# How Male or Female partner's exposure to Employment Uncertainty through Plant Closure affects their Fertility: A Couple-Level Analysis through Norwegian Register Data.

## 1. Introduction

Birth rates in the Nordic countries used to be among the highest in Europe and relatively stable (Andersson et al., 2009). In the case of Norway, the total fertility rate (TFR) fluctuated between 1.7 and 1.9 since the late 1970s. In 2009, after a brief rise, the TFR reached a high of 1.98. However, it has mostly been decreasing since then, and it fell to a level of 1.41 in 2022. Since 2010, birth rates have been falling rapidly in Norway, like in other Nordic countries, where postponement of reproduction (Hellstrand et al., 2021), health factors (Syse et al., 2020) or educational differences (Comoli et al., 2021) cannot fully explain the fertility decline. This decline was unexpected to some demographers, as these countries have extensive and generous welfare state provisions and family support policies that support the reconciliation of employment and family commitments for both women and men (McDonald, 2000; Esping-Andersen et al., 2002).

Prior research for Norway suggests that the reduction in fertility is not a result of changes in people's economic situation (Hart & Kravdal, 2020). However, a general feeling of economic uncertainty may have played a role in the Norwegian context (Hart & Kravdal, 2020). Generally, economic uncertainty is defined as a lack of clarity regarding future economic prospects (Beckert, 1996; Bloom, 2014; Vignoli et al., 2020a; Vignoli et al., 2020b). However, during the financial crisis, the Norwegian economy suffered the least compared to other Nordic countries, with relatively low unemployment rates and a GDP decline of only 1.6% in 2009 (Dølvik & Oldervoll, 2019). Moreover, Norway is also characterised by high incomes and a strong welfare state, which may take away much insecurity caused by unstable labour market conditions (Nguyen, 2017). On the other hand, there is evidence that after the 2008-09 financial crisis, Norwegians became more sensitive towards stable jobs and increasingly saw them as prerequisites for starting a family (OECD, 2023). So, economic uncertainty at the macro level may not have been so large, but this led to micro-level reactions to changes in economic conditions, i.e. employment uncertainty, which has increased among Norwegians following the 2008-09 financial crisis and could be an important factor in the fertility decline in Norway.

In this study, we investigate the impact of employment uncertainty on fertility in Norway. To do so, we use the exposure to plant closure as an indicator of employment uncertainty, an individual-level reaction to economic uncertainty and exploit that plant closures are an exogenous shock. Exogeneity here means that plant closures are beyond individuals' control, as they do not choose that their plant closes or does not close (Brand, 2015). Our longitudinal data comes from several administrative Norwegian registers covering the years 2005 to 2017, and we focus on couples (cohabiting or married) in the private sector aged 15 to 50. We employ discrete-time event history analysis as our main regression approach to model the couple's transition to first and second births.

This article responds to the call for additional studies that rigorously model the causal impact of employment uncertainty on fertility behaviour. It employs a combined approach that has been rarely used in previous research by analysing whether employment uncertainty due to an exogenous shock (i.e., firm closures) influences the transition to first or second childbirth within a couple. In addition to enhancing our understanding of the causal effects of employment uncertainty on fertility, we aim to uncover the underlying mechanisms. Specifically, we investigate whether the impact of plant closure on fertility operates through an income or employment uncertainty effect. We also explore gender dynamics by examining whether experiencing plant closure affects fertility differently depending on whether it is experienced by women or men in the couple.

In all, we aim to test a model of fertility that incorporates employment uncertainty faced by both men and women. We extend the existing frameworks by allowing economic uncertainty to affect men and women in different, perhaps offsetting, ways. This insight is not novel in population studies, but models of fertility behaviour and analyses of relationships between employment uncertainty and fertility tend to focus on either men or women in isolation. Our effort to incorporate gender-specific influences of economic uncertainty in explaining couples' childbearing thus constitutes an innovation.

In so doing, we focus on Norway, a unique context traditionally characterized by relatively high fertility rates and a stable labour market in Europe, which received limited investigation at the couple level. Despite fertility levels declining annually after 2009[1] and unemployment slightly increased for both men and women in their prime earning age[2] in the period considered in this study, Norway maintains relatively low unemployment levels compared to other Western countries and offers generous unemployment benefits and family support programs. This setting could potentially mitigate the influence of economic resources on fertility behaviours, making partnered individuals more secure in their fertility choices, even in the face of income reduction due to unemployment. Consequently, if any negative effect of job loss on fertility is identified in this specific context, it could potentially be more pronounced in other, less favourable contexts. For our analyses, we rely on data from

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[1] https://www.ssb.no/en/statbank/table/04232/chartViewLine/
[2] https://www.ssb.no/en/statbank/table/08517/chartViewLine/

Norwegian population registers for the period 2005-2017, allowing us to focus on the couple level and provide a wide range of information on partners and their fertility histories.

## 2. Data and Methods

### *2.1 Data*

We use data from high-quality administrative registers covering the total population of Norway from 2005-2017. From this register, we generate outcome variables for conception leading to birth in the next three years. All administrative registers in Norway include a personal identification number, which makes it possible to link information from different registers. The registers we combine provide detailed information on the birth dates of all children, economic activity, educational attainment, marital status, and age. The data include all men and women aged 15-50 from 2005 until 2014. We then added information from other registers, such as income, education, cohabitation, marital status, and employment registers from 2005 until 2014.

Since we want to identify the effect of employment uncertainty due to plant closure on couples' fertility outcomes, the sample is restricted to people in the sample who appeared at least once in the employment registers between 2005-2014 using spell information. So, people are not necessarily employed for all years of analysis. Some employments are not on the employment register, such as small and short employments, freelancers, contractors, persons with care wages and employments without wages. However, employment spells with at least 4 hours of work a week, with employment lasting more than a week in a year, will be captured in the employment register. The partners' characteristics, such as employment status, income, and birth date, were incorporated based on the marital partner or cohabiting partner ID number from cohabitation and marriage registers. With our current study design, we can assess whether someone who experienced plant closure in 2014 will have a conception leading to birth until 2017.

**Exposure to Plant Closure (2005-2014)**

**Other registers (education, income) (2005-2014)**

**Couple's birth conception variable (2005-2017)**

We then reduce our data to the couple level from the individual level by keeping unique couple-years based on couple ID. Our data is now in couple-year format instead of person-years. The main model for our analysis is:

$$y_{ct} = a + \beta_c x_{ct} + \beta_m x_{mt} + \beta_f x_{ft} + \beta_j x_{jt} + \epsilon_{ct}$$

$y_{ct}$ : couple's birth outcome at time t

$x_{ct}$ : couple's plant closure status at time t

$x_{mt}$ : male partner's individual chars. at time t (place of birth, male's age),

$x_{ft}$ : female partner's individual chars. at time t (place of birth, female's age) and

$x_{jt}$ : joint characteristics of both partners at time t (educational homogamy, income share of male partner to total income, total household income, partnership type etc.) affecting childbearing plans.

### *2.2 Variables*

Our treatment variable is experiencing a plant (establishment) closure at the couple level, which means if either partner experienced a plant closure during the study period. Plant closures can be considered an exogenous shock, whereas experiencing unemployment is not entirely exogenous, as it is influenced by an individual's education, skills, and motivation to secure reemployment promptly. Therefore, our focus is solely on exposure to the shock, not the actual outcome of unemployment, an approach that allows us to examine the impact of employment uncertainty rather than unemployment itself (Rege et al. 2007 for Norway; Huttunen et al. 2011 for Finland). In our analysis, we only consider private sector plants as public sector plant workers could receive special government support following closure.

We categorise workers as either displaced or nondisplaced based on their experience of a plant closure in a given year. A plant is considered closed in year *t* if it is present in the register for that year *t* but is absent in year *t+1* or subsequent years (Kellokumpu, 2015). This method may lead to misclassification in some instances, for example, if a plant's absence in the register is due to temporary shutdowns or interruption in operations but resumes activity in subsequent years or if a plant relocates to a new location without formal closure. To ensure an accurate identification of real closures, we define exiting plants where more than two-thirds of the workforce relocates to a single new plant in the following year as not real closures. Furthermore, we only consider plants with a workforce of at least five people to prevent considering the closure of self-employed enterprises or small family businesses as plant closures. In such cases, determining whether the closure qualifies as an exogenous shock is less clear.

At the couple level, we distinguish across situations where both partners do not experience plant closures: the male partner experienced plant closures, and the female partner experienced plant closures. Due to the limited occurrence of cases where both partners experienced plant closures, this category is not included in the analysis as there is too much uncertainty in the estimates. The primary independent variable (firm closure) is whether any partner in the couple undergoes Plant Closure (PC) in a given year.  with three categories: i. No partner experienced PC ii. The male partner experienced PC iii. The female partner experienced PC.

Our outcome variable indicates whether a couple had a birth conception within the subsequent three years, further distinguishing by first or second parity. For example, if a person gives first birth in 2017, this variable will show first birth conception in 2015 as it is within three years from 2017. Similarly, we create indicators for second birth using children's birth date and subtract nine months from it to get the year of second birth conception. Children born abroad are excluded from the analysis as years when a person is not registered. Also, we only have birth dates of children born, as information on pregnancies that were aborted or ended in stillbirth is not available.

Using event history analysis, this study aims to investigate the impact of a couple's unemployment status on the probability of their childbirth following the plant closure. We use the nine-month lagged date from the date of birth of children to ensure that plant closure should occur before conception of birth. We ran a binary logit regression for the people suffering from plant closure. We then predict the probability of the first and second birth conception in the following three years. We clustered our analysis by a couple of IDs generated earlier to correctly calculate the standard errors by accounting for within-couple clustering over the years and only considered the couple years where both partners had an income in the year before closure so that our couple was exposed to the risk of plant closure.

Our base model has the plant closure variable, year, place of birth (men & women), female's age, male age, educational homogamy, and partnership type (cohabiting/married). Our second model adds household income tertile in the year of closure to control for income loss due to experiencing plant closure. We also analysed heterogeneity based on the income share of male partners to total household income. We use continuous measures for this between 0 and 1 based on men's share of total household income. A couple's income pairing is based on a yearly, time-varying based on the share of annual income contributed to the household income by men. We also look for the effect heterogeneity of plant closures on fertility by female age and birth order (A decline in first birth probability might be smaller than a higher-order birth). We use quadratic terms for men's income share and female ages, assuming a non-linear relationship between them and fertility, as done by previous studies.

### *2.3 Analytical strategy*

Building on prior studies (Di Nallo & Lipps, 2023; Huttunen & Kellokumpu, 2016), we examine how job loss due to plant closure affects subsequent fertility differently, depending on whether it impacts the male or female partner within a couple. We use binary logistic regression under the discrete-time event history analysis framework. We follow individuals from age 15 until childbirth or censoring events (turning 50, mortality, permanent emigration, or reaching the end of the observation period in 2017, whichever occurs first). We run a binary logistic regression for the first and second birth separately. We used the nine-month lagged date from the date of birth of children to ensure that plant closure should occur before conception of birth.

In **Model 1**, we analyse the effect of exposure to firm closures for either partner on the likelihood of the couple transitioning to first or second childbirth relative to situations where neither partner experienced firm closures. All models control for both partners' ages to mitigate the potential confounding effect of age differences among the couples being compared. A year dummy is also included to account for any overarching trends affecting fertility and the risk of plant closure over time. Because fertility, income, and education levels are somewhat different for immigrant women than Norwegian-born women, we included a dummy variable separating those born in Norway from those born abroad (Dommermuth & Lappegård, 2017).

**Model 2** introduces control for household income tertiles in the year of closure to investigate the mechanism behind plant closure and fertility relationship. We will observe whether the decline in household income might have led to the adverse reaction of plant closure for fertility decisions if the effect of plant closure remains after controlling for household income tertiles in the year of closure. However, if the effect remains after controlling for household income tertiles in the year of closure, then we can conclude that plant closure's effect on fertility operates through the employment uncertainty effect.

Several interactions are incorporated in further models to explore which subgroups of couples are more vulnerable to the consequences of job loss on fertility. In **Model 3**, we investigate how the effect of firm closure on a couple's fertility varies based on men's contribution to household income, introducing interaction terms between firm closure and men's share of total household income. We assume a non-linear relationship between them and fertility and use continuous quadratic terms for the income share of men to total household income. **Model 4** examines how the effects of firm closure on fertility are contingent on life course stages, with an interaction between firm closure and women's age. Also, in this case, we assume a non-linear relationship between a female's age and fertility modelling age in a quadratic form.

We study the effect of firm closure on both first childbirth and second childbirth occurring within the following three years using logistic regressions with clustered standard errors at the couple level to account for the dependence between observations within the same couple.

## 3. Results

### *3.1 The main effect of plant closure on a couple's fertility (first and second birth)*

We start by analysing the effect of plant closure on couple fertility depending on whether the male or female partner experiences the closure. **Fig 1a** shows the Average Marginal Effects of plant closure on the conception of the first, depending on whether it was the male partner or the female partner who experienced plant closure, with respect to the situation in which none of the partners experienced a plant closure. We observe a negative effect on the probability of first birth for a couple for both male partners (-0.015) and female partners (-0.02) experiencing plant closure.

To investigate whether the decrease in fertility linked to plant closure for the male partner is primarily due to income-related factors or other aspects such as employment uncertainty and career prospects, we replicated the model, adding total household income as a covariate (**Fig 1b**). Our expectation was that if the decline in fertility were solely driven by income changes, the negative effect of plant closure on the probability of first birth for a couple would disappear when accounting for the total household income. When controlling for total household income in the year of closure, we observed a non-significant effect on fertility following the male partner's job loss due to plant closure, with the magnitude of the effect diminishing from nearly -0.015 to nearly 0. However, the negative effect on the probability of first birth for a couple persisted when the female partner experienced Plant Closure even after accounting for household income levels. This suggests that for females, while income loss may contribute to postponing or foregoing the decision to have a first birth, factors related to job uncertainty and career prospects play a larger role.

Similarly, we analyse the effect of plant closure on a couple's second birth depending on whether the male or female partner experiences the closure, with respect to the situation in which none of the partners experienced a plant closure. **Fig 2a** shows a negative effect on the probability of first birth for a couple for male partners (-0.02), while female partners' experience of plant closure has no significant effects.

To investigate whether the decrease in the couple's second birth probability is linked to plant closure for the male partner is primarily due to income-related factors or other aspects such as employment uncertainty and career prospects, we replicated the model, adding total household income as a covariate (**Figure 2b**). We observed a same magnitude negative effect on the couple's second birth probability following the male partner's experiencing plant closure. However, the effect remained insignificant when the female partner experienced Plant Closure, even after accounting for household income levels. This suggests that for males, while income loss may contribute to postponing or foregoing the decision to have a first birth, factors related to job uncertainty and career prospects play a larger role.

### *3.2 Heterogeneous fertility effects*

Having established the presence of a negative average effect of experiencing plant closure on couple's fertility when the male partner of the couple is exposed to a plant closure, we proceed to compare the probabilities of first and second birth conception following plant closure according to the division of the couple's income (**Figure 3a, 3b**) and the age of the woman (**Figure 4a, 4b**).

**Figures 3a** and **3b** illustrate how fertility patterns respond to exposure to plant closure by one of the partners across the income distribution within the couple. We expected that the negative impact of female unemployment on fertility would be more pronounced in couples where partners contribute equally or where the woman serves as the primary income provider. Conversely, in couples adhering to traditional gender roles where the man assumes the role of primary financial provider, the impact of female employment uncertainty on fertility may be less significant.

Our findings regarding the transition to the couple's first birth show that couples where female partners are affected by plant closure have lower first birth probability than those where male partners experienced closure and unaffected couples, regardless of the various combinations of partners' contributions to total household income.

Similarly, for transition to second birth, we find that couples, where male partners are affected by plant closure, have lower second birth probability than those where female partners experience closure and unaffected couples, regardless of the various combinations of partners' contributions to total household income.

We finally conducted an examination of the impact of plant closure on fertility across women's ages (**Figure 4a, 4b**). Our findings indicate no discernible differences in the transition to the couple's first and second childbirth following plant closure across all women ages.

## 4. Discussion

We observed negative impacts of plant closures on first birth within three years (~1.5 percentage points (ppts) for men & 2 ppts for women) and second birth for male partners (2 ppts). However, the negative impacts of plant closures on first birth go away for men after controlling for household income, indicating income effect, while for women, employment uncertainty. This suggests that the possible mechanism through which female job displacement affects first-birth probability is the income effect and employment uncertainty. We observed negative impacts of plant closures on second birth even after controlling for household income within three years (~2 percentage points for men & no significant. effect for women). This suggests that the possible mechanism through which male experience of plant closure affects second birth probability is not only the income effect, but uncertainty also plays a role in the decision of second birth.

These results align with couple-level studies from Finland by Huttunen, 2016 who also found a 4% decrease in the probability of giving birth following female job loss due to plant closure. Di Nallo 2023 also found in the UK and Germany that women's job loss negatively affects the chances of birth by four ppts. Men’s job loss also has a slightly negative effect on both countries. The Nordic countries' favourable employment conditions, gender-egalitarian attitudes, and robust welfare state provisions may explain the lower impacts and narrow differences in males' and female partners' fertility response to plant closures. This study contributes to understanding how experiencing plant closure influences fertility decisions within couples. By disentangling the effects of income and employment uncertainty, we provide insights into the mechanisms driving these decisions.

We did not find any significant heterogenous effects on the relationship between plant closure and fertility by male’s income share to the household income and female’s age.

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## Tables & Figures

**Figure 0a:** Loss in household net income following female partner's exposure to plant closure

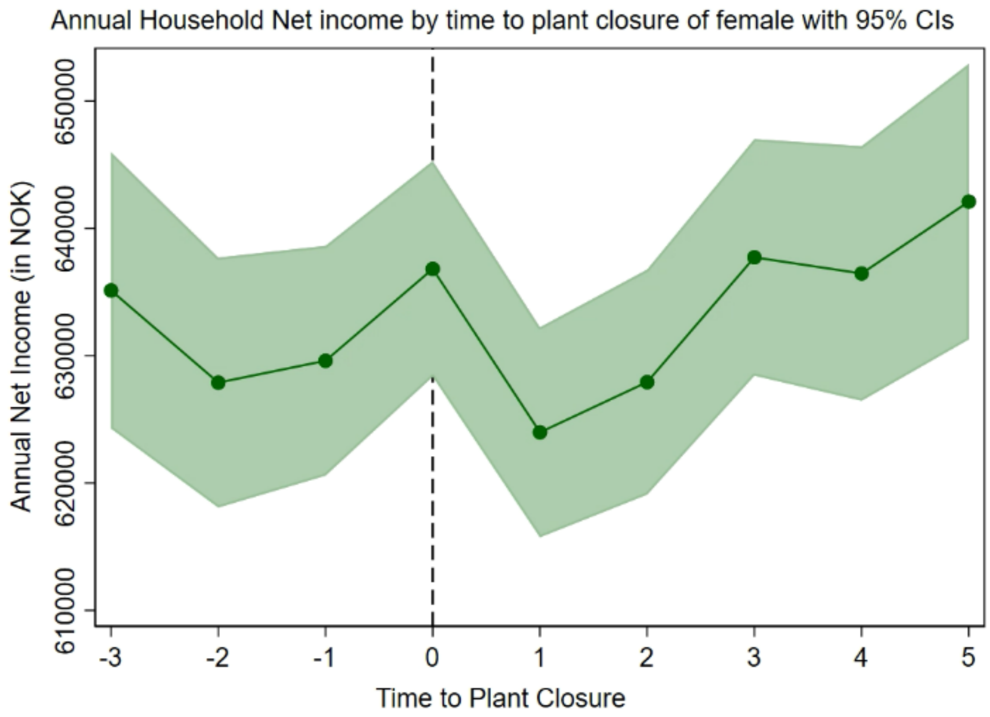



**Fig 0b:** Loss in household net income following male partner's exposure to plant closure

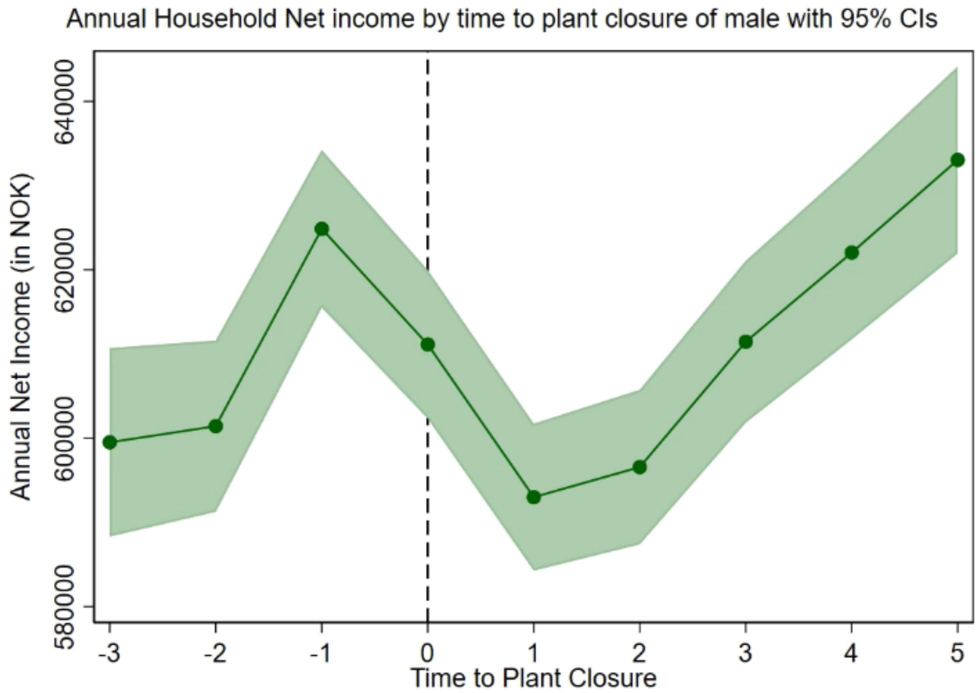


**Figure 1a:** Average Marginal Effect of Plant Closure on the Conception of first births (95% CI)

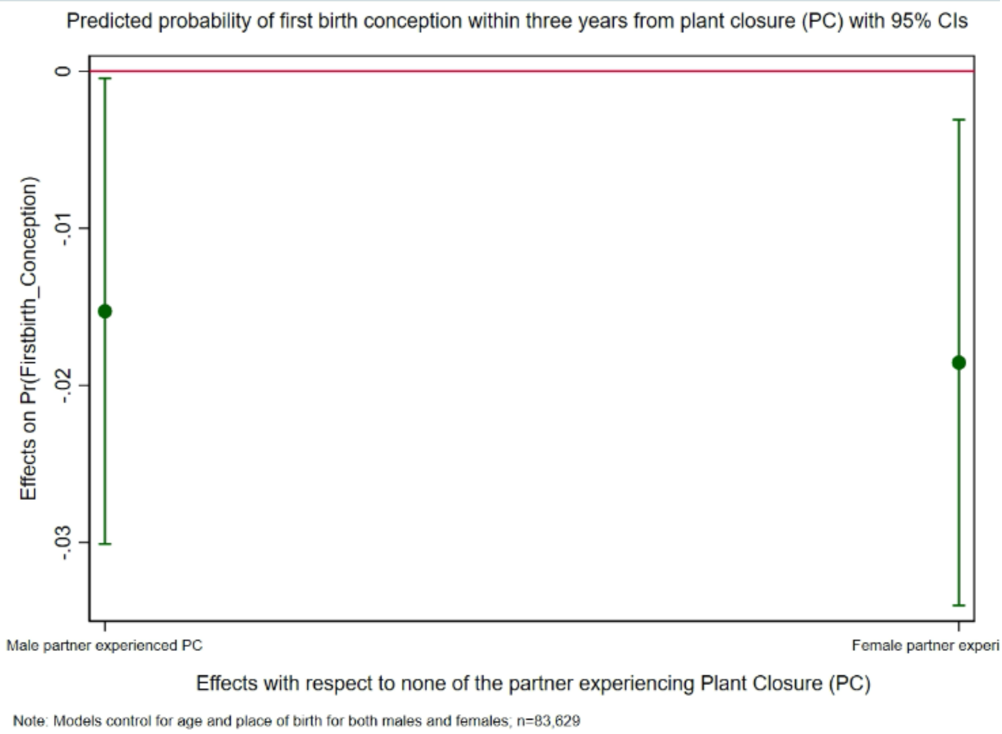
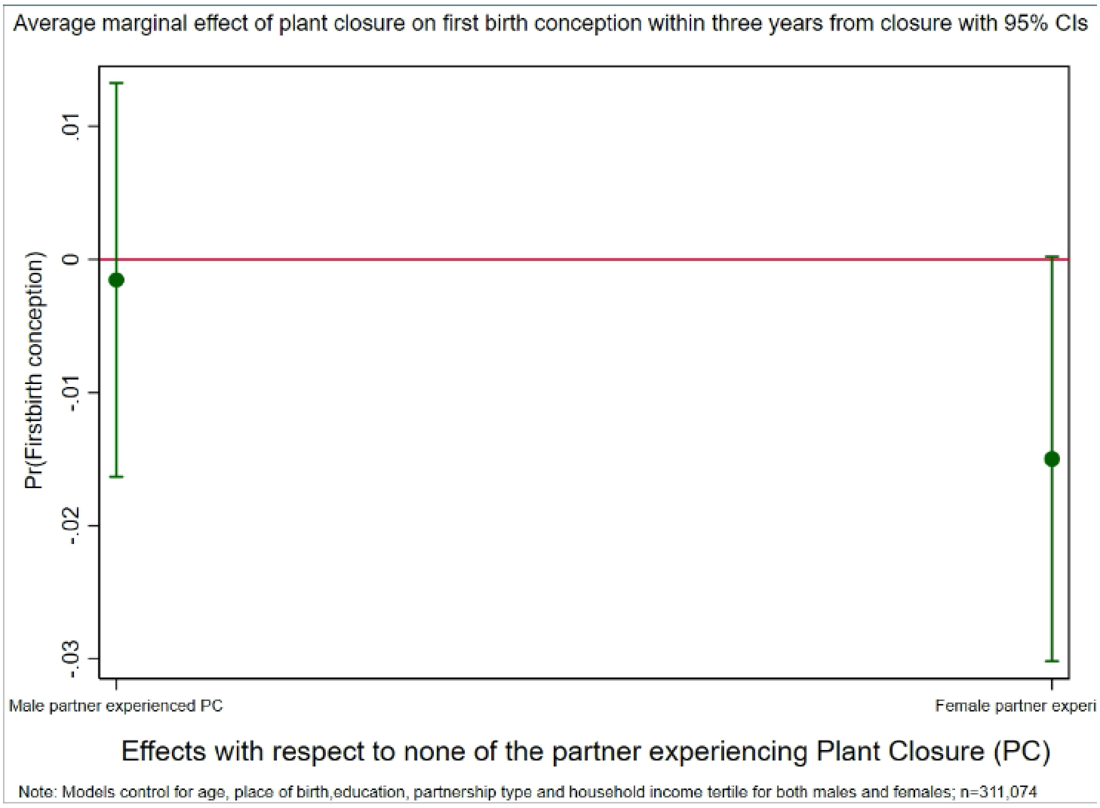



**Figure 1b:** Average Marginal Effect of Plant Closure on the Conception of first births (95% CI) net of household income in the year of closure.




*Note*: Results from discrete-time logistic regressions of plant closure on the probability of first and second birth conception. Models control for year dummy, age and place of birth of both partners. *Source*: Data from Norwegian population registers.

**Figure 2a:** Average Marginal Effect of Plant Closure on the Conception of second births (95% CI)

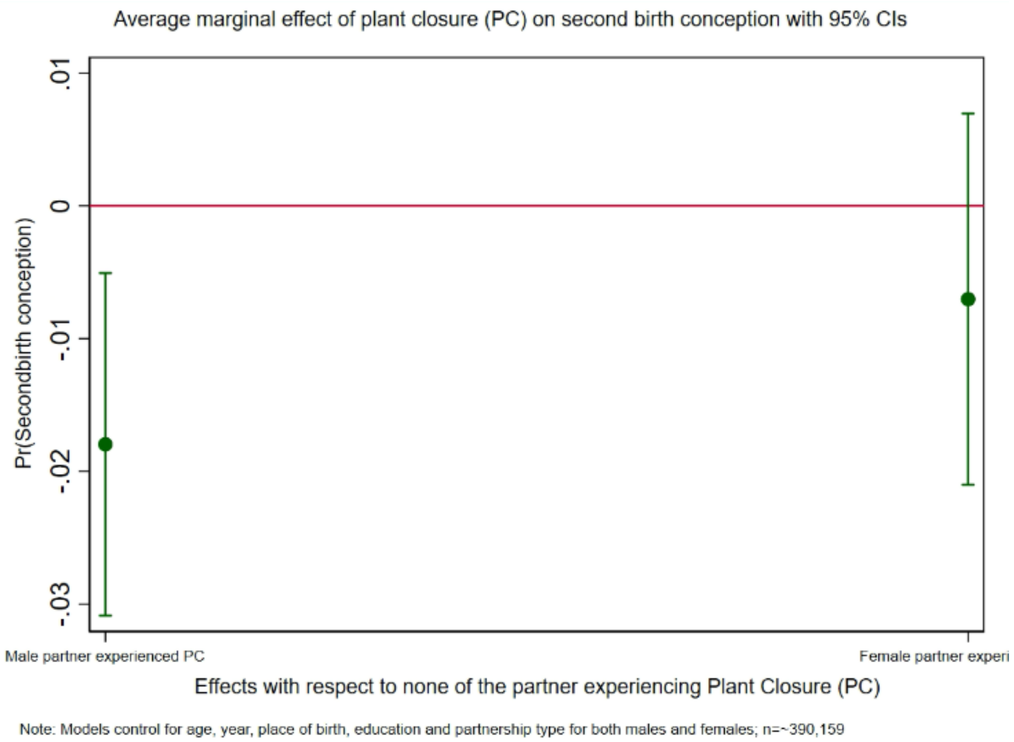
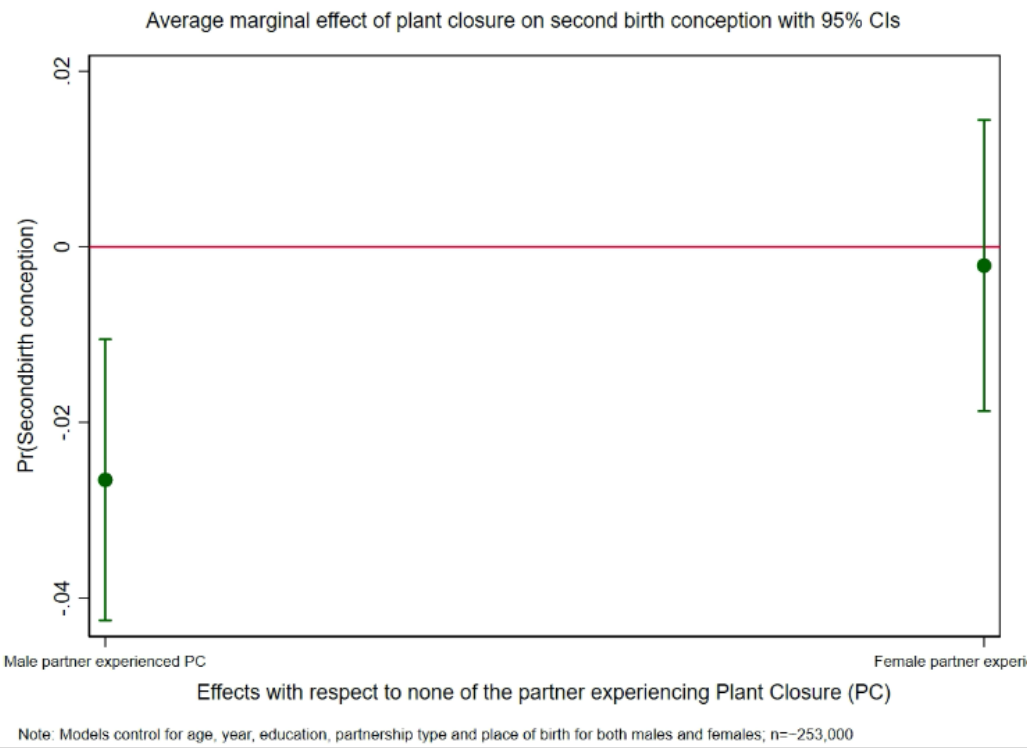



**Figure 2b:** Average Marginal Effect of Plant Closure on the Conception of second births net of total household income (95% CI)




*Note*: Results from discrete-time logistic regressions of plant closure on the probability of first and second birth conception. Models control for year dummy, age and place of birth of both partners and total household income.
*Source*: Data from Norwegian population registers.

**Figure 3a:** Predicted probability of first birth conception after plant closure by male partners' contribution to household income (95% CI)

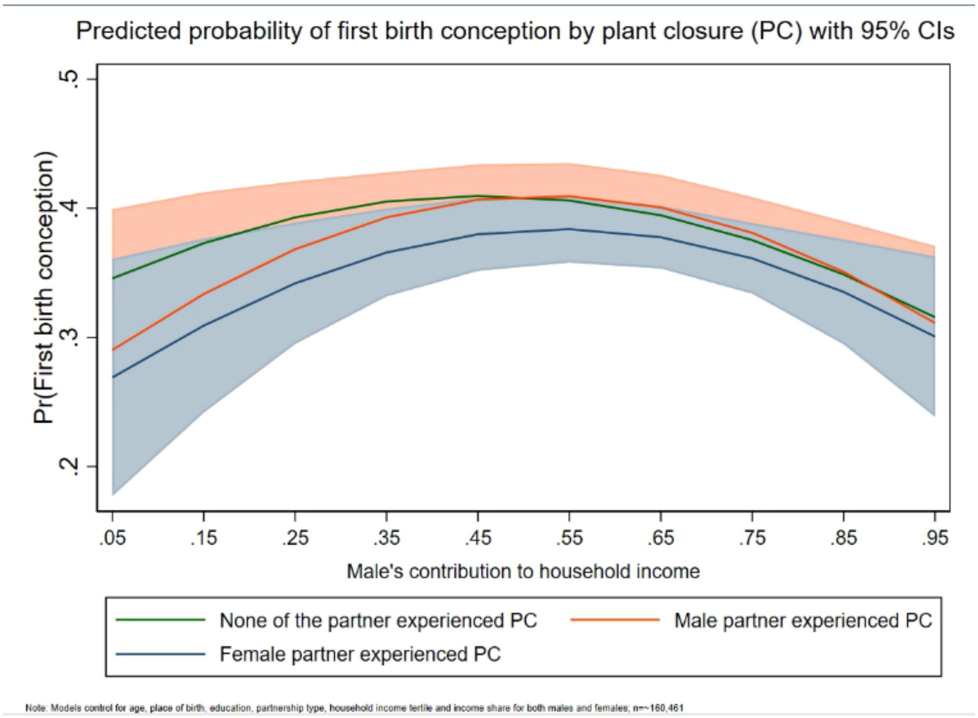
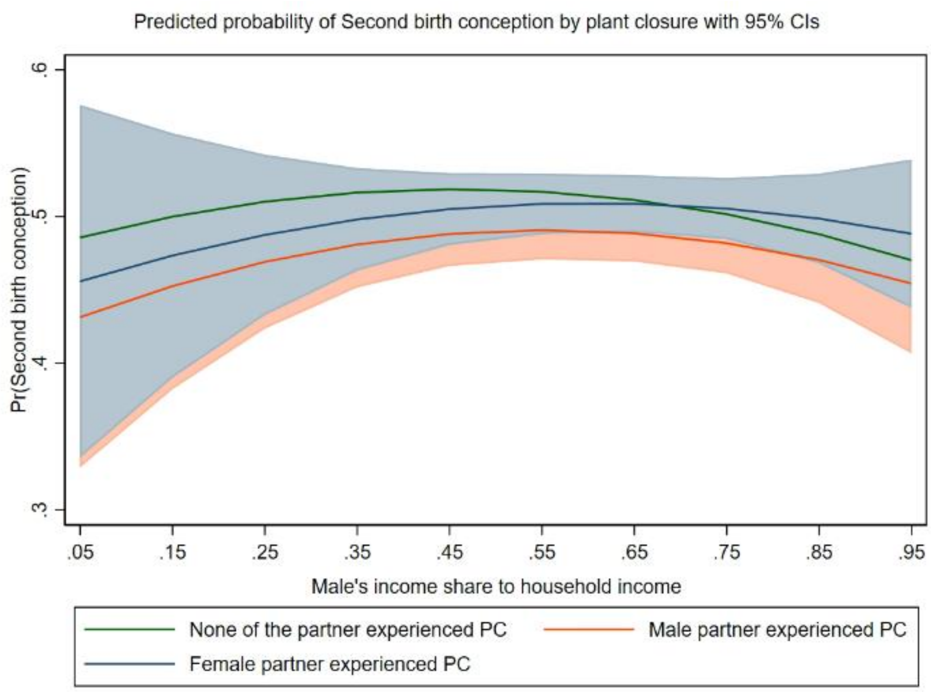



**Figure 3b:** Predicted probability of second birth conception after plant closure by male partners' contribution to household income (95% CI)




*Note*: Results from discrete-time logistic regressions of plant closure on the probability of first and second birth conception. Models control for year dummies, age, and place of birth of both partners and incorporate an interaction term squared to the male partner's share in total household income. *Source*: Data from Norwegian population registers.

**Figure 5a:** Predicted probability of first birth and second birth conception after plant closure by female partner's age (95% CI)

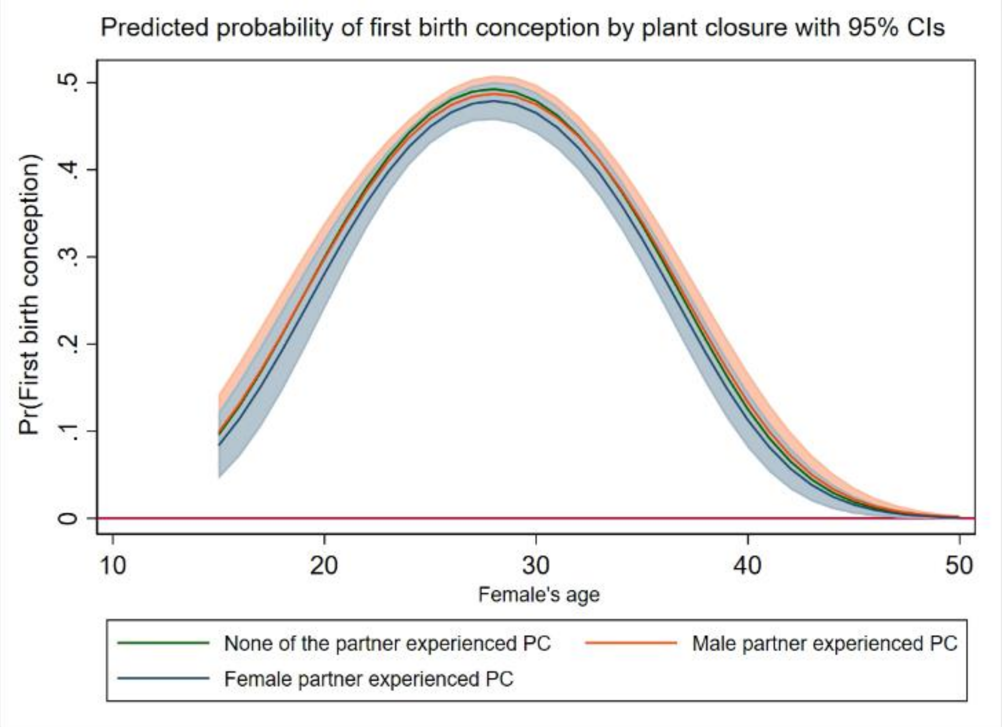
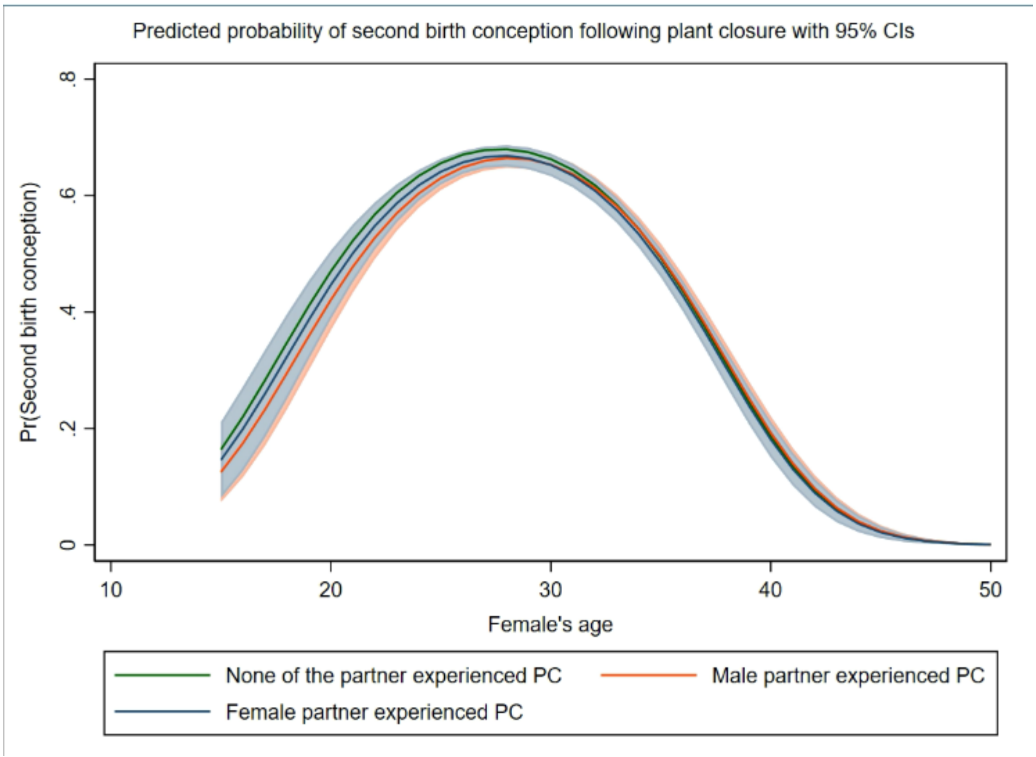



**Figure 5b:** Predicted probability of second birth conception after plant closure by female partner's age (95% CI)




*Note*: Results from discrete-time logistic regressions of plant closure on the probability of first and second birth conception. Models control for year dummies, age and place of birth of both partners and incorporate an interaction term with female age-squared. *Source*: Data from Norwegian population registers.