Midlife Crisis? The Labor and Health Impacts of the Menopause Transition*

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Abstract

We estimate the labor and health effects of the menopause transition for U.S. women. Using data from the NLSYW and the SWAN and applying an event study methodology which exploits the individual-level variation in the time of menopause, we find that women undergoing this transition have a lower probability of employment of almost 20 percentage points, and a higher probability of working part-time if they remain employed. We do not find significant impacts on their monthly earnings or hourly wage. Regarding health, we find that menopause increases the probability of having osteoporosis and bone fractures but does not have a significant impact on the probability of being diagnosed with diabetes, high blood pressure, or high cholesterol. We also find that the probability of taking hormones to treat symptoms increases throughout the menopause transition, as expected. However, such increase in hormonal take-up is concentrated among White and highly educated women, which highlights the unequal access to treatment, and probably different menopause experiences, associated with traditional markers of socioeconomic status.

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1 Introduction

This paper estimates the labor and health impacts of the menopause transition for U.S. women. This transition is a years-long period of substantial changes for aging women, marking the end of a woman's reproductive life. The associated hormonal changes lead to a variety of physical, cognitive, and emotional symptoms that, depending on severity, could affect a woman's performance and ability to work, as well as the overall quality of life. In addition, these hormonal changes and how they are treated could have long-term consequences for both physical and mental health, which could in turn also interact with labor outcomes.

Throughout women's lives, the interaction of biological and social factors impact their work and health outcomes and their overall welfare. For instance, menstrual periods increase school dropout and absenteeism among teenage girls (Vashisht et al., 2018), as well as absenteeism from work for adult women (Ichino and Moretti, 2009). The effects of childbearing are perhaps the most studied and a large literature shows that entry into motherhood disrupts a woman's labor force attachment, leading to a significant and persistent "child penalty" (Kleven et al., 2023, 2019; Kuziemko et al., 2018; Casarico and Lattanzio, 2024). Unlike childbearing, menopause affects all middle-aged women, mostly exogenously, and with varying degrees of severity. However, little is known about the causal effects of menopause on labor outcomes. In addition, the health care, medical training, and overall research about menopause is more limited and studies beyond pure correlational ones are for the most part scarce.

Not surprisingly, menopause is starting to become a topic of public discussion at both the policy, public health, and popular levels. Menopause activists, journalists, and, more recently, social-media influencers are breaking the silence around it and pushing for more awareness and changes in favor of women at this stage. In May 2024, some U.S. senators proposed the Advancing Menopause Care and Mid-Life Women's Health Act, which would provide millions of dollars in funding to federal research on menopause and women's health, raise public awareness about it, and provide adequate training to health care providers.

Although some medical studies and policy papers present evidence on the costs of menopause on women's labor outcomes, health, and general wellbeing, many of these studies are mostly descriptive and correlational. Only a couple of studies provide causal evidence of such impacts using quasiexperimental methods. For the UK,

Bryson et al. (2022) estimate the labor market impacts of early menopause, defined as having menopause before age 45, and menopausal symptoms on women's employment. Using differences-in-differences, they find that employment rates of women in their 50s are about 9 percentage points lower for those who experienced *early* menopause, compared to those who did not. Regarding symptoms, each additional symptom reduces employment, and also full-time employment, by about 0.5 percentage points, with emotional symptoms having the largest negative effects (1-2 percentage points, 2-4 percentage points if severe). More recently, Conti et al. (2024) use administrative data from Norway and Sweden and a stacked DiD design to show that receiving a menopause-related diagnosis, which is how they observe menopause in their data, permanently decreases a woman's full-time employment and earnings, and increases her receipt of government transfers. The authors estimate a 20 percent earnings loss compared to before menopause, and show that doctor visits also increase after the menopause diagnostic.

To provide evidence on the labor and health impacts of menopause for U.S women, we use data from the National Longitudinal Survey of Young Women (NLSYW, 1988-2003) and the Study of Women's Health Across the Nation (SWAN, 1997-2006), two longitudinal surveys that provide information on the menopause event, together with labor, health and socio-demographic variables. These data focus on similar cohorts of women, those born between 1942-1954, observed at different times and ages. Our NLSYW sample includes women ages 36-61, whereas our SWAN sample includes women ages 42-52. These surveys also complement each other, because the NLSYW has more detailed labor and sociodemographic variables, whereas the SWAN has a richer array of health variables. More details on the similarities and differences between them are provided in the Data section.

We use an event study methodology in which menopause is the event. Medically speaking, menopause is established when a woman's period has been missing for at least 12 months but the associated hormonal changes and symptoms start years earlier, during a period called "perimenopause". Such symptoms tend to increase sharply, and become potentially more disruptive to a woman's life, about two years before her period stops. Thus, we set the event time at two years before a woman's last menstrual period (Politi et al., 2008), and we define a window of five years before and after that (up to seven years before and three years after actual menopause) for both data sources. We also restrict our analysis to the subsample of women who went through menopause, i.e.

are observed both before and after their last menstrual period, naturally. The latter implies that we drop women whose menstrual period stopped due to a medical treatment or procedure, like chemotherapy or hysterectomy. Importantly, our design includes all women undergoing menopause, independently of whether they are (endogenously) in contact with the healthcare system or whether they are explicitly diagnosed with it by a healthcare provider.

Given that the effects of menopause on labor and health outcomes are potentially heterogeneous over time and between cohorts defined by menopause age, we follow the recent econometrics literature and use the imputation procedure proposed by Borusyak et al. (2024) to estimate them. This procedure is robust to treatment-effect heterogeneity and straightforward to implement. First, woman, age, and year fixed effects are estimated with OLS regressions of the outcomes of interest using only untreated observations (not-yet-treated observations, in our case). Then, using these estimated fixed effects, untreated potential outcomes are imputed to treated observations for each period. The individual treatment effect is estimated as the difference between the observed outcome for woman a given woman at a certain time and the imputed outcome. Finally, the average treatment effect on the treated (ATT) at each period is computed as the simple average of such individual effects at each period. Using this same procedure, we also report a single difference-in-differences "post" menopause average effect for some outcomes and estimate heterogeneous impacts of menopause by education, race, and hormone take-up. The procedure allows for pre-trends testing, which we also report.

Our results suggest that the menopause transition affects women's labor market outcomes mainly by reducing their probability of employment (10-20 percentage points, 3 years after menopause). For women who remain employed, this transition increases their probability of working part-time but does not significantly affect their earnings. Regarding health, we find that menopause significantly increases the probability of getting an osteoporosis diagnostic (5 pp 3 years after menopause) and of having a bone fracture (2 pp 3 years after menopause). We find no statistically significant impacts of menopause on other chronic illnesses, like high blood pressure or high cholesterol. For other health outcomes, we reject the null of no pre-trends, which suggests caution.

We also find that the probability of taking hormone replacement therapy (HRT), an effective treatment for the symptoms and physical consequences of menopause, increases

steadily during the post-period between 6 and 18 percentage points in the NLSYW data. When using SWAN, we find no effect of menopause on hormone use (we show results for estrogen, but results are similar when using other types of hormones) on our full sample, likely due to sample restrictions used in that study and the fact that SWAN (but not the NLSYW) uses data for years after the publication of the Women's Health Initiative (WHI) preliminary results of 2002, which led to a sharp decrease in the medical prescription and use of HRT.

We explore whether the estimated effects vary according to women's individual characteristics. We proxy socioeconomic status (SES) using women's schooling and find that the effect of menopause on employment is slightly stronger for more educated women in the NSLYW sample (but not SWAN). We also estimate effects by women's race (white vs rest) and find suggestive evidence that effects on labor outcomes are stronger for non-white women. Finally, we present results separately for women who report using HRT during the study. Although these results are conditioned on an outcomes (hormone use) we consider that they are nonetheless informative, given that HRT use may mediate the relation between menopause and labor and health outcomes. We show that more educated and white women are more likely to use HRT during the menopausal transition. Additionally, we show that HRT use may have a protective effect on labor and health, as women reporting to use hormones show smaller (or null) effects of menopause on key employment and physical and mental health outcomes. However, these results must be interpreted with caution—and as correlational rather than causal—as HRT is not exogenous.

Our paper is most closely related to Conti et al. (2024). Like them, we use a longitudinal dataset from a developed country and a DiD approach with a dynamic specification. A key difference, apart from the country of the study (U.S. vs Norway and Sweden) is that they use administrative data, whereas we use survey data. The latter relies on a woman's responses but allows us to observe the age at menopause according to the date of last period, as reported by her, regardless of receiving a formal medical diagnostic, as in the administrative data used by Conti et al. (2024). We view this as an advantage of our data, notwithstanding the potential measurement error inherent to self-reporting, as receiving a formal menopause diagnosis depends on a woman's healthcare access and use, which might be endogenous, i.e., driven by the severity of symptoms, labor status, SES, and other individual characteristics. Such endogeneity might be even more important in the U.S. given that its health care system is mostly

private, rather than publicly-funded as in Norway and Sweden. Our data also has a more comprehensive range of variables which is not limited to concrete medical diagnoses. In particular, our data include self-reported physical and emotional indicators, together with standard labor market variables. Other differences between this previous study and ours are discussed in detail in the next section. In spite of these important differences, our research and Conti et al. (2024) both find consistent results in terms of the effects of menopause on the probability of employment and full-time employment.

The rest of the paper is organized as follows. Section 2 presents background information on menopause and reviews the existing literature on its effects on labor outcomes and health. Section 3 presents the data we use while Section 4 discusses our empirical strategy. Our main results and robustness checks are presented in Section 5 and 6, respectively. Section 7 concludes.

2 Background

Menopause is the moment in a woman's life when her menstrual period stops completely. The medical criterion for establishing this moment is when a woman has not had her period for 12 consecutive months. In this paper and discussion, we focus on natural menopause, which excludes women that have their uterus and/or ovaries removed, as menopause can also happen when a woman has a hysterectomy, or a surgical removal of her ovaries.

The natural menopausal transition is also called perimenopause, the period before menopause when important hormonal changes begin and when certain symptoms generally associated with menopause start to appear. During perimenopause, in which hormones like estrogen and progesterone, begin to decrease gradually, leading to a variety of physical and emotional symptoms that, depending on severity, could affect a woman's performance at work and overall quality of life, like irregular and, sometimes heavy, menstrual periods, hot flashes, incontinence, trouble sleeping, weight gain, vaginal dryness and painful intercourse, irritability, mood swings, anxiety and depression. Cognitive symptoms include memory loss, brain fog, and difficulty concentrating. Perimenopause usually starts between the ages of 45 and 55, and lasts on average 2 years, but it could last up to 10 to 14 years and could start as soon as during a woman's early thirties. The onset age and duration seems to depend on a woman's lifestyle, race and ethnicity, among other factors. The period

after menopause is called postmenopause, in which women become more prone to heart disease and osteoporosis.

Medical treatment for menopausal symptoms varies from lifestyle and nutrition changes to non-hormonal medications and HRT. HRT addresses symptoms by leveling the hormone levels, and it comes in a variety of ways like pills, patches, rings, gels or creams. While the benefits of using hormones to manage and mitigate the symptoms of the menopausal transition have been known for decades there has been much discussion regarding the potential risks associated with HRT. The publication of the WHI's results in 2002 originally suggested that long-term HRT use increased the risk of breast cancer, stroke, blood clots, and heart attacks among healthy post-menopausal women (Daysal and Orsini, 2011), leading to a substantial fall in the use of HRT. Since then, many concerns regarding the results from the WHI have been raised, and while new studies suggest that HRT may actually have beneficial health effects and even reduce all-cause mortality, the use of HRT has not entirely returned to pre-WHI levels (Cagnacci and Venier, 2019). In any case, whether a woman decides to take HRT or not for menopausal symptoms is an individual decision discussed with her doctor and will in general depend on severity of symptoms, personal preferences, among other determinants.

3 Data

We use two main data sources which allow us to look at labor and health outcomes for middle-aged women in the US: the National Longitudinal Survey of Young Women (NLSYW) and the Study of Women's Health Across the Nation (SWAN) . Both are panel data that allows us to follow individual women in time and cover their menopausal transition.

3.1 NLSYW

The NLSYW is collected by the U.S. Bureau of Labor Statistics and follows 5,159 women aged 14-24 when first interviewed in 1968, until 2003.[1] For our analysis, we use only eight survey rounds (1988, 1991, 1993, 1995, 1997, 1999, 2001 and 2003). In 1988, women in our sample were between 34 and 44 years old; in 2003, they were between 49 and 61 years old.

[1]These data are public and can be obtained at www.nlsinfo.org/investigator.

Starting in 1995, the NLSYW included some questions about menopause. Namely, whether the respondents' period had stopped for 12 months or more; when this is the case, the survey asks about the date of the last period and the reason for period cessation. To construct the age at menopause, we use the date of last period only for women whose period stopped because of menopause or other reasons (about 50% of the sample), and ignore those whose period stopped due to pregnancy or breastfeeding (0.2%), and medical reasons (chemotherapy or radiation, and surgery, 52%). The survey also has information on other health variables (self-reported overall health, list), labor market outcomes (employment status, work hours, labor income, occupation, and whether the woman likes her job), sociodemographics, and whether the woman takes hormonal supplements and birth control pills to control menopausal or aging symptoms.

We further restrict our sample to women age 36 and older who went through menopause during the period covered by our data (1988-2003) so that we observe them both before and after this event. We also keep only women with 6–8 observations (interviews) during this period. Finally, we exclude women with a real hourly wage above or below the top and bottom 1% of the wage distribution.

Our labor market outcomes of interest are a dummy for whether the woman is employed at the time of the interview, her weekly hours of work (both her usual work hours and those on the week previous to the survey, in levels and logs), real monthly labor income, and hourly wage (both in levels and logs), and a dummy equal to one if the woman likes her job, and zero otherwise. For health, our dependent variables are dummies for self-reported poor health and for whether the woman has ever taken hormones to alleviate menopausal or aging symptoms.

We estimate whether the impacts of the menopause transition on labor and health outcomes differ by education (at most high school education vs more than HS), race (White vs Non-White) and hormone replacement therapy (HRT). We use education as a proxy for SES as it is available for all women independent of work status and is almost always time-invariant (i.e., for this age groups most women have completed their education). For education, we define a dummy equal to one if the woman has at most high school education.

3.2 SWAN

As a secondary data source we use data from SWAN, a longitudinal, epidemiologic study designed to examine the health of middle-aged women. The study includes a wide set of health variables as well as some labor outcomes and detailed demographics. The longitudinal survey from SWAN began in 1996–97 and follow-up surveys are conducted approximately every year. It included women that were 42–52 years old at baseline, had a uterus and at least one intact ovary, reported a menstrual period within the past three months and had not taken hormone medications (such as birth control pills, estrogen or progesterone preparations) in the last three months.[2] We use data for years 1997–2006. As with the NLSYW data, we construct the age at menopause variable when a woman's period is reported to have been absent for 12 months or more due to menopause or other reasons, excluding women whose period stopped due to medical reasons or pregnancy/breastfeeding. As the study's eligibility criteria requires women to be pre-menopausal in the first interview and we use 10 years of follow-up data, we can identify the time of menopause for all individuals in the data. We restrict our analysis to women with at least six interviews.

We use a set of health outcomes, focusing on variables that are highly prevalent among this age group, and include the most common chronic health conditions—namely, we construct variables for whether women are diagnosed by a health care provider with diabetes, high blood pressure, cholesterol, osteoporosis. Given the medical association between bone health and menopause and its prevalence, we also include a variable for bone fractures and anemia. In terms of mental health and mood-related variables, we also look at sadness, loneliness, nervousness, among other outcomes. For labor variables, the SWAN only includes questions about whether a woman works and whether she works full-time.

In terms of potential heterogeneous effects, we explore whether effects are different according to women's SES, which we proxy with schooling by using a dummy equal to one for women with at most high school and according to race, where we run regressions separately for non-hispanic white women. Additionally, we explore patterns in hormone use around the menopausal transition. Both surveys include variables regarding the use of hormones (SWAN has includes more detailed questions on types of hormones). Although we cannot directly distinguish whether hormones

[2]These data and information is available at https://www.swanstudy.org

are taken to treat menopause symptoms, we document how effects differ for women on HRT and whether women taking hormones may experience menopause-related outcomes differently. Although we acknowledge that taking hormones is highly endogenous, we argue that presenting results separately for women who report ever taking hormones during the study period versus those who do not is helpful to show how effects may differ along this dimension. It is also worth noting that as the period covered by NSLYW and SWAN differs, and that the (now highly controversial) recommendations warning against HRT from the Women's Health Initiative in 2002 are likely to reduce HRT use around menopause in SWAN but not NSLYW.

We use both data sources in our analysis. Although the cohorts of women in both surveys are by and large the same (NLSYW: born 1943–1953; SWAN: born 1942–1954), the time when we observe women is different (NLSYW: 1998–2003; SWAN: 1997–2006). This is relevant when comparing the results from these alternative data sources for two main reasons. First, as we limit our analysis in each survey to women that underwent menopause during the analysis of each survey, women with eariler menopause will be overrepresented in our NLSYW sample (and underrepresented in SWAN), as can be see in the histograms in Figure 1. Second, the results from the WHI cautioning against the use of HRT were published in 2002, affecting women in our SWAN (but not NSLYW) sample. This led to a large, decrease in the use of hormones for treating (pre)menopausal symptoms which is likely to affect how (peri)menopause is experienced and its observed effects on labor and health outcomes.

4 Empirical Methodology

4.1 Standard event study

As a starting point, we frame our empirical strategy using a standard (unadjusted) event study methodology for estimating the short- and medium-term effects of menopause on health and labor outcomes. Our setup is analogous to that used by Kleven et al. (2019) to estimate the child-penalty, but in our case, the event is menopause. Although menopause is established 12 months after a woman's last period ($t = 0$), we set the date of the event as two years before such last period ($t = -2$) because menopausal symptoms tend to increase sharply around that time. Additionally, most symptoms do not return to pre-menopausal levels until eight years after the final menstrual period

(Politi et al., 2008). In this setting, the baseline estimation would be:

$$y_{iat} = \sum_{\substack{d=-6 \\ d\neq -2}}^{6} \mathbb{1}(t - e^i = d)\beta_d + \gamma_a + \delta_t + \varepsilon_{ij}, \tag{1}$$

where y_{iat} is outcome for individual i of age a at time t. In this strategy, we would have coefficients β_d for each period d, relative to the year of the event (menopause), and include a full set of age dummies and year fixed effects.

4.2 Adjusting for heterogeneous effects across cohorts and time

In our case, women with the same menopause age constitute a cohort. Recent advances in the econometrics literature have shown that when treatment date differs between groups, as in our case, the standard event-study approach, consisting of an OLS estimation as in equation 1, may lead to biased estimators due to heterogeneous effects across cohorts and time (Roth et al., 2023).[3] As it is plausible that the effects of menopause are not constant over time or between cohorts defined by menopause age, in our preferred approach, we use the imputation procedure proposed by Borusyak et al. (2024) to estimate the effects of menopause on labor and health outcomes. This procedure is robust to treatment-effect heterogeneity and straightforward to implement. First, woman, age, and year fixed effects are estimated with OLS regressions of the outcomes of interest using only untreated observations. In general, untreated observations are never-treated and not-yet-treated observations; in our case, given that we restrict the sample to women who underwent menopause during our period of analysis, we only have the second comparison group (not-yet-treated women). Then, using these estimated fixed effects, untreated potential outcomes are imputed to treated observations for each period. The individual treatment effect is estimated as the difference between the observed outcome for woman i at time t and the imputed outcome. Finally, depending on the estimation target, the average effect is computed as a weighted sum of the individual treatment effects. In our case, this is just a simple average for the overall average

[3]Specifically, this recent literature has shown that the standard event study approach is valid only under the assumption of homogeneous effects and, thus, does not identify a reasonable average of heterogeneous effects due to negative weighting on some comparison groups.

treatment effect on the treated (ATT) at each period, which we report in regular event-plot type figures, together with their confidence intervals. This procedure also allows us to get a single difference-in-differences "post" average effect (corresponding to β_1 in equation **??**) and to analyze heterogeneous effects by the characteristics already described above (education, race, and hormone take-up), as in the triple-difference design suggested in Borusyak et al. (2024).[4]

The procedure assumes parallel trends for potential outcomes and allows testing for this assumption using the periods before treatment. In our case, as mentioned, even though the age of the last period is the actual menopause age, we consider the event date to be two years before this date, coinciding with the period in which perimenopausal symptoms might be more intense.

5 Results

5.1 Labor Impacts of Menopause

Figure 2 shows the effects of menopause on our main labor outcomes. We present estimates using data from both NSLYWS and SWAN for variables that are available in both sources. As mentioned, throughout our analysis, the event period is two years ($t = -2$) before a woman's last period. Panels (a) and (b) show that the probability of employment decreases steadily and significantly starting in perimenopause. In (a, NLSYW), the fall in the employment probability reaches 20 percentage points (pp) by the third year after menopause. The pattern is similar in (b, SWAN), although the effect is smaller in magnitude, as it reaches about 10 pp after three years. Panels (c) and (d) show that the probability of working less than 35 hours or part-time increases starting around perimenopause and continues to do so throughout the post-period, with the majority of the impacts reaching between 10 and 15 percentage points for both NLSYW and SWAN. These patterns are consistent with the findings of Bryson et al. (2022) who show that women experiencing early menopause (menopause before 45, present in the NLSYW, but not SWAN, sample) show a reduction in employment but no difference in full-time employment rates. For these outcomes, the estimated effects before $t = -2$ are close to zero and not statistically significant, and the pre-tend test for the assumptions of parallel trends fails to reject the null of no pre-trends (p-values

[4]We use the authors' own Stata commands: **did_imputation** for implementing the procedure and obtaining all of our estimates, and **event_plot** for producing our figures.

reported panels a-d are all > 0.10). In Panel (e), we find no statistically significant effects of the menopause transition on log monthly earnings.

In summary, Figure 2 suggests that the menopause transition affects women's labor market outcomes by mainly reducing their probability of employment. For women who remain employed, such transition increases their probability of working part-time, but does not affect their earnings significantly. Our findings suggest that women with early menopause show larger effects on their labor outcomes, especially at the extensive margin.

As mentioned, the imputation method allows us to estimate a single, post-treatment average impact. We report these estimates for our main labor outcomes and for some additional outcomes available in the NLSYW in the first row of Table 1. We find negative and significant impacts on the probability of employment (10 pp, column 1) and weekly work hours for women who continue working (14 percent, column 2) and for the whole sample of women (about 7 hours, column 5). We also find an increase of 9 percentage points in the probability of working fewer than 35 hours per week (significant at 1 percent, column 6). We find no evidence of pre-trends for these outcomes, as confirmed by the F-statistic and associated p-value at the bottom of these columns. In columns 3 and 4, the post-treatment estimates for log earnings and the log hourly wage are not statistically significant, but the PT test rejects the null at 5 and 10 percent, respectively. We also find no significant impacts on the probabilities of working less than usual, taking time off or being absent from work (columns 7-9), or liking her job (column 10).

Overall, these post-period average impacts are consistent with the patterns in Figure 2, and suggest that the menopause transition affects the probability that a woman works and her hours if she does, but does not affect her monthly earnings or hourly wage.

5.2 Health Impacts of Menopause

Figure 3 shows our main results of the effects of menopause on health outcomes from NLSYW (a) and SWAN (b)–(f). Panel (a) shows that the probability of reporting poor health increases after menopause, reaching an increase of almost 5 pp 3 years after menopause. However, such increase seems to start earlier ($t = -5$) than our specified treatment date ($t = -2$). As a result, the pre-trends test rejects the assumption of

parallel trends (p-value=0.02). Diagnosed diabetes shows an increase after menopause although pre-trends also fail to satisfy the parallel trends assumption. The impacts on high blood pressure and cholesterol are shown in Panels (c) and (d) and are overall not statistically significant.

We find strong evidence of menopause on bone health, mainly, significant increases on the probability of both an osteoporosis diagnostic in Panel (e) and having a bone fracture in Panel (f) of Figure 3. The probability of osteoporosis increases by 5 pp 3 years after menopause, while the probability of having a broken bone increases by more than 2 pp. For these outcomes, pre-trends are flat and close to zero.

The menopausal transition can affect women's labor market attachment and work intensity through the physical or emotional symptoms. Figure 4 shows the effects of menopause on some mental health and emotional related variables from SWAN. Panel (a) shows an increase in the probability of feeling blue following menopause of around 4 pp starting in perimenopause. Perhaps surprisingly, Panels (b) and (c) show a decrease in the probability of feeling tense/nervous and lonely of almost 20 pp 3 years after menopause. The probability of vaginal dryness increases by around 5 pp after menopause.

As complementary evidence for our main labor findings, in Table 2, we present post-treatment average impacts for the emotional symptoms experienced frequently by the woman during the week previous to the survey using the variables available in the NLSYW. We do not present event-study figures for these for brevity and because, as shown at the bottom of the table, for many of them, the PT test rejects the assumptions of parallel trends. Columns 1, 2 and 3 show positive and significant impacts of menopause on the probabilities of being unable to shake the blues (4.6 pp), having trouble keeping tasks in mind (5.5 pp) and feeling that everything took extra effort (4 pp). In the first two columns, the PT test rejects the assumption of parallel trends at 10 percent, and it does so at 1 percent in the third column. Column 4 shows that the probability of reporting frequent restless sleep during the reference week increases significantly by 7.8 pp in the post-period, but the pre-trend coefficients and the PT tests at the bottom show that this symptom starts increasing much earlier, up to five years (pre3) before actual menopause ($t = 0$). We find no significant impacts on the probability of frequently feeling lonely and sad (columns 5 and 6), and a significant increase in feeling like she could not get going (4.4 pp, column 7).

In sum, we take these estimates in Figure 4 Table 2 as suggestive evidence for the impact that menopause could have on women's labor market outcomes by affecting their emotional state, particularly their motivation and energy levels. However, the associated PT tests for several emotional outcomes caution against a stronger interpretation.

5.2.1 Hormone use

We explore how the use of hormones varies with menopause as HRT is known to help manage many of the symptoms associated with menopause. We present results from NLSYW and SWAN, although, as discussed above, these are likely to vary significantly due to the publication of results from the WHI cautioning against hormone use in 2002.

Figure 5 shows the use of hormones around menopause as it can be an important mediator between health and labor variables. Panel (a) comes from NLSYW and shows that the probability of taking hormones for menopause or aging symptoms increases steadily during the post-period between 6 and 18 percentage points and shows no pre-trends ($p - value = 0.27$). When using SWAN, we find no effect of menopause on hormone use (we show results for estrogen, but results are similar when using other types of hormones) on our full sample, likely due to the publication of WHI and the sample restrictions used in that study.

As HRT is likely to be highly endogenous to patient characteristics, we explore whether use varies with education or race in Panels (c)–(f). This may be due to differences in symptom prevalence between women with different characteristics, but may also be due to provider discretion. Panels (c) and (d) show that women with higher education (more than HS) are more likely to use HRT around menopause. Panels (e) and (f) show an increase in the probability of using hormones only for White women.

Table 1 shows the difference-in-difference pointwise estimates for health-related variables from NLSYW. For the probability of taking hormones for menopause or aging symptoms (column 11), we find a positive effect of 11 percentage points, significant at 1 percent. In the last column, we find a positive impact of 2.6 percentage points on the probability of reporting poor health in the post-period. However, some of the pre-trend coefficients are statistically significant and the corresponding PT test rejects

the parallel trends assumption at 5 percent.

5.3 Heterogeneous Impacts of Menopause by Education

As mentioned previously, we conduct the same analysis on the impacts of menopause of labor outcomes by educational attainment: by whether the woman has at most high school education. Thus, highly educated women are those with at least college. Our results for these heterogeneous impacts by education are presented in Figure 6. The estimates in the pre-period, although they appear separately in the graph, are the same for both groups by construction; only those for the post-period ($t = -2$ and onward) are separately estimated for each group.

Panel (a) shows that employment decreases for both groups of women in the post-period in NLSYW, but the impacts are larger and statistically significant only for highly educated women. Trends in the pre-period are flat and close to zero. In SWAN, results are noisier as only less than 5% of the sample has less than high school. The menopause transition seems to impact women differently depending on their education. Highly educated women seem to reduce their employment and work hours more, whereas women with high school education or less seem to have some negative (and mostly insignificant), impacts on earnings and wages.

Panel (c) shows the effects for osteoporosis. The effects look similar and are noisy, but this is probably due to the small number of women in the low schooling category.

Table 3 reports single average impacts for the whole post-period for the same two groups (Panel A) for a wider set of outcomes. The first row shows the estimates for women with higher education (more than high school) and the second for the other group. Column 1 shows that the employment probability decreases significantly for both groups, although slightly more for the highly educated group (9.2 pp) compared to the other group (6 pp). Columns 2, 5, 6 and 7 confirm that highly educated women decrease their work intensity, captured with different measures of work hours, by more than women with lower education during the menopause transition ($t = -2$ onward). For instance, weekly work hours decrease by 15 percent for the first group, and only 5.9 percent for the second group. The probability of working less than 35 hours per week increases significantly by 9.5 pp for highly educated women and not significantly for the other group. As shown in the previous figures, highly educated women are

20.55 pp more likely to have taken hormones for menopause or aging symptoms in the post-period, whereas the estimate for women with lower education is close to zero and insignificant (column 11). Finally, in column 12, the effect of the menopause transition on the likelihood of reporting poor health is larger for women with lower education (4 pp) than women with at least college (1.2 pp).

Regarding emotional symptoms, Panel A of Table 4 shows that women with high school or less are 3.6 percentage points more likely to report being unable to shake the blues in the post-period, whereas the estimate for women with more than high school is smaller and not significant (column 1). However, in that same column we reject the null of no pre-trends at 10 percent.Women in both education groups are more likely to report having trouble keeping tasks in mind by about 3.2-4.5 percentage points (29-41 percent, compared to the baseline probability at $t = -2$) but the impact for women with more than high school is significant at 1 percent, while the one for the other group is only significant at 10 percent. Highly educated women are also more likely to report suffering from restless sleep (5.4 pp, significant at 5 percent, column 4) and to feel lonely (2.4 pp, significant at 10 percent, column 6). In contrast, the post estimate for women with at most high school education is not significant for sleep, and negative and significant for feeling lonely.

5.4 Heterogeneous Impacts of Menopause by Race

Figure 7 shows the heterogeneous impacts of menopause by race (White versus Non-White). As shown in Table A1 in the Appendix, about 80 percent of the sample is White in NSLYW (and about 50% in SWAN). Almost all non-white women are Black, with a tiny proportion being Hispanic. Panels (a) and (b) shows that Non-White women decrease their employment probability more than White women, although the difference for most coefficients is not statistically significant.

In terms of the probability of having osteoporosis, Non-White women appear to have a greater effect of menopause on bone health, although bot White and Non-White women show deteriorated health in this respect.

The single DD estimates for the post-period in Panel B of Table 3 show pointwise estimates for variables from NLSYW. White women undergoing the menopausal transition decrease their employment probability by less (7.6 pp) than their Non-white counterparts (11 pp, column 1) but, if employed, they decrease their

weekly work hours by 13 percent (column 2). Non-white women do not reduce their work hours significantly if employed in the post period. Accordingly, in column 6, White women are 8.7 pp more likely to work fewer than 35 hours per week in the post period, whereas the corresponding estimate for Non-Whites is not significant. Maybe because of these differences in work hours if employed, White women experience a reduction of 6.8 percent in their hourly wage, and Non-white women do not (column 4). The results for earnings follow the same pattern, but the F statistic at the bottom of column 3 indicates that we might have a significant pre-trend in this variable. In column 5, when including women with zero work hours in the estimation, both groups present similar decreases that are statistically significant at 5 percent (4.5 hours per week for Whites and 4.7 hours per week for Non-Whites).

In Panel B, we find no significant impacts of the menopausal transition for either race group in columns 7 to 10. As shown in the corresponding figure, in column 11, we find that White women are 16.5 pp more likely to take hormones for menopausal or aging symptoms in the post period. In contrast, the estimate for Non-White women is negative and insignificant in that same column. The results for having ever taken hormones confirm that access to this type of medical treatment for menopause is unequal in education and race.

For emotional symptoms, Panel B of Table 4 shows that White women are more likely to report them in the post period, whereas most estimates are not significant for Non-White women. For instance, columns 2 and 5 show that the probabilities of reporting having trouble minding tasks and feeling lonely increase by 5.2 and 2.3 pp, respectively, in the post-period for White women. We find similar impacts for this group for being unable to shake the blues (column 1), experiencing restless sleep (column 4) and for could not get going (column 7) but in these columns the F test implies that we might have pre-trends in these outcomes. For Non-White women, we find mostly insignificant impacts, except for a decrease of 5.7 pp in the probability of feeling lonely (column 5), which is only significant at 10 percent. These differences might reflect different awareness or attitudes toward these negative emotions, and the willingness to report them, rather than differences in actual experiences. An additional caveat is that our sample is predominantly white (80%).

5.5 Heterogeneous Impacts of Menopause by HRT

Although taking HRT is an endogenous decision, which could depend on a woman's preferences for market work, the severity of her symptoms, individual characteristics, and access to healthcare among other dimensions as can be seen in Figure 5, in this subsection, we provide heterogeneous estimates along this dimension for descriptive purposes as hormone use may be an important mediator between menopause, labor outcomes, and health.

Figure 8, Panels (a) and (b) shows that for women who report never having taken hormones for menopause or aging symptoms ($HRT = 1$) the probability of employment falls more dramatically than for women that have taken hormones. This can be seen both when using NLSYW and SWAN.

Panel (c) shows the effects on osteoporosis. Coefficients in the post-period often overlap for both hormone users and others. While this may appear surprising given the known protective effect of estrogens on bone health, it is also likely that women with worse bone health are also more likely to use hormones. In terms of feeling blue, Panel (d) shows a protective effect of hormones on these kinds of feelings.

The single post-period DD estimates from NSLYW variable are consistent with these dynamic patterns (Table 3). Women who have taken HRT decrease their employment probability by less (6.8 pp, column 1), but if employed decrease their work hours by more (15 percent, column 2), compared to women who have not taken HRT (11 pp in column 1 and 6.1 percent, significant at 10 percent only in column 2, respectively). Women who have taken HRT are also more likely to work less than 35 hours per week (10.45 pp, column 6), while women who have not experience no impacts in this outcome. In contrast, columns 3 and 4 in Table 3 show that earnings and hourly wage for women who have not taken HRT decrease significantly by 13-14 percent, while we find no impacts for the group who took this medical treatment. In column 12, the former group of women is also 2.5 times more likely to report poor health that the latter. However, in these columns (3, 4 and 12), the F tests rejects the null of no pre-trends in outcomes, suggesting caution.

Regarding emotional symptoms, Panel C of Table 4 shows that women who have taken HRT are significantly more likely to report negative emotional symptoms, like being unable to shake the blues, having trouble minding tasks, experiencing that

everything took extra effort, restless sleep or that they could not get going, compared to women who have not taken such medical treatment. These results could be due to the endogeneity of getting HRT, i.e. that women with the worst emotional and physical symptoms are the ones who seek hormonal treatment. However, for most of these emotional outcomes, we reject the null of no significant pre-trends. Focusing only on outcomes for which we have no pre-trends (columns 2, 5, and 6), we have mixed results. Women who took HRT are more likely to report having trouble minding tasks (5.6 pp) than women who did not (3.7 pp), but only the latter have a 3.2 pp increase in the probability of feeling sad (significant at 10 percent only). We find no significant impacts for either group on the probability of feeling lonely.

Overall, our labor results suggest that women who take HRT decrease their employment by less but work fewer hours if they remain employed, compared to women who did not take HRT. Results regarding earnings and wage suggest that women who take HRT also experience no significant impacts, whereas women who did not take HRT experience some negative impacts in these variables. However, the latter results should be taken cautiously due to the potential presence of pre-trends in these variables.

6 Robustness

As a robustness check for our main results, we include women whose menstrual period stopped for 12 months or more due to medical reasons back into the sample. The result of these robustness exercises are reported in Appendix B.

In particular, we repeat our estimations, including women whose menstrual period stopped for 12 months or more due to medical reasons, such as chemotherapy, radiation therapy, or surgery, back in the sample. Although some of these women could have had this medical event before or after natural menopause, we dropped them because their health could impact their labor market outcomes differently than those who only experienced natural menopause. The Figures in Appendix B show that including them back in the sample does not change our main results.

7 Conclusions

As women age past their reproductive years, all women inevitably go through the menopause transition. However, there is little evidence on the economic costs of this biological process through which basically half of the adult population transitions. Our research begins to fill this gap. We analyze how this transition affects U.S. women's labor outcomes and health and find strong and persistent effects on the probability of employment of up to 20 pp by the third year after menopause. We also find that the probability of working part-time increases around menopause (around 10-15 pp). In terms of health, we find strong effects of menopause on overall bone health, and estimate that the probability of osteoporosis and broken bones increases by 5 and 2 pp respectively.

Our heterogeneity analysis shows that our estimated effects on labor outcomes are stronger for women with more schooling and for non-white women. This may be due to difference in the severity of symptoms for women with these characteristics, or it could also reflect the fact that women in different types of occupations (which vary with SES) may be able to cope with the menopause transition differently. Alternatively, higher SES women may be less income-constrained and thus may be able to reduce their labor supply as they experience (peri)menopausal symptoms, whereas low SES women may not. It may also be due to the fact that women from different SES or race may have different access to HRT which can mediate the relation between menopause and labor outcomes by mitigating experienced symptoms. We document different patterns in HRT take-up around menopause and show that more educated and white women are more likely to use hormones during this phase.

Our results point to important economic costs of menopause, both in terms of labor outcomes and health. They suggest that while the menopause transition is inevitable for women, its negative effects on individual's economic and health outcomes need not be. The effects we estimate are slightly stronger for more educated women and non-white women. They are also stronger for women who do not take HRT—perhaps not-coincidentally less educated and non-white women. Taken together, our results suggest that policies that support women going through menopause, particularly women with low SES and women of disadvantaged minorities, are likely to mitigate the economic and social costs of menopause. To the degree that HRT may have a protective effect for labor and health, improving access to it may be an relevant policy implication.

References

Aguilar-Gomez, Sandra, Eva Arceo-Gomez, and Elia De la Cruz Toledo, "Inside the black box of child penalties: Unpaid work and household structure," *Available at SSRN 3497089*, 2019.

Autor, David H and David Dorn, "The growth of low-skill service jobs and the polarization of the US labor market," *American economic review*, 2013, *103* (5), 1553–1597.

Borusyak, Kirill, Xavier Jaravel, and Jann Spiess, "Revisiting event-study designs: robust and efficient estimation," *Review of Economic Studies*, 2024, p. rdae007.

Brown, Wendy J, Gita D Mishra, and Annette Dobson, "Changes in physical symptoms during the menopause transition," *International Journal of Behavioral Medicine*, 2002, *9*, 53–67.

Bryson, Alex, Gabriella Conti, Rebecca Hardy, Darina Peycheva, and Alice Sullivan, "The consequences of early menopause and menopause symptoms for labour market participation," *Social Science & Medicine*, 2022, *293*, 114676.

Cagnacci, Angelo and Martina Venier, "The controversial history of hormone replacement therapy," *Medicina*, 2019, *55* (9), 602.

Casarico, Alessandra and Salvatore Lattanzio, "What firms do: Gender

inequality in linked employer-employee data," *Journal of Labor Economics*, 2024, *42* (2), 325–355.

Conti, Gabriella, Rita Ginja, Petra Persson, and Barton Willage, "Themenopause" penalty"," Technical Report, IFS Working Papers 2024.

Daysal, N Meltem and Chiara Orsini, "The Miracle Drug: Hormone Replacement Therapy and Labor Market Behavior of Middle-Aged Women," 2011.

de Chaisemartin, Clément and Xavier D'Haultfoeuille, "Fuzzy differences-in-differences," Technical Report 2015.

DeChaisemartin, Clément and Xavier d'Haultfoeuille, "Two-way fixed effects estimators with heterogeneous treatment effects," *American economic review*, 2020, *110* (9), 2964–2996.

Faubion, Stephanie S, Felicity Enders, Mary S Hedges, Rajeev Chaudhry, Juliana M Kling, Chrisandra L Shufelt, Mariam Saadedine, Kristin Mara, Joan M Griffin, and Ekta Kapoor, "Impact of menopause symptoms on women in the workplace," in "Mayo Clinic Proceedings," Vol. 98 Elsevier 2023, pp. 833–845.

Goodman-Bacon, Andrew, "Difference-in-differences with variation in treatment timing," *Journal of econometrics*, 2021, *225* (2), 254–277.

Hodis, Howard N and Wendy J Mack, "Menopausal hormone replacement therapy and reduction of all-cause mortality and cardiovascular disease: it is about time and timing," *The Cancer Journal*, 2022, *28* (3), 208–223.

Ichino, Andrea and Enrico Moretti, "Biological gender differences, absenteeism, and the earnings gap," *American economic journal: applied economics*, 2009, *1* (1), 183–218.

Kleven, Henrik, Camille Landais, and Gabriel Leite-Mariante, "The child penalty atlas," Technical Report, National Bureau of Economic Research 2023.

_ , _ , and Jakob Egholt Søgaard, "Children and gender inequality: Evidence from Denmark," *American Economic Journal: Applied Economics*, 2019, *11* (4), 181–209.

Kuziemko, Ilyana, Jessica Pan, Jenny Shen, and Ebonya Washington, "The mommy effect: Do women anticipate the employment effects of motherhood?," Technical Report, National Bureau of Economic Research 2018.

Monteleone, Patrizia, Giulia Mascagni, Andrea Giannini, Andrea R Genazzani, and Tommaso Simoncini, "Symptoms of menopause—global prevalence, physiology and implications," *Nature Reviews Endocrinology*, 2018, *14* (4), 199–215.

Politi, Mary C, Mark D Schleinitz, and Nananda F Col, "Revisiting the duration of vasomotor symptoms of menopause: a meta-analysis," *Journal of general internal medicine*, 2008, *23*, 1507–1513.

Roth, Jonathan, "Pretest with caution: Event-study estimates after testing for parallel trends," *American Economic Review: Insights*, 2022, *4* (3), 305–322.

_ , Pedro HC Sant'Anna, Alyssa Bilinski, and John Poe, "What's trending in

difference-in-differences? A synthesis of the recent econometrics literature," *Journal of Econometrics*, 2023, *235* (2), 2218–2244.

Schmidheiny, Kurt and Sebastian Siegloch, "On event studies and distributed-lags in two-way fixed effects models: Identification, equivalence, and generalization," *Journal of Applied Econometrics*, 2023, *38* (5), 695–713.

Strezhnev, Anton, "Semiparametric weighting estimators for multi-period difference-in-differences designs," in "Annual Conference of the American Political Science Association, August," Vol. 30 2018.

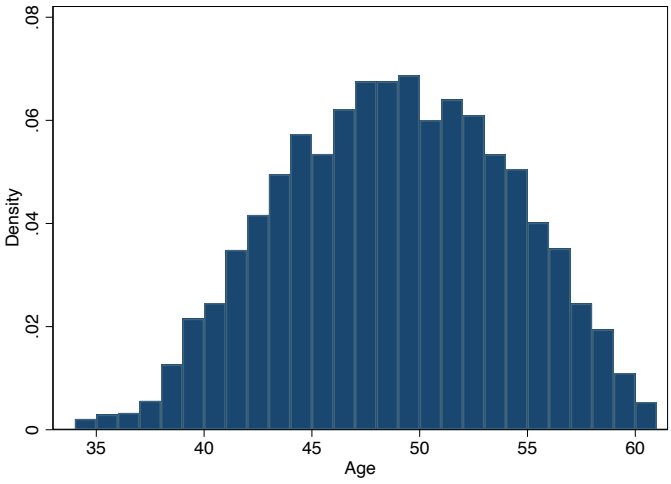
Sun, Liyang and Sarah Abraham, "Estimating dynamic treatment effects in event studies with heterogeneous treatment effects," *Journal of econometrics*, 2021, *225* (2), 175–199.

Vashisht, Aditi, Rambha Pathak, Rashmi Agarwalla, Bilkish N Patavegar, and Meely Panda, "School absenteeism during menstruation amongst adolescent girls in Delhi, India," *Journal of Family and Community Medicine*, 2018, *25* (3), 163–168.

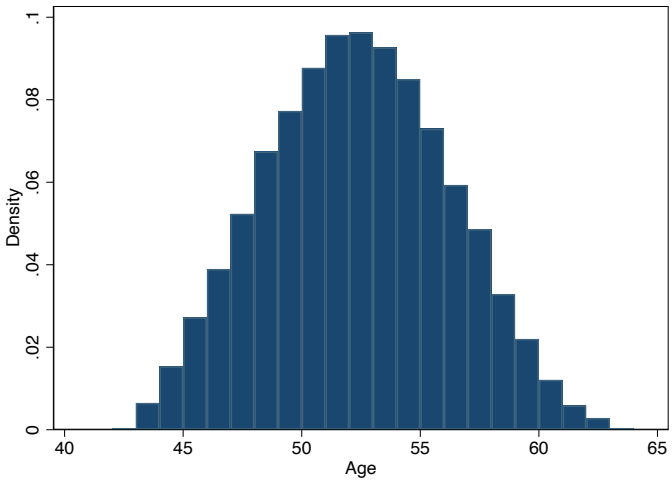
8 Figures and tables

Figure 1: Age distribution: NLSYW vs SWAN

(a) NLSYW

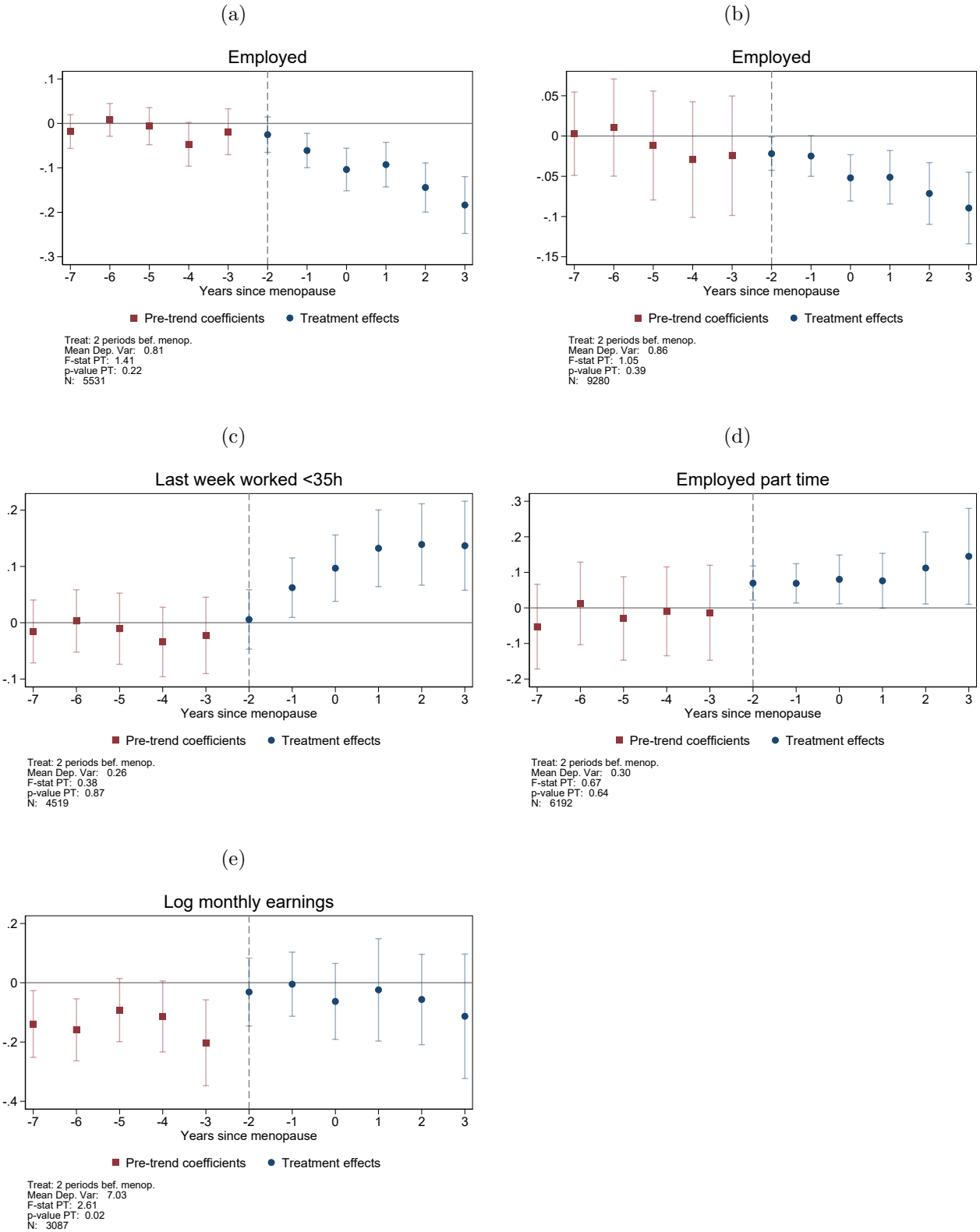


(b) SWAN



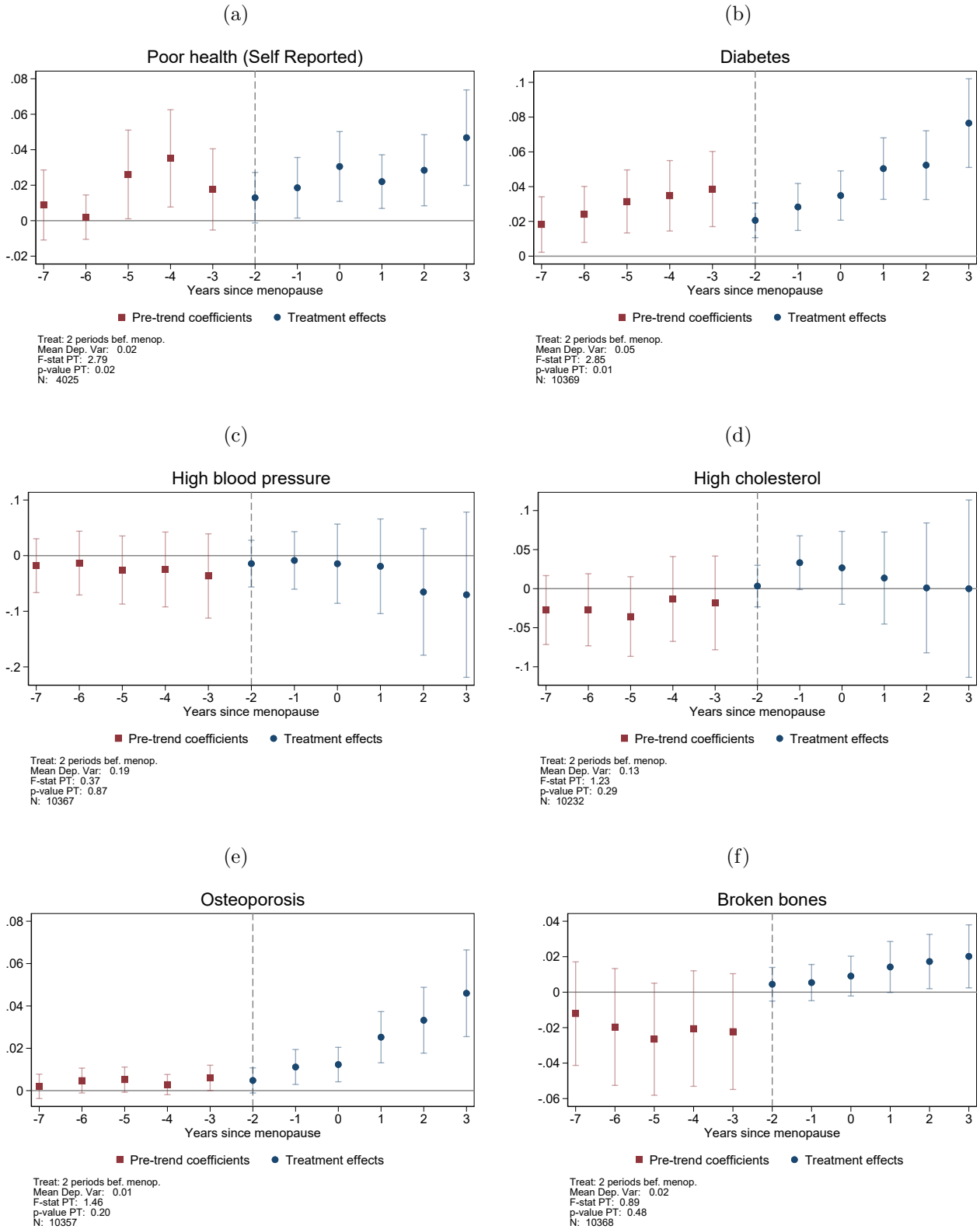
Notes: Age distribution across surveys. The mean and median is 48 in NSLYW and 52 in SWAN.

Figure 2: The Effect of Menopause on Labor Outcomes



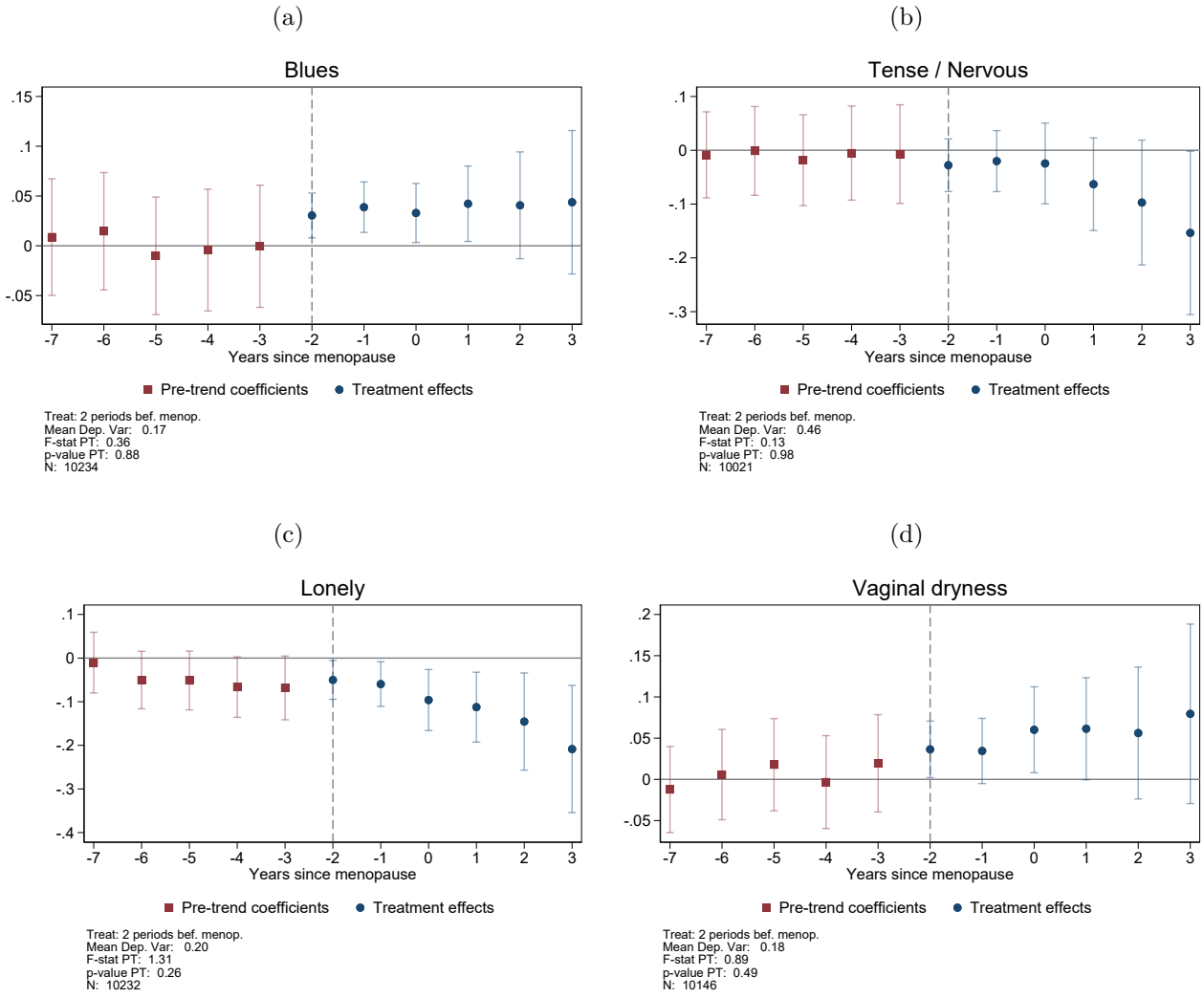
Notes: Each graph shows the estimated average treatment effects by year using the imputation method by Borusyak et al. (2024), with their 95% confidence intervals. The vertical dashed line indicates the reference period, two years before menopause ($t = -2$). Data from NSLYW (Panels a, c and e) and SWAN (Panels b and d). Standard errors are clustered at the individual level.

Figure 3: The Effect of Menopause on Health Outcomes



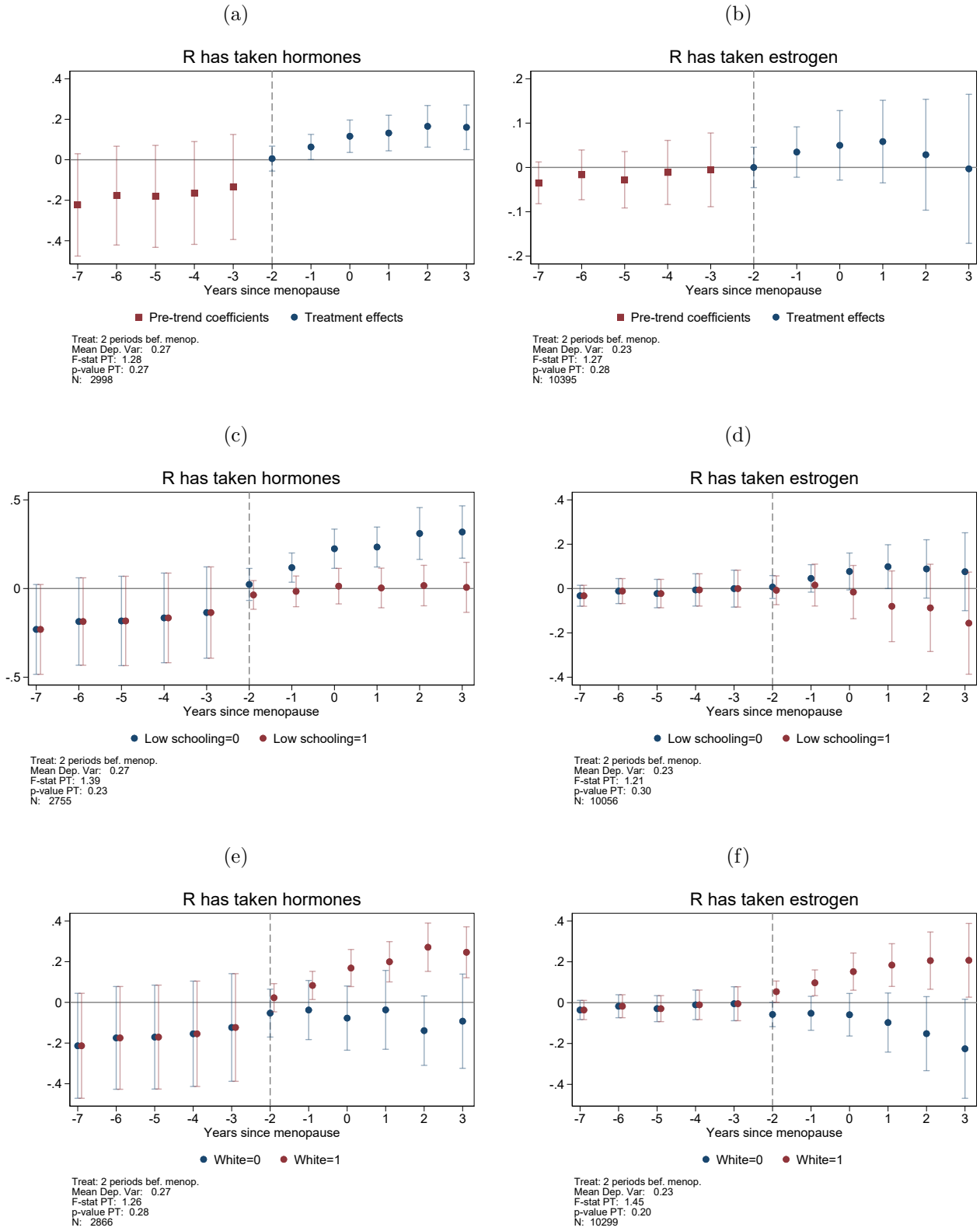
Notes: Each graph shows the estimated average treatment effects by year using the imputation method by Borusyak et al. (2024), with their 95% confidence intervals. The vertical dashed line indicates the reference period, two years before menopause ($t = -2$). Data from NSLYW (Panel a) and SWAN (Panels b, c, d, e and f). Standard errors are clustered at the individual level.

Figure 4: The Effect of Menopause on Other Health-Related Outcomes



Notes: Each graph shows the estimated average treatment effects by year using the imputation method by Borusyak et al. (2024), with their 95% confidence intervals. The vertical dashed line indicates the reference period, two years before menopause ($t = -2$). Data from SWAN (Panels a, b, c and d). Standard errors are clustered at the individual level.

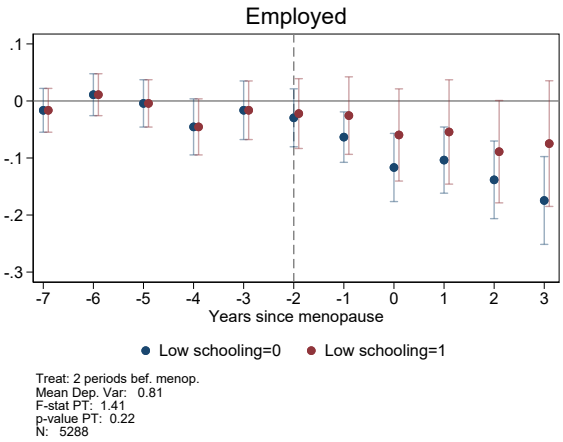
Figure 5: Hormone Replacement Therapy use in Menopause



Notes: Each graph shows the estimated average treatment effects by year using the imputation method by Borusyak et al. (2024), with their 95% confidence intervals. The vertical dashed line indicates the reference period, two years before menopause ($t = -2$). Data from NSLYW (Panels a, c and e) and SWAN (Panels b, d and f). Standard errors are clustered at the individual level.

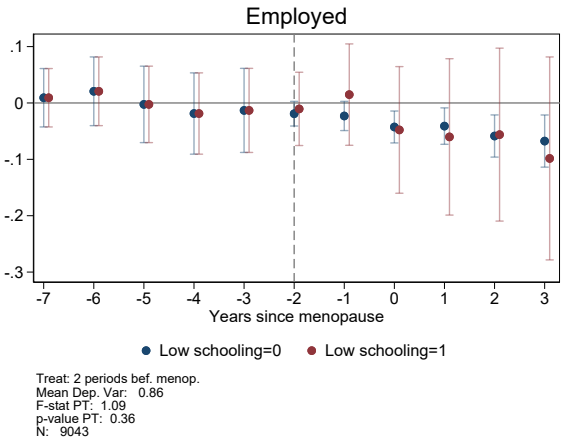
Figure 6: Heterogeneity by Education

(a)



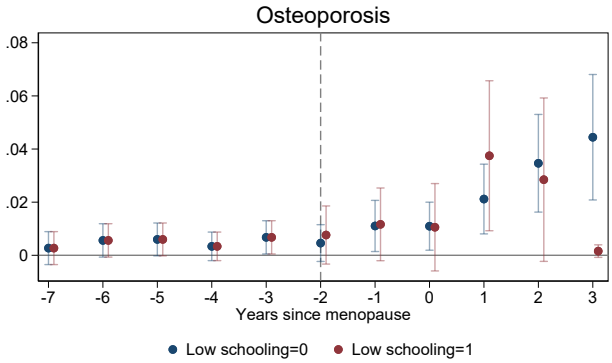
Treat: 2 periods bef. menop.
Mean Dep. Var: 0.81
F-stat PT: 1.41
p-value PT: 0.22
N: 5288

(b)



Treat: 2 periods bef. menop.
Mean Dep. Var: 0.86
F-stat PT: 1.09
p-value PT: 0.36
N: 9043

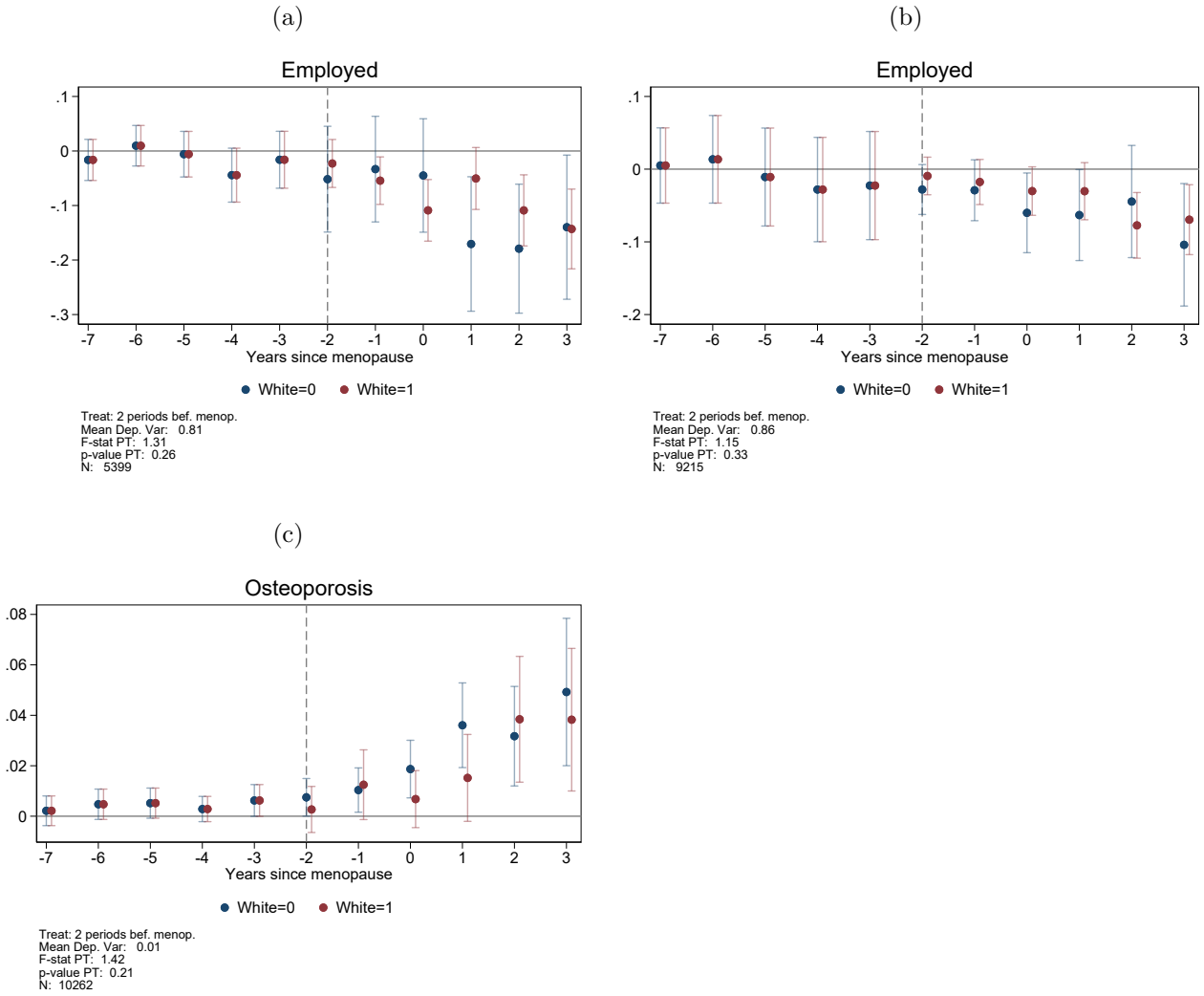
(c)



Treat: 2 periods bef. menop.
Mean Dep. Var: 0.01
F-stat PT: 1.65
p-value PT: 0.14
N: 10019

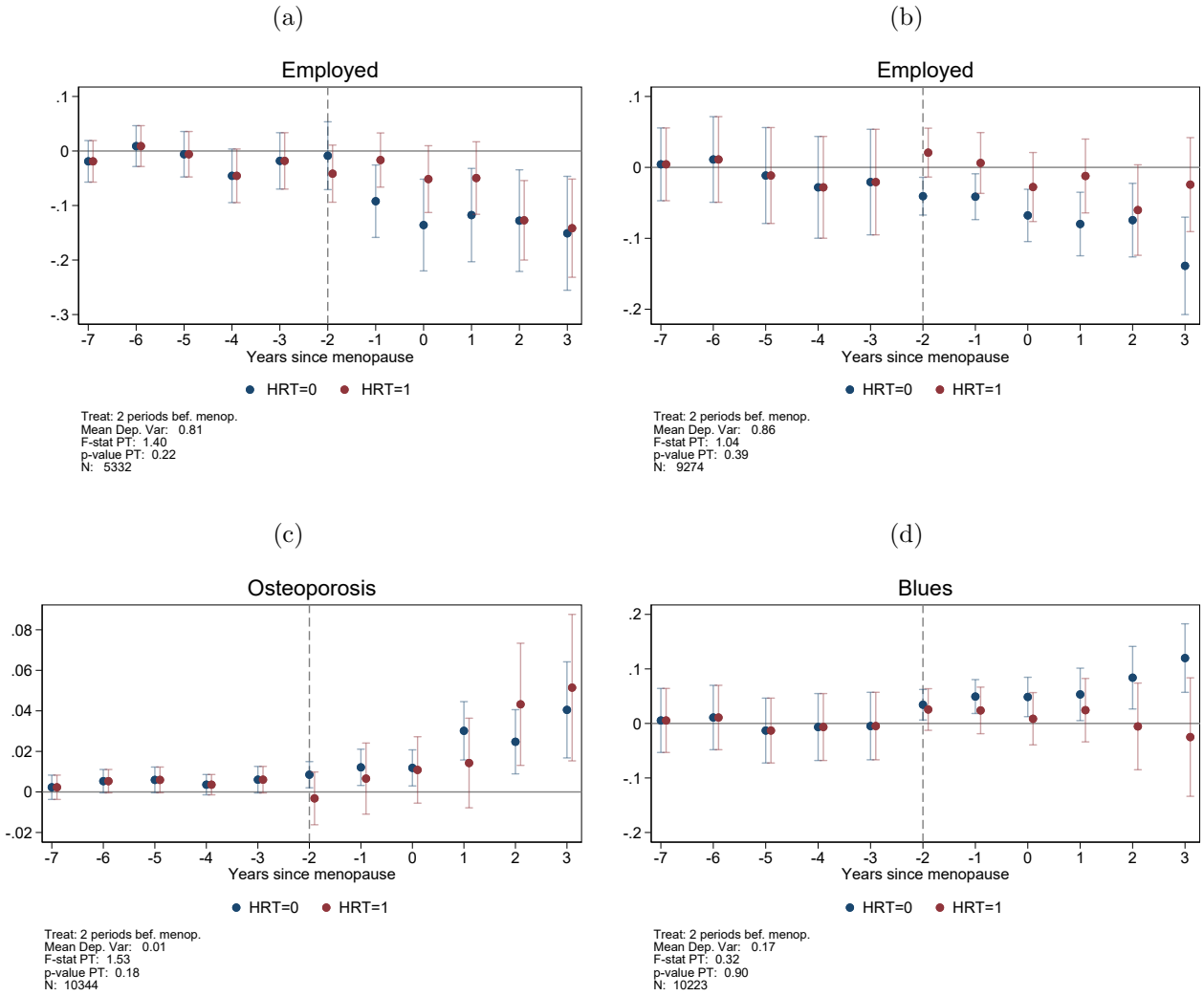
Notes: Each graph shows the estimated average treatment effects by year using the imputation method by Borusyak et al. (2024), with their 95% confidence intervals. The vertical dashed line indicates the reference period, two years before menopause ($t = -2$). Data from NSLYW (Panel a) and SWAN (Panels b and c). Standard errors are clustered at the individual level.

Figure 7: Heterogeneity by Race



Notes: Each graph shows the estimated average treatment effects by year using the imputation method by Borusyak et al. (2024), with their 95% confidence intervals. The vertical dashed line indicates the reference period, two years before menopause ($t = -2$). Data from NSLYW (Panel a) and SWAN (Panels b and c). Standard errors are clustered at the individual level.

Figure 8: Heterogeneity by Hormone Replacement Therapy



Notes: Each graph shows the estimated average treatment effects by year using the imputation method by Borusyak et al. (2024), with their 95% confidence intervals. The vertical dashed line indicates the reference period, two years before menopause ($t = -2$). Data from NSLYW (Panel a) and SWAN (Panels b, c and d). Standard errors are clustered at the individual level.

Table 1: Single DD estimate: Main Outcomes

	(1) Employed	(2) Log work hours	(3) Log earnings	(4) Log wage	(5) Work hours	(6) Worked<35h	(7) Worked less than usual	(8) Took time off work	(9) Absent from work	(10) Likes her job	(11) Has taken hormones	(12) Poor health
tau	-0.102***	-0.139***	-0.041	-0.031	-7.090***	0.090***	0.010	-0.004	0.031	0.014	0.109***	0.026***
	(0.018)	(0.023)	(0.054)	(0.038)	(0.971)	(0.023)	(0.029)	(0.029)	(0.020)	(0.030)	(0.038)	(0.005)
pre1	-0.019	-0.004	-0.203***	-0.158***	-1.166	-0.022	-0.034	-0.196	0.011	-0.040	-0.135	0.018
	(0.026)	(0.042)	(0.074)	(0.058)	(1.484)	(0.035)	(0.038)	(0.169)	(0.023)	(0.038)	(0.132)	(0.012)
pre2	-0.047*	0.014	-0.114*	-0.074	-2.627*	-0.034	-0.044	-0.205	0.027	0.043	-0.164	0.035**
	(0.025)	(0.036)	(0.061)	(0.051)	(1.364)	(0.032)	(0.036)	(0.168)	(0.022)	(0.035)	(0.130)	(0.014)
pre3	-0.006	0.004	-0.092*	-0.062	-1.103	-0.011	-0.005	-0.212	0.008	-0.040	-0.181	0.026**
	(0.021)	(0.037)	(0.054)	(0.043)	(1.310)	(0.032)	(0.037)	(0.169)	(0.021)	(0.033)	(0.128)	(0.013)
pre4	0.008	-0.022	-0.159***	-0.085**	-1.681	0.003	0.010	-0.195	0.043**	0.010	-0.177	0.002
	(0.019)	(0.034)	(0.053)	(0.040)	(1.147)	(0.028)	(0.033)	(0.170)	(0.021)	(0.031)	(0.124)	(0.006)
pre5	-0.018	-0.032	-0.139**	-0.069	-0.732	-0.015	-0.037	-0.197	0.007	-0.030	-0.223*	0.009
	(0.019)	(0.039)	(0.057)	(0.043)	(1.196)	(0.029)	(0.035)	(0.172)	(0.020)	(0.033)	(0.129)	(0.010)
R^2												
Ref. period	-2.000	-2.000	-2.000	-2.000	-2.000	-2.000	-2.000	-2.000	-2.000	-2.000	-2.000	-2.000
Dep. var. mean	0.813	3.511	7.028	1.989	25.506	0.256	0.322	0.168	0.149	0.387	0.267	0.024
PT test F-stat	1.411	0.354	2.608	1.936	0.878	0.376	0.735	0.333	1.012	1.511	1.284	2.787
PT test p-value	0.218	0.880	0.024	0.086	0.495	0.866	0.598	0.893	0.409	0.184	0.269	0.017
Observations	5759	3946	3165	3281	5706	4688	4152	2535	4741	4741	3216	4253

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2: Single DD estimate: Emotional symptons

	(1) Unable to shake blues	(2) Trouble mind tasks	(3) Everything took extra effort	(4) Restless sleep	(5) Lonely	(6) Sad	(7) Could not get going
tau	0.046***	0.055***	0.040***	0.078***	0.008	0.018	0.044***
	(0.013)	(0.013)	(0.014)	(0.018)	(0.022)	(0.020)	(0.014)
pre1	0.053*	0.054	-0.023	0.073**	0.027	0.026	0.036
	(0.028)	(0.034)	(0.033)	(0.037)	(0.030)	(0.027)	(0.032)
pre2	0.034	0.096***	-0.009	0.076**	0.017	0.050**	0.062*
	(0.025)	(0.035)	(0.035)	(0.035)	(0.026)	(0.025)	(0.032)
pre3	0.077***	0.058*	0.028	0.115***	0.035	0.060**	0.083***
	(0.027)	(0.032)	(0.033)	(0.035)	(0.028)	(0.028)	(0.029)
pre4	0.024	0.033	-0.058*	0.038	-0.002	0.029	0.023
	(0.024)	(0.031)	(0.032)	(0.031)	(0.024)	(0.025)	(0.029)
pre5	0.013	0.052	-0.065**	0.037	-0.011	0.015	0.037
	(0.025)	(0.035)	(0.031)	(0.035)	(0.024)	(0.027)	(0.030)
R^2							
Ref. period	-2.000	-2.000	-2.000	-2.000	-2.000	-2.000	-2.000
Dep. var. mean	0.085	0.109	0.092	0.189	0.063	0.085	0.112
PT test F-stat	2.125	1.861	3.253	2.391	0.920	1.332	2.091
PT test p-value	0.060	0.099	0.006	0.036	0.467	0.249	0.064
Observations	4253	4253	4253	4253	4253	4253	4253

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3: Heterogeneous DD estimates: Main Outcomes

	(1) Employed	(2) Log work hours	(3) Log earnings	(4) Log wage	(5) Work hours	(6) Worked<35h	(7) Worked less than usual	(8) Took time off work	(9) Absent from work	(10) Likes her job	(11) Has taken hormones	(12) Poor health
Panel A: Education												
HS or less=0	-0.092***	-0.151***	-0.025	0.009	-6.735***	0.095***	0.070*	0.008	0.041	0.037	0.205***	0.012**
	(0.019)	(0.035)	(0.051)	(0.038)	(1.388)	(0.030)	(0.040)	(0.040)	(0.030)	(0.043)	(0.048)	(0.005)
HS or less=1	-0.060**	-0.059*	-0.041	-0.062	-2.757**	0.033	-0.061*	-0.063*	0.013	-0.022	-0.008	0.040***
	(0.029)	(0.033)	(0.063)	(0.052)	(1.329)	(0.028)	(0.033)	(0.034)	(0.025)	(0.035)	(0.039)	(0.009)
PT test F-stat	1.361	0.378	2.390	1.818	0.803	0.532	0.901	0.309	1.028	1.521	1.397	2.702
PT test p-value	0.237	0.864	0.036	0.107	0.548	0.752	0.480	0.908	0.400	0.181	0.224	0.020
Observations	5463	3748	3162	3277	5413	4469	3977	2313	4519	4519	2920	3957
Panel B: Race												
White=0	-0.111***	-0.032	0.093	0.033	-4.740**	-0.003	-0.031	-0.059	0.050	0.034	-0.063	0.054***
	(0.033)	(0.037)	(0.101)	(0.083)	(2.195)	(0.035)	(0.052)	(0.046)	(0.044)	(0.048)	(0.064)	(0.015)
White=1	-0.076***	-0.126***	-0.116**	-0.068*	-4.543***	0.087***	0.009	-0.016	0.019	0.017	0.165***	0.018***
	(0.021)	(0.027)	(0.045)	(0.035)	(1.112)	(0.028)	(0.033)	(0.035)	(0.022)	(0.036)	(0.043)	(0.005)
PT test F-stat	1.296	0.358	2.372	1.803	0.861	0.360	0.641	0.311	0.940	1.500	1.267	2.541
PT test p-value	0.263	0.877	0.038	0.110	0.507	0.876	0.669	0.906	0.454	0.187	0.277	0.027
Observations	5591	3845	3159	3269	5540	4570	4086	2415	4621	4621	3048	4085
Panel C: Hormone Replacement Therapy												
HRT=0	-0.110***	-0.061*	-0.142**	-0.125***	-4.029***	0.022	-0.052	-0.042	0.002	0.027		0.043***
	(0.024)	(0.036)	(0.057)	(0.045)	(1.418)	(0.030)	(0.036)	(0.038)	(0.025)	(0.030)		(0.009)
HRT=1	-0.068***	-0.149***	-0.010	0.009	-6.450***	0.104***	0.027	-0.018	0.029	-0.025		0.017***
	(0.024)	(0.029)	(0.065)	(0.048)	(1.254)	(0.026)	(0.036)	(0.032)	(0.027)	(0.040)		(0.006)
Dep. var. mean	0.813	3.511	7.028	1.989	25.506	0.256	0.322	0.168	0.149	0.387		0.024
PT test F-stat	1.474	0.360	2.819	2.154	0.902	0.392	0.740	0.412	0.916	1.491		2.676
PT test p-value	0.195	0.876	0.016	0.057	0.479	0.855	0.594	0.841	0.470	0.190		0.021
Observations	5525	3789	3144	3258	5476	4505	4000	2350	4554	4554		4021

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Heterogeneous DD estimates: Emotional symptons

	(1) Unable to shake blues	(2) Trouble mind tasks	(3) Everything took extra effort	(4) Restless sleep	(5) Lonely	(6) Sad	(7) Could not get going
Panel A: Education							
HS or less=0	0.012	0.045***	0.018	0.054**	0.024*	0.009	0.015
	(0.019)	(0.016)	(0.019)	(0.025)	(0.013)	(0.029)	(0.019)
HS or less=1	0.036**	0.032*	0.025	0.037	-0.048***	0.009	0.026
	(0.017)	(0.019)	(0.021)	(0.026)	(0.017)	(0.018)	(0.021)
PT test F-stat	2.006	1.713	2.712	1.964	0.873	1.240	1.801
PT test p-value	0.076	0.129	0.019	0.082	0.498	0.289	0.110
Observations	3957	3957	3957	3957	3957	3957	3957
Panel B: Race							
White=0	0.002	0.018	0.059	0.035	-0.057*	0.004	0.025
	(0.036)	(0.039)	(0.040)	(0.039)	(0.031)	(0.031)	(0.032)
White=1	0.042***	0.052***	0.017	0.058***	0.023*	0.004	0.029*
	(0.012)	(0.012)	(0.015)	(0.021)	(0.014)	(0.026)	(0.016)
PT test F-stat	2.285	1.831	3.215	2.707	1.024	1.665	2.378
PT test p-value	0.045	0.104	0.007	0.020	0.402	0.141	0.037
Observations	4085	4085	4085	4085	4085	4085	4085
Panel C: Hormone Replacement Therapy							
HRT=0	0.022	0.037**	0.034	0.025	0.014	0.032*	0.030
	(0.018)	(0.019)	(0.021)	(0.027)	(0.016)	(0.018)	(0.019)
HRT=1	0.037**	0.056***	0.031*	0.078***	-0.006	0.001	0.033*
	(0.018)	(0.018)	(0.018)	(0.022)	(0.030)	(0.026)	(0.019)
Dep. var. mean	0.085	0.109	0.092	0.189	0.063	0.085	0.112
PT test F-stat	2.227	1.671	3.385	2.411	0.919	1.191	1.967
PT test p-value	0.050	0.139	0.005	0.035	0.468	0.312	0.081
Observations	4021	4021	4021	4021	4021	4021	4021

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix

A: Descriptive Statistics

Table A1: Descriptive Statistics

	(1) Perimenop. (t=-2)	(2) Menopause (t=0)	(3) Post-menop. (t>0)
Age	47.73	49.72	52.60
	(3.29)	(3.35)	(3.72)
Education (yrs)	13.38	13.35	13.33
	(2.79)	(2.71)	(2.58)
White	0.81	0.80	0.78
	(0.39)	(0.40)	(0.41)
Dummy for HS or less	0.52	0.52	0.53
	(0.50)	(0.50)	(0.50)
Has taken hormones	0.27	0.40	0.52
	(0.44)	(0.49)	(0.50)
Employed	0.81	0.78	0.73
	(0.39)	(0.41)	(0.45)
Work hours (prev week)	25.51	23.74	22.54
	(21.26)	(20.43)	(20.39)
Monthly income (real)	1080.83	963.16	846.53
	(948.32)	(953.30)	(966.67)
Hourly wage (real)	8.66	8.49	8.89
	(4.35)	(4.24)	(4.55)
Worked<35h	0.26	0.27	0.29
	(0.44)	(0.44)	(0.45)
Worked less than usual	0.32	0.29	0.31
	(0.47)	(0.45)	(0.46)
Took time off from work	0.17	0.16	0.18
	(0.37)	(0.37)	(0.38)
Absent from work	0.15	0.16	0.14
	(0.36)	(0.37)	(0.34)
Likes her current job	0.39	0.31	0.27
	(0.49)	(0.46)	(0.45)
Poor health (Self-rep.)	0.02	0.04	0.05

(continued on next page...)

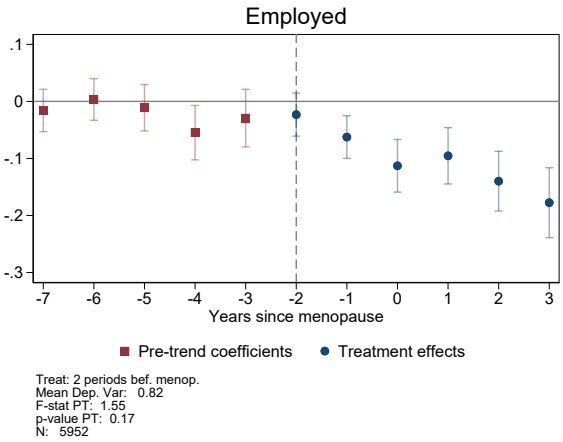
Table A1: Descriptive Statistics *(continued from previous page)*

	(1) Perimenop. (t=-2)	(2) Menopause (t=0)	(3) Post-menop. (t>0)
	(0.15)	(0.21)	(0.22)
Unable to shake blues	0.08	0.11	0.09
	(0.28)	(0.31)	(0.28)
Trouble keeping mind on tasks	0.11	0.12	0.11
	(0.31)	(0.32)	(0.31)
Everything took extra effort	0.09	0.12	0.13
	(0.29)	(0.33)	(0.34)
Restless sleep	0.19	0.19	0.21
	(0.39)	(0.40)	(0.41)
Lonely	0.06	0.09	0.07
	(0.24)	(0.29)	(0.26)
Sad	0.08	0.12	0.10
	(0.28)	(0.32)	(0.30)
Could not get going	0.11	0.14	0.12
	(0.32)	(0.35)	(0.32)
Observations	502	499	3171

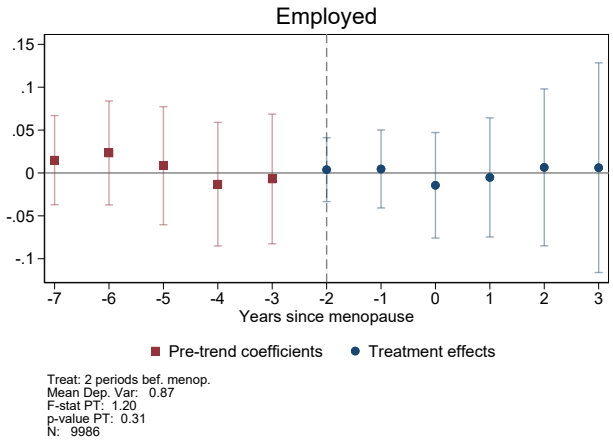
B: Robustness check including women whose period stopped for medical reasons

Figure B1: The Effect of Menopause on Labor Outcomes

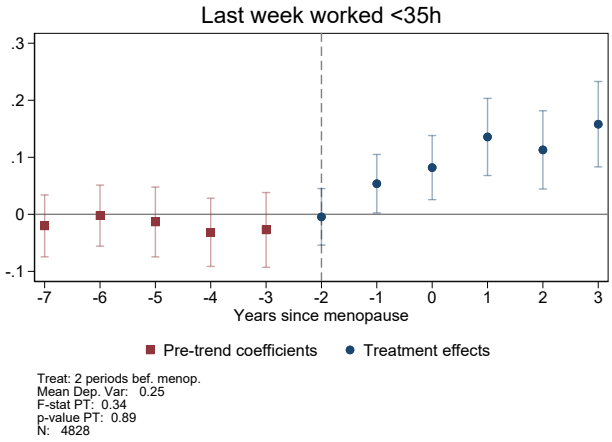
(a)



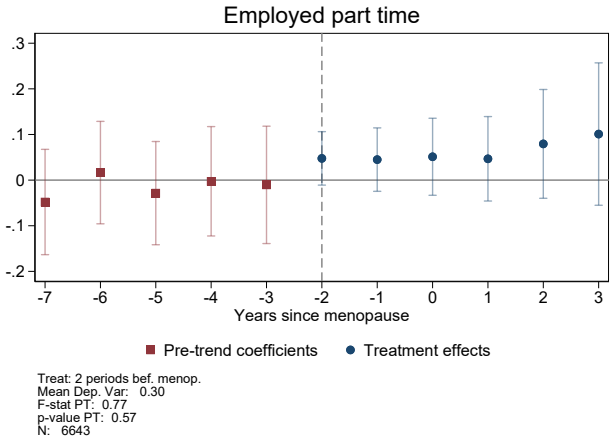
(b)



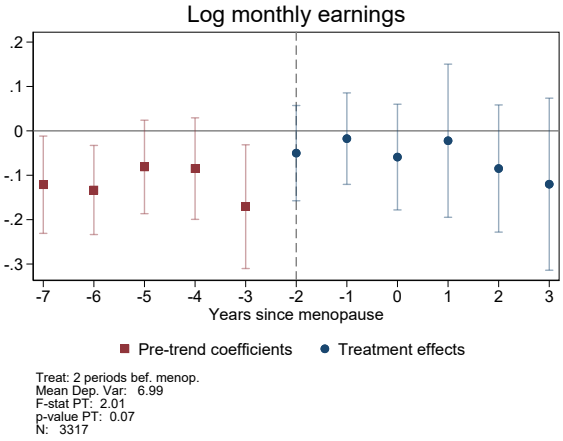
(c)



(d)

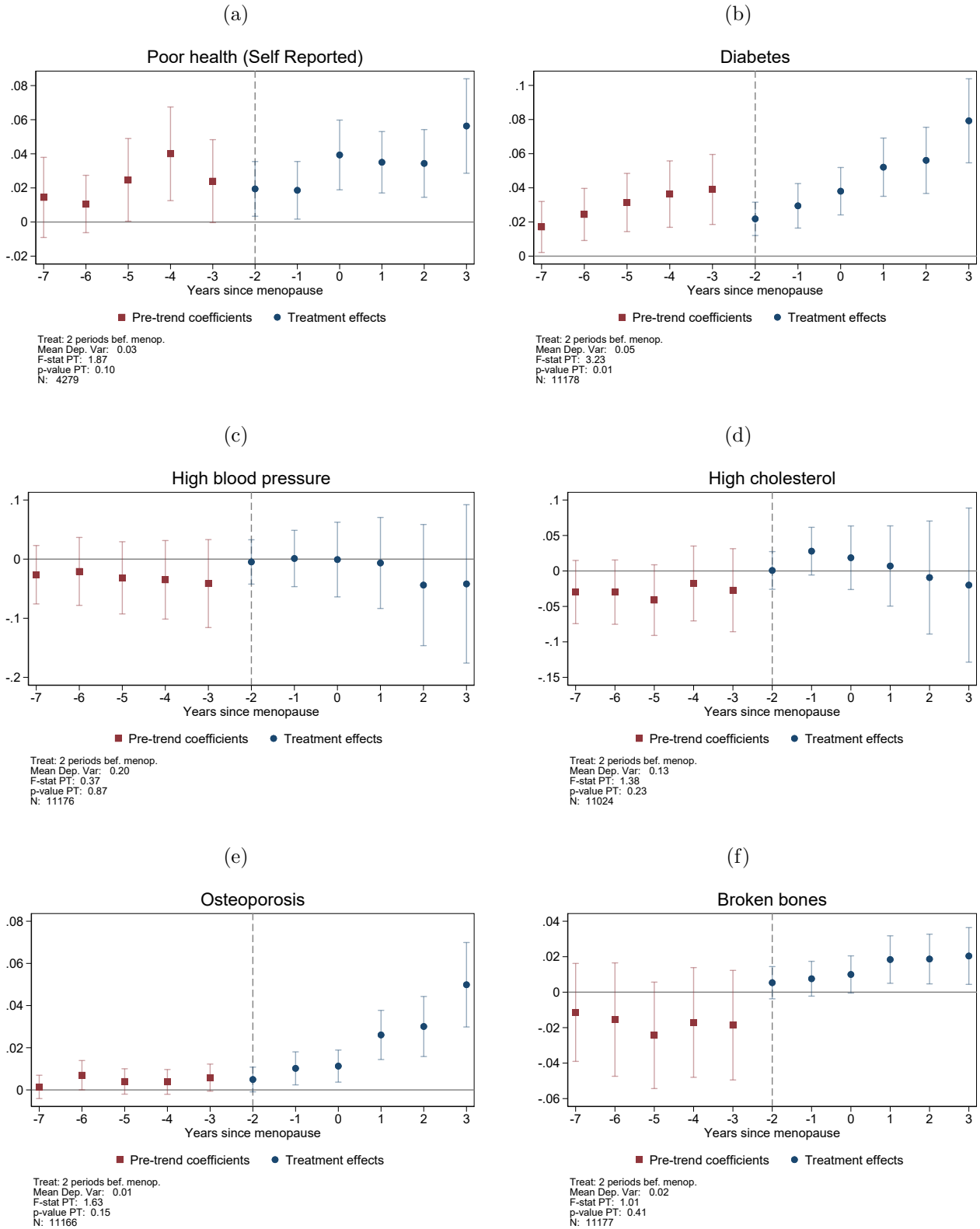


(e)



Notes: Each graph shows the estimated average treatment effects by year using the imputation method by Borusyak et al. (2024), with their 95% confidence intervals. The vertical dashed line indicates the reference period, two years before menopause ($t = -2$). Data from NSLYW (Panels a, c and e) and SWAN (Panels b and d). Standard errors are clustered at the individual level.

Figure B2: The Effect of Menopause on Health Outcomes



Notes: Each graph shows the estimated average treatment effects by year using the imputation method by Borusyak et al. (2024), with their 95% confidence intervals. The vertical dashed line indicates the reference period, two years before menopause ($t = -2$). Data from NSLYW (Panel a) and SWAN (Panels b, c, d, e and f). Standard errors are clustered at the individual level.

Table B1: Single DD estimate: Main Outcomes

	(1) Employed	(2) Log work hours	(3) Log earnings	(4) Log wage	(5) Work hours	(6) Worked<35h	(7) Worked less than usual	(8) Took time off work	(9) Absent from work	(10) Likes her job	(11) Has taken hormones	(12) Poor health
tau	-0.104***	-0.133***	-0.052	-0.045	-6.976***	0.082***	0.008	-0.005	0.025	0.005	0.122***	0.034***
	(0.017)	(0.022)	(0.052)	(0.036)	(0.934)	(0.023)	(0.027)	(0.028)	(0.019)	(0.029)	(0.037)	(0.006)
pre1	-0.029	0.013	-0.171**	-0.131**	-1.262	-0.027	-0.035	-0.197	0.020	-0.044	-0.137	0.024*
	(0.026)	(0.040)	(0.071)	(0.055)	(1.418)	(0.033)	(0.037)	(0.167)	(0.023)	(0.037)	(0.132)	(0.012)
pre2	-0.055**	0.013	-0.085	-0.058	-2.543**	-0.032	-0.056	-0.208	0.027	0.035	-0.166	0.040***
	(0.024)	(0.034)	(0.058)	(0.049)	(1.296)	(0.031)	(0.034)	(0.166)	(0.021)	(0.034)	(0.130)	(0.014)
pre3	-0.011	0.018	-0.081	-0.052	-0.918	-0.013	-0.008	-0.214	0.008	-0.038	-0.176	0.025**
	(0.021)	(0.036)	(0.054)	(0.041)	(1.258)	(0.031)	(0.035)	(0.168)	(0.020)	(0.032)	(0.129)	(0.012)
pre4	0.003	-0.006	-0.133***	-0.073*	-1.483	-0.002	0.011	-0.189	0.045**	0.006	-0.174	0.011
	(0.019)	(0.033)	(0.051)	(0.038)	(1.114)	(0.027)	(0.032)	(0.169)	(0.020)	(0.031)	(0.125)	(0.009)
pre5	-0.016	-0.017	-0.121**	-0.058	-0.531	-0.020	-0.038	-0.191	0.010	-0.026	-0.227*	0.014
	(0.019)	(0.038)	(0.056)	(0.041)	(1.164)	(0.028)	(0.034)	(0.170)	(0.020)	(0.032)	(0.129)	(0.012)
R^2												
Ref. period	-2.000	-2.000	-2.000	-2.000	-2.000	-2.000	-2.000	-2.000	-2.000	-2.000	-2.000	-2.000
Dep. var. mean	0.815	3.512	6.994	1.966	25.649	0.246	0.316	0.161	0.142	0.387	0.276	0.032
PT test F-stat	1.548	0.204	2.010	1.479	0.849	0.344	1.026	0.372	1.149	1.333	1.328	1.872
PT test p-value	0.172	0.961	0.075	0.194	0.515	0.886	0.401	0.868	0.333	0.248	0.250	0.097
Observations	6221	4238	3411	3534	6161	5025	4458	2679	5085	5085	3424	4548

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B2: Single DD estimate: Emotional symptons

	(1) Unable to shake blues	(2) Trouble mind tasks	(3) Everything took extra effort	(4) Restless sleep	(5) Lonely	(6) Sad	(7) Could not get going
tau	0.012	0.004	0.013	0.044***	-0.002	-0.009	0.003
	(0.010)	(0.010)	(0.011)	(0.011)	(0.016)	(0.018)	(0.011)
pre1	0.013	0.034*	0.007	0.046*	0.039**	0.027	0.037*
	(0.015)	(0.021)	(0.026)	(0.024)	(0.020)	(0.018)	(0.020)
pre2	0.022	0.027	0.007	0.056**	0.039**	0.026*	0.048**
	(0.016)	(0.020)	(0.026)	(0.024)	(0.017)	(0.016)	(0.022)
pre3	0.040**	0.015	0.020	0.063**	0.010	0.013	0.034*
	(0.016)	(0.018)	(0.024)	(0.024)	(0.015)	(0.016)	(0.017)
pre4	0.022	0.016	-0.004	0.033	0.023	0.029*	0.035*
	(0.016)	(0.020)	(0.023)	(0.023)	(0.015)	(0.016)	(0.018)
pre5	0.006	0.026	-0.032	0.030	0.005	0.002	0.030*
	(0.015)	(0.022)	(0.023)	(0.025)	(0.014)	(0.015)	(0.017)
R^2							
Ref. period	-2.000	-2.000	-2.000	-2.000	-2.000	-2.000	-2.000
Dep. var. mean	0.023	0.032	0.053	0.108	0.023	0.028	0.025
PT test F-stat	1.546	0.730	1.666	1.582	1.975	1.259	1.292
PT test p-value	0.173	0.601	0.140	0.163	0.080	0.279	0.265
Observations	4548	4548	4548	4548	4548	4548	4548

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$