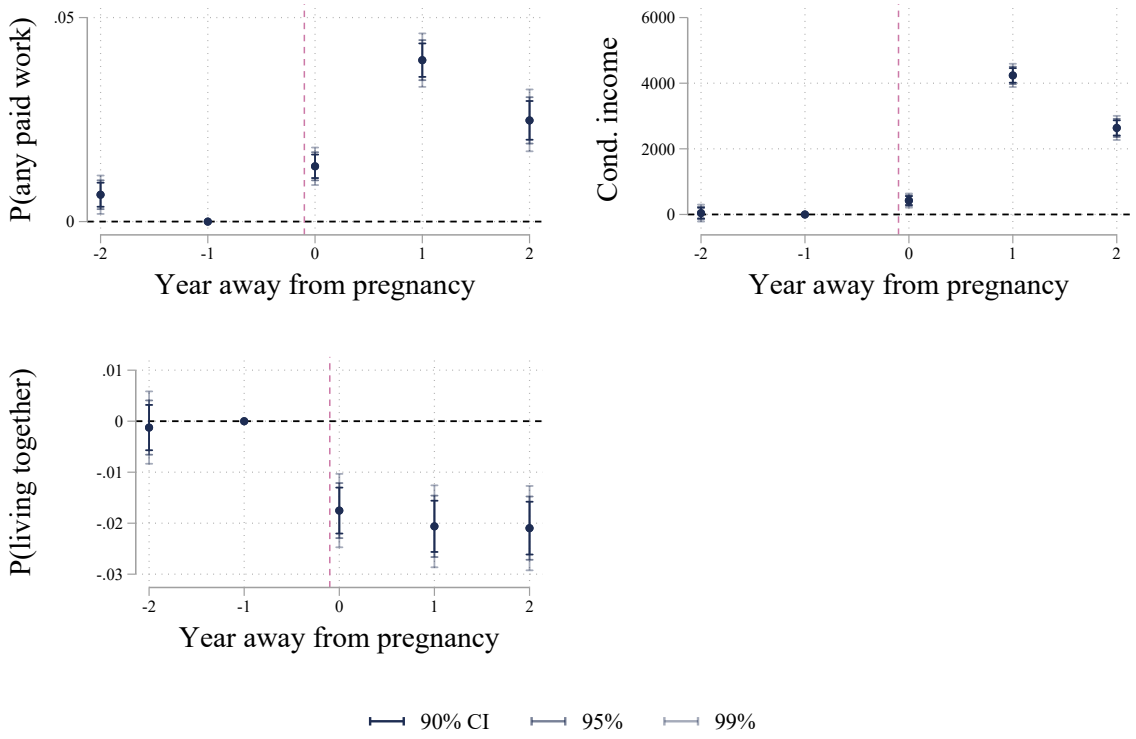
other out in the combined approach.

5.2 Labour market and couple dynamics

Descriptive results Figure 4 plots the descriptive trends for labour market outcomes for women with a miscarriage and women who complete the pregnancy. Trends in employment are stable for both groups before the event. After the event, the proportion of women with a miscarriage having any paid work decreases slowly from 90% before the miscarriage to 86% two years after the event, whereas there is about a 6 percentage points drop for women who complete the pregnancy between event time minus one and one year after the pregnancy.

Both women who have a miscarriage and who complete the pregnancy have similar earnings in the period before the event of about 38,000 €, and the trend before the event is slightly increasing for both groups. After the event, there is a drop in income for women who have a baby to 35,000 €. The income of women with a miscarriage slowly decreases to 37,000 € by event time 2. The proportion of couples living together increases for both groups before the event, and keeps increasing after the event, although at a lower pace, up to 94%.

Figure 5: The effect of a miscarriage on labour market and couple dynamics



Note: Estimates of β^k (Equation 1) using the reweighting estimator of Sun and Abraham (2021) where women with a completed pregnancy are a control group for the treatment group of women with a miscarriage. The control group is CEM weighted in order to have a comparable age, fertility treatment, calendar year, pre-birth employment and income quintile distribution as the women with a miscarriage. 90, 95, and 99% confidence intervals are reported, and event-time -1 is the reference period.

Event study results Figure 5 shows the regression results for labour market outcomes and the probability of living together. For the probability of having any paid work, there is a small pre-trend on the aggregate. This does not imply violation of assumptions, because the assumptions are formulated for the cohort-specific treatment effects. We test the assumptions in section 6.1 and provide further supporting evidence. We find that women with a miscarriage are more likely to have any paid work in the period of the miscarriage and up to two years after the event. Similarly, women with a miscarriage earn more than women with a completed pregnancy. In contrast, a couple is less likely to live together after a miscarriage compared to a couple with a completed pregnancy.

To check whether the changes after the miscarriages are due to the miscarriage or results are driven by changes in the control group, Figure A8 shows the separate results by group. For both labour market outcomes, women with a miscarriage are on a decreasing trend after the event. However, women who give birth to a baby experience a sharp decrease of both probability to have any paid work and conditional income after birth of the child. This is in line with the literature on labour market effects of the first child in the Netherlands and elsewhere (Kleven et al., 2019; Rabaté and Rellstab, 2021). These patterns imply that the positive labour market effects of a miscarriage are mainly driven by the drop in labour market outcomes of the control group. For the probability of living together, it is unlikely that the effect found in the control group analysis stems from a change of behaviour of the control group: the separate analyses show no diverging trends.

The labour market advantage of women with a miscarriage compared to women who give birth to a baby seems to fade over time. This may be linked to subsequent fertility. We further explore the role of subsequent fertility in Section 7, and Figures A16-A17.

6 Robustness checks

6.1 Testing identifying assumptions

We follow Sun and Abraham (2021) and estimate and aggregate cohort-specific treatment effects. Therefore, the identifying assumptions must hold by treatment cohort. Figures A9 - A11 show that the estimated event-study treatment effects are similar for all cohorts.

We test for every cohort and outcome if any pre-trends are different from zero. This provides support to both assumptions (cohort specific parallel trends in the absence of treatment and no anticipation of treatment by cohort). Table 3 indicates for each estimate whether there is a violation of zero pre-trends based on the 90% confidence interval (which is a more conservative approach than a 95% CI). For most outcomes, either zero or at most one cohort violate the assumption, with the exception of the probability of any paid work, for which two cohorts do not satisfy the zero pre-trend condition.

In the main results, we included all cohorts in the aggregation of the effect, independently of whether they satisfy the zero pre-trends condition. To assess whether the inclusion of these cohorts change our results, we plot our main results next to the aggregation of all cohorts that satisfy assumption ii). We show here the comparison of results for the labour market outcomes and the couple dynamics (Figure 6), as the number of cohorts not satisfying pre-trends was largest for the estimates on the probability of paid work.

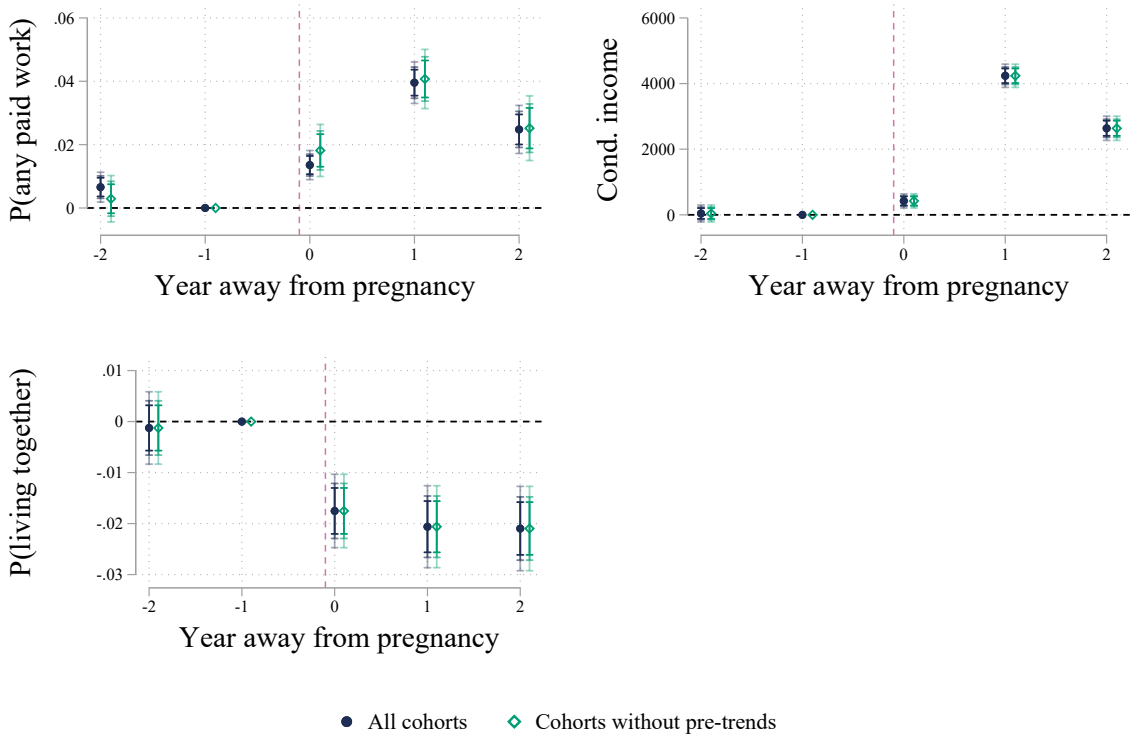
Not including the cohorts with non-zero pre-trends in the aggregation barely changes the results. This is also true for the other outcomes (see Figure A12 and A13).

Table 3: Overview of cohorts where identifying assumptions are not satisfied

Cohort	2011	2013	2014	2015	2016
Mental health care use women					
Any mental health care		X			
Any therapy					
Cond. therapy costs			X		
Psychotropic drugs					
Mental health care use partner					
Any mental health care		X			
Any therapy		X			
Cond. therapy costs					X
Psychotropic drugs		X			
Labour market outcomes women					
Paid work	X	X			
Cond. Income					
Live together					

Note: An 'X' indicates for which cohorts and for which outcomes pre-trends are statistically not zero based on a 90% confidence interval. In a robustness test, these cohorts are dropped in the calculation of the aggregate treatment effect by event time. These results are shown and compared to the aggregate treatment effects by event time for all cohorts in Figure A12-6.

Figure 6: Labour market outcomes and couple dynamics: aggregated event-study results only based on cohorts with no pre-trends

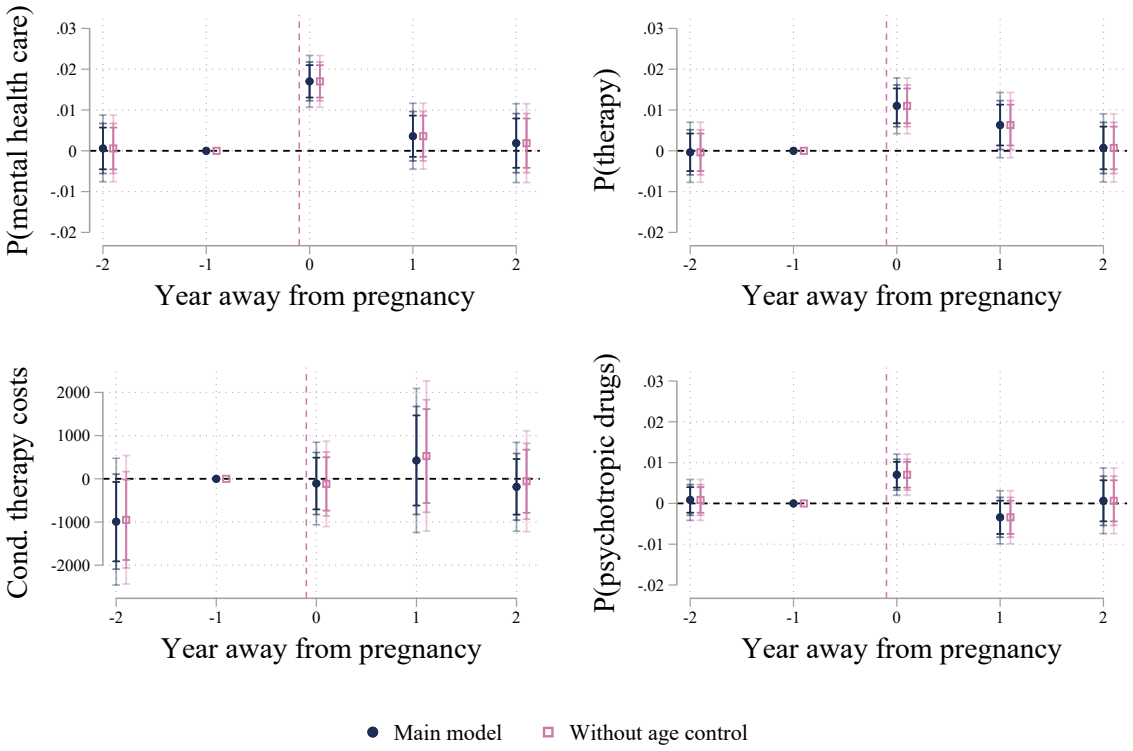


Note: Compares estimates of the reweighting estimator of Sun and Abraham (2021) using all cohorts to the reweighting estimator when only using cohorts with zero pre-trends in the aggregation. Women with a completed pregnancy are a control group for the treatment group of women with a miscarriage. The control group is CEM weighted in order to have a comparable age, fertility treatment, calendar year, pre-birth employment and income quintile distribution as the women with a miscarriage. 90, 95, and 99% confidence intervals are reported, and event-time -1 is the reference period.

6.2 No control variables

The identifying assumptions for the model we use have been derived only for a model without additional control variables. In our main specification, we nevertheless control for age groups because age of the mother is one of the major risk factors of a miscarriage. We assess the robustness of this choice by comparing the results of our main specification to a specification where we do not include this age control variable. Figure 7 compares event study coefficients for both of these models, and shows that there is virtually no difference between the two approaches. This also holds for the other outcomes in this study (Figure A14 and A15) and supports the assumption that miscarriages are exogenous after controlling for individual fixed effects.

Figure 7: Women's mental health care use: no age controls



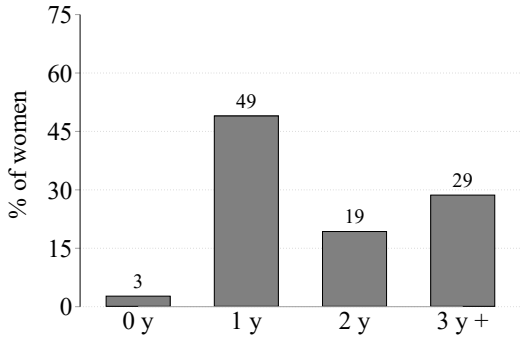
Note: Comparing estimates of β^k (Equation 1) not including age group controls with the main specification. We use the reweighting estimator of Sun and Abraham (2021) where women with a completed pregnancy are a control group for the treatment group of women with a miscarriage. The control group is CEM weighted in order to have a comparable age, fertility treatment, calendar year, pre-birth employment and income quintile distribution as the women with a miscarriage. 90, 95, and 99% confidence intervals are reported, and event-time -1 is the reference period.

7 The role of subsequent fertility

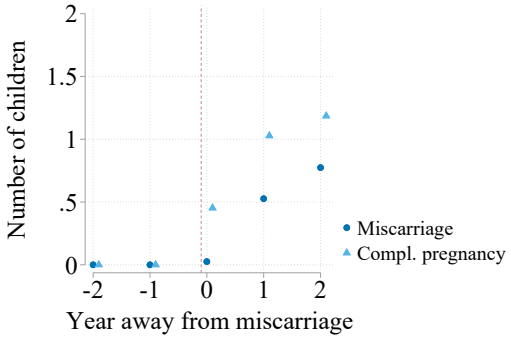
Many women have a baby relatively soon after their miscarriage. Figure 8 panel a) shows the time it takes to have a baby for our sample of women who have a miscarriage. Three years after the miscarriage, around 70% of women have had a baby. Panel b) plots the average total number of children by event time for both women with a miscarriage and women with a completed pregnancy.[24] By ignoring differences in future fertility after having a miscarriage, we pool women for whom the consequences of a miscarriage may be very different. These fertility dynamics after a miscarriage are relevant to interpret our results for at least three reasons. First, some of our estimated effects could be potentially driven by future fertility, either because of postpartum depression or decreased labour market participation after a child birth. Second, a miscarriage may be perceived as a signal for fertility problems such that a woman updates her prior belief about her fertility downwards. Through this channel, a miscarriage may influence her mental health and tension within the family. Completing a pregnancy may have the opposite impact on

[24]Note that for women who complete the pregnancy, the average number of children is 0.5 at event time zero, since the event time zero does not mark the calendar year of birth but the second month of pregnancy.

Figure 8: Fertility after a miscarriage



(a) Time to the first child after a miscarriage



(b) Total number of children

Note: Panel (a) displays the time it takes for women with a miscarriage and no children before to their first child. Panel (b) descriptively plots the number of children by event time for both women with a miscarriage and women who complete their pregnancy. The miscarriage or the 2 months pregnancy mark happens at event time zero. CEM weights are applied, making women who have a baby comparable on the dimensions of age, calendar year, fertility treatment, pre-child employment and income quintiles.

beliefs. Third, having a child may affect the grief after the miscarriage.

7.1 Time to first child

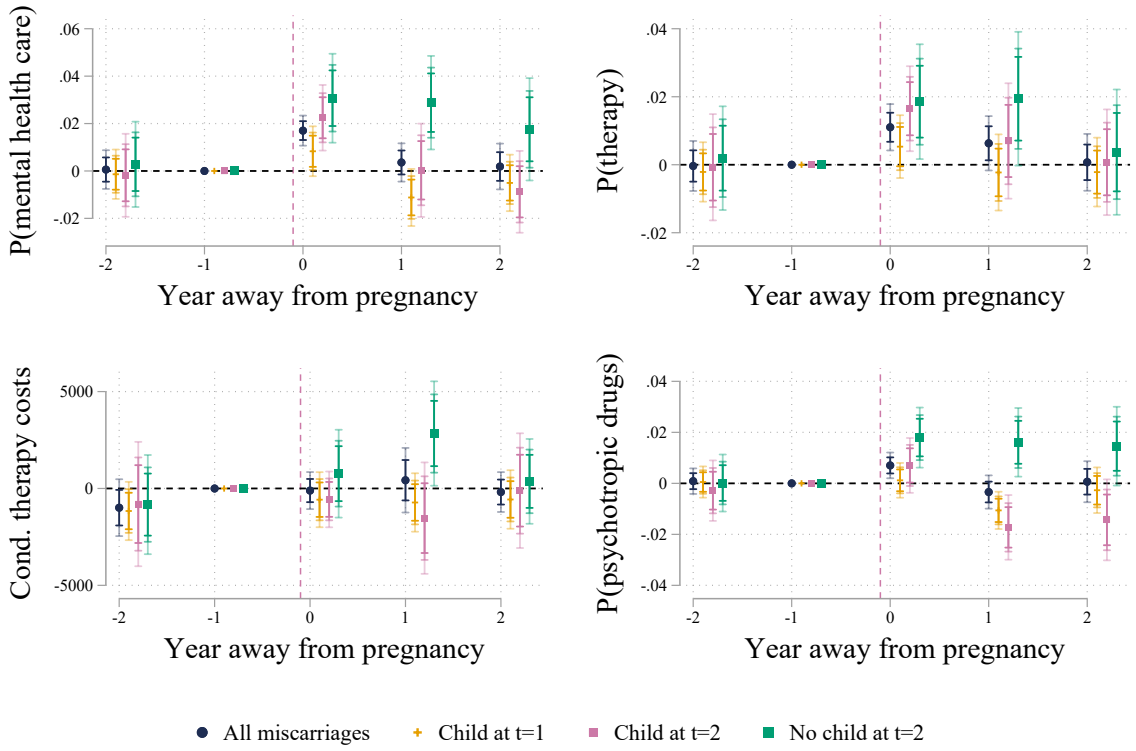
To get a better insight into how our results interact with fertility, we split our sample in three different groups: 1) women who have their first child one year after the miscarriage, 2) women who have their first child two years after the miscarriage, 3) women who remain childless for at least two years after the miscarriage.[25] This is an endogenous sample selection, since women with worse mental health, labour market outcomes or a separation after the miscarriage may be less likely to become pregnant again. However, we still find this analysis may illustrate the potential importance of this channel.

Figure 9 shows the results by the time of the arrival of the first child for women's mental health care use. Already at event time zero, the increase in the probability of mental health care use is the highest among women who remain childless two years after the miscarriage. This supports the hypothesis about the selection mechanism: women most affected by the first miscarriage are the ones who are less likely to have a child two years after the miscarriage. In contrast, we do not see any evidence for treatment of post-partum depression as a main driver of mental health care use, as women who have a child after the miscarriage reduce their mental health care use, if anything. The results for partner's mental health care use show that the timing of the first child is less relevant for males because there are no large differences between the three groups (Figure A16).

In contrast, paid work and income change very differently depending on when the women have the first child after the miscarriage (see Figure A17). The effect on the probability of employment is similar for the three groups of women in event time zero. This implies that a miscarriage has a limited effect on the probability of having any paid work, as

[25]Since only 3% of women have a child in the same year as the miscarriage, we disregard this group.

Figure 9: Women's mental health care use after a miscarriage by arrival of the first child



Note: Estimates of β^k (Equation 1) using the reweighting estimator of Sun and Abraham (2021) by arrival of the first child. Women with a completed pregnancy are a control group for the treatment group of i) all women with a miscarriage; ii) women with a miscarriage and a child one year later 'Child at t=1'; iii) women with miscarriage and a child two years later 'Child at t=2'; and iv) women with a miscarriage and no child two years after the miscarriage 'No child at t=2'. The control group is CEM weighted in order to have a comparable age, fertility treatment, calendar year, pre-birth employment and income quintile distribution as the women with a miscarriage. 90, 95, and 99% confidence intervals are reported, and event-time -1 is the reference period.

the small positive effect that we see for all three groups mainly stems from a decrease in the probability of work in the control group of women with a completed pregnancy. One year after the miscarriage, the probability to have paid work decreases by about four percentage points for women who have their first child in that year. We observe a similar drop of about four percentage points at event time two for the group of women who have a child then.

Women who give birth to a child in event time one and two have slightly higher income at event time zero than women with a completed pregnancy at event time zero. In contrast, women who have no child by event time two - the ones who increase mental health use most in that period, have similarly low income as women who complete the pregnancy. The difference in conditional income between the women who complete a pregnancy in event time one or two and women who do not have a child yet by event time two is about 1000 € per year. This may be suggestive evidence that for these women, the mental health effects of a miscarriage may go along with labour market effects such as being less likely to get a promotion/wage pay raise. At event time one and two, a similar pattern emerges as for the probability of paid work: as soon as the child arrives, the group has worse labour market outcomes than the ones remaining childless.

The estimated effect on the probability of living together is also different among these groups. Whereas for women who have a child at event time two the probability of living together is the same as for women who complete the pregnancy throughout the entire observation period, women who have a child at event time one are slightly less likely to keep living together with their partner compared to the control group. The estimated effects are largest for women who do not have a child by event time two: these women are four to five times less likely to keep living together with their partner. This provides further evidence that the fertility outcomes and relationship decisions are correlated: a miscarriage reduces the probability of living together, and henceforth future fertility.[26]

7.2 Signals about fertility

A second way of studying the impact that (signals about) fertility may have on the other outcomes is to zoom in on two subgroups: i) women who already have children, and ii) women aged 40+ with no children yet.[27] By focusing on these subgroups of women, we narrow down the sample to (i) women who know that they are not infertile; and (ii) have a higher likelihood of staying childless. We do not condition on any post-treatment outcome.

Indeed, women who are 40+ (917 women, or 6% of all the women with a miscarriage) are more likely to remain childless up to three years after the miscarriage compared to all women with a miscarriage.[28] The drawback of this approach is that the group of women aged 40+ in the year of the miscarriage is small and hence we lose power in the statistical analysis. We show the results in the Appendix (Figures A18 - A20). In terms of effect size, women aged 40+ seem to increase their mental health care use (and especially medication

[26]The results remain valid if we drop cohorts with non-zero pre-trends similar to the procedure in section 6.1.

[27]The sample of women with fertility treatment would also have been an interesting group to analyse. However, unfortunately this sample is too small to produce viable results.

[28]69% of 40+ women have no child up to three years after the miscarriage, compared to 29% of all women with a miscarriage.

use) more than other women with a miscarriage. Partners of women aged 40+ are on average less likely to use mental health care compared to all partners. On the labour market outcomes, there are no noteworthy differences between women aged 40+ and all women with a miscarriage.

The results for women with a miscarriage who already have children are also displayed in Figures A18 - A20. These women and their partners have very similar mental health outcomes as women with a miscarriage and no children yet. Labour market outcomes do not evolve differently for these women compared to childless women with a miscarriage - but there are pre-trends for every cohort in this group, potentially induced by earlier children. In this setting, the assumption of zero pre-trends is therefore not satisfied. The pre-trends also preclude a conclusion about the results on the probability of living together for this group.

Together, this suggests that signals about fertility are unlikely to be one of the main drivers influencing the effect of a miscarriage on our outcomes, albeit lack of power prevent us from drawing definite conclusions. There seem to be no large differences between 40+ childless women at the time of the miscarriage, childless women with a miscarriage, and women who already have children when having the miscarriage.

8 Discussion

Miscarriages are the most frequent complication in pregnancy. In this study, we focus on women with a miscarriage who do not have children (yet) to estimate the effect of a miscarriage on mental health care use of both the woman and her partner, couple separation, and women's labour market outcomes using the recently developed techniques for event studies. In a second step, we explore the role of fertility and how it interacts with our findings.

We find that women are 1.1 percentage points (or 16%) more likely to use any therapy in the year of the miscarriage compared to women who complete their pregnancy. While we find in our main model that women with a miscarriage are also more likely to have psychotropic medication prescribed, we show in the analysis by group that this result is because the control group of women with a completed pregnancy decreases their drug use. In addition, we do not find evidence for an increased intensity in therapy conditional on therapy use after a miscarriage. For male partners, we do not find any effect of a miscarriage on mental health care use.

The increased use of therapy due to a miscarriage does not persist longer than a year. This may be related to future subsequent fertility. Most women have a child in the two years following the miscarriage. However, this does not threaten the interpretation of the estimate for event time zero, as at this point in time, only 3% of women already have had a child since the miscarriage. Therefore, it is unlikely that the effects we find for the year of the miscarriage are for example distorted by a higher incidence of postpartum depression in the treatment group.

Fertility plays an important role when examining labour market outcomes, as women typically experience large earnings and employment probability declines after the birth of their first child. This implies not only that the control group's labour market outcomes decline in event time 0 and 1, but also that fertility changes the labour market trajectories

of parts of the treatment group after having had a child. We therefore examine the effects by timing of the first child of the treatment group. When taking subsequent fertility into account in this manner, we only find limited evidence for labour market effects of a miscarriage for most women. However, descriptive evidence suggests that women who do not have a child three years after the miscarriage see their income stagnate at the same time. This is the same group that suffers the largest immediate effects on mental health care use. This would be consistent with a story in which mental health issues triggered by a miscarriage may lead to short term lower probability of promotion and/or salary stagnation. The probability of couples living together decreases by around 2 percentage points after a miscarriage compared to women who complete the pregnancy. This effect is mainly driven by women who do not have a child two years after the miscarriage.

Our results on mental health care use are in line with Jacob et al. (2017), the most similar study in the literature. They measure mental health effects with indicators of being diagnosed with depression, anxiety, or adjustment disorder by a GP in Germany, and they find a 1.9 percentage point increase in the likelihood of being diagnosed with depression, a 0.3 percentage point increase in the likelihood of an anxiety diagnosis, and a 1 percentage point increase in diagnosed adjustment disorder 12 months after a miscarriage compared to women with completed pregnancies.[29] The increased use of mental health care shows that at least part of mental health issues after a miscarriage do not go untreated in the Netherlands. Our estimates show an increase in use that is small in absolute terms, implying that only a small group of women and partners get treated for mental health problems. Since we do not observe mental health directly, we cannot establish whether only a small group of women suffers from a mental health decline after a miscarriage, or whether there is a group that has untreated mental health problems.

There may be labour market effects of a miscarriage for women who are more likely to suffer from mental health consequences and who are more likely to separate from their partner. Compared to other studies in the economics of grief, it seems that labour market effects of losing an unborn child are smaller than losing an older child (as documented for example by Breivik and Costa-Ramón, 2021).

The implications of our findings are fourfold. First, we show that miscarriages happen frequently and that there is a group of people for which this has mental health consequences. Knowing about the high frequency of miscarriages and the fact that they may entail mental health consequences could help to reduce the stigma around the two issues, and make it easier to talk about and deal with them. If the taboo around mental health problems and miscarriage prevents people from activating their support network, dealing with the loss may be more difficult. This is also argued by Freidenfelds (2019), who notes the importance of creating a narrative of pregnancies that includes miscarriage.

Second, it is unknown to health care professionals ex-ante who will need mental health care. For this reason, it is important that mental health care is readily available and provided by the most suited mental health care expert to anyone who needs it. Since health care is highly specialised, and midwifes or gynecologists are no experts on mental health, this requires efficient communication between the hospital, the midwife and the

[29]Note that the measures of mental health diagnosis by the GP and our measure of therapy use are not entirely comparable because our measure may include therapy for other diagnoses, and there may be patients who are diagnosed by the GP but do not go to therapy afterwards. Moreover, the mental health care system in the Netherlands is organised differently than the system in Germany.

GP. Sometimes, referrals from specialists back to the GP do not go smoothly, which may cause discontinuity in care (NHG, 2017b). While efficient communication between providers is important for any type of health problem, the effective functioning of the health care system concerning mental health issues after a miscarriage is key, because there is a stigma on both.

Third, our results also highlight the importance of taking into account the relationship between fertility and mental health (care). Our descriptive evidence shows larger effects on mental health care for women that remain childless two years after childbirth. Integrated policies that complement current practice with mental support can potentially improve the well-being of these women and their partners.

Fourth, New Zealand was one of the first country to introduce three days of leave after a miscarriage in 2021. Following this, Dutch policy makers are currently examining this option for the Netherlands (NOS, 2021). It has been argued that such a policy may give a couple the space to grief and accommodate the new situation, and future research should evaluate whether a paid miscarriage leave can alleviate the mental health effect of a miscarriage for both women and their partners.

References

ACOG. Clinical Management Guidelines for Obstetrician – Gynecologists. *Obstetrics & Gynecology*, 132(5):168–186, 2018.

W. Affleck, V. Carmichael, and R. Whitley. Men's Mental Health: Social Determinants and Implications for Services. *Canadian Journal of Psychiatry*, 63(9):581–589, 2018.

A.-M. N. Andersen, J. Wohlfahrt, P. Christens, J. Olsen, M. Melbye, and A.-m. Nybo. Maternal age and fetal loss: population based register linkage study. *BMJ*, 320(June): 1708–1712, 2000.

C. Banno, M. Sugiura-Ogasawara, T. Ebara, S. Ide, T. Kitaori, T. Sato, K. Ando, and Y. Morita. Attitude and perceptions toward miscarriage: a survey of a general population in Japan. *Journal of Human Genetics*, 65:155–164, 2020.

V. Baranov, S. Bhalotra, P. Biroli, and J. Maselko. Maternal Depression, Women's Empowerment, and Parental Investment: Evidence from a Randomized Control Trial. *American Economic Review*, 110(3):824–859, 2020.

A. V. Bell. "I'm Not Really 100% a Woman If I Can't Have a Kid": Infertility and the Intersection of Gender, Identity, and the Body. *Gender and Society*, 33(4):629–651, 2019.

C. Bellhouse, M. J. Temple-Smith, and J. E. Bilardi. "It's just one of those things people don't seem to talk about..." women's experiences of social support following miscarriage: a qualitative study. *BMC Women's Health*, 18(1):1–9, 2018.

B. Biasi, M. S. Dahl, and P. Moser. Career Effects of Mental Health. *NBER Working Paper*, (29031), 2021.

A.-L. Breivik and A. Costa-Ramón. The career costs of children's health shocks. *Working paper*, 2021.

N. Brier. Grief following miscarriage: A comprehensive review of the literature. *Journal of Women's Health*, 17(3):451–464, 2008.

A. N. Broen, T. Moum, A. S. Bødtker, and Ekeberg. The course of mental health after miscarriage and induced abortion: A longitudinal, five-year follow-up study. *BMC Medicine*, 3, 2005.

D. Carter, S. Misri, and L. Tomfohr. Psychologic aspects of early pregnancy loss. *Clinical Obstetrics and Gynecology*, 50(1):154–165, 2007.

CBS. Doden en gewonden in het wegverkeer, 2019a. Retrieved from https://www.cbs.nl/nl-nl/maatschappij/verkeer-en-vervoer/transport-en-mobiliteit/mobiliteit/verkeersongevallen/categorie-verkeersongevallen/doden-en-gewonden-in-het-wegverkeer.

CBS. Geboort kerncijfers, 2019b. Retrieved from https://opendata.cbs.nl/statline/#/CBS/nl/dataset/37422ned/table?dl=D146.

G. P. Cumming, S. Klein, D. Bolsover, A. J. Lee, D. A. Alexander, M. Maclean, and J. D. Jurgens. The emotional burden of miscarriage for women and their partners: Trajectories of anxiety and depression over 13 months. *BJOG: An International Journal of Obstetrics and Gynaecology*, 114(9):1138–1145, 2007.

F. deMontigny, C. Verdon, S. Meunier, and D. Dubeau. Women's persistent depressive and perinatal grief symptoms following a miscarriage: the role of childlessness and satisfaction with healthcare services. *Archives of Women's Mental Health*, 20(5):655–662, 2017.

A. T. Dulay. Spontaneous abortion, 2019. Retrieved from https://www.msdmanuals.com/professional/gynecology-and-obstetrics/abnormalities-of-pregnancy/spontaneous-abortion.

R. G. Farquharson, E. Jauniaux, and N. Exalto. Updated and revised nomenclature for description of early pregnancy events. *Human Reproduction*, 20(11):3008–3011, 2005.

J. Farren, M. Jalmbrant, L. Ameye, K. Joash, N. Mitchell-Jones, S. Tapp, D. Timmerman, and T. Bourne. Post-traumatic stress anxiety and depression following miscarriage or ectopic pregnancy: A prospective cohort study. *BMJ Open*, 6(11), 2016.

J. Farren, N. Mitchell-Jones, J. Y. Verbakel, D. Timmerman, M. Jalmbrant, and T. Bourne. The psychological impact of early pregnancy loss. *Human Reproduction Update*, 24(6):731–749, 2018.

L. Freidenfelds. *The Myth of the Perfect Pregnancy*. Oxford Scholarship online, 2019.

J. Gardner and A. J. Oswald. Do divorcing couples become happier by breaking up ? *Journal of the Royal Statistical Society*, 169(2):319–336, 2006.

R. Gillespie. Childfree and feminine: Understanding the gender identity of voluntarily childless women. *Gender and Society*, 17(1):122–136, 2003.

L. Jacob, I. Polly, M. Kalder, and K. Kostev. Prevalence of depression, anxiety, and adjustment disorders in women with spontaneous abortion in Germany – A retrospective cohort study. *Psychiatry Research*, 258(May):382–386, 2017.

L. Janys and B. Siflinger. Abortion and mental health: The role of selection. (July), 2019.

T. Kajii, A. Ferrier, N. Niikawa, H. Takahara, K. Ohama, and S. Avirachan. Anatomic and chromosomal anomalies in 639 spontaneous abortuses. *Human Genetics*, 55(1): 87–98, 1980.

G. King and R. Nielsen. Why Propensity Scores Should Not Be Used for Matching. *Political Analysis*, 27(4):435–454, 2019.

K. Kleinhaus, M. Perrin, Y. Friedlander, O. Paltiel, L. Deutsch, R. Yanetz, D. Malaspina, and S. Harlap. Paternal Age and Spontaneous Abortion. *American Journal of Epidemiology*, 163(suppl_11):S56–S56, 2006.

H. Kleven, C. Landais, J. Posch, A. Steinhauer, and J. Zweimüller. Child Penalties Across Countries : Evidence and Explanations. *AEA Papers and Proceedings*, 109:122–126, 2019.

R. Layard. The economics of mental health. *IZA World of Labor*, (321), 2017.

M. Lemmers, M. A. Verschoor, P. M. Bossuyt, J. A. Huirne, T. Spinder, T. E. Nieboer, M. Y. Bongers, I. A. Janssen, M. H. Van Hooff, B. W. Mol, W. M. Ankum, and J. E. Bosmans. Cost-effectiveness of curettage vs. expectant management in women with an incomplete evacuation after misoprostol treatment for first-trimester miscarriage: a randomized controlled trial and cohort study. *Acta Obstetricia et Gynecologica Scandinavica*, 97(3):294–300, 2018.

S. Miller, L. R. Wherry, and D. Greene Foster. The Economic Consequences of Being Denied an Abortion. *NBER Working Paper*, (26662), 2020.

S. Mukherjee, D. R. Velez Edwards, D. D. Baird, D. A. Savitz, and K. E. Hartmann. Risk of miscarriage among black women and white women in a us prospective cohort study. *American Journal of Epidemiology*, 177(11):1271–1278, 2013.

NHG. Zwangerschap en kraamperiode. *NHG-Standaard M32*, 2012.

NHG. Miskraam. *NHG-Standaard M03 Versie 4.0*, 2017a.

NHG. Richtlijn Informatie-uitwisseling tussen huisarts en medisch specialist (Richtlijn HASP). 2017b.

NHS. Causes miscarriage, 2018. Retrieved from https://www.nhs.uk/conditions/miscarriage/causes/.

NOS. Kabinet onderzoekt betaald verlof na doodgeboorte of miskraam, 2021. Retrieved from https://nos.nl/artikel/2376439-kabinet-onderzoekt-betaald-verlof-na-doodgeboorte-of-miskraam.

NVOG. Richtlijn miskraam. Technical report, 2020. https://richtlijnendatabase.nl/richtlijn/miskraam/startpagina_-_miskraam.html.

J. Nynas, P. Narang, M. K. Kolikonda, and S. Lippmann. Depression and Anxiety Following Early Pregnancy Loss. *The Primary Care Companion For CNS Disorders*, 17 (1):1–11, 2015.

K. L. Obst, C. Due, M. Oxlad, and P. Middleton. Men's grief following pregnancy loss and neonatal loss: a systematic review and emerging theoretical model. *BMC pregnancy and childbirth*, 20(1):11, 2020.

S. Petrou, J. Trinder, P. Brocklehurst, and L. Smith. Economic evaluation of alternative management methods of first-trimester miscarriage based on results from the MIST trial. *BJOG: An International Journal of Obstetrics and Gynaecology*, 113(8):879–889, 2006.

S. Quenby, I. D. Gallos, R. K. Dhillon-Smith, M. Podesek, M. D. Stephenson, J. Fisher, J. Brosens, J. Brewin, R. Anderson, S. Daher, L. Regan, M. Al-Memar, T. Bourne, R. Rai, O. B. Christiansen, M. Mayumi Sugiura-Ogasa, J. Odendaal, A. J. Devall, P. R. Bennett, S. Petrou, and A. Coomarasamy. Miscarriage matters: the epidemiological, physical, psychological and economic burden of early pregnancy loss. *The Lancet*, 397: 1658–1667, 2021.

S. Rabaté and S. Rellstab. The child penalty in the Netherlands and its determinants. *CPB Discussion Paper*, 2021.

R. Rai and L. Regan. Recurrent Miscarriage. *The Lancet*, 368:601–611, 2006.

S. Rellstab, P. Bakx, P. García-Gómez, and E. van Doorslaer. The kids are alright - labour market effects of unexpected parental hospitalisations in the Netherlands. *Journal of Health Economics*, 69, 2020.

Rijksinstituut voor Volksgezondheid en Milieu. Onbedoelde zwangerschap, 2021. Retrieved from https://www.loketgezondleven.nl/gezondheidsthema/seksuele-gezondheid/cijfers-en-feiten-seksuele-gezondheid/onbedoelde-zwangerschap.

Rijksoverheid. Hoe hoog is mijn ziektewetuitkering?, 2020a. Retrieved from https://www.rijksoverheid.nl/onderwerpen/ziektewetuitkering/vraag-en-antwoord/hoe-hoog-is-de-ziektewetuitkering.

Rijksoverheid. Hoe lang heb ik recht op een ziektewetuitkering?, 2020b. Retrieved from https://www.rijksoverheid.nl/onderwerpen/ziektewetuitkering/vraag-en-antwoord/hoe-lang-recht-op-een-ziektewetuitkering.

Rijksoverheid. Waar vind ik hulp bij psychische problemen?, 2020c. Retrieved from https://www.rijksoverheid.nl/onderwerpen/geestelijke-gezondheidszorg/vraag-en-antwoord/waar-vind-ik-hulp-bij-psychische-problemen.

K. M. Shreffler, A. L. Greil, and J. Mcquillan. Pregnancy Loss and Distress Among U.S. Women. *Family Relations*, 60(3):342–355, 2011.

B. Siflinger. The Effect of Widowhood on Mental Health - an Analysis of Anticipation Patterns Surrounding the Death of a Spouse. *Health Economics (United Kingdom)*, 26 (12):1505–1523, 2017.

R. Slama, J. Bouyer, G. Windham, L. Fenster, A. Werwatz, and S. H. Swan. Influence of paternal age on the risk of spontaneous abortion. *American Journal of Epidemiology*, 161(9):816–823, 2005.

Statline. Geboorte; Kerncijfers, 2019. Retrieved from https://opendata.cbs.nl/statline/#/CBS/nl/dataset/37422NED/table?dl=3A806.

Statline. Gezondheid en zorggebruik; geslacht, leeftijd, persoonskenmerken, 2020. Retrieved from https://opendata.cbs.nl/statline/#/CBS/nl/dataset/83384NED/table?ts=1602774077053.

E. A. Stuart, K. Duckworth, J. Simmons, and C. L. Barry. Using Propensity Scores in Difference-in-Difference Models to Estimate the Effects of a Policy Change. *Health Service Outcomes Research Methodologies*, 14(4):166–182, 2014.

L. Sun and S. Abraham. Estimating dynamic treatment effects in event studies with heterogeneous treatment effects. *Journal of Econometrics*, 225(2):175–199, 2021.

UVW. Actuele bedragen, 2020a. Retrieved from https://www.uwv.nl/particulieren/bedragen/detail/maximumdagloon.

UVW. Ik ben ziek en heb een werkgever, 2020b. Retrieved from https://www.uwv.nl/particulieren/ziek/ziek-met-werkgever/ik-ben-net-ziek/detail/ik-ben-in-loondienst-en-ben-ziek/kan-mijn-werkgever-mij-ontslaan-tijdens-ziekte.

UVW. Mijn werknemer is zwanger, 2020c. Retrieved from https://www.uwv.nl/werkgevers/werknemer-krijgt-kind/zwanger/na-aanvraag-zwangerschapsuitkering/detail/zwangerschap-voortijdig-ge-eindigd.

G. J. Van den Berg, P. Lundborg, and J. Vikström. The Economics of Grief. *Economic Journal*, 127(604):1794–1832, 2017.

M. Verschoor. *Management of first trimester miscarriage ; new insight in old dilemmas*. PhD thesis, University of Amsterdam, 2017.

H. Volgsten, C. Jansson, A. S. Svanberg, E. Darj, and A. Stavreus-Evers. Longitudinal study of emotional experiences, grief and depressive symptoms in women and men after miscarriage. *Midwifery*, 64(May):23–28, 2018.

V&Z. Wachttijden in de generalistische basis-ggz, 2020. Retrieved from https://www.staatvenz.nl/kerncijfers/wachttijden-de-generalistische-basis-ggz.

M. Wager. I. Childless by Choice? Ambivalence and the Female Identity. *Feminism and Psychology*, 10(3):389–395, 2000.

H. M. Williams, A. Topping, A. Coomarasamy, and L. L. Jones. Men and Miscarriage: A Systematic Review and Thematic Synthesis. *Qualitative Health Research*, 2019.

A1 Appendix

A1.1 Data

Table A1: Data sets used for this study

Data	Name data set	Years
Hospital	LMR	2009-2012
	LBZ	2013-2018
Health insurance expenditure	Zvwzorgkostentab	2009-2018
Psychotropic prescription drugs	Medicijntab	2009-2018
Demographic info	Gbapersoontab	2009-2018
Parents-children linkages	Kindoudertab	1990-2018
Income	Inpatab	2009-2018
Partners	Huishoudenbus	2009-2018

Note: Information about the data sets can be found at https://www.cbs.nl/nl-nl/onze-diensten/maatwerk-en-microdata/microdata-zelf-onderzoek-doen/catalogus-microdata (available in Dutch only).

A1.2 Mental health care use in the population

Table A2: Population statistics mental health care use women aged 25-39 in the Netherlands in 2009-2018

	Mean
Any mental health care	0.11
Any therapy	0.07
Conditional therapy costs	4,379
Starting therapy per year	0.03
Duration therapy in years	1.83
Psychotropic drugs	0.08
Anti-psychotics (N05A)	0.01
Anxiolytics (N05B)	0.02
Hypnotics and sedatives (N05C)	0.01
Antidepressants (N06A)	0.06
Starting psychotropic drugs per year	0.02
Duration psychotropic drug use in years	2.17
N	*17,008,656*

Note: Women aged 25-39 fall into the interquartile age range of women with a miscarriage.

A1.3 Unweighted descriptive statistics

Table A3: Summary statistics before and in the year of the pregnancy (unweighted)

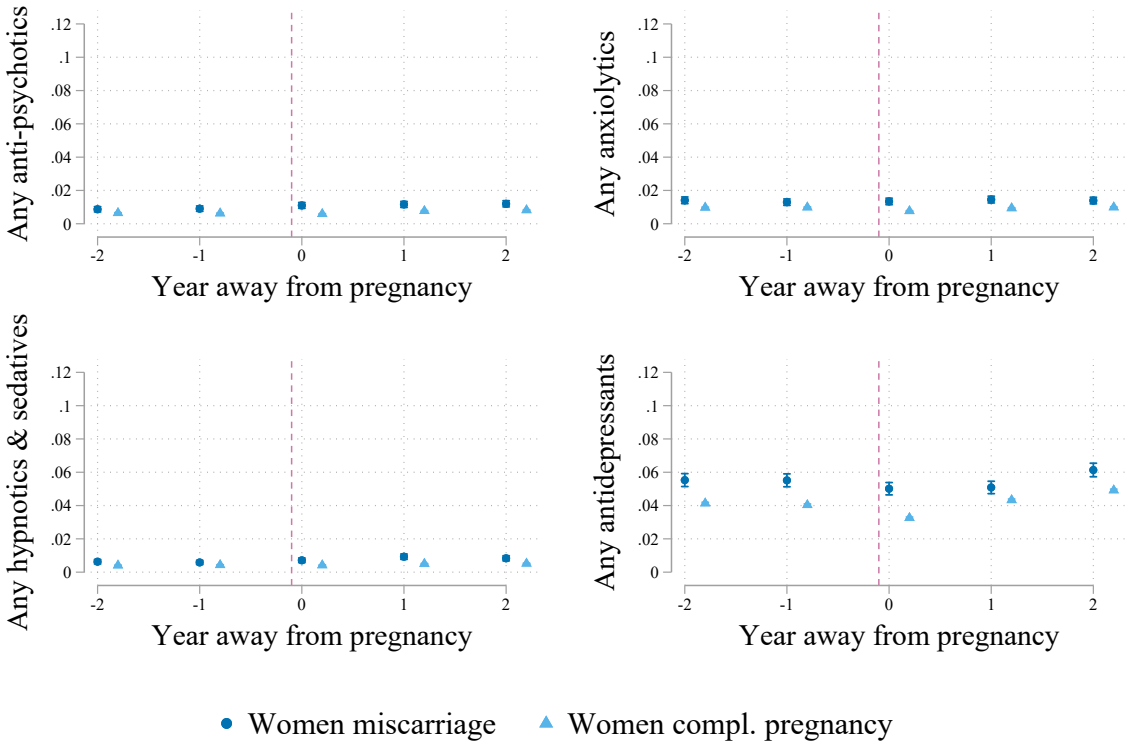
	2 years before the pregnancy			**Year of the pregnancy**		
	Mean miscarriage	Mean completed pregnancy	Std Diff	Mean miscarriage	Mean completed pregnancy	Std Diff
Mental health						
Any MHC	0.11	0.08	0.07	0.11	0.07	0.11*
Any therapy	0.07	0.05	0.05	0.08	0.05	0.08
Cond. therapy costs	3,250	3,728	-0.04	2,950	3,021	-0.01
Psychotropic drugs	0.07	0.05	0.06	0.06	0.04	0.08
Anti-psychotics (N05A)	0.01	0.01	0.02	0.01	0.01	0.04
Anxiolytics (N05B)	0.01	0.01	0.03	0.01	0.01	0.04
Hypnotics & sedatives (N05C)	0.01	0.00	0.02	0.01	0.00	0.03
Antidepressants (N06A)	0.06	0.04	0.06	0.05	0.03	0.07
Demographics						
Age	28.78	27.1	0.24*	30.78	29.1	0.24*
Age partner	31.71	30.54	0.14*	33.48	32.13	0.16*
Lives with partner	0.71	0.66	0.07	0.89	0.88	0.04
Separation	0.05	0.05	0.02	0.03	0.02	0.04
Number of children	0.00	0.00	n.a.	0.03	0.44	-0.78*
Fertility treatment[a]	0.00	0.00	0.02	0.01	0.00	0.06
Dutch	0.74	0.68	0.08	0.74	0.68	0.08
Surinamese	0.03	0.02	0.01	0.03	0.02	0.01
Antilles/Aruba	0.01	0.01	0.01	0.01	0.01	0.01
Moroccan	0.02	0.03	-0.02	0.02	0.03	-0.02
Turkish	0.03	0.03	-0.02	0.03	0.03	-0.02
Western	0.11	0.13	-0.05	0.11	0.13	-0.05
Non-western	0.07	0.09	-0.06	0.07	0.09	-0.06
Labour market						
Employed	0.89	0.83	0.12*	0.90	0.83	0.14*
Income from work	36,770	34,027	0.08	39,163	36,735	0.07
Mental health partner						
Any MHC	0.06	0.05	0.02	0.06	0.05	0.02
Any therapy	0.03	0.03	0.01	0.03	0.03	0.02
Cond. therapy costs	4,174	3,664	0.03	3,927	3,200	0.05
Psychiatric drugs	0.03	0.03	0.02	0.03	0.03	0.01
Anti-psychotics (N05A)	0.01	0.01	0.00	0.01	0.01	0.00
Anxiolytics (N05B)	0.01	0.01	0.01	0.01	0.01	0.01
Hypnotics & sedatives (N05C)	0.00	0.00	0.01	0.00	0.00	0.01
Antidepressants (N06A)	0.02	0.02	0.02	0.03	0.02	0.02
Treatment cohort						
Cohort 2011	0.21	0.21	0.01	0.21	0.21	0.01
Cohort 2013	0.22	0.2	0.02	0.22	0.2	0.02
Cohort 2014	0.19	0.2	-0.01	0.19	0.2	-0.01
Cohort 2015	0.20	0.20	0.00	0.20	0.20	0.00
Cohort 2016	0.18	0.19	-0.02	0.18	0.19	-0.02
N	13,347	385,077		13,347	385,077	

Note: Unweighted summary statistics two years before and in the year of the first pregnancy. * |StdDiff| > 0.1 (Stuart et al., 2014). Standardised difference StdDiff=$\frac{\bar{X}_{G1}-\bar{X}_{G2}}{(\hat{\sigma}^2_{G1}+\hat{\sigma}^2_{G2})^{0.5}}$ where $\bar{X}_{G1}$ corresponds to the group mean of variable X, and $\hat{\sigma}^2$ to the estimated variance.

[a] This variable includes only fertility treatment before the event.

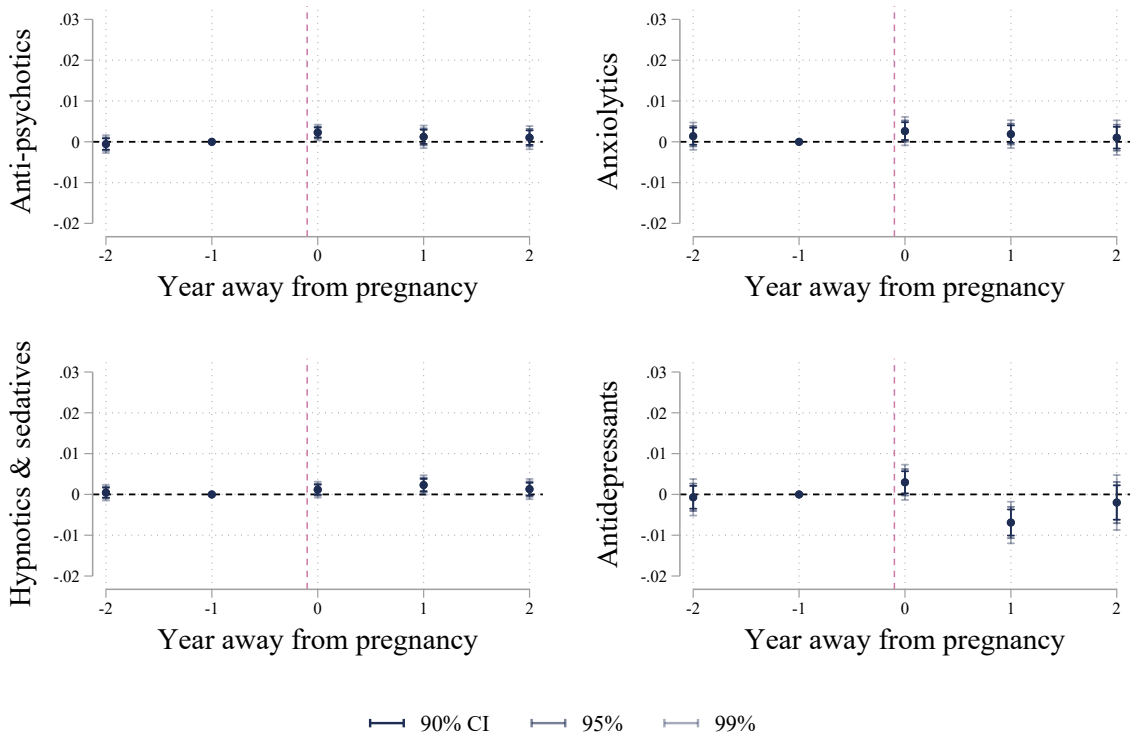
A1.4 Results by psychotropic drug type

Figure A1: Descriptive trends by type of psychotropic drugs



Note: Descriptive trends of women with a miscarriage and women who complete their pregnancy. The miscarriage or the 2 month pregnancy mark happens at event time zero. CEM weights are applied, making the women who have a baby comparable to the women with a miscarriage on the dimensions of age, calendar year, fertility treatment, pre-event employment and income quintiles. 95% confidence intervals are depicted. $N_{T(women)} = 13,347$; $N_{C(women)} = 385,077$.

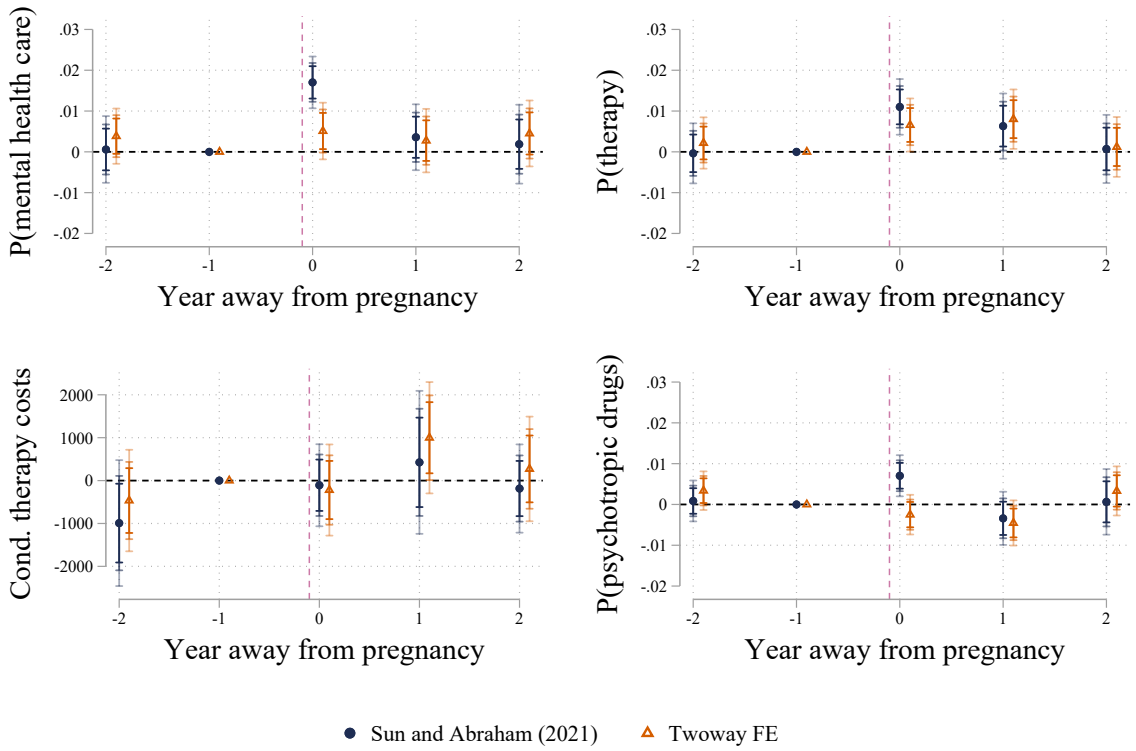
Figure A2: The effect of a miscarriage on psychotropic drug use



Note: Estimates of β^k (Equation 1) using the reweighting estimator of Sun and Abraham (2021) where women with a completed pregnancy are a control group for the treatment group of women with a miscarriage. The control group is CEM weighted in order to have a comparable age, fertility treatment, calendar year, pre-birth employment and income quintile distribution as the women with a miscarriage. 90, 95, and 99% confidence intervals are reported, and event-time -1 is the reference period.

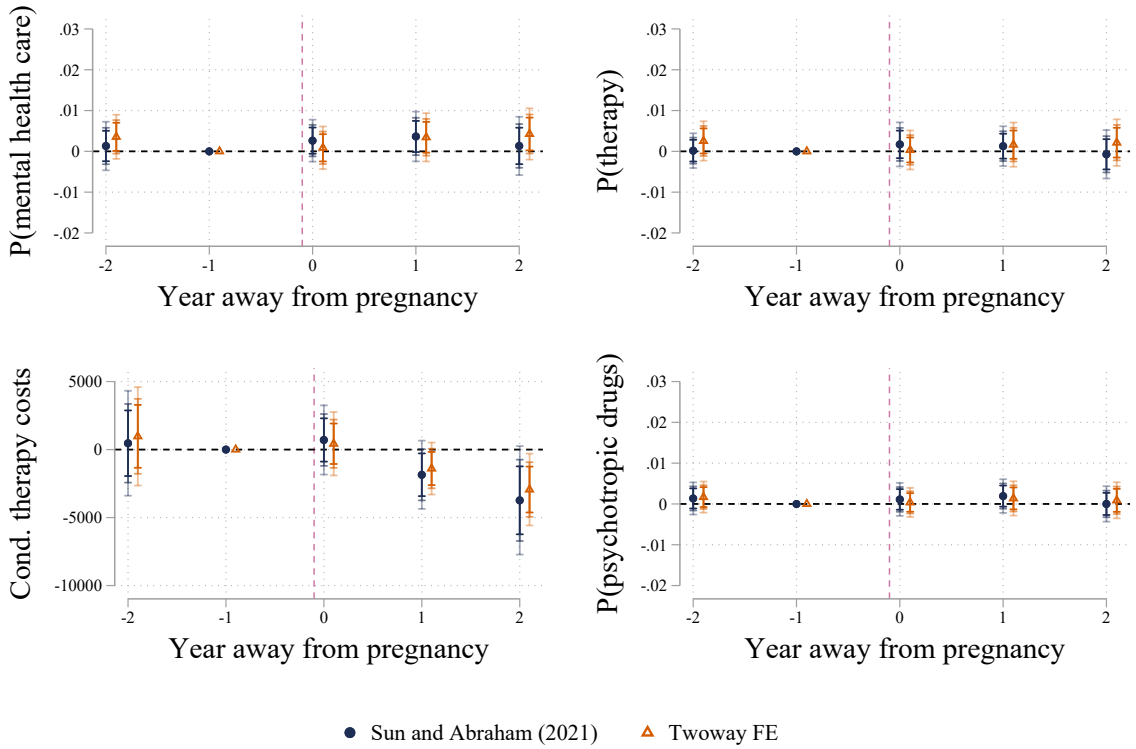
A1.5 Comparison of twoway fixed effects estimates and the Sun and Abraham (2021) method

Figure A3: Mental health care use partners: comparison Sun and Abraham estimator and twoway fixed effect



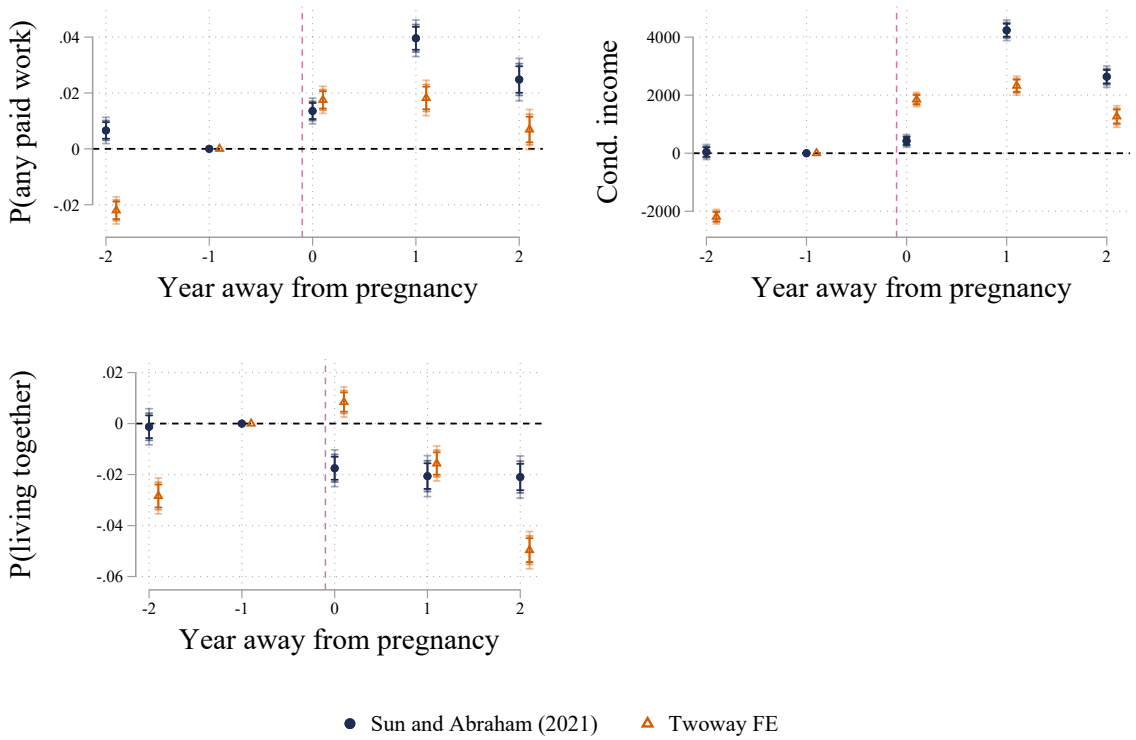
Note: Compares the estimates of β^k (Equation 1) using the reweighting estimator of Sun and Abraham (2021) to the twoway fixed effect (FE) estimates. For both estimators, women with a completed pregnancy are a control group for the treatment group of women with a miscarriage. The control group is CEM weighted in order to have a comparable age, fertility treatment, calendar year, pre-birth employment and income quintile distribution as the women with a miscarriage. 90, 95, and 99% confidence intervals are reported, and event-time -1 is the reference period.

Figure A4: Mental health care use partners: comparison Sun and Abraham estimator and twoway fixed effect



Note: Compares the estimates of β^k (Equation 1) using the reweighting estimator of Sun and Abraham (2021) to the twoway fixed effect (FE) estimates. For both estimators, women with a completed pregnancy are a control group for the treatment group of women with a miscarriage. The control group is CEM weighted in order to have a comparable age, fertility treatment, calendar year, pre-birth employment and income quintile distribution as the women with a miscarriage. 90, 95, and 99% confidence intervals are reported, and event-time -1 is the reference period.

Figure A5: Labour market and couple dynamics: comparison Sun and Abraham estimator and twoway fixed effect

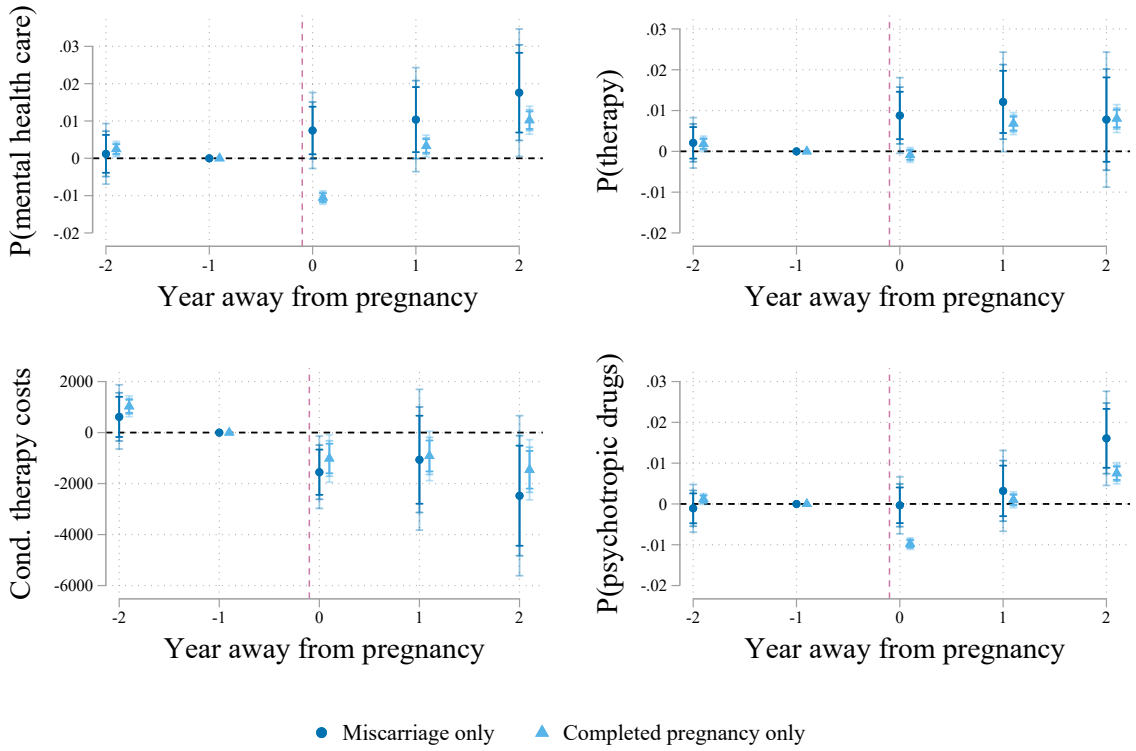


Note: Compares the estimates of β^k (Equation 1) using the reweighting estimator of Sun and Abraham (2021) to the twoway fixed effect (FE) estimates. For both estimators, women with a completed pregnancy are a control group for the treatment group of women with a miscarriage. The control group is CEM weighted in order to have a comparable age, fertility treatment, calendar year, pre-birth employment and income quintile distribution as the women with a miscarriage. 90, 95, and 99% confidence intervals are reported, and event-time -1 is the reference period.

A1.6 Separate analysis of miscarriages and completed pregnancies

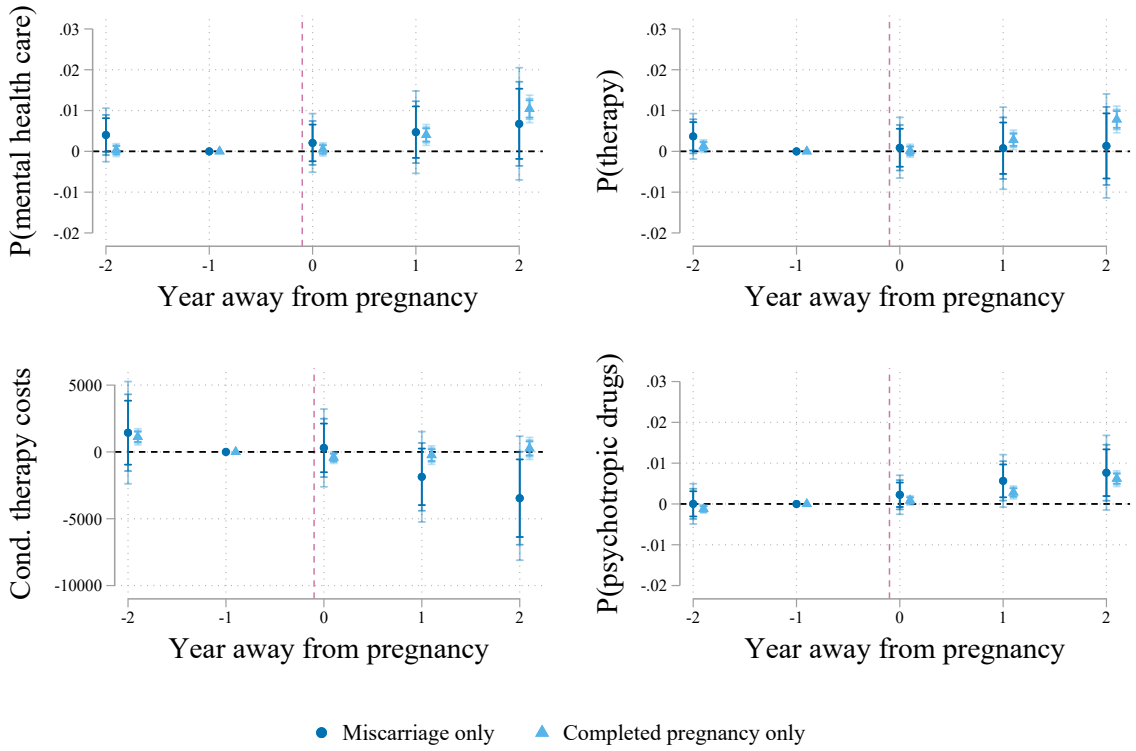
We estimate a version of the Sun and Abraham (2021) estimator for the case without control group. Since this model has to be estimated by cohort, this comes at a cost when there is no control group: calendar year and event time are perfectly collinear and therefore, the calendar year fixed effects that were part of the main specification cannot be included in this specification. This implies that assumption ii) becomes stricter: apart from no anticipation we also need to assume that there are no time trends in the outcomes. Despite these short-comings, estimating the model separately is useful in our context since it allows us to distinguish whether the estimated effects in the control group approach are due to changes in the treatment or the control group.

Figure A6: Women's mental health care use: separate results for women with a miscarriage and women who complete their pregnancy



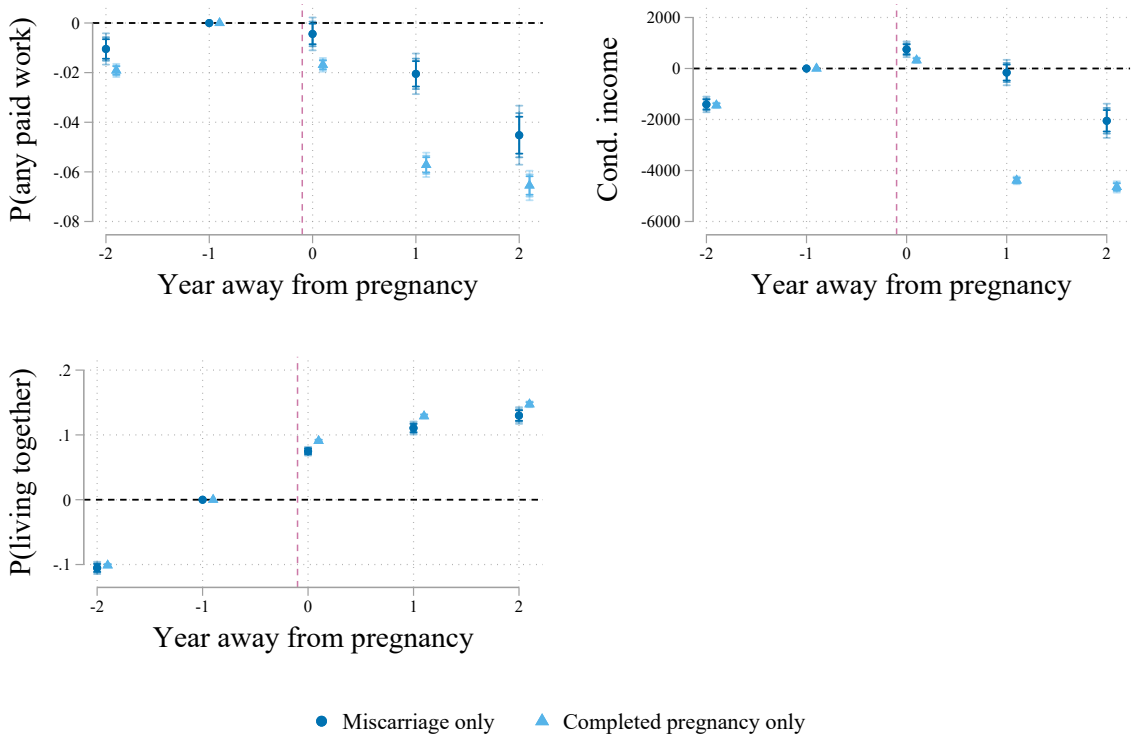
Note: Presents the estimates of β^k (Equation 1) using the reweighting estimator of Sun and Abraham (2021) separately for women with a miscarriage and for women with a completed pregnancy. The later are CEM weighted in order to have a comparable age, fertility treatment, calendar year, pre-birth employment and income quintile distribution as the women with a miscarriage. 90, 95, and 99% confidence intervals are reported, and event-time -1 is the reference period.

Figure A7: Partners' mental health care use: separate results for partners of women with a miscarriage and partners of women who complete their pregnancy



Note: Presents the estimates of β^k (Equation 1) using the reweighting estimator of Sun and Abraham (2021) separately for women with a miscarriage and for women with a completed pregnancy. The later are CEM weighted in order to have a comparable age, fertility treatment, calendar year, pre-birth employment and income quintile distribution as the women with a miscarriage. 90, 95, and 99% confidence intervals are reported, and event-time -1 is the reference period.

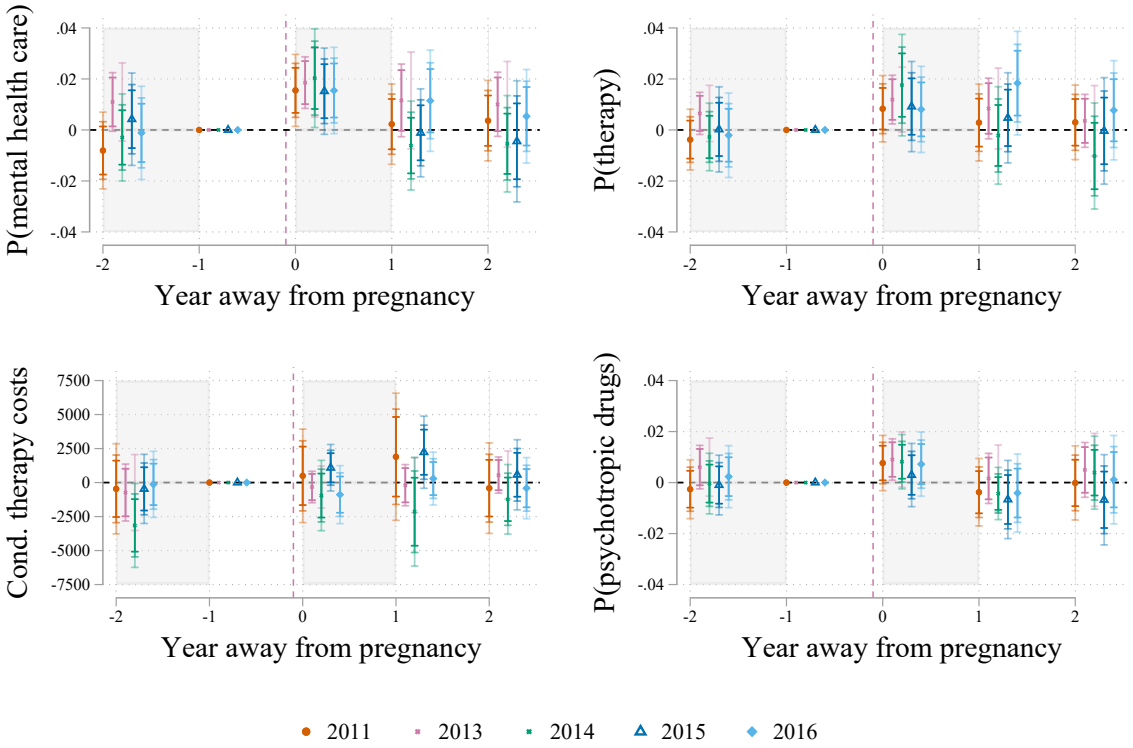
Figure A8: Women's labour market outcomes and couple dynamics: separate results for partners of women with a miscarriage and partners of women who complete their pregnancy



Note: Presents the estimates of β^k (Equation 1) using the reweighting estimator of Sun and Abraham (2021) separately for women with a miscarriage and for women with a completed pregnancy. The later are CEM weighted in order to have a comparable age, fertility treatment, calendar year, pre-birth employment and income quintile distribution as the women with a miscarriage. 90, 95, and 99% confidence intervals are reported, and event-time -1 is the reference period.

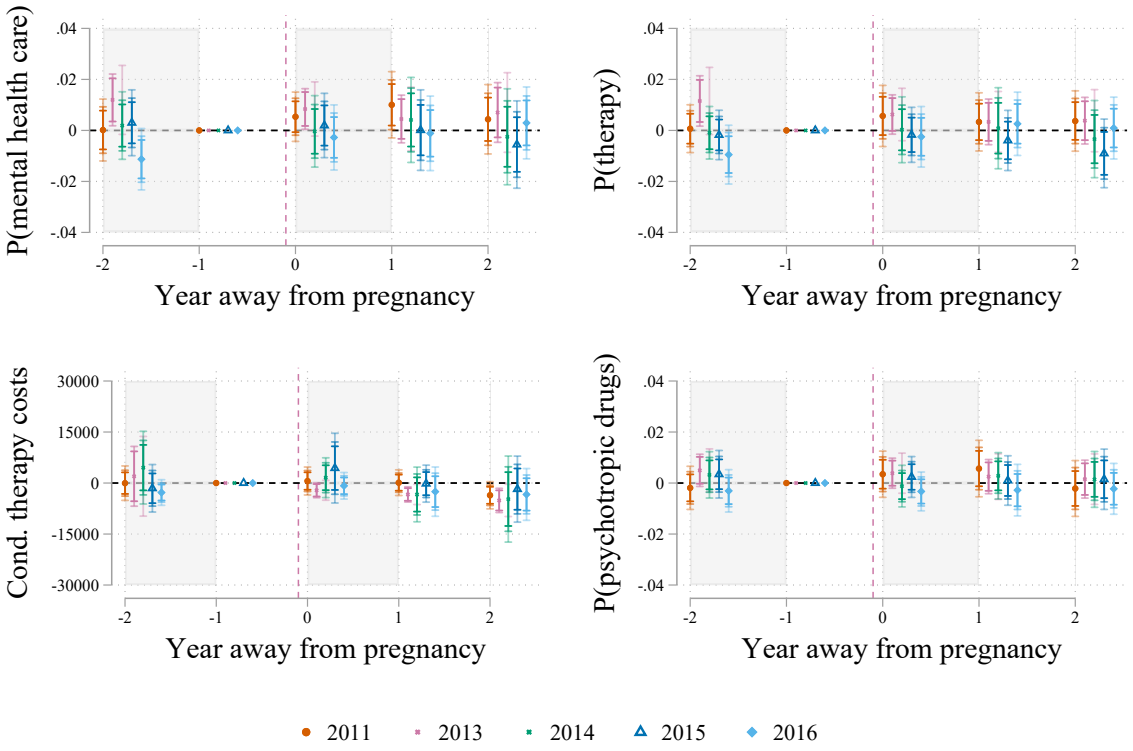
A1.7 Results by treatment cohort

Figure A9: Women's mental health: event-study results by miscarriage cohort



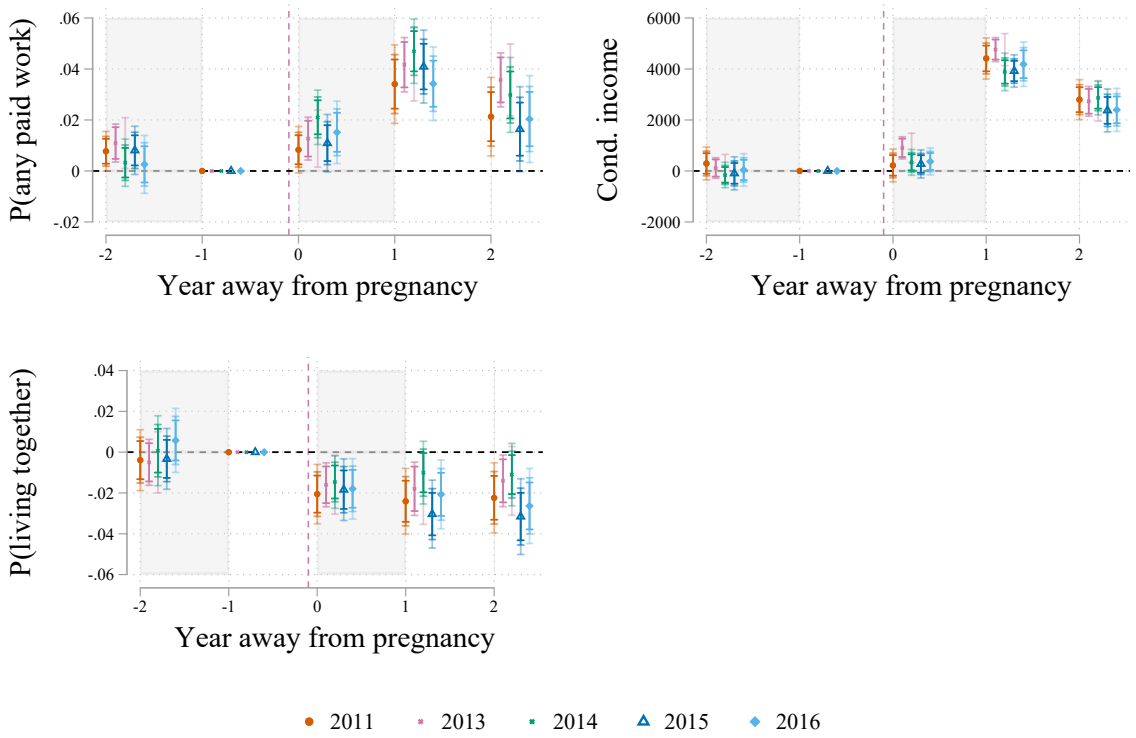
Note: Presents the estimates of β^k (Equation 1) by treatment cohort. Women with a completed pregnancy are a control group for the treatment group of women with a miscarriage. The control group is CEM weighted in order to have a comparable age, fertility treatment, calendar year, pre-birth employment and income quintile distribution as the women with a miscarriage. 90, 95, and 99% confidence intervals are reported, and event-time -1 is the reference period.

Figure A10: Partner's mental health: event-study results by miscarriage cohort



Note: Presents the estimates of β^k (Equation 1) by treatment cohort. Women with a completed pregnancy are a control group for the treatment group of women with a miscarriage. The control group is CEM weighted in order to have a comparable age, fertility treatment, calendar year, pre-birth employment and income quintile distribution as the women with a miscarriage. 90, 95, and 99% confidence intervals are reported, and event-time -1 is the reference period.

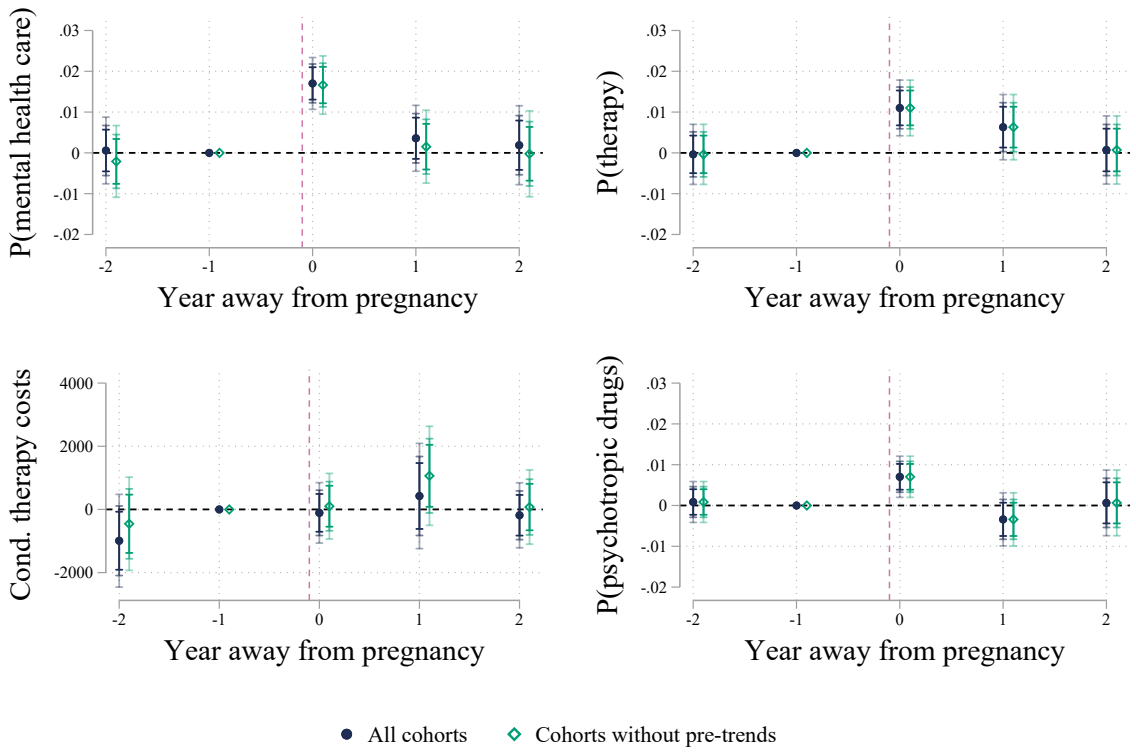
Figure A11: Labour market and couple dynamics: event-study results by miscarriage cohort



Note: Presents the estimates of β^k (Equation 1) by treatment cohort. Women with a completed pregnancy are a control group for the treatment group of women with a miscarriage. The control group is CEM weighted in order to have a comparable age, fertility treatment, calendar year, pre-birth employment and income quintile distribution as the women with a miscarriage. 90, 95, and 99% confidence intervals are reported, and event-time -1 is the reference period.

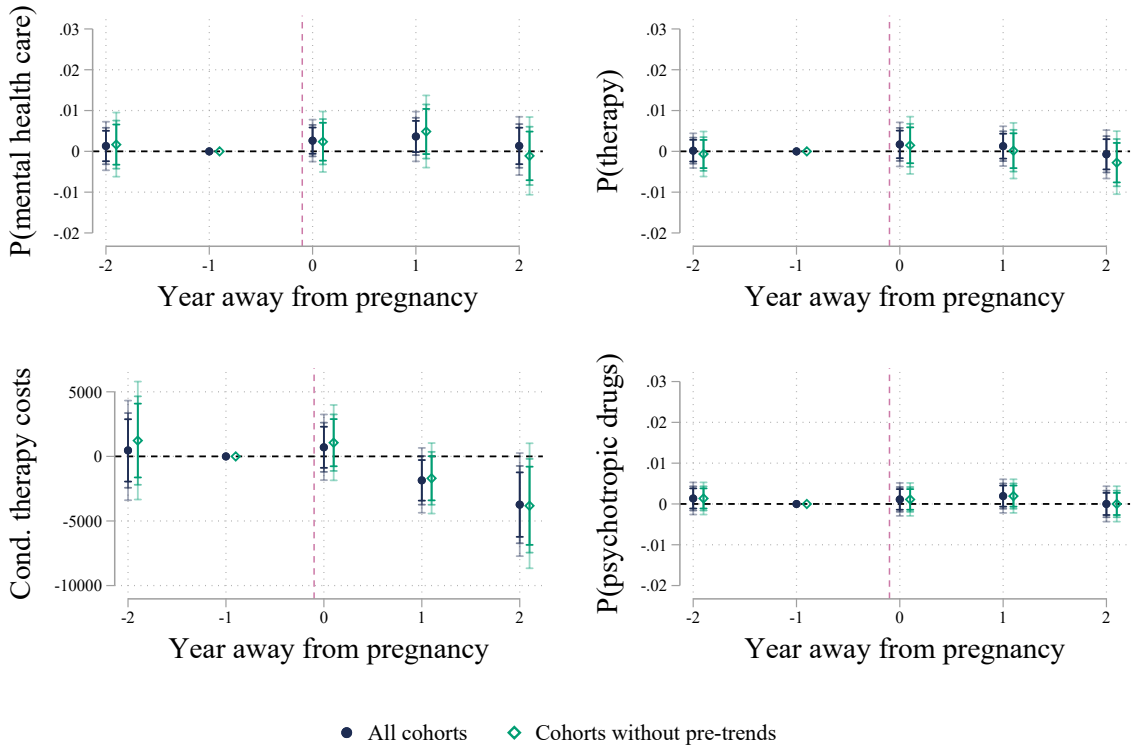
A1.8 Excluding cohorts with non-zero pre-trends

Figure A12: Women's mental health care: aggregated event-study results only based on cohorts with no pre-trends



Note: Compares estimates of the reweighting estimator of Sun and Abraham (2021) using all cohorts to the reweighting estimator when only using cohorts with zero pre-trends in the aggregation. Women with a completed pregnancy are a control group for the treatment group of women with a miscarriage. The control group is CEM weighted in order to have a comparable age, fertility treatment, calendar year, pre-birth employment and income quintile distribution as the women with a miscarriage. 90, 95, and 99% confidence intervals are reported, and event-time -1 is the reference period.

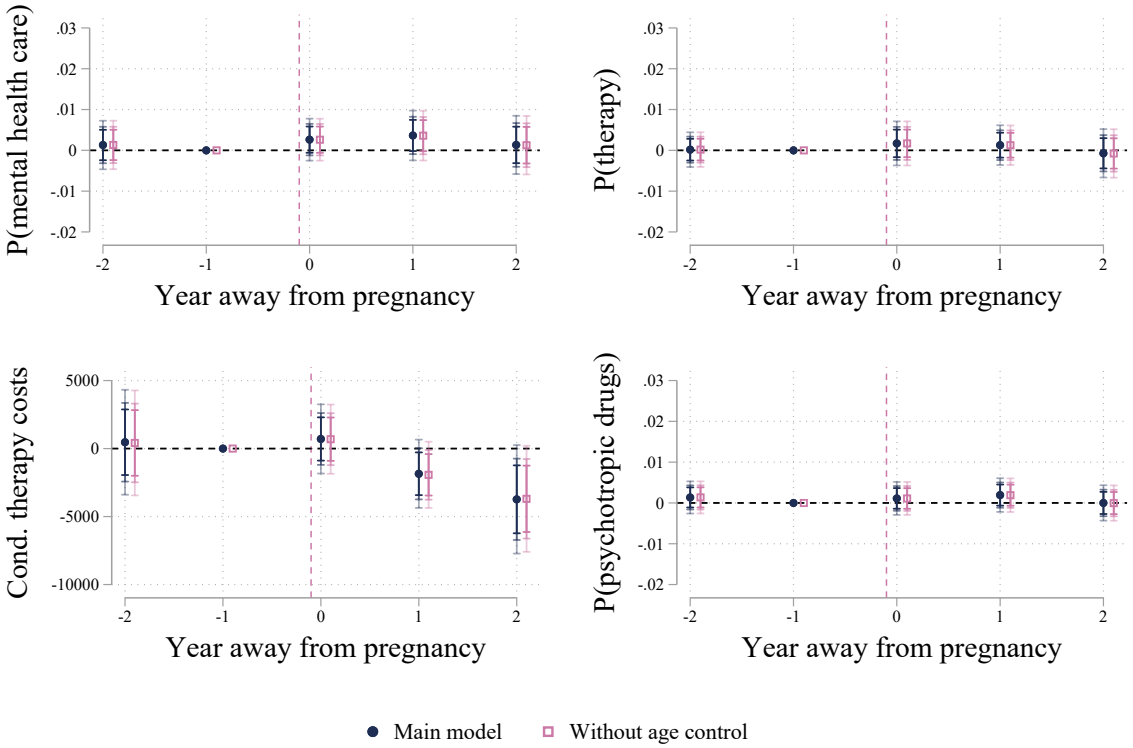
Figure A13: Partner's mental health care use: aggregated event-study results only based on cohorts with no pre-trends



Note: Compares estimates of the reweighting estimator of Sun and Abraham (2021) using all cohorts to the reweighting estimator when only using cohorts with zero pre-trends in the aggregation. Women with a completed pregnancy are a control group for the treatment group of women with a miscarriage. The control group is CEM weighted in order to have a comparable age, fertility treatment, calendar year, pre-birth employment and income quintile distribution as the women with a miscarriage. 90, 95, and 99% confidence intervals are reported, and event-time -1 is the reference period.

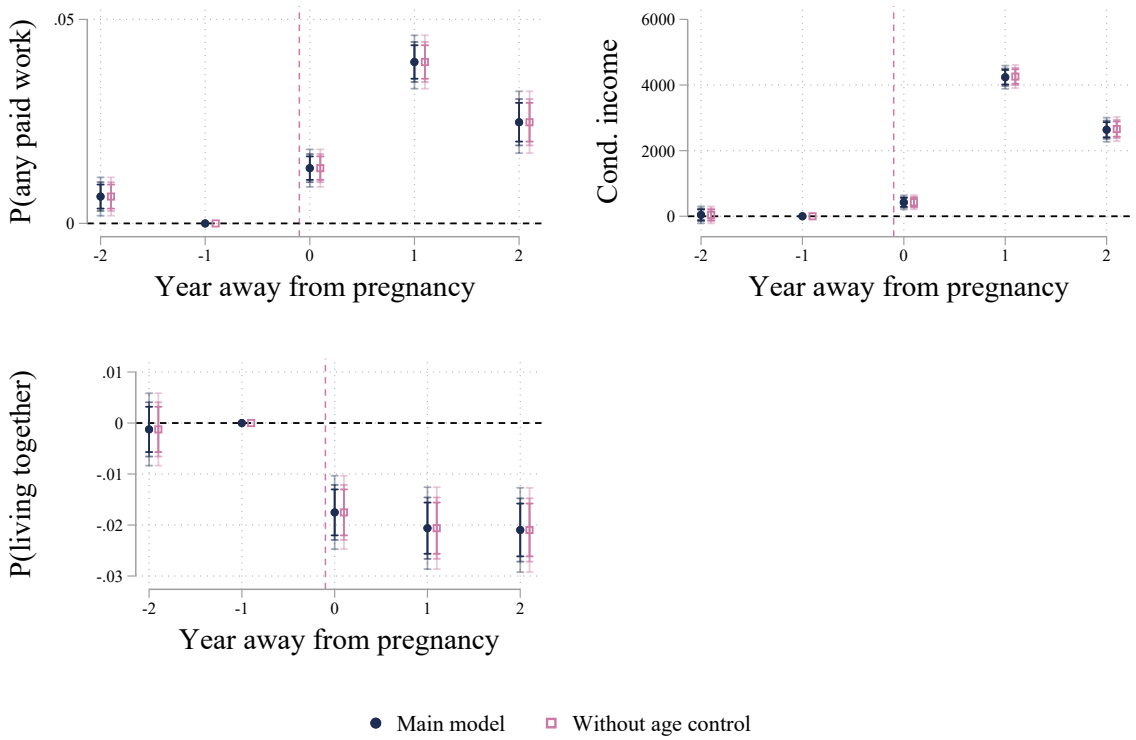
A1.9 Robustness check: no age controls

Figure A14: Partners' mental health care use: no age controls



Note: Comparing estimates of β^k (Equation 1) not including age group controls with the main specification. We use the reweighting estimator of Sun and Abraham (2021) where women with a completed pregnancy are a control group for the treatment group of women with a miscarriage. The control group is CEM weighted in order to have a comparable age, fertility treatment, calendar year, pre-birth employment and income quintile distribution as the women with a miscarriage. 90, 95, and 99% confidence intervals are reported, and event-time -1 is the reference period.

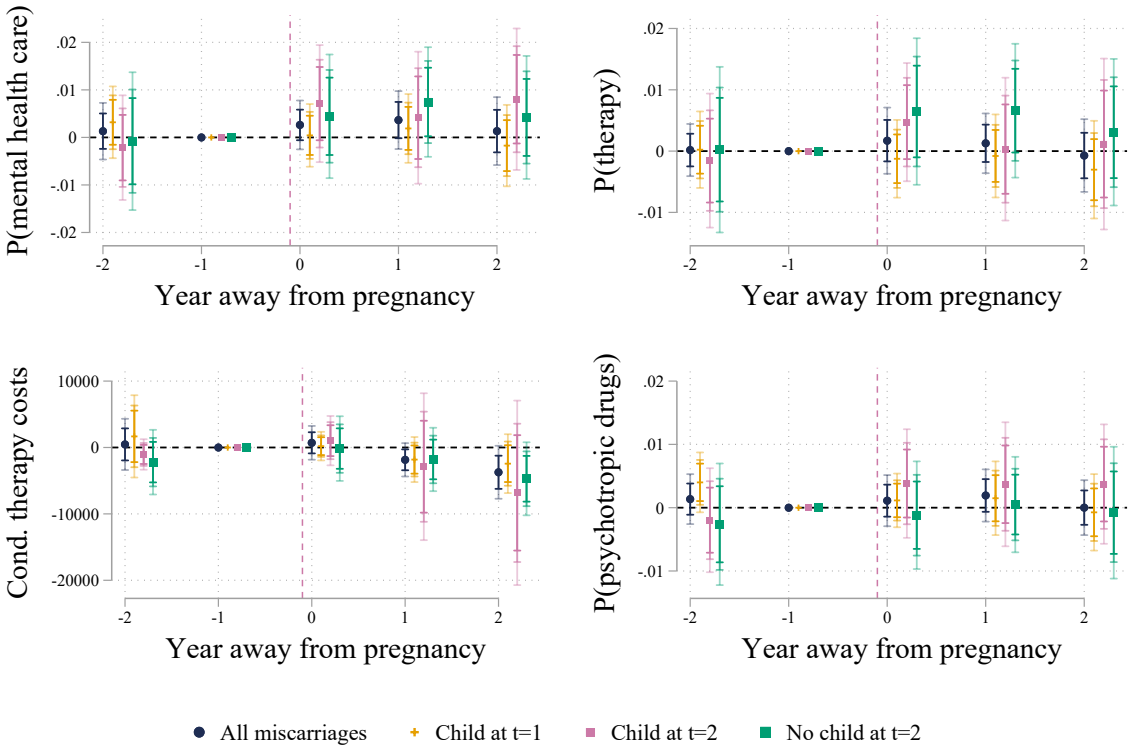
Figure A15: Women's labour market outcomes and couple dynamics: no age controls



Note: Comparing estimates of β^k (Equation 1) not including age group controls with the main specification. We use the reweighting estimator of Sun and Abraham (2021) where women with a completed pregnancy are a control group for the treatment group of women with a miscarriage. The control group is CEM weighted in order to have a comparable age, fertility treatment, calendar year, pre-birth employment and income quintile distribution as the women with a miscarriage. 90, 95, and 99% confidence intervals are reported, and event-time -1 is the reference period.

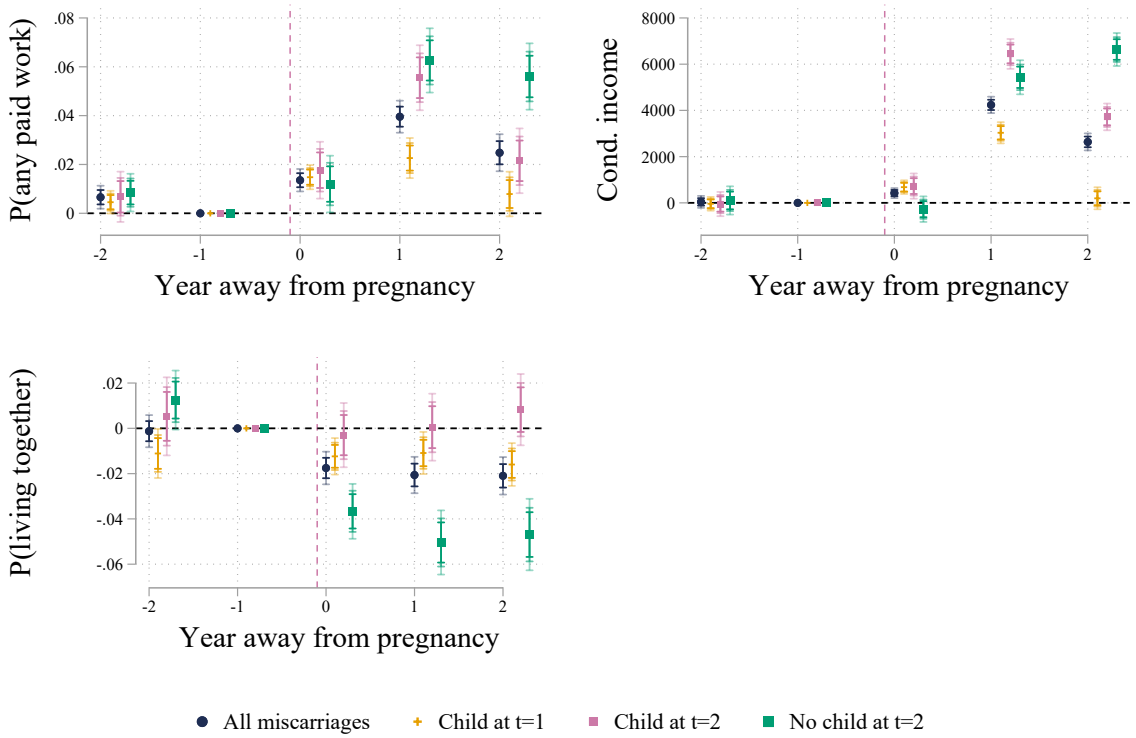
A1.10 Subsequent fertility

Figure A16: Partner's mental health care use after a miscarriage by arrival of the first child



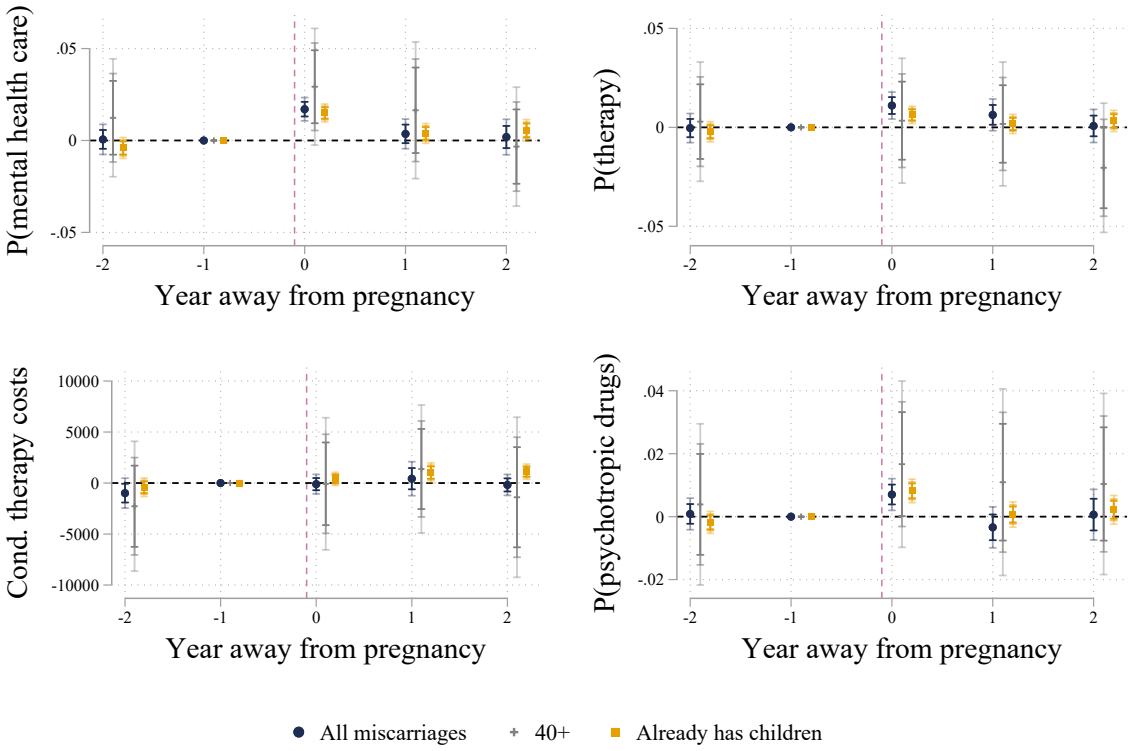
Note: Estimates of β^k (Equation 1) using the reweighting estimator of Sun and Abraham (2021) by arrival of the first child. Women with a completed pregnancy are a control group for the treatment group of i) all women with a miscarriage; ii) women with a miscarriage and a child one year later 'Child at t=1'; iii) women with miscarriage and a child two years later 'Child at t=2'; and iv) women with a miscarriage and no child two years after the miscarriage 'No child at t=2'. The control group is CEM weighted in order to have a comparable age, fertility treatment, calendar year, pre-birth employment and income quintile distribution as the women with a miscarriage. 90, 95, and 99% confidence intervals are reported, and event-time -1 is the reference period.

Figure A17: Labour market outcomes and couple dynamics after a miscarriage by arrival of the first child



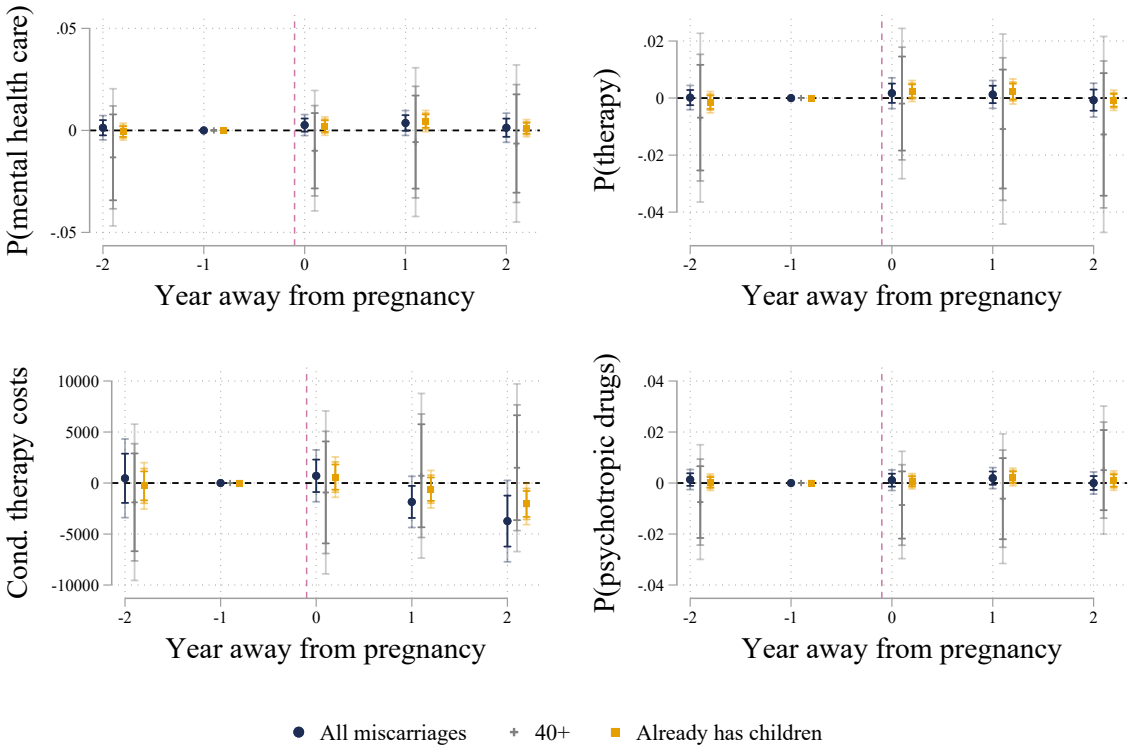
Note: Estimates of β^k (Equation 1) using the reweighting estimator of Sun and Abraham (2021) by arrival of the first child. Women with a completed pregnancy are a control group for the treatment group of i) all women with a miscarriage; ii) women with a miscarriage and a child one year later 'Child at t=1'; iii) women with miscarriage and a child two years later 'Child at t=2'; and iv) women with a miscarriage and no child two years after the miscarriage 'No child at t=2'. The control group is CEM weighted in order to have a comparable age, fertility treatment, calendar year, pre-birth employment and income quintile distribution as the women with a miscarriage. 90, 95, and 99% confidence intervals are reported, and event-time -1 is the reference period.

Figure A18: Women's mental health care use: heterogeneity by fertility signals



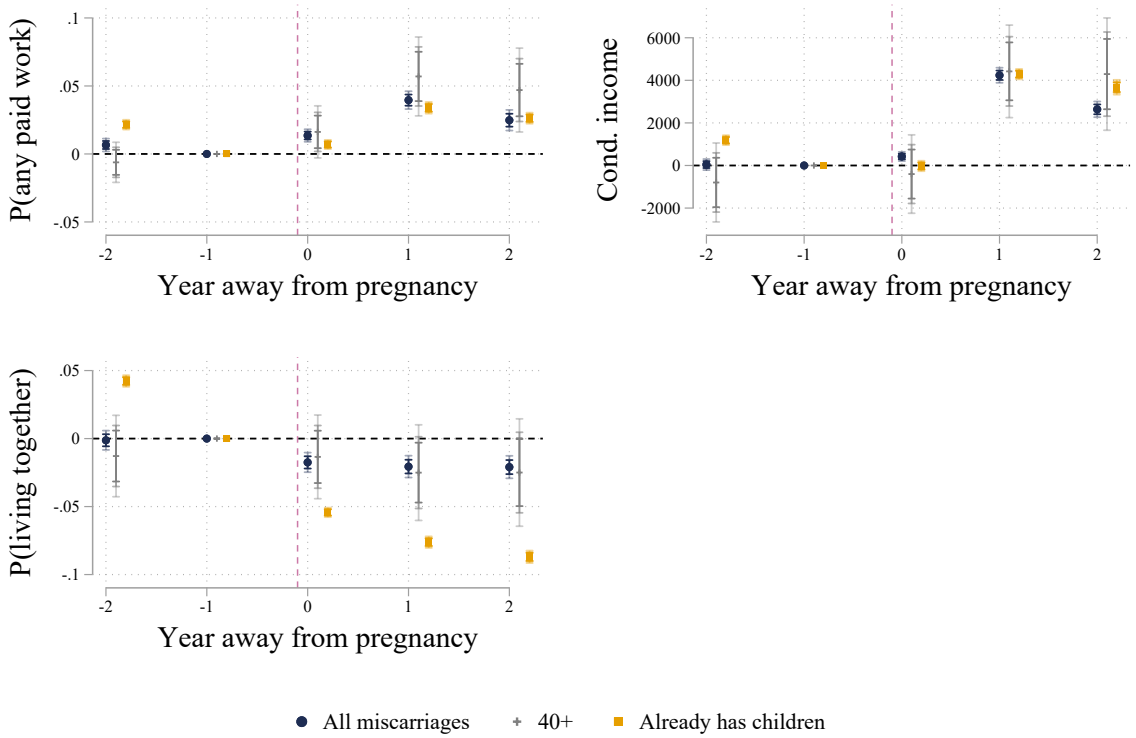
Note: Estimates of β^k (Equation 1) using the reweighting estimator of Sun and Abraham (2021) for two subgroups for whom it may be more or less difficult to become pregnant after the miscarriage. The '40+' sample includes only women who are 40 or older at the pregnancy. The sample 'Already has children' includes women who already have children before the miscarriage. The control group is CEM weighted in order to have a comparable age, fertility treatment, calendar year, pre-birth employment and income quintile distribution as the women with a miscarriage. 90, 95, and 99% confidence intervals are reported, and event-time -1 is the reference period.

Figure A19: Partner's mental health care use: heterogeneity by fertility signals



Note: Estimates of β^k (Equation 1) using the reweighting estimator of Sun and Abraham (2021) for two subgroups for whom it may be more or less difficult to become pregnant after the miscarriage. The '40+' sample includes only women who are 40 or older at the pregnancy. The sample 'Already has children' includes women who already have children before the miscarriage. The control group is CEM weighted in order to have a comparable age, fertility treatment, calendar year, pre-birth employment and income quintile distribution as the women with a miscarriage. 90, 95, and 99% confidence intervals are reported, and event-time -1 is the reference period.

Figure A20: Labour market outcomes and couple dynamics: heterogeneity by fertility signals



Note: Estimates of β^k (Equation 1) using the reweighting estimator of Sun and Abraham (2021) for two subgroups for whom it may be more or less difficult to become pregnant after the miscarriage. The '40+' sample includes only women who are 40 or older at the pregnancy. The sample 'Already has children' includes women who already have children before the miscarriage. The control group is CEM weighted in order to have a comparable age, fertility treatment, calendar year, pre-birth employment and income quintile distribution as the women with a miscarriage. 90, 95, and 99% confidence intervals are reported, and event-time -1 is the reference period.