Pension Caregiver Credits and the Gender Gap in Old-Age Income*

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Abstract

We study a 2001 pension insurance reform in Germany that introduced additional caregiver credits for working mothers with children between the ages of 3 and 10. Using administrative social security data from Germany combined with a difference-in-differences design, we find that the reform leads to a 66.5% increase in yearly retirement contributions during the eligibility period. 66% of the total effect can be explained by a change in the labor market outcomes of eligible mothers, while the remaining 34% is the mechanical effect of the reform. We find a significant increase in employment earnings, driven by both an increase in employment and a switch from marginal to employment subject to social security contributions. This translates into a 9.1 percentage point (18.3%) reduction in the gender gap in lifetime earning points. Finally, a simple life-cycle model predicts that the pension reform leads to a 12% increase in retirement income and a 15% reduction in the gender gap in old-age income.

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1 Introduction

Across OECD countries, a sizable gender gap exists in old age pension income (Figure 1). In the United States, women receive 33% lower retirement income than men and the poverty rate of women aged 65 or older is almost twice that of men (Jankowski, 2011). This gender difference largely results from family caregiver responsibilities (in terms of unpaid care to children and sick or elderly relatives) which leads to more career breaks, lower average lifetime earnings, and, consequently, lower Social Security benefits at retirement. Under current Social Security rules, caregivers are covered only indirectly through spousal and survivor benefits. However, given the recent changes in marital patterns and family structure, women are increasingly ineligible to receive these benefits that are based on the contributions of their spouse. Therefore, analysts and policymakers have increasingly questioned the adequacy of these benefits for women and have directed increasing attention to the adoption of caregiver credits.

Caregiver credits have become an established component of public pension programs in high-income OECD countries (Jankowski, 2011). The primary objective of these credits is to improve the adequacy of caregivers' earning records and old-age benefits for women. Despite the widespread adoption of these credits, there exists limited causal empirical evidence on the impact of these policies on the gender gap in old age income. These credits may influence the pre-retirement labor supply of women which will affect their eventual retirement benefits beyond the direct effect of the credits provision. Depending on the cost-effectiveness of the program, it may be optimal to implement alternative policies that encourage employment of mothers but do not directly affect retirement income. One such example is the expansion of childcare provision.

In this paper, we exploit a 2001 pension insurance reform in Germany that introduced additional caregiver credits for working mothers with children between the ages of 3 and 10 to study how caregiver credits affect the gender gap in pension income. Using administrative social security data from Germany, we estimate the causal effect of the policy on pre-retirement labor supply and pension contributions of eligible women in a difference-in-differences design. Theoretically, this policy has ambiguous effects on these outcomes. On one hand, an increase in future pension benefits may increase employment and earnings of mothers of young children, leading to higher contributions to the pension fund; on the other, the income effect may lead to lower labor supply of mothers, which may have negative effects

on their future employment rate. Depending on whether the substitution or income effect dominates, there may be important long run consequences on the old-age pensions of women.

We find that caregiver credits led to a 66.5% increase in pension contributions of mothers. 66% of the total effect can be explained by an increase in employment earnings of eligible mothers, suggesting that the substitution effect dominates. The remaining 34% can be explained by the mechanical effect of the reform. We find that mothers are more likely to be employed and are more likely to switch from marginal jobs to employment subject to social security contributions. Using an alternative specification that relies on the timing of when the child turns three, we show that mothers increase employment earnings soon after they become eligible and have sustained, higher levels of earnings while their children are less than ten years of age. In preliminary analyses, we find no heterogeneous effects in terms of age of child, pre-birth earnings, and public childcare availability. In the final part of the paper, we build a simple dynamic life cycle model to predict future retirement income as a result of the reform. We find that the reforms lead to a 12% increase in pension contributions which translates into a 15% reduction in the gender gap in old-age pension earnings.

2 Literature Review

Our research contributes to several strands of literature. First, we contribute to a large literature on the effects of pension generosity. Previous literature have focused on the impact on retirement timing (Krueger and Pischke, 1992), retirement savings (Choukhmane, 2019), and labor supply of older workers (Lalive and Staubli, 2015). In contrast, there are relatively few papers that consider the effectiveness of caregiver credits. Key exceptions are papers by D'Addio and Whitehouse (2009) and Stahlberg et al. (2006) that find mixed evidence on the importance of caregiver credit programs for reducing the gender gap in old-age income. However, these papers are largely descriptive and do not consider how the policy may lead to changes in labor supply that can amplify or lessen the benefits of the program. We build on this evidence by providing the causal estimates on impact of caregiver credits on maternal employment and long-term consequences on the gender gap in pensions.

Second, this paper will produce new estimates of income and substitution effects on pre-retirement labor supply generated by changes in future pension benefits. The literature on workers near retirement age has found mixed results on the relative magnitudes of the income and substitution effects (Gelber et al., 2016; Lalive and Zweimüller, 2009). However,

few studies have considered how pension benefits can affect labor market decisions of prime-age workers. By considering the responses of younger workers, we provide new evidence on key labor supply elasticities that can shed light on the discount factor individuals apply to future pension benefits. The results can inform current policy debates on the role of pension benefits as a policy tool to incentivize employment while maintaining the sustainability of the pension system.

Finally, we contribute to an extensive literature on gender inequality in the labor market as reviewed by Blau and Kahn (2017). Recent work suggests that motherhood continues to play a dominant role in explaining key gender differences in the labor market (Blau and Kahn, 2017). Using data from MBA students, Bertrand et al. (2010) show a significant gender gap in earnings emerges after the birth of the first child that is almost entirely explained by career breaks and reduced work hours. Similarly, Kleven et al. (2018) utilizes administrative data from Denmark to show that the arrival of children creates a long-run gender gap in earnings of around 20% driven by hours worked, participation and wage rates. We build on this literature by considering the long-term consequences of this gender gap on old-age income and poverty risk.

3 Context

3.1 German Pension System

The German public pension system covers 85% of the German population and is financed on a pay-as-you-go scheme. Among retirees' households, a large majority of household income comes from the public pension system (Thiemann, 2014). Participation is mandatory for nearly all employees except for civil servants and self-employed. Contributions to the pension system are paid equally by employers and employees. The legal retirement age is 65 but is scheduled to rise to 67 years over a transition period from 2012 to 2029. For individuals who have contributed at least 45 years, the retirement age is 63. Since 2002, all individuals over the age of 27 with at least 5 years of contributions receive an annual letter with detailed information on their total pension contributions and expected pension income (Dolls et al., 2018).

The pension benefit amount is based on four factors: 1) earning points, 2) retirement age, 3) pension type, and 4) current pension value (Thiemann, 2014). Earning points are

calculated based on lifetime earnings. For each year of contribution, individuals accumulate earning points that depend on their annual earnings. One earning point is equivalent to the national average earnings. Specifically, the pension value in year t for worker i who retired at age a is given by:

$$P_{iat} = \left(\sum_{\tau=1}^{a-1} EP_{i\tau} \cdot Z_{ia} \right) T_i \cdot PV_t \tag{1}$$

where $EP_{i\tau}$ denotes the earning points in year τ of employment history and is equivalent to $E_{i\tau}/\bar{E}_\tau$, where $E_{i\tau}$ is total earnings and $\bar{E}_\tau$ is the national annual average earnings. In Figure 2, we show the close correlation between the actual reported earning points in the data with estimated earning points that are calculated by dividing observed total earnings from employment with average total earnings across workers in that year. Z_a is the adjustment factor that depends on retirement age. T_i is the type of pension (e.g., disability, widow) and equals 1 for old age pension. Finally PV_t is the current pension value. In 2015, one earning point was worth 348 per year (Thiemann, 2014).

3.2 Caregiver Credits Reform

In Germany, women receive nearly 50% lower pensions than men due to lower lifetime earnings that result from more part-time work, more career breaks and lower wages. To address this gender disparity in old age income, mothers are awarded special benefits for each child they have.[1] Under the caregiver credit program "Kindererziehungszeiten", the mother is credited for a period of three years with one pension point per year regardless of employment status (Thiemann, 2014).[2] These child-related benefits in the public pension system are tax-financed.

In 2001, a major pension reform was announced and introduced additional credits for mothers until the child is 10 years old (Berücksichtigungszeiten). Similar to the older caregiver credits, these additional credits are also financed through income taxes on current workers. If the mother is working while the child is between the ages of 3 and 10, the mother's pension entitlement for this period will be increased by 50 percent up to the limit

[1] Any parent is eligible for these benefits but, by default, the benefits are awarded to the mother unless a written request is made to the German statutory pension insurance scheme. Only 5% of these benefits are awarded to fathers.

[2] For children born from 1986 to December 31, 1991, mothers receive earning points only for the first year of child's life (Jankowski, 2011).

of 1 pension point.[3] For high-earning mothers with annual earning points greater than 1, i.e. those with earnings above the national average, no top-up is provided. This is a sizable increase in pension value; mothers are eligible for a maximum increase of 928 in annual pension benefits. As a result, relative to the credits received during the first years of the child's life, under this policy, mothers are encouraged to return to the labor force while providing child care.

Although the reform was introduced in 2001, credits are provided retroactively for eligible caregiving periods of all mothers with children after 1992. In this way, eligible mothers pre-2001 received a positive shock in pension wealth which translates to a pure income effect on their labor supply decisions after the announcement of the reform. However, eligible mothers after 2001 experience both the income and substitution effects. Depending on whether the income or substitution effect dominates, it is theoretically ambiguous the labor supply responses of these mothers. In our main analysis, we will focus on the eligible mothers after 2001 and explore the impact of this reform on their labor supply, lifetime earnings and future pension income. Moreover, we plan to exploit the unique retrospective feature of this reform to estimate the pure income effect using the pre-2001 eligible mothers. This will allow us to separately identify the income and substitution effects to infer important implications to public finances as a result of the behavioral responses of mothers.

4 Data and Summary Statistics

4.1 Data

For our analysis, we utilize two sets of German administrative data. First, we utilize the Biographical Data of Social Insurance Agencies in Germany (BASiD), for the years 1951 - 2009. This data-set comes from the Federal Employment Agency (BA), the Institute for Employment Research (IAB), and the German Pension Insurance (GRV). In particular, the BASiD is a 1% random sample of the population of the German Pension insurance (GRV) with pension account information.[4] It allows us to track over 600,000 individuals over their entire work history and link it to pension accounts. It includes detailed information on worker

[3] If the mother has two or more children, one of which is under the age of 10, then she receives an additional one-third of a pension point if she does not work.

[4] Data access was provided via on-site use at the Research Data Centre (FDZ) of the German Federal Employment Agency (BA) at the Institute for Employment Research (IAB) and subsequently remote data access.

characteristics such as age, gender, education, wages, occupation, full-time/part-time status, and benefit receipt history. Each worker can also be linked to aggregate yearly information at the establishment level such as the firm wage distribution and number of employees. Moreover, the BASiD provides the exact date of childbirth and allows us to track yearly pension contributions. Note that because caregiver credits are provided retroactively once the child reaches age 10, the reported pension earning points do not necessarily include caregiver credits. To understand the total impact of the policy on pension contributions, we impute total pension contributions as well as the caregiver credits by applying the formula in Section 3 to the reported employment earnings that are subject to social security contributions.

We will utilize this data set in our main analysis to investigate the effect of the introduction of caregiver credits on pension contributions, yearly earnings (both conditional on working and non conditional on working), employment (full-time or part-time), and marginal status. Marginal employment, or colloquially "minijobs" is a specific variety of part-time work for those who earn less than 325 per month.[5] During the relevant time period, these workers are exempt from paying social security contributions and their employers pay a reduced contribution rate. As a result, they do accumulate pension contributions for marginal employment earnings.[6]

Second, we obtained the German Microcensus data, a 1% representative survey of households in Germany, for the years 1980-2010 provided by the Research Data Centre of the Federal Statistical Office. This cross-sectional dataset contains detailed information on household income and socio-demographic information, such as employment status, working hours, income, pension insurance status, education, and marital status. This allows us to explore heterogeneity by household and spouse characteristics.

4.2 Summary Statistics

Table 1 provides the summary statistics for mothers in the treated group, i.e., those with children aged 3-10 in the year prior to the reform, 2000. The data for these outcomes come from BASiD. On average, mothers are 35 years old and had their first child at age 29. 79% have had vocational training or more. Mothers have accumulated nearly six total earning points. In 2015, each earning point is worth 348 per year in pension income (Thiemann,

[5]In 2003, the threshold for marginal employment was raised to 400.

[6]Beginning in 1999, minijobbers can opt into social security contributions in order to be eligible for old-age pensions. However, only a small percentage of minijobbers do so (Steiner and Wrohlich, 2005).

2014). This suggests that if mothers retire immediately, their annual pension income would equal 2,088. On average, mothers are contributing 0.32 earning points. Since each earning point corresponds to the national average earnings, this suggests that mothers are earning and contributing in pension credits at a rate that is 32% of the national average. Average total earnings from regular employment is 6,109 and increases to 7,694 once marginal employment earnings are included. Around 64% of mothers are employed but nearly 40% are marginal workers if employed and 31% of mothers are working full-time.

5 Empirical Strategy

5.1 Difference-in-Differences Specification

To estimate the causal impact of the caregiver credits on labor supply and earnings of mothers, we utilize a difference-in-differences design, comparing the outcomes of women with one child aged 3 to 10 to mothers with only one child aged 15 to 25 who did not benefit from the reform. Because the 2001 reform credits were granted retrospectively for all caregiving periods after 1992, we restrict the control group to the set of mothers who did not earn below the average national level during the eligibility period and hence did not receive any retrospective credits.[7] Note that treated mothers of children aged 4 or older in 2001 may have received additional credits, as well. For this reason, we will show that our results are robust when we consider only mothers of children aged 3 to 4 as the treatment group. In particular, we will estimate:

$$y_{it} = \sum_{j \neq 2000} \gamma_j \cdot Year_{t=j} \cdot Age3to10_i + \alpha Age3to10_i + X_i\phi + \delta_t + \epsilon_{it} \tag{2}$$

where $Age3to10_i$ takes value 1 for mothers i with a child between 3 and 10 years old and 0 for mothers with a child between 15 and 20 years old who did not benefit from the reform. δ_t is a set of year fixed effects. X_i is the set of demographic controls including age of child, age of mother at the time of birth, region of residence at time of birth, full-time status at time of birth, occupation at time of birth, employment status at time of birth, age group of mother time trend and region of residence at time of birth time trend. The regression is

[7] Recall that the 50% bonus on earning points was provided only up to a maximum of 1 earning point. As a result these women would not have received additional credits.

estimated using data from 1998 to 2006. γ_j's are our coefficients of interest and capture the effect of the reform on mothers with children aged 3-10 relative to 2000, the year prior to the reform.

We also estimate a parametric version of the regression to better analyze the statistical significance and magnitude of the estimates:

$$\begin{aligned} y_{it} =& \beta_1 Age3to10_i \cdot Post_{2001 \leq t \leq 2003} + \beta_2 Age3to10_i \cdot Post_{2004 \leq t \leq 2006} \\ &+ \alpha Age3to10_i + X_i\phi + \delta_t + \epsilon_{it} \end{aligned} \tag{3}$$

where $Post_{2001 \leq t \leq 2003}$ and $Post_{2004 \leq t \leq 2006}$ are indicator variables that equal 1 for years 2001 to 2003 and 2004 to 2006, respectively. β_1 and β_2 are the difference-in-differences coefficients for the two post periods. When presenting results, we will mostly focus on these two parameters. We include the same set of controls as in the previous specification and, in all specifications, standard errors are corrected for heteroskedasticity and serial correlation within individuals across years.

5.2 Internal Validity of the Research Design

In order for equations (2) and (3) to recover the causal effect of the 2001 pension reform, the trends in labor supply outcomes of treated mothers would have evolved similarly to the control group of mothers of children aged 15 to 20 absent the reform. In our analysis, we will provide empirical evidence that the two groups display parallel trends prior to the reform. This assumption would fail, for example, if there were concurrent reforms in 2001 that affected only mothers of children aged 3 to 10. While the caregiver credits were introduced as part of a major reform to the pension scheme, the major changes of the "Riester Reform" were the introduction of private funded pensions and strengthening of the occupational pensions. These changes, however, were adopted nationally and did not depend on the ages of children. More worrisome are maternity leave and childcare reforms that occurred during the 1990s and 2000s. In 1996, a law was passed that mandated local authorities to offer all children between the ages of three and six the opportunity to attend a pre-school (Fagnani, 2012). However, this reform largely expanded childcare availability for 3-year-old children as older children were already attending pre-school (Bauernschuster and Schlotter, 2015). As a result, we would expect labor supply responses to be concentrated among mothers of 3-year-olds and in areas where the expansion of childcare availability is the largest. However,

we will show in our results that mothers of children of all age groups respond similarly and we do not find any heterogeneous effects along the public childcare availability dimension. Moreover, we include region-specific time fixed effects to control for any differential trends across regions as a result of this law. Finally, a series of maternity reforms occurred during the 1990s, of which the most recent one prior to 2002 was implemented in 1992 (Schönberg and Ludsteck, 2014). This reform increased job protection to 36 months from 18 months with no other changes to the benefit amount. However, Schönberg and Ludsteck (2014) found limited effects of this reform on short- and long-term employment outcomes of mothers. Moreover, if such effects existed, we would observe diverging trends between the treatment and control groups starting as early as 1996 since mothers of aged 4 children in 1996 would have been eligible for the maternity reform compared to the control group. The lack of pretrends in our results would provide evidence to refute this hypothesis.

5.3 Event-Study Design

To explore the dynamic effects of the reform by age of the child, we exploit differences in the timing of when the child turns three and, hence, become eligible for the policy. We utilize a generalized difference-in-differences approach in which we compare treated mothers whose children are three or younger in 2001 with a comparison group of ineligible mothers whose children are 11 and older in 2001. We estimate the following equation:

$$y_{it} = \sum_{j \neq 2} \alpha_j \cdot TimeSinceAge3_{j=t} + \sum_{j \neq 2} \beta_j \cdot TimeSinceAge3_{j=t} \cdot Treat_i + \delta_i + \psi_t + X_{it}\phi + \epsilon_{it} \quad (4)$$

where $TimeSinceAge3_t$ denotes years relative to when the child turns three. $Treat_i$ is an indicator variable that takes on the value of 1 for for treated mothers of children born between 1998 and 2002 (i.e., those that are age 3 or younger in 2001), and 0 for control mothers of children born between 1981 and 1990 (i.e., age 11 or older in 2001). Note that in this analysis, the issue of retrospective crediting is not relevant because we will be analyzing employment outcomes of mothers while their children are aged 3 to 10. For control mothers, these outcomes are measured prior to the announcement of the policy in 2001. In this specification, we also include year fixed effects, ψ_t, and individual fixed effects δ_i. We also

control for a set of time-varying demographic controls that consists of age group of mother times year fixed effects and region of birth by year fixed effects. The year before the age 3 (i.e. when the child is age two) is omitted. Our coefficients of interest are β_j's which capture the impact of the reform on outcomes for the treated mothers.

The identifying assumption using this strategy is that conditional on the controls, the timing of when the child turns three is uncorrelated with the outcome variables. This is reasonable given that the reform was not announced until well after fertility decisions have already been made. In addition, recent studies (e.g., Goodman-Bacon, 2019; Borusyak and Jaravel, 2017; de Chaisemartin and D'Haultfoeuille, 2020; Callaway and Sant'Anna, 2020) have shown that the estimated coefficients in an event study specification may biased if there are heterogeneous treatment effects correlated with the timing of the event (e.g., if mothers that become eligible in 2001 respond differently than those that become eligible in a later year). This issue however is less of a concern in our setting because we are using a control group.

6 Main Results

6.1 Effect on Pension Contributions

We begin by documenting the impact on pension contributions as a result of the reform. In Figure 3, we plot the estimated coefficients γ_j and the corresponding 95% confidence intervals for the outcome variable total annual pension earning points.[8]

Figure 3 shows that the coefficients are flat and insignificantly different from zero prior to 2001, providing support for our empirical strategy. The coefficients become positive and significant after the implementation of the reform for both pension earning points measures. In Table 2 Column (1), we report the coefficients from estimating equation (3). We find a 0.153 points or 66.5% increase in total pension earning points between 2004 and 2006 (baseline mean 0.23 points). Given that each earning point is worth 348, this translates into 373 increase in lifetime annual pension benefits for fully treated mothers between 2004 and 2006.[9] In 2000, men in the BASiD dataset have on average 11.71 lifetime non-marginal

[8] As described in Section 4.1, total earning points is imputed account for the additional caregiver credits mothers are expected to receive. Appendix Figure A2 presents the regression estimates for the actual reported pension earning points.

[9] Mothers treated between 2004 and 2006 experienced a 0.153 average increase in points per year. If fully

earning points, while women have on average 5.89 lifetime non-marginal earning points, translating into a 49.7% gender gap. As a result, using these estimates, a simple back-of-the-envelope calculation implies that the reform increased the lifetime pension earning points of mothers by 1.07 (0.153*7), leading to a 9.1 percentage point (18.3%) reduction in the gender gap in lifetime earning points.

6.2 Decomposing the Mechanical and Behavioral Effect of the Reform

We next quantify how much of the total effect on pension contributions can be explained by the mechanical effect of the reform (i.e. additional pension credits obtained for a given level of earnings) versus the behavioral effect (i.e. induced change in pension points due to a change in labor supply). To answer this question, we estimate the impact of the reform on total imputed pension contributions with and without caregiver credits. Figure 4 presents these results. By construction, the pre-period coefficients are the same as the reform has not been implemented yet. However, beginning in 2001, there is a divergence. As expected, there is a larger increase when we include caregiver credits, but a positive and significant effect emerges even when caregiver credits are excluded, suggesting a nontrivial behavioral response in employment earnings. Column (2) of Table 2 shows the estimates from equation (3) when we exclude the additional caregiver credits. Taking into account the additional earning points as a result of the policy, there is 66.5% increase in total earning points including caregiver credits (baseline mean 0.23), while excluding caregiver credits leads to a 44% increase. Comparing the effect size between the two outcome variables suggests that 66% of the total effect can be explained by the behavioral effect.

Interestingly, from Figure 4 we can also observe that the behavioral effect of the policy is increasing in each year since 2001. This pattern suggests that mothers are increasing employment earnings. This may be indicative of increasing labor force attachment of mothers. In the remaining part of the paper, we will explore the underlying mechanisms for the large behavioral response we observe.

treated, they are eligible for these pension credits for 7 years (when their children are between 3 to 10). This means a total increase in pension points of 373=348*0.153*(10-3).

6.3 Effects on Employment Earnings

Given the large behavioral response presented in Section 6.2, we now turn to analyzing the effect of the reform on mothers' total employment earnings subject to social security contributions. Specifically, in Figure 5 we show the estimated coefficients γ_j's and the corresponding 95% confidence intervals for total employment earnings. We find that the reform had a positive and significant impact, which is confirmed by the coefficients reported in Table 3 Column (1). Our estimates point to a 1,955 or 32% increase in employment earnings (baseline mean 6,109) on average between four to six years after the reform.

Dynamic Effects on Earnings

We next explore the dynamic impacts of the reform to understand when mothers respond to the policy. In Figure 8, we plot the coefficients from estimating equation (4) for each age of the child. In line with our main difference-in-differences results, we observe a significant increase in pension earning points and employment earnings. The effects are increasing between age three and four, then stabilizing. The standard errors however do increase because we only have data up to 2009 and so the last coefficients are estimated using only mothers with the oldest children.

7 Extensive and Intensive Margin

In this section, we investigate to what extent the increase in total employment earnings is driven by the extensive or the intensive margin.

As a result of the reform, mothers may increase their participation in the pension system by entering regular employment from (i) nonemployment, or (ii) marginal employment. Column (2) of Table 3 shows that regular employment increases by 10.5 percentage points, or 17%.[10] This result is confirmed by Figure 6, which plots the point estimates and the corresponding 95% confidence intervals in the first five years after the introduction of the policy. In Column (3) and Figure 7a, we show that this increase in pension insurance participation, in part, comes from a shift from marginal to regular employment. Conditioned on being employed, marginal status reduces by 11.5 percentage points or 22% (baseline mean 40%).[11] To

[10] Regular employment is a dummy outcome variable that equals 1 if employed in a regular job and 0 otherwise.

[11] Given that prior to 1999 marginal workers were not required to register in the social security system,

understand whether the reduction in marginal employment completely offsets the increase in regular employment, in Figure 7b and in Table 3 Column (4) we show the effect of the reform on overall employment, defined as employment in either regular or marginal jobs. We find a significant 11% increase in overall employment (baseline mean 65%), providing compelling evidence of an effect at the extensive margin.

Next, we explore the impacts on the intensive margin. Column (5) suggests that there are no effects on full-time employment conditioned on working, suggesting that mothers are not switching between part-time and full-time employment. Given the reduction in marginal employees, this means that the new regular workers equally distribute between full time and part time jobs. These results also suggest a positive increase in hours worked as marginal employees switch into full-time employment. Using the microcensus data, we find suggestive, positive impacts on hours worked (Figure 9). However, Column (6) shows no significant impact on total employment earnings conditional on working.

Together these results suggest that the increase in employment earnings results mostly from the extensive margin.

8 Heterogeneity Analysis

In previous sections, we found three main results. First, the introduction of caregiver credits increased the pension contributions of eligible mothers by 66.5%. Second, this increase in pension earning points is mainly driven by a behavioral response in terms of employment earnings, which explains 66% of the total effect on pension contributions. Third, the increase in employment earnings is mostly driven by the extensive margin: an increase in regular employment, which comes from a combination of new employment entries and shifts from marginal to regular jobs. In this section, we will explore potential heterogeneous treatment effects and redistribution impacts induced by the reform.

8.1 Heterogeneity by Age of the Child

The dynamic results presented in Section 6.3 suggest that treated mothers respond to the reform soon after their child has turned three and this effect is persistent. We may be interested in whether there are heterogeneous responses for mothers of children of different

we restrict our analysis to data from 1999 for marginal outcome variables.

age groups when the reform is first implemented. For example, mothers of 3-year-olds in 2001 may respond differently than mothers of 10-year-olds in 2001 since these mothers of younger children can expect to benefit from the reform for a longer period of time.

To analyze this, we modify the difference-in-differences specification (3) such that there is a separate treatment variable for mothers of children aged 3-5 and for mothers of children aged 6-10. We chose these age cutoffs based on the entry age for primary education. Table 4 report the results for total pension earning points including caregiver credits, employment earnings and regular employment.[12] We find limited evidence that mothers with children of different ages respond differently.

8.2 Heterogeneity by Marital Status

We next explore heterogeneity by marital status of mothers. The direction of this heterogeneity is, a priori, ambiguous. On one hand, because marginal jobs are not taxed and married women can have access to social security benefits through their spouses, marginal jobs may be more appealing for married mothers. As a result, single mothers may be more likely to explain the shift from marginal to regular employment. On the other hand, given that single mothers are more likely to already be employed and work in regular jobs, the increase in regular employment may be driven by married women.

To provide evidence of this, we use our Microcenses dataset which contains information on marital status. Appendix Figure A3 shows no significant difference between married and single mothers on the effect of the reform on employment, hours worked, and pension insured.

8.3 Heterogeneity by Childcare Availability

Next, we explore heterogeneity by childcare availability. In our setting, mothers with greater access to childcare may be more responsive to the reform as they may face fewer barriers in increasing their labor supply. Since 1996, all children aged three to five have a legal right to a kindergarten slot in subsidized half-day childcare.[13] This led to an expansion of public childcare especially for 3-year-olds. Since the expansion takes place at the municipal level, regions differ considerably in terms of availability. As a result, mothers may differ in terms

[12]Note that because of how we defined the treatment variables, the coefficients report the total average treatment effects for mothers of children aged 3-5 and aged 6-10, respectively.

[13]Elementary education begins at age six.

of access to childcare. In addition, the school day for all ages ends between 1pm and 2pm, which may make it difficult for mothers to combine a full-time career with parenting without additional childcare. Public after-school care is available but slots are generally limited and vary across regions.

In Tables 6 and 7, we study the impact of caregiver credits reform for mothers living in states with high or low childcare provision. We use two alternative measures of childcare provision, (i) kindergarten (daycare) slots for 3- to 5-year-olds and (ii) after-school childcare slots for 6- to 9-year-olds. Appendix Figure A1 shows the distribution of the childcare provision based on these two measures across Germany. Daycare slots are widely available for at least a majority of students while after-school care provision is much more limited. We define an area as one with high childcare availability if it is above the median in the distribution of daycare or after-school care slots-to-population ratio in 1998.

The results in the two tables reveal limited evidence of heterogeneous treatment effects based on public childcare availability in terms of both daycare availability and after-school care. It is important to note that the measures used in this analysis only captures public institutional care. Mothers in Germany have access to a variety of alternative childcare options. These include informal care provided through social networks, including family and friends. In West Germany, grandparents, for example, are an important source of childcare, especially for those who live close to their grandchild (Garcia-Moran and Kuehn, 2017). Mothers also have access to private childcare options. To capture heterogeneity in access to care, we utilize the microcensus to understand whether households with additional non-parent adults (over the age of 18) respond differently. Similar to results we document for public childcare availability, Appendix Figure A4 also suggests no heterogeneous treatment effects based on whether the household included additional adults.

8.4 Heterogeneity by Pre-Birth Earnings

We next explore heterogeneity by pre-birth earnings of mothers. A priori, the impact of the policy by income is ambiguous. On one hand, mothers with higher pre-birth earnings are likely to be more educated and may have better knowledge of the policy. In a recent paper that studies the impact of retirement savings subsidies, Chetty et al. (2014) show that individuals with higher income are more responsive to retirement subsidy change. Because nearly all women earn less than the national average in income, these mothers would also benefit from the reform. They may also have better access to alternative childcare options,

which can facilitate any additional increase in working hours or transitions into the labor force. On the other hand, mothers with lower pre-birth earnings may have lower baseline levels of pension contributions and hence, the substitution effects of the policy may be larger for these women.

In Table 5, we report the difference-in-differences coefficients for estimating equation (3) in which we allow the effects to differ based on whether the mother earned above the median in the pre-birth earnings distribution. The results paint a consistent pattern that treated mothers with below-median pre-birth earnings experience an increase in pension contributions between 2001 and 2003, while there is no effect for mothers of higher earnings. The increase in pension contributions for low-income mothers is driven by an increase in total regular employment earnings as well as regular employment. These effects are persistent. By 2004 to 2006, we also observe that mothers of higher pre-birth earnings respond in similar magnitude as mothers below the median. However, because the baseline levels of the outcome variable is considerably higher for mothers above the median, the response is much larger in percentage terms for low-income mothers. Specifically, there is a doubling in pension contributions and employment earnings for low-income mothers, as well as a 39% increase in the likelihood of holding a regular employment position. In contrast, mothers with higher pre-birth earnings increased pension contributions by 59%, employment earnings by 47%, and regular employment by 27%. These differences imply potential positive redistributive consequences of this reform.

9 Caregiver Credits in a Life-Cycle Model

In order to investigate the long run effects of the 2001 introduction of caregiver credits and its welfare implications, we develop a finite-horizon dynamic life-cycle model. In ongoing work, we plan to estimate the parameters of the model using a simulated minimum-distance procedure as in Cesarini et al. (2017).

During the working age, mothers choose their labor earnings, consumption, and assets to maximize their utility. Because we observe only total earnings and not hours worked in the administrative dataset, we follow the public economics literature (Gelber et al., 2016) and model individuals as trading off consumption against pre-tax earnings. Retirement occurs exogenously when the individual reaches age 65 in the period T_{ret}. During retirement, the agents receive pension benefits and maximize their utility by choosing consumption and

assets. The maximization problem during retirement is affected by the labor supply choice before retirement through the budget constraint. This is because, following the German pension system, we model retirement pension benefits as a linear function of lifetime earnings.

In each period, each mother with a child of age a_t, chooses consumption c_t, assets A_{t+1}, and hours h_t (that determines the pension earning points EP_{t+1}) by maximizing her lifetime utility:

$$V_t(A_t, EP_t, a_t) = \max_{c_t, h_t, A_{t+1}, EP_{t+1}} \{u(c_t, h_t) + \frac{1}{1+\delta} V_{t+1}(A_{t+1}, EP_{t+1}, a_{t+1})\} \tag{5}$$

where the period period utility is

$$u(c_t, h_t) = \frac{c_t^{1-\gamma_c}}{1-\gamma_c} + \beta \frac{(H-h_t)^{1-\gamma_h}}{1-\gamma_h} - qI(h_t > 0) \tag{6}$$

V_{t+1} is the continuation value. Following Gelber et al. (2016), q is the fixed cost of participation to allow for extensive margin decisions on whether to earn a positive amount. δ is the discount rate. We follow Cesarini et al. (2017) and use a Stone-Geary utility function with β as the relative weight on consumption in utility. γ_c is the subsistence consumption level and γ_E is the maximum possible level of earnings. H represents the maximum hours worked.

Prior to retirement, i.e. $t \leq T_{ret}$, utility is maximized subject to the intertemporal budget constraint:

$$A_{t+1} = (1+r)(A_t + w(1-\tau_t)h_t - c_t + Y_t) \tag{7}$$

where A_t represents assets at the beginning of the period and we set $A_T \geq 0$, r is the interest rate, Y_t is the unearned income (e.g. spouse's income). During retirement ($t > T_{ret}$) the labor supply is set to zero ($h_t = 0$). Finally, τ_t is the marginal tax rate.

Prior to retirement, mothers accumulate pension earning points based on the following:

$$EP_{t+1} = EP_t + f_t(wh_t) \tag{8}$$

where the function f_t translates total earnings into pension earning points that depends on the national average earnings, $\bar{wh}$, and, as in the caregiver credits reform, the age of the

child, a_t:

$$f_t(x) = \frac{1}{\bar{w}\bar{h}} \begin{cases} x & \text{if } a_t \notin [3, 10] \\ \max\{\min\{1.5x, 1\}, x\} & \text{if } a_t \in [3, 10] \end{cases} \tag{9}$$

During retirement, $t > T_{ret}$, the budget constraint is given by:

$$A_{t+1} = (1 + r)(A_t + \rho EP_{T_{ret}} - c_t + Y_t) \tag{10}$$

where pension benefits, $\rho EP_{T_{ret}}$, depend on total earning points over the working periods ($EP_{T_{ret}} = \sum_{t=0}^{T_{ret}} EP_t$) and the monetary value of pension points, ρ ($\approx$350). We assume individuals die deterministically at $t = T$ and restrict end-of-life assets to be greater than or equal to zero, $A_T \geq 0$.

10 Simulations

In this section, we show the preliminary results of the model simulation. We made the following assumptions: Mothers live deterministically until period $T = 85$, they retire at age 65 and give birth to their child at age 30. We assume perfect information, no uncertainty, and perfect markets. Following Thiemann (2014), we fix the value of a pension point to 348. The level of unearned income is set at the value of average male income in our data (48,000) to proxy for husband's income. We also set hourly wage to 16 which corresponds to the national average income of 30,000 for someone who works 1,880 annual working hours.[14] The discount rate (δ) is set equal to the interest rate (r) to 0.015, following Cesarini et al. (2017). For tractability in our preliminary analysis, we assume = 0 and study only the employment response along the intensive margin. We plan to relax this assumption in ongoing work. To match womens pension before reform we set $\beta = 5.632$. Finally, to match the employment earnings response in our data, we fix $\gamma_c = 1$, $\gamma_h = 1.525$, and the Frisch elasticity $= \frac{1}{\gamma_h} \times \frac{h_{max} - h}{h} = \frac{1}{1.525} \times \frac{1880 - 860}{860} = .78$. This elasticity is large compared to what has been found in the literature (Chetty et al., 2011). This is partly because we are modelling the employment response as coming from the intensive margin only even though the increase in employment earnings in the data comes largely from the extensive margin.

Our simulations show that, in response to the reform, eligible mothers temporarily in-

[14] This assumes someone is working 40 hours per week with 5 weeks of vacation.

crease their earnings during the seven years when their children are aged three to ten, as shown in Figure 10a. By construction, this increase is fully driven by an increase in working hours (Figure 10c).[15] We also observe that mothers then slightly reduce labor supply in the years when they are not eligible for the additional pension caregiver credits. Figure 10d shows that this temporary increase in employment earnings translates into an 12% increase in pension contributions (7,608 to 8,524) and a permanent increase in consumption (Figure 10e). Given that in 2015 the average male pensioner receives 13,848 per year compared to 7,608 for women (Thiemann, 2014), this approximates a 15% reduction in the gender gap in old-age pension earnings.

In the next steps of this project, we plan to use the estimated model to predict future pension benefits of treated mothers and to evaluate counterfactual policies. The model will allow us to estimate the income and substitution effects of the policy on pre-retirement labor earnings and identify key labor elasticities to future pension benefits. We plan to compare the caregiver reform to alternative policies including childcare provision and tax subsidies to mothers. The findings of our analysis will help inform current policy discussions on potential solutions to reduce the old-age gender gap.

11 Conclusions

This paper presents new evidence on the effects of caregiver credits on mothers' old age income and employment outcomes. We show that an extension of a pension subsidy that is proportional to employment earnings during periods of caregiving raises mothers' annual retirement contributions by 66.5% and employment earnings by 32%. Two thirds of the effect on pension contributions comes from an increase in women's labor supply, which is largely driven by the extensive margin: a combination of new employment entries and shifts from marginal to regular jobs.

Our heterogeneity analysis shows that the reform does not differentially affect mothers based on their access to childcare, marital status or age of their children. Instead, results are driven by mothers with pre-birth earnings below the median, suggesting potential positive redistribution effects.

Using a simple dynamic lifecycle model, we show that this corresponds to a 12% increase in future retirement income and a 15% reduction in the overall gender gap in old age income.

[15] The current version of the model does not account for a potential response at the extensive margin yet.

The findings of our analysis suggest important labor supply responses of mothers with young children to retirement policy changes. Given that older women are increasingly at risk of poverty, our analysis suggests that caregiver credits can be an important policy tool in reducing the gender gap in pension income and, at the same time, incentivize mothers to remain attached to the labor force.

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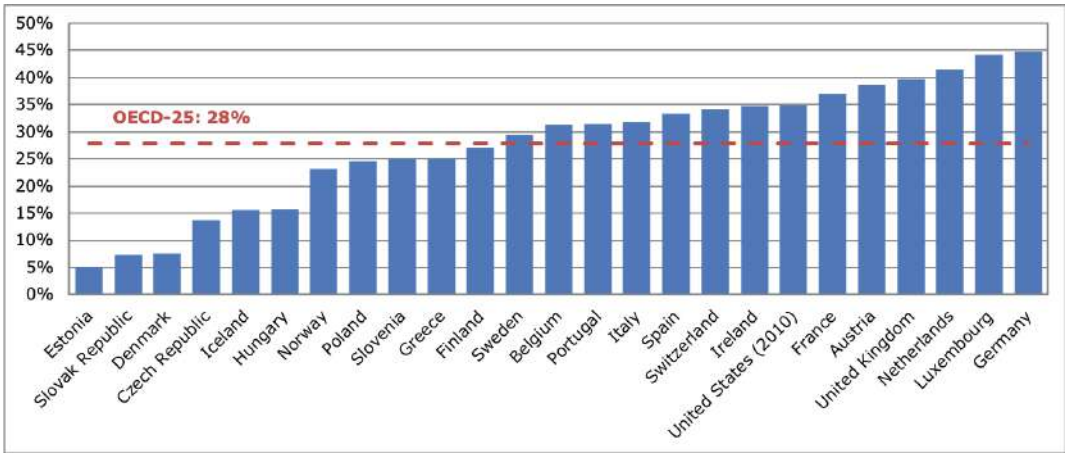
Figures and Tables

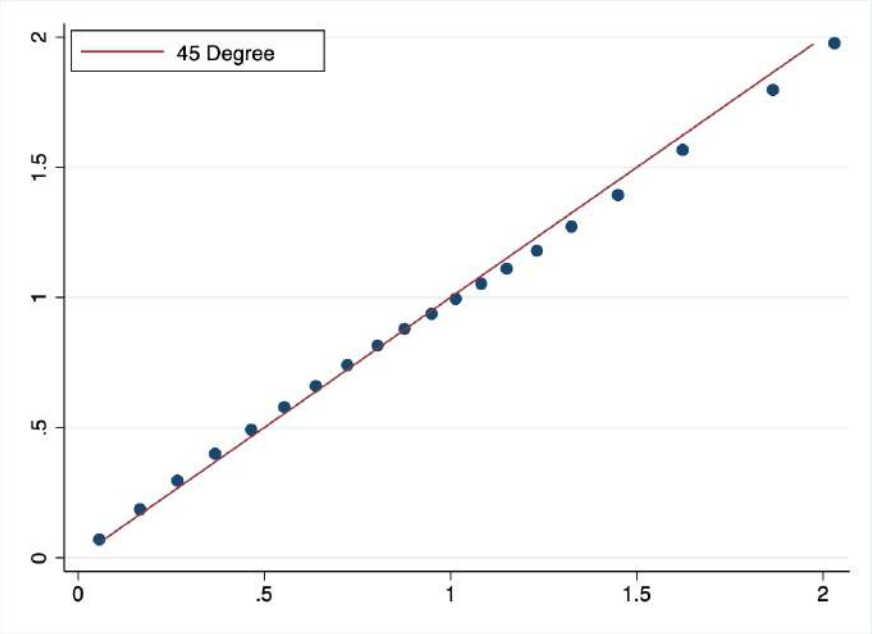
Figures

Figure 1: Average Gender Gap in Retirement Income, 2011



Note: The gender pension gap is defined as the difference between male and female average gross (public and private) pension payments divided by male ones. It includes persons who obtain old-age benefit (public or private), survival pension or disability benefit. Data for the United States come from 2010. Source: dAddio (2015) "The Gender Pension Gap in OECD countries: Socio-Economic Factors, Pension systems design and Rules that matter"

Figure 2: Estimated vs. Actual Earning Points



Notes: Estimated earning points are calculated by dividing total annual earnings by average total annual earnings across all workers in the BASiD. Actual earning points are reported total earning points associated with employment spells.

Figure 3: Effect of Pension Caregivers Reform on Total Pension Earning Points (Incl. Caregiver Credits)

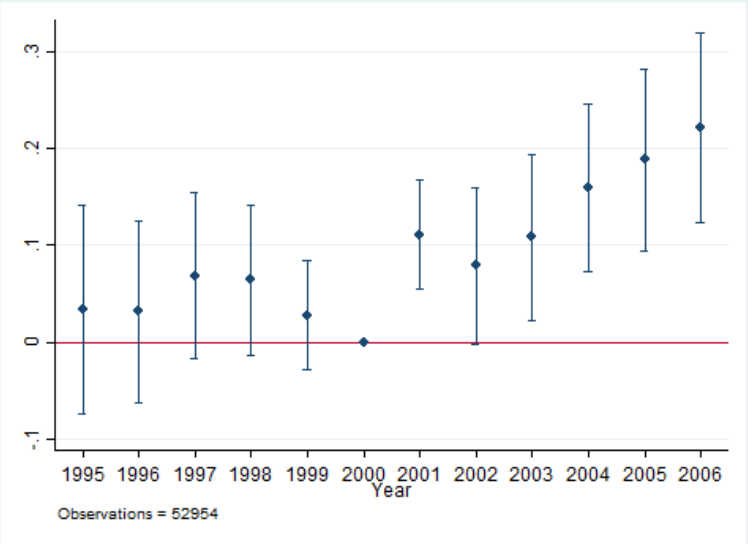


Figure 4: Decomposition of Mechanical and Behavioral Responses to the Reform

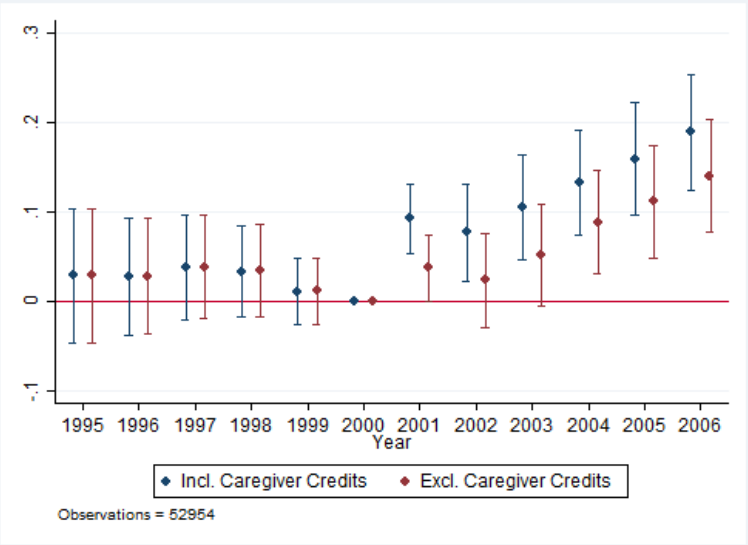


Figure 5: Effect of Pension Caregivers Reform on Total Employment Earnings

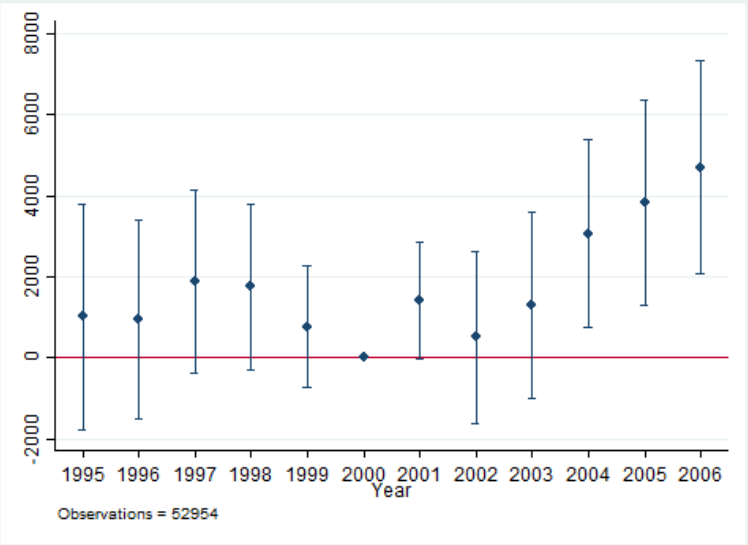


Figure 6: Effect of Pension Caregivers Reform on Regular Employment

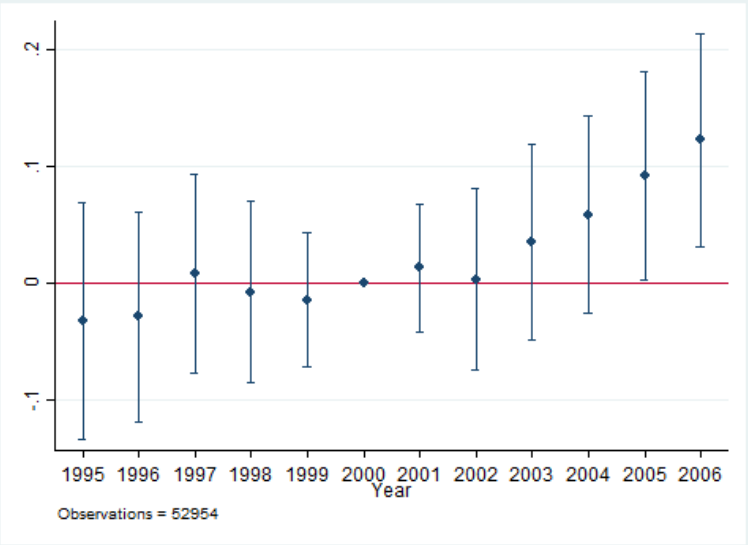
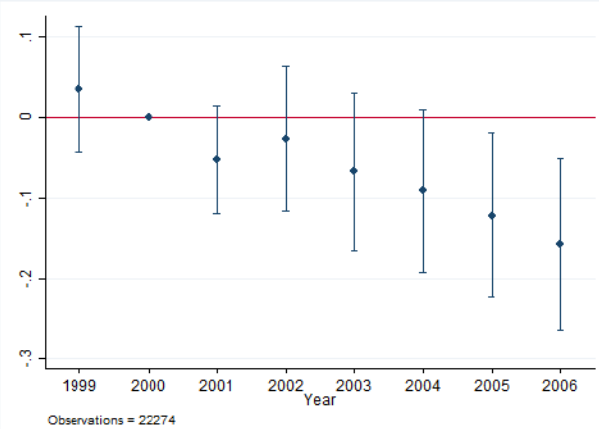


Figure 7: Effect of Pension Caregivers Reform on Marginal and Overall Employment

(a) Marginal Employment (Conditional on Working)



(b) Employment (Regular and Marginal)

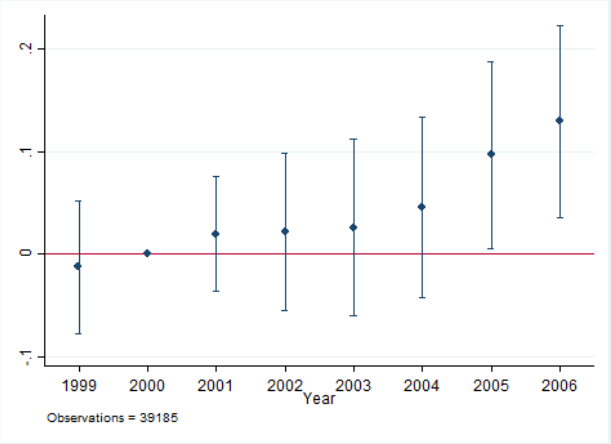


Figure 8: Dynamic Effect of Pension Caregivers Reform on Total Employment Earnings

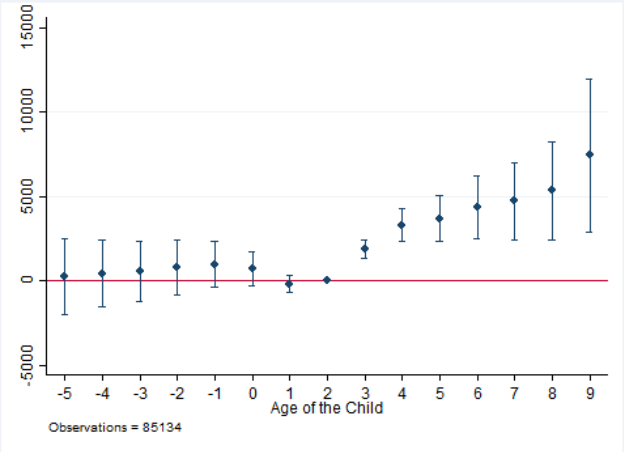


Figure 9: Effect of Pension Caregivers Reform on Hours Worked

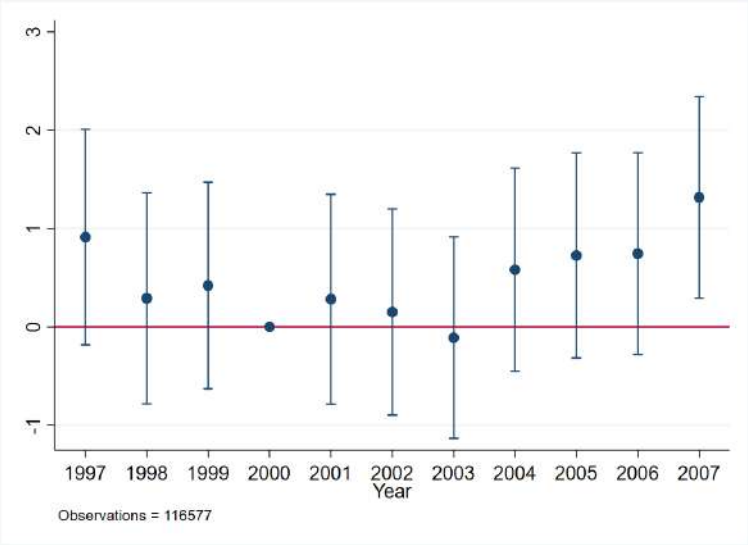
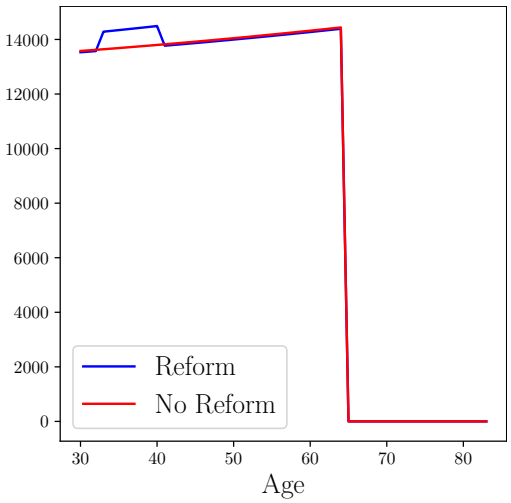
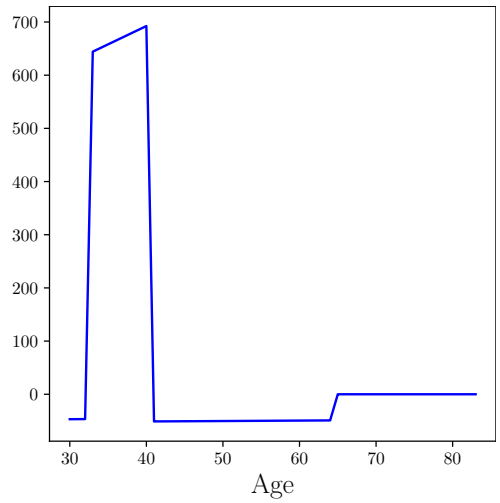


Figure 10: Model Simulations of Pension Caregivers Reform

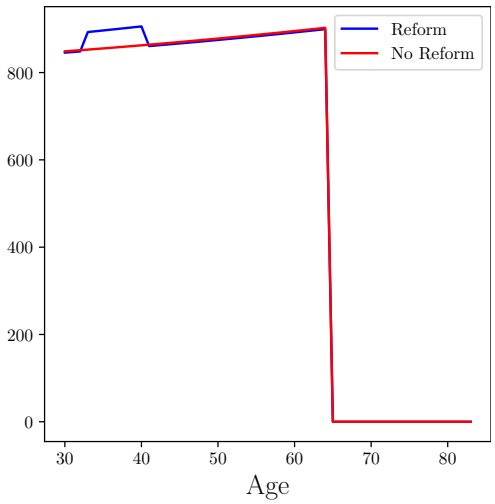
(a) Earnings



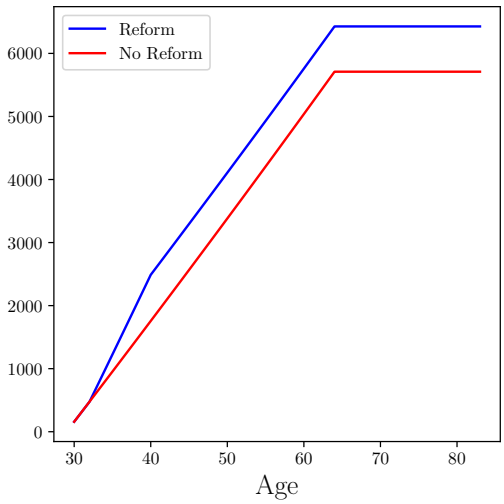
(b) Earnings Difference



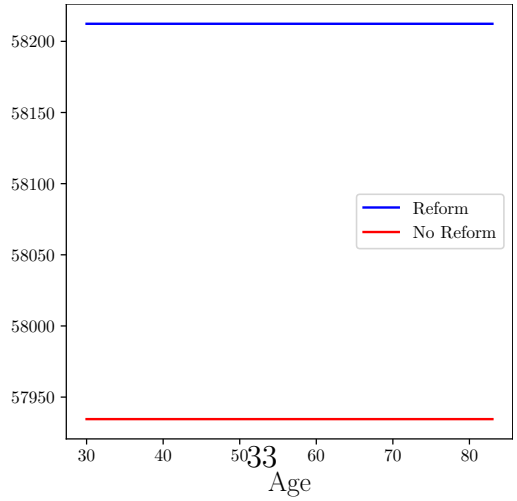
(c) Hours Worked



(d) Cumulative Earning Points (Monetary)



(e) Consumption



Tables

Table 1: Summary Statistics of Mothers with Child Aged 3-10, 2000

	Mean	SD	Observations
Age	35.22	5.37	4583
Age at First Birth	28.77	5.08	4583
Vocational Training or More	0.79	0.41	4050
Lifetime Earning Points	5.99	5.98	4583
Lifetime Non-marginal Earning Points	5.44	5.57	4583
Annual Earning Points	0.32	0.56	4583
Annual Non-marginal Earning Points	0.26	0.43	4583
Total Earnings	6108.98	9978.38	4583
Total Earnings (>0)	15819.30	10209.26	1659
Total Earnings (Incl. Marginal)	7694.29	12485.76	4583
Any Employment (Incl. Marginal)	0.64	0.48	4583
Regular Employment	0.39	0.49	4583
Marginal	0.40	0.49	2966
Fulltime	0.31	0.46	2943

Table 2: Effect on Pension Contributions

	(1) Total Imputed Pension Earning Points (Incl. Caregiver Credits)	(2) Total Imputed Pension Earning Points (Excl. Caregiver Credits)
Age 3-10 × 2001-2003	0.061*	0.004
	(0.037)	(0.036)
Age 3-10 × 2004-2006	0.153***	0.102***
	(0.038)	(0.038)
Baseline Mean	0.23	0.23
Observations	52,954	52,954
Sample	1995-2006	1995-2006

Table 3: Effects on Employment Outcomes

	(1) Total Employment Earnings	(2) Regular Employment	(3) Marginal if Employed	(4) All Employment	(5) Full-Time	(6) Total Employment Earnings (>0)
Age 3-10 × 2001-2003	3.319	0.031	-0.026	0.029	0.016	-2196.553
	(955.527)	(0.034)	(0.044)	(0.032)	(0.062)	(1569.513)
Age 3-10 × 2004-2006	2809.323***	0.105***	-0.115**	0.099**	0.045	1588.072
	(1009.368)	(0.035)	(0.055)	(0.041)	(0.072)	(2026.790)
Baseline Mean	6108.98	0.39	0.40	0.64	0.51	15819.30
Observations	52,954	52,954	22,274	39,185	17,180	17,180
Sample	1995-2006	1995-2006	1999-2006	1999-2006	1995-2006	1995-2006

Table 4: Heterogeneity by Age of Child

	(1) Total Imputed Pension Earning Points (Incl. Caregiver Credits)	(2) Total Employment Earnings	(3) Regular Employment
Age 3-5 × 2001-2003	0.052	27.482	0.017
	(0.037)	(948.923)	(0.036)
Age 6-10 × 2001-2003	0.064*	-4.746	0.034
	(0.038)	(981.185)	(0.035)
Age 3-5 × 2004-2006	0.147***	2666.357***	0.103***
	(0.038)	(982.607)	(0.037)
Age 6-10 × 2004-2006	0.155***	2848.395***	0.105***
	(0.039)	(1036.503)	(0.036)
Baseline Mean for Age 3-5	0.19	5146.78	0.36
Baseline Mean for Age 6-10	0.25	6719.04	0.41
Observations	52,954	52,954	52,954
Sample	1995-2006	1995-2006	1995-2006

Table 5: Heterogeneity by Pre-Birth Earnings

	(1) Total Imputed Pension Earning Points (Incl. Caregiver Credits)	(2) Total Employment Earnings	(3) Regular Employment
Age 3-10 × 2001-2003	0.189***	3599.169***	0.130***
	(0.043)	(1105.238)	(0.047)
Age 3-10 × 2001-2003 × Above Median	-0.146**	-4859.863***	-0.098*
	(0.071)	(1867.838)	(0.060)
Age 3-10 × 2004-2006	0.208***	4477.206***	0.142***
	(0.046)	(1218.694)	(0.052)
Age 3-10 × 2004-2006 × Above Median	0.062	561.236	0.050
	(0.080)	(2155.882)	(0.069)
Baseline Mean for Below Median	0.18	4717.15	0.36
Baseline Mean for Above Median	0.35	9435.49	0.53
Observations	34,259	34,259	34,259
Sample	1995-2006	1995-2006	1995-2006

Table 6: Heterogeneity by Public Daycare Availability

	(1) Total Imputed Pension Earning Points (Incl. Caregiver Credits)	(2) Total Employment Earnings	(3) Regular Employment
Age 3-10 × 2001-2003	0.057	-530.138	0.036
	(0.055)	(1445.926)	(0.047)
Age 3-10 × 2001-2003 × Above Median	0.080	2146.719	0.043
	(0.089)	(2353.916)	(0.072)
Age 3-10 × 2004-2006	0.184***	3261.584**	0.125**
	(0.058)	(1551.664)	(0.052)
Age 3-10 × 2004-2006 × Above Median	0.070	1751.020	0.073
	(0.093)	(2509.213)	(0.076)
Baseline Mean for Below Median	0.27	7289.43	0.46
Baseline Mean for Above Median	0.35	9235.51	0.52
Observations	32475	32475	32475
Sample	1995-2006	1995-2006	1995-2006

Table 7: Heterogeneity by After-School Public Childcare Availability

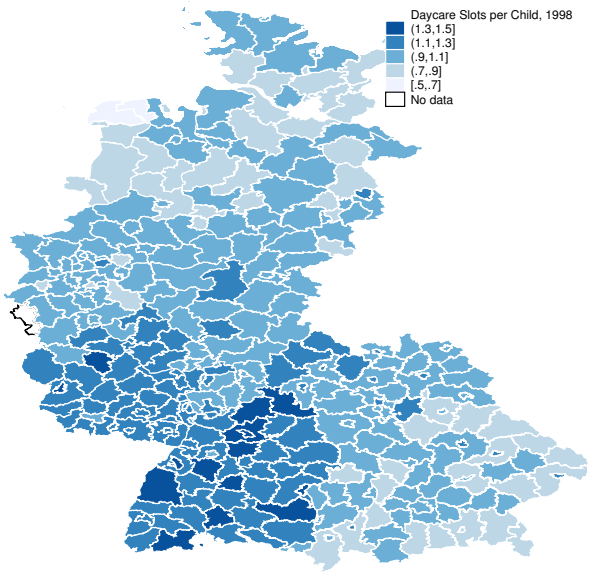
	(1) Total Imputed Pension Earning Points (Incl. Caregiver Credits)	(2) Total Employment Earnings	(3) Regular Employment
Age 3-10 × 2001-2003	0.087	296.517	0.068
	(0.054)	(1425.095)	(0.048)
Age 3-10 × 2001-2003 × Above Median	-0.011	-347.969	-0.051
	(0.089)	(2358.449)	(0.069)
Age 3-10 × 2004-2006	0.198***	3536.949**	0.161***
	(0.060)	(1618.870)	(0.053)
Age 3-10 × 2004-2006 × Above Median	0.031	932.663	-0.033
	(0.091)	(2474.876)	(0.075)
Baseline Mean for Below Median	0.29	7764.89	0.47
Baseline Mean for Above Median	0.32	8520.11	0.51
Observations	32475	32475	32475
Sample	1995-2006	1995-2006	1995-2006

Appendix

A Additional Figures

Figure A1: Childcare Availability in Western Germany, 1998

(a) Daycare slots per 3-5 year olds



(b) After-school care slots per 6-9 year olds

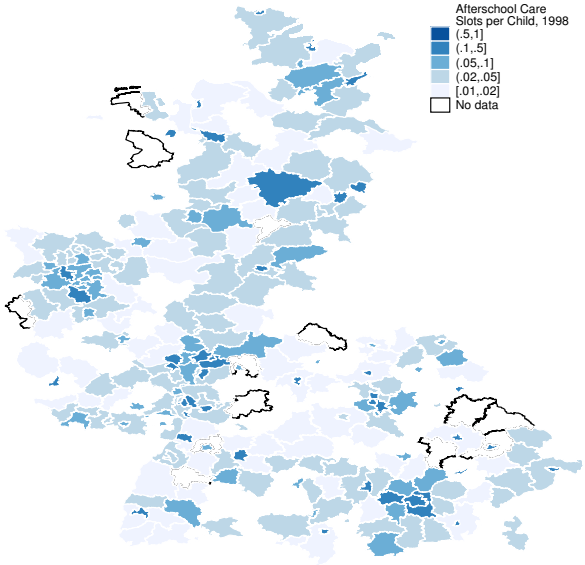


Figure A2: Total Reported Pension Earning Points

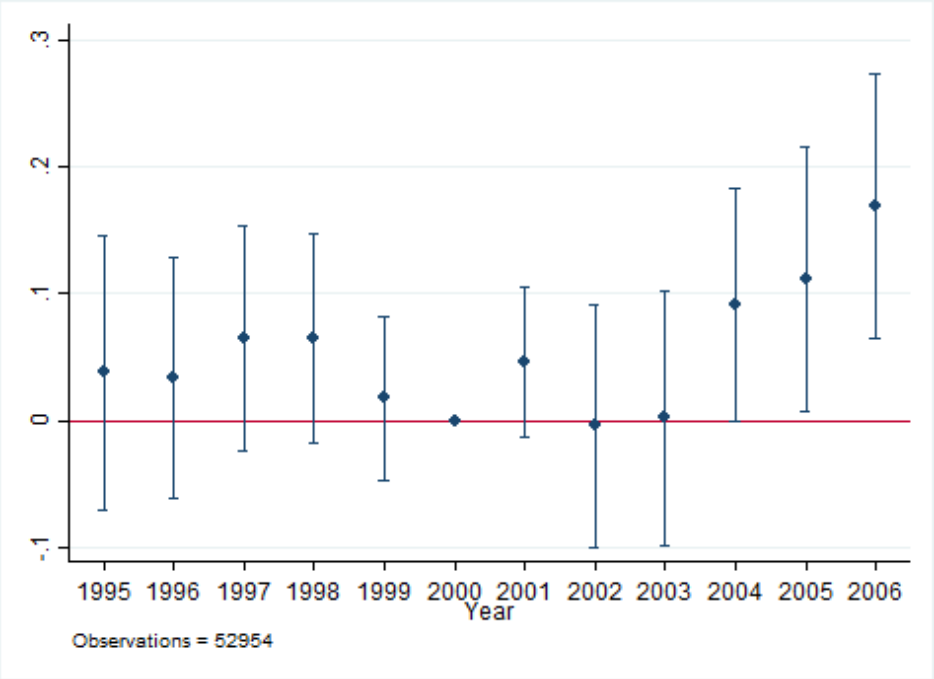
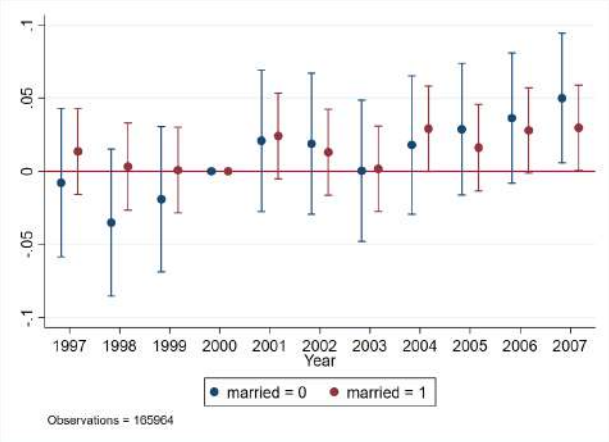
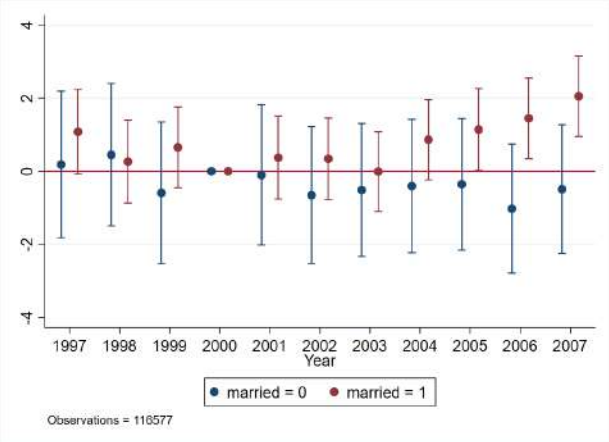


Figure A3: Heterogeneity by Marital Status

(a) Employed



(b) Hours Worked



(c) Pension Insured

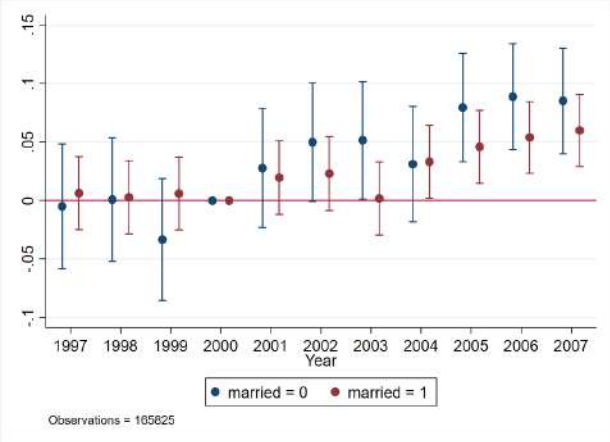
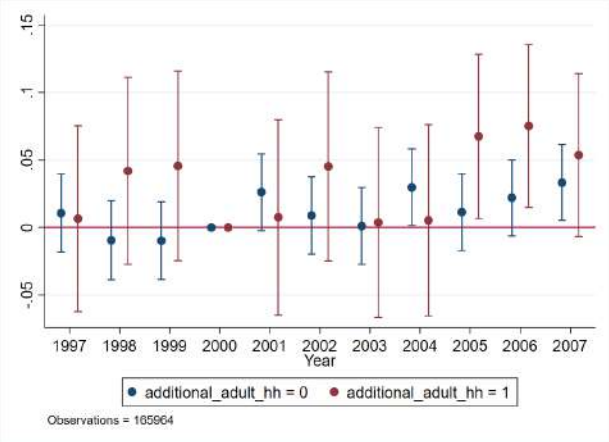
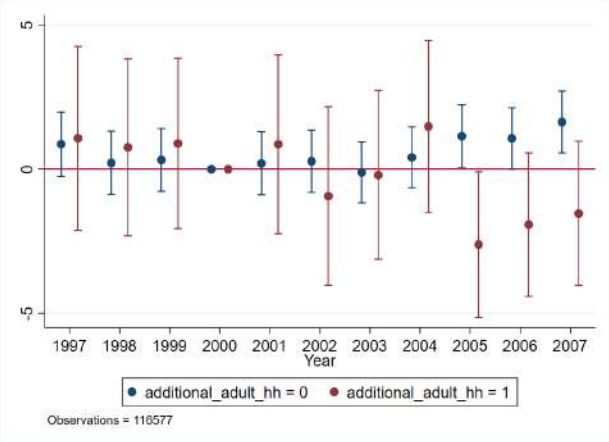


Figure A4: Heterogeneity by Childcare Availability: Has Additional Adults in HH

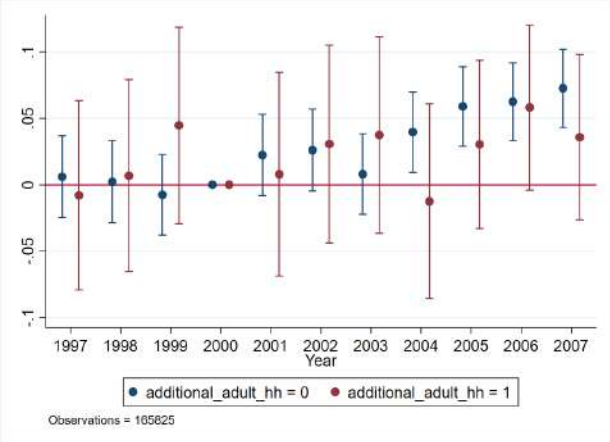
(a) Employed



(b) Hours Worked



(c) Pension Insured



B Additional Tables

Table A1: Effect on Pension Contributions

	(1) Total Reported Pension Earning Points
Age 3-10 × 2001-2003	-0.023
	(0.039)
Age 3-10 × 2004-2006	0.088**
	(0.040)
Baseline Mean	0.32
Observations	52,954
Sample	1995-2006