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Discussion Papers

Pension Incentives and Early Retirement

Barbara Engels, Johannes Geyer and Peter Haan

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Pension incentives and early retirement[*]

Barbara Engels[†], Johannes Geyer[‡] and Peter Haan[§]

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In this paper we exploit a cohort-specific pension reform to estimate the causal labour market effects of changes in the financial incentives to retire. In particular, we analyze the effects of the introduction of cohort-specific deductions for early retirement on female retirement, employment and unemployment. For the empirical analysis we use high-quality administrative data from the German pension insurance. We present evidence for sizable labour market effects. In addition to direct effects on women older than 60 we find important anticipation effects before reaching the pension eligibility age. Overall we document that the pension reform leads to a postponement of retirement, an increase in employment and a shifting in unemployment over age rather than a substitution into unemployment.

Keywords: retirement age, pension reform, labour supply, actuarial deductions, cohort-specific pension reform, labour market effects.
JEL classification: J14; J18; J22; J26, H21.

1. Introduction

Ageing populations present significant challenges for public pension systems. Therefore, most OECD countries have reversed their retirement policies since the 1990s and started to encourage longer working lives alleviating the decline of the working age population (OECD, 2006, 2011). Reforms include tighter qualifying conditions and increases in the pension eligibility age, the introduction of actuarial deductions for early retirement, increases in the normal retirement age (NRA), i.e. the age at which people can first draw full benefits without actuarial deductions,[1] increases in the statutory retirement age or a combination of these policies.

The effectiveness of pension reforms strongly depends on the induced labour market effects, in particular on the impact on employment and retirement. Therefore, it is crucial to empirically evaluate these policies and to quantify the causal labour market effects. It is the aim of this paper to provide novel insights to this important question. More specifically, we estimate the causal labour market effects of a pension reform that introduced actuarial deductions for early retirement in combination with an increase in the normal retirement age. We quantify the impact of financial incentives on employment, retirement, and the take-up of disability or unemployment benefits. A pension reform induces direct labour market effects for individuals who reach the pension eligibility age. In addition, a pension reform might lead to anticipation effects for individuals before reaching that age. For example, individuals might increase employment prior to the age of pension eligibility in order to compensate for the reduced generosity of the pension system. Moreover, there exists convincing empirical evidence that individuals use unemployment benefits or disability pensions as a substitution for or a bridge into retirement (e.g., Duggan *et al.* (2007), Coe and Haverstick (2010), Grogger and Wunsch (2012), Inderbitzin *et al.* (2013), Giesecke and Kind (2013), Staubli and Zweimüller (2013) or Atalay and Barrett (2015)). Therefore, in order to capture the full labour market effects of the pension reform, in this paper we analyze both the labour market effects before ("anticipation effect") and after ("direct effect") reaching the pension eligibility age.

The identification of the effects of the pension system on the labour market is a challenging task. One central problem is that decisions on the labour market are likely to be influenced by unobserved individual factors which are correlated with the financial incentives of the pension system (e.g. Chan and Stevens (2004) or Hanel and Riphahn (2012)). For example, the individual social security wealth, which is a measure of finan-

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[1]This definition of the NRA is equal to the OECD definition of the "pensionable age" (OECD, 2011, p. 20).

cial retirement incentives, depends on the working and earnings history of an individual. Therefore, the causal interpretation of estimated employment effects obtained in commonly used regressions that use cross-sectional variation in the social security wealth requires strong assumptions (Gruber and Wise, 2004).

In this paper we propose a different estimation strategy and directly exploit exogenous cohort-specific variation in the introduction of actuarial deductions for early retirement. In more detail, we focus on the 1992 pension reform in Germany which increased the NRA and introduced deductions for early retirement for women born after December 1939. The estimation is based on high-quality administrative data from the German public pension insurance. For the identification we exploit the following variation: women born before January 1940 could retire without deduction from age 60 onwards while for women born in subsequent months until December 1944 deductions were gradually introduced by month of birth; therefore, all cohorts born between January 1940 and December 1944 were affected by the reform in a different way. In addition the NRA was gradually increased from the age of 60 years to the age of 65, while both the pension eligibility age (60) and the statutory retirement age (65) remained constant.[2]

This specific design allows us to estimate the direct effect and the anticipation effect (behavioural reaction before reaching age 60, i.e. the age of pension eligibility) of the pension reform. First, in order to estimate the direct effect of the pension reform on labour market outcomes we exploit the cohort-specific age pattern of the deductions and estimate the effects of deductions on retirement, employment and unemployment for women who are eligible for pensions. Crucially, the changes in the financial incentives do not only vary by cohort but the age structure of deductions differs across cohorts. Second, in order to account for both the direct effect and the anticipation effect of the reform we focus on the induced financial changes on the retirement age, the exit age of employment and different measures of duration of employment, disability and unemployment between age 55 to 65. These outcomes include the behaviour of individuals before and after the pension eligibility age. For the construction of these outcomes we use completed individual labour market histories at the age of 65, i.e. when women have reached the statuary retirement age, instead of using the monthly labour market outcomes. Therefore, we need to apply a different estimation strategy: instead of using the cohort and age-specific variation in deductions we exploit the cohort-specific variation in the

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[2]Several studies use this specific pension reform as additional variation in the context of option-value models (e.g. Hanel, 2010). The identification of these models still partly relies on cross-sectional variation and requires structural assumptions. Moreover, some studies used option-value models to evaluate this reform ex ante, e.g. Siddiqui (1997); Börsch-Supan (2000); Berkel and Börsch-Supan (2004).

deductions women face at the age of 60, i.e. the maximum deductions. In order to capture additional cohort-specific variation we follow Mastrobuoni (2009) and control for observed cohort-specific trends.

Our approach follows several studies that rely on exogenous cohort-specific variation in pension reforms to estimate the labour market effects of pension reforms. For example, Mastrobuoni (2009) focuses on the increase of the NRA in the US to estimate the causal effect on retirement age. Since the reform was introduced in different steps it affected adjacent cohorts differently. Similarly, Staubli and Zweimüller (2013) use cohort-specific variation in the implementation of an increase in the pension eligibility age in Austria to estimate the employment and fiscal effects of this reform. They find a modest increase in employment and a substantial increase in registered unemployment for both men and women. They do not find large effects on disability take-up. Manoli and Weber (2016) analyse the same reform and show that employment effects are mainly explained by individuals who keep their pre-retirement jobs longer. Atalay and Barrett (2015) analyse a reform in Australia that gradually increased the pension eligibility age for women from 60 to 65. Since the Australian pension system follows a non-contributory scheme they are able to identify the effect of the reduction in social security wealth on employment behaviour. Hanel (2012) analyse a Swiss reform that increased the NRA for women. They find relatively large effects on employment comparable to the findings in Mastrobuoni (2009) for the US (for the Swiss reform, see also Lalive and Staubli (2015)). Our paper is also related to another strand of literature that focuses on programme substitution effects, e.g. between unemployment insurance, disability and retirement if the attractiveness of one of these programmes changes in comparison to the other programmes (e.g. Duggan *et al.*, 2007; Karlström *et al.*, 2008; Li and Maestas, 2008; Coe and Haverstick, 2010; Staubli, 2011; Borghans *et al.*, 2014).

The empirical results provide evidence for sizable labour market effects. In particular, for women older than 60 years who are directly affected by the pension reform we find that an increase in the deductions by one percentage point reduces the average retirement rate by about 1.8 percentage points, increases employment by about 1 percentage point and leads to substitution effects into unemployment of about 0.8 percentage points. Furthermore, the results document that anticipation effects are important. First, we show that the anticipation effect reinforces the direct effect on retirement and employment; we find that due to the pension reform employment prior to the age of 60 years increases whereas during the same period retirement is reduced. Moreover, when including in addition women younger than 60 the substitution effects into unemployment show an interesting pattern. We find that prior to the age of 60 unemployment is reduced whereas

after the age of 60 unemployment increases. Thus, over the full period between the ages 55 and 65 the effect of the pension reform is close to zero. Hence, our results suggest that the pension reform induces a shifting in unemployment periods before retirement rather than a stronger substitution into unemployment. This shifting is consistent with previous empirical evidence that unemployment is often used as a bridge into retirement. Finally, our analysis documents interesting effect heterogeneity. The size of the reform effects differ by East and West Germany, by the previous employment history and by the presence of children.

The paper is structured as follows. In Section 2 we describe the institutional background and the pension reform of 1992. We present the data and provide descriptive statistics in Section 3. The empirical models are presented in Section 4. Section 5 provides estimation results. Section 6 concludes.

2. Institutional Background

In this section we provide a brief overview of the German pension system and discuss in detail how the 1992 pension reform affected the different cohorts over time. Moreover we provide evidence how the pension system interacts with other social security programmes and highlight potential substitution patterns between the different programmes.

2.1. Germany's pension system

The statutory public pension system covers all private and public sector employees. It provides old-age pensions, disability pensions and survivors benefits. Depending on the length of the insurance record and other qualifying conditions the pensionable age is between 60 and 65 for the cohorts under study (1938–1944).[3] In addition, people who are not able to work due to severe health conditions can retire before the age of 60 (disability pension).[4] In Appendix A we provide a detailed overview of the different pathways to retirement and discuss the eligibility rules.

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[3]This is different for later birth cohorts. In 1999 the pension for women was abolished for cohorts born after 1951 (see Geyer and Welteke, 2016, for an analysis of that reform). Since 2012 the statutory retirement age has gradually increased from 65 to 67 due to a reform in 2007.

[4]Note that the German pension system provides two different types of pensions due to impaired health. The disability pension ("Erwerbsminderungsrente") is similar to disability benefits in the US. Eligibility for full benefits requires that an individual is unable to work more than 3 hours a day for at least six months. Eligibility for partial disability benefits require that the individual is unable to work more than 6 hours a day. Eligibility requires 5 years of contributions. It is the only pension available before the age of 60. In addition, there exists a second type of old-age pension which is available from age 60 for people with severe disability status under German law. We refer to this

In this paper we focus on the most important pathway to retirement for women, namely the women's pension. This pension allows women to retire at the age of 60. Eligibility for this pension requires 15 years of contributions of which at least 10 years have to be earned after the age of 40. According to the data about 60% of all women with an insurance record were eligible for that programm, (see Table 2). Women with a shorter employment history could enter retirement only at the age of 65 or via other pathways to retirement, e.g. via disability pension. In general, women not eligible for the women's pension at the age of 60 can be classified as non-employed and are not part of the labour force.

2.2. Pension benefits before and after the 1992 pension reform

The calculation of pension benefits is based on a point system and takes into account the whole earnings history and insurance record of an individual. A year's contribution at the average earnings of contributors earns one pension point. Moreover, pension points can be acquired during other insurance periods (e.g. unemployment, child raising and during the provision of informal care). Until the 1992 reform, the old-age pension benefit was the product of the sum of pension points at retirement and the money value of a pension point (pension-point value). Accordingly, the old-age pension in year t was calculated as:

$$\text{Pension}_t^{pre92} = \sum_{a=age}^{\text{ret. age}} \text{pension point}_a \times \text{pension-point value}_t \tag{1}$$

The pension-point value is indexed to average earnings and is adjusted annually. If an individual was eligible for early retirement e.g. through the women's pension, she could claim full pension benefits before the statutory retirement age of 65 without actuarial deductions for early retirement.

The 1992 reform reduced incentives for early retirement through the women's pension by introducing actuarial deductions. The pension eligibility age remained at age 60, as did the statutory retirement age of 65. However the NRA, the age at which a full pension without deductions is available, gradually shifted from age 60 to 65, depending on the month and year of birth of the individual. Deductions for the pension for women started with the cohort born in January 1940 and were fully phased-in for women born in December 1944 and later. The pension formula was supplemented by an access factor

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pension type as "disability pension II". Severe disability status requires a degree of disability of 50% or more and does not require work incapacity.

D that reduces the pension benefit by 0.3% per month if a person retires before reaching the NRA (Equation 2).[5]

$$\text{Pension}_t^{post92} = \sum_{a=age}^{\text{ret. age}} \text{pension point}_a \times \text{pension-point value}_t \times (1 - D_{c,\text{ret. age}}) \quad (2)$$

D depends on the month of birth c and the retirement age. As explained above, the NRA (pension for women) varies across cohorts born between 1940 and 1944. For example, if a woman born in November 1941 retired at the age of 61 in November 2002, D equals 0.033 and her pension would be permanently reduced by 3.3%. If she retired six month earlier, D would be 0.051. For a women born one month later in December 1941 the deductions at age 61 equal 3.6%, retiring six months earlier results in a deduction of 5.4%. The maximum deduction (retiring at age 60) reaches 18% for women born in December 1944 and all following cohorts. Deductions are reduced when entering retirement after the age of 60 and the NRA, when $D = 0$, is at the age of 65. As an example, we show this variation for selected retirement ages and different months of birth in Table 1. This is the variation we exploit in the empirical analysis.

Table 1: Example of variation in deductions by retirement age and cohort

Ret. age	Born in November...						Born in December...					
	1939	1940	1941	1942	1943	1944	1939	1940	1941	1942	1943	1944
60	0	3.3	6.9	10.5	14.1	17.7	0	3.6	7.2	10.8	14.4	18
60 + 6 mon	0	1.5	5.1	8.7	12.3	15.9	0	1.8	5.4	9	12.6	16.2
61	0	0	3.3	6.9	10.5	14.1	0	0	3.6	7.2	10.8	14.4
62	0	0	0	3.3	6.9	10.5	0	0	0	3.6	7.2	10.8
63	0	0	0	0	3.3	6.9	0	0	0	0	3.6	7.2
64	0	0	0	0	0	3.3	0	0	0	0	0	3.6
65	0	0	0	0	0	0	0	0	0	0	0	0

Note: The table shows the variation in D from Equation 2 (multiplied by 100) by retirement age, year of birth and month of birth. For example, if a woman was born in November 1941 and retires with 60, her pension is permanently reduced by 6.9%. If she was born in December, the deduction would be at 7.2%.

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[5] D equals -0.005 for each month retiring after the SRA of 65 (i.e. a bonus of 6% per year). However, retiring after age 65 is very uncommon in Germany.

2.3. Disability pensions and Unemployment benefits

Previous literature provides convincing evidence that due to pension reforms other benefit programmes, in particular unemployment insurance and disability pensions, become more attractive and therefore individuals enter these other programmes instead of retirement. In the following, we briefly describe the design of unemployment and disability benefits in Germany and discuss the potential for substitution effects.

Unemployment benefits Unemployment benefits in Germany replace about 60% of previous net earnings and increase pension entitlements.[6] Eligibility and entitlement period depend on the age and the previous working history. The maximum entitlement period for unemployment benefits changed during our observation period. In more detail, the maximum entitlement period for individuals above the age of 57 was up to 32 months until January 2006. Between February 2006 and December 2007 it was reduced to 18 months and again increased in 2008 to 24 months. In the empirical specification we control for these reforms by including the age and time-specific maximum entitlement period. In general there exists a strong interdependence between unemployment benefits and pensions for older individuals. As documented in Grogger and Wunsch (2012) a large share of older individuals uses unemployment benefits as a bridge into retirement. In particular there is clear evidence that unemployed individuals exhaust their full entitlement period for unemployment benefits before entering retirement. The design of the institution provides strong incentives for this behaviour; unemployment benefits are relatively generous, periods in unemployment increase pension entitlements and finally search requirements for unemployed persons close to retirement are very low. Therefore an increase in the NRA is likely to affect the take-up of unemployment benefits. In particular, individuals have an increased incentive to postpone entry into unemployment to smooth the transition into retirement at the NRA without actuarial deductions.

Disability pension Disability pension is the only pathway to retirement before the age of 60. Therefore, when we discuss retirement effects before the age of 60 in the following analysis we always refer to the effects on disability pensions. A pension reform changed the disability pension scheme in 2001. The cohorts born between 1938 and 1944 were mainly affected by the earlier regime. Before 2001 eligibility for disability benefits depended on one of two earnings tests. Full benefits were granted if the individual had a general and significant limitation in the ability to work. That is, full benefits required an

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[6]People receiving unemployment benefits acquire pension entitlements as if they earned 80% of their previous gross earnings.

earnings capacity of 15% or less of average gross earnings (Erwerbsunfähigkeitsrente). In addition a second scheme provided partial disability benefits (66% of full benefits) related to the individual occupation. This less strict earnings test was passed if the worker did not find a job matching his specific job profile and faced a substantial reduction in earnings (at least 50%) when changing to a different job (Berufsunfähigkeitsrente).[7]

The disability pension scheme was reformed in 2001. The occupation-related scheme was abolished and the earnings criterion was replaced by two working hours thresholds. Eligibility requires the long-term (at least six months) inability to perform an activity under normal labour market conditions for at least six hours (partial disability pension) or at least three hours (full disability pension) per day (Erwerbsminderungsrente). In both schemes the pension is calculated according to the previous insurance biography. It amounts to a pension that would be paid if the individual continued to work until the age of 60 (55 in the old regime). When reaching the SRA the disability pension is converted into an old-age pension usually of the same level. In the empirical analysis we control for the 2001 reform.

In Germany, health-related eligibility criteria for disability pensions are relatively strict in particular after the 2001 reform. About 50% of all applications are defeated. Therefore, using disability pensions as a pathway to regular old-age pensions is difficult and often not an attractive option. Moreover, since 2001 actuarial deductions apply to this type of pension as well. The reference age for deductions is 63 and deductions amount to a maximum of 10.8%. Nearly 100% of these pensions are reduced by maximum deductions since most people claim this pension before age 60 (Deutsche Rentenversicherung, 2015, p.83).

Thus overall, disability pensions became less attractive after 2001. However, the average share of women entering retirement through disability remained relatively constant at about 15% across cohorts (Table 12).

3. Data and Descriptive Evidence

3.1. Public pension insurance accounts

We use high-quality administrative data from the German pension insurance. The scientific use file is a 5% random sample of all German citizens with a statutory pension insurance account between the ages of 30 and 67 (*Versicherungskontenstichprobe*, SUFVSKT). The data are available since 2002 (though wave 2003 is missing). The data

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[7]For more details, see Börsch-Supan and Wilke (2004).

include mainly characteristics which are relevant for the pension insurance: we obtain detailed information about the individual employment history including employment status and accumulated pension contributions, i.e. pension points. Moreover the data include information on the number and age of children and regional information.[8]

3.2. Sample

Our analysis focuses on women born between 1938 and 1944 for which we observe the whole employment history including the date of retirement. We exclude women with special pension schemes who were not affected by the pension reform (miners, civil servants and self-employed), women with pensions according to the Foreign Pension Law (*Fremdrentengesetz*), and women with partial pensions. Overall, our population covers 81% of all women born in the cohorts of interest. For more details about the sample and the number of observations, see Appendix B.

As explained in Section 2.1, not all women were eligible for the pension for women. The data allow to identify eligibility for this pension type: women have to be at least 60 years old, fulfill a 15-year waiting period, and have to have accumulated more than 120 months of compulsory contributions after their 40th birthday. In the main text we focus our analysis only on women that fulfill the two latter criteria. In addition we present the results of the main specifications for the full sample including women who are not eligible in Appendix C.

3.3. Descriptive Statistics

Before we turn to the multivariate analysis we provide descriptive statistics on the women born in different cohorts. In Table 2 we present information about employment behaviour at different points over the life cycle and about the key explanatory variables. The statistics are only calculated for women eligible for the women's pension. In the last column we present the cohort-specific share of women who qualify for that pension; overall the share remains constant across the different cohorts.

In the first two columns of Table 2 we describe the key demographic variables for our analysis and show how these differ between cohorts. The number of children slightly decreases over the cohorts; at the same time the share of women born in West Germany increases. In the regressions we will account for these cohort-specific differences. Furthermore, we show in column 3 that the number of pension points accumulated over the

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[8]A detailed description of the data can be found in Stegmann *et al.* (2005) and Himmelreicher and Stegmann (2008). Panel mortality is negligible (Fachinger and Himmelreicher, 2006).

Table 2: Descriptive statistics

Cohort	Children	West	Pension points	Employed at 45	Retirement Entry at 60	Retirement Entry at 65	Share of eligible women
1938	2.11	0.76	23.2	0.87	0.63	0.04	0.59
1939	1.99	0.76	23.9	0.84	0.62	0.05	0.60
1940	1.99	0.81	24.5	0.84	0.41	0.05	0.61
1941	1.95	0.78	25.1	0.84	0.34	0.05	0.60
1942	1.89	0.78	25.8	0.86	0.33	0.05	0.61
1943	1.88	0.78	25.5	0.84	0.33	0.07	0.62
1944	1.90	0.80	25.2	0.87	0.33	0.11	0.61

Notes: The last column denotes the share of women eligible for the women's pension. The two columns "retired at 60" and "retired at 65" denote the share of women who enter retirement at that age. The column "employed at 45" shows the employment rate at age 45.
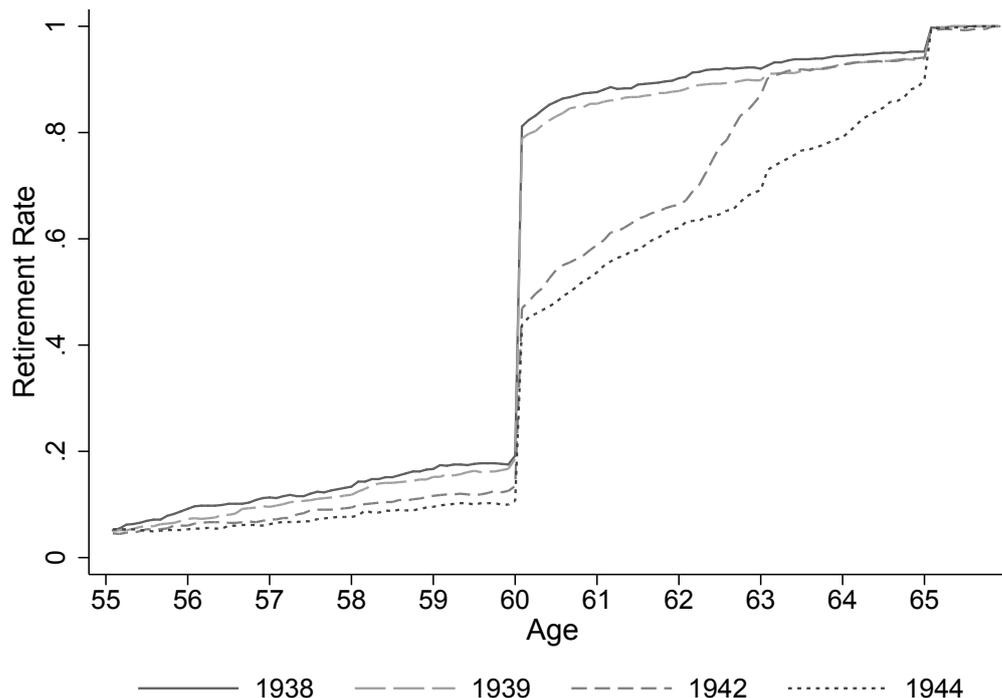
Source: FDZ-RV – SUFVSKT 2004-2012, own calculations

working life is increasing over the cohorts. In the analysis we use the information about the pension points to distinguish women with high and low labour market attachments. This allows us to gain important insights about potential effect heterogeneity of the pension reform. Note that this variable is partly endogenous as it also depends on the retirement entry and the employment prior to retirement. However, as the main fraction of the working life is not affected by the pension reform, the inclusion of this variable does not change the estimation results of the central variables.

In the second part of Table 2 we present several labour market outcomes. First, we show that the employment rates in the middle of the working life, i.e. at age 45, are very similar at about 85% across cohorts. This suggests that for the adjacent cohorts there is no trend or cohort-specific effect on employment. In contrast, the retirement entry rates at age 60 and 65 differ markedly between the cohorts, and these differences are consistent with the incentives of the pension reform. Several points are remarkable: First, the share of women entering retirement at age 60 amounts to 60% for the pre-reform cohorts which could enter retirement at this age without deductions. This share drops markedly for the cohorts born after 1939. Second, despite of deductions a remarkable share of women affected by the reform still enters retirement at the age of 60 (e.g. 33% of women born in 1944). Finally, the fraction of women entering retirement at the age of 65 remains fairly low. It increases only slightly for the later cohorts for which the NRA gets closer to 65.

In order to get further information about the labour market effects of the pension reform we focus on the central labour market outcomes for relevant cohorts and ages. In more detail, we present the outcomes for the cohorts 1938 and 1939, i.e. cohorts not affected by the reform, for cohort 1942 for which the reform has been partly implemented and for cohort 1944 which is nearly fully affected by the reform.[9]

Figure 1: Retirement rates by age and cohort

Notes: The figure shows the share of retired women by age (monthly data) who are eligible for the pension for women.
Source: FDZ-RV – SUFVSKT2004-2012, own calculations

Figure 1 shows remarkably similar age-specific retirement patterns of the two pre-reform cohorts which face the same pension rules. For women born in 1938 or 1939 retirement rates increase at age 60 by about 60 percentage points whereas retirement rates increase by only about 30 percentage points for the younger cohorts. Second, in line with the incentives induced by the pension reform, retirement rates after the age of 60 increase faster for women born in 1942 than for women born in 1944: we observe a

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[9]Note, in the econometric specification we stratify by the month of birth to make use of all cohorts between January 1939 and December 1944.

steep increase between age 62 and 63 for cohort 1942, i.e. the age at which women born in 1942 reach their cohort-specific NRA. Women born in 1944 enter retirement later: more than 10% of the women only retires at the age of 65. Third, before the age of 60 retirement rates are relatively low for all cohorts. As discussed above, retirement before the age of 60 is only possible through disability pensions. The rates are slightly lower for the cohorts affected by the reform which might be related to anticipation effects.

Figure 2: Employment rates by age and cohort

Notes: The figure shows the share of employed women by age (monthly data) who are eligible for the pension for women.
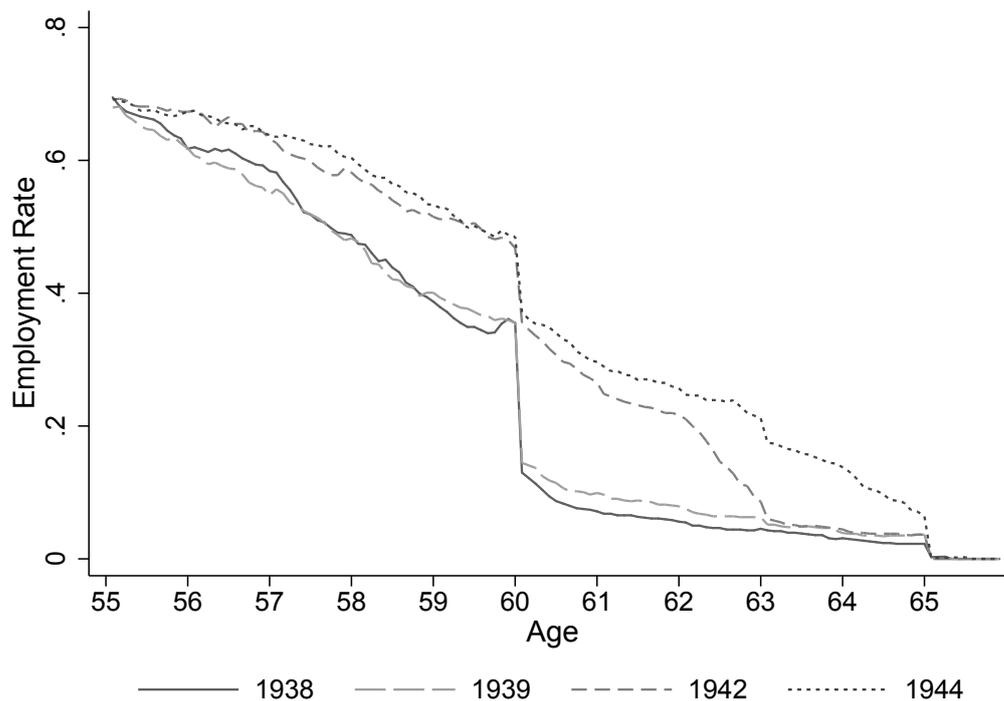*Source*: FDZ-RV – SUFVSKT2004-2012, own calculations

Turning to the age-specific employment rates (Figure 2) we find a similar development, yet with one important exception. The pattern of the employment rates for cohorts 1938 and 1939 are again remarkably similar. Most important, there exists a sizable drop in the employment rate at the age of 60 for the two pre-reform cohorts. The pattern is different for the cohorts affected by the pension reform. Consistent with the incentives induced by the deductions, the drop at the age of 60 is smaller and the employment rates remain higher beyond the age of 60 for the cohort 1944 even until the age of 65.

However, in contrast to the retirement rates we find sizable differences between the pre- and post-reform cohorts already before the age of 60. In more detail, at the age of 55 we observe similar employment rates across all cohorts. However, after the age of 55 employment rates for women born in 1938 and 1939 decrease much faster than for women born in 1942 or 1944. At age 55 employment rates are about 70% for all cohorts, yet at age 57 it has decreased by about 15 percentage points for women born in 1938 and 1939 and by about 5 percentage points for the other two cohorts. Just before the age of 60 the employment rate of the pre-reform cohorts amounts only to 33% while the two younger cohorts have an employment rate of about 50%. The large differences in the employment rates for the pre- and post-reform cohorts before the age of 60 are consistent with sizable anticipation effects of the pension reform which have been documented for similar pension reforms in several studies (e.g. Staubli and Zweimüller (2013)).

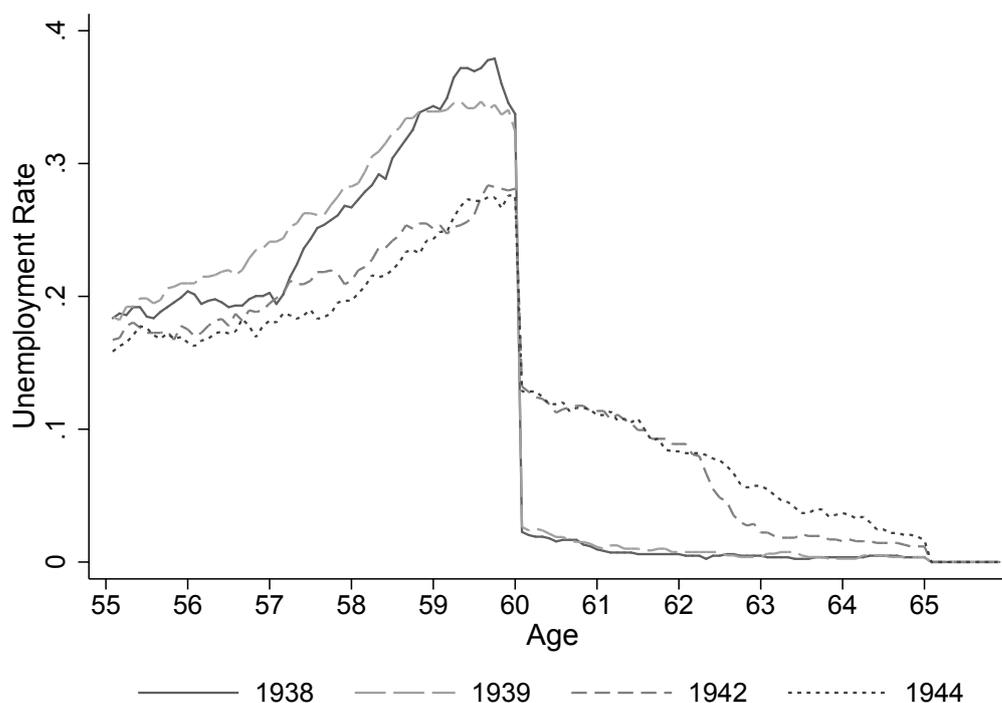Figure 3: Unemployment rates by age and cohort

Notes: The figure shows the share of unemployed women by age (monthly data) who are eligible for the pension for women.
Source: FDZ-RV – SUFVSKT2004-2012, own calculations

The cohort-specific pattern of the unemployment rates (Figure 3) again suggest sizable

anticipation effects. For all cohorts, unemployment rates strongly increase before the age of 60, but the increase is much lower for cohorts affected by the reform. After age 60, however, the unemployment rate of cohorts 1938 and 1939 drops almost to zero while it remains high for the other two cohorts. As discussed in Section 2.3, unemployment is often used as a bridge into retirement, i.e. individuals exhaust their entitlement period for unemployment benefits before entering retirement. For women of cohorts 1938 and 1939 this effect is particularly strong between the ages of 55 and 60. For younger cohorts a transition from unemployment into retirement is less attractive at the age of 60 as they face deductions for early retirement. Thus the observed shift of the unemployment rate of younger cohorts is consistent with an anticipation of the financial incentives induced by the pension reform.

In summary, the descriptive statistics provide several pieces of evidence which are crucial for the following analysis. First, we show that the age-specific retirement, employment and unemployment rates for the cohorts that where not affected by the reform are very similar. This is supportive evidence for the identifying assumption of the empirical model. As discussed below, we need to assume that in the absence of cohort-specific changes in pension rules, the cohort-specific retirement behaviour does not differ across cohorts. Second, we find strong differences for the cohorts affected by the reform in comparison to the pre-reform cohorts which are consistent with the incentives induced by the pension reform. Finally, we provide evidence for sizable anticipation effects in employment and unemployment and to a lesser extend in retirement.

In the following multivariate analysis we exploit the described variation to estimate the causal labour market effects of the pension reform and to quantify the impact of financial incentives on employment, unemployment and retirement.

4. Empirical Analysis

In order to identify the causal effect of the pension reform on labour market outcomes we propose two different estimation approaches. First we concentrate on the direct effects of the pension reform and estimate the effect of the introduction of the deductions on retirement, employment and unemployment for women who have reached the pension eligibility age of 60. In the second approach we focus on the effect of the pension reform on the retirement age, the exit age of employment and different measures of durations in employment, retirement and unemployment between the ages of 55 and 65. The second approach allows to study the overall effect of the reform including both the direct effects and the anticipation effects. Crucially, both empirical strategies exploit the cohort-

specific pattern of the deductions described above to estimate the causal effects of the reform. In the following, we present the two approaches and discuss the identifying variation.

4.1. Direct effects on labour market outcomes

For the identification of the direct employment effects we exploit the cohort-specific introduction of the pension reform and construct a variable D_{it} which captures the deductions for early retirement at a given age. We then estimate the effect of the deduction variable on different labour market outcomes. As presented in Table 1, deductions vary across women by month of birth and by age. This allows controlling for age and cohort fixed effects when estimating the direct effect of deductions on labour market behaviour.

We propose the following equation:

$$y_{it} = \alpha + \theta_{it} + \lambda_c + \gamma D_{it} + \beta_x X_{it} + \epsilon_{it} \qquad (3)$$

where y_{it} is an indicator variable for different labour market outcomes, namely retirement, employment and unemployment. D_{it} is the variable of central interest which measures the deductions for early retirement. Furthermore, we include age fixed effects (θ_{it}), cohort fixed effects (λ_c) and individual variables including the number of children, region, changes in the legislation for disability pensions and in the entitlement rules for unemployment insurance (X_{it}).

4.2. Overall effects on labour market outcomes

Deductions directly affect the financial incentives to retire for women older than 60 when they have reached the pension eligibility age. By definition there are no deductions D_{it} for women before reaching age 60. However, as we discussed above and presented in Section 3, the reform might induce anticipation effects at earlier ages. In order to capture these anticipation effects we propose a specification similar to Mastrobuoni (2009) and estimate the effect of the reform on the retirement age, the exit age of employment and different measures of durations in employment, retirement and unemployment between the ages of 55 and 65. For the construction of these outcomes we use completed individual labour market histories at the age of 65, i.e. when women have reached the statutory retirement age, instead of using the monthly labour market outcomes as in Equation (3). Therefore, we need to apply a different estimation strategy than for the direct reform effects. Instead of using the cohort and age-specific variation in deductions we exploit

the cohort-specific variation in the deductions at the age of 60, i.e. the maximum deductions. In order to capture additional cohort-specific variation we control for additional individual characteristics and observed cohort-specific trends. In more detail, we add the age at first childbirth and employment status at age 45. Moreover, we impute the cohort-specifitc share of married women at age 60 using surveydata from the German Socio-Economic Panel (SOEP),[10]

We propose the following specification:

$$y_i = \alpha + \gamma MaxD_i + \beta_x X_i + \epsilon_i. \tag{4}$$

where y_i captures different individual labour market outcomes measured at the end of the working life. $MaxD_i$ is the variable of interest which measures the maximum deductions women face at the age of 60.[11] In addition we control for individual and cohort-specific variables including information about cohort-specific trends in household formation and employment status at age 45 (X_i).

5. Results

In the following we discuss the estimation results. We first focus on the direct labour market effects and discuss potential heterogenous effects. Then we discuss the results for the outcome variables which include both the direct effects and the anticipation effects (overall effects). Again we discuss the average effect for the population and present heterogenous effects.

5.1. Direct financial effects on labour market outcomes

In Table 3 we present the estimation results for the direct effects of the pension reform. We consider the effects of the deductions on retirement, employment and unemployment. All outcomes are measured in percent. The variable of interest is the deduction variable which measures the relative deductions of the pension benefits as defined in Table 1. For all outcomes we focus on three specifications in which we all control for age-specific effects. In the first specification (columns I, IV and VII) we only include the deduction variable, in the second specification (columns II, V and VIII), we add individual-specific variables such as region, accumulated pension points (which are a function of the full employment and earnings history), and number of children, as well

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[10]SOEP is a representative panel study of households and individuals. To obtain detailed information about SOEP, see Wagner *et al.* (2007).

[11]The first row of Table 1 shows how the maximum deductions vary between cohorts.

as time-varying variables which capture age and time-specific changes of the entitlement period for unemployment benefits and changes of rules for disability benefits. Finally, in the last specification (columns III, VI and IX) we additionally include cohort fixed effects which capture remaining differences between cohorts. In all specifications we include women eligible for the women's pension aged between 55 and 65. This results in close to 700,000 person-months observations. Note that women younger then 60 do not contribute to the identification of the coefficient of the deduction variable but provide identifying variation for the individual-specific effects and the cohort effects. In Appendix C (Table 15) we present results for the estimation with the full sample including women who are not eligible for this pathway.

Table 3: Regression results: Direct effects on labour market behaviour

	Retirement			Employment			Unemployment		
	I	II	III	IV	V	VI	VII	VIII	IX
Penalty in %	-2.341**	-1.876**	-1.858**	1.685**	1.167**	1.004**	0.582**	0.658**	0.873**
	(0.124)	(0.112)	(0.106)	(0.117)	(0.092)	(0.091)	(0.064)	(0.070)	(0.090)
West Germany		-0.102**	-0.101**		0.196**	0.195**		-0.111**	-0.112**
		(0.006)	(0.006)		(0.007)	(0.008)		(0.006)	(0.006)
Children		-0.008**	-0.008**		0.005	0.005		-0.003†	-0.003†
		(0.002)	(0.002)		(0.003)	(0.003)		(0.002)	(0.002)
Pension points		-0.000	-0.000		0.004**	0.004**		-0.001**	-0.001**
		(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.000)
Observations	669,840	669,840	669,840	669,840	669,840	669,840	669,840	669,840	669,840
Cohort Effects	No	No	Yes	No	No	Yes	No	No	Yes
X Variables	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Pre-reform mean	0.501			0.292			0.137		

Notes: In addition to the reported variables we control in Specifications II, III, V, VI, VIII, IX, for changes in the legislation for disability pensions and in the entitlement rules for unemployment insurance. Standard errors in parentheses; Significance levels: † p <0.10, ∗ p <0.05, ∗∗ p <0.01. The mean is calculated for pre-reform cohorts 1938 and 1939. The estimated model is described in Section 4.1.
Source: FDZ-RV – SUFVSKT 2004-2012, own calculations

First, we discuss the effects on retirement. In the basic specification (I) without additional variables we find that an increase in deductions by 1 percentage point reduces the average retirement rate of about 50% by more than 2 percentage points. This effect is smaller when adding time-varying or individual-specific variables. In the augmented specification for retirement (III) we add cohort-specific fixed effects. This specification implies that an increase in deductions by 1 percentage point reduces the average retirement rate by about 1.9 percentage points. It is important to note that the cohort-specific fixed effects do not affect the estimation results, i.e. the results with and without co-

hort effects do not differ significantly. This supports the results from the descriptive analysis that absent of the cohort-specific variation in the pension rules and conditional on individual characteristics the retirement behaviour of the adjacent cohorts does not differ. The effects of the individual-specific variables suggest that West German women aged 55 to 65 have lower retirement rates than East German women (about 10%). We find that one additional child reduces the retirement rate by about 8%. The effect of accumulated pension points is not significant. Both the regional difference and the effect of children can be explained by the longer working history of East German women and women with no or fewer children. Due to the longer working history they can afford to enter retirement earlier.

The effects of financial incentives on employment (columns IV to VI) are smaller than the effects on retirement. In particular, the augmented specification including cohort effects (VI) shows that an increase in deductions by 1 percentage point increases the average employment rate of about 30% by slightly more than 1 percentage point. Again we find that including individual-specific variables (V) reduces the effect of the specification without control variables (IV), but that adding the cohort fixed effects does not significantly change the results. Furthermore, we find that West German women have a significantly higher employment rate than East German women, that children have no significant effect and that pension points are positively correlated with employment rates. The latter effect is consistent with higher pension points indicating a strong labour market attachment.

The difference between the changes in employment and retirement can be explained by the effects of deductions on unemployment (columns VII to IX). In the augmented specification we find that an increase in deductions by 1 percentage point increases the average unemployment rate of about 14% by 0.9 percentage points (IX). The point estimate does not change much without cohort fixed effects and individual-specific variables. Again we find different effects for women in East and West Germany, and by accumulated pension points.

In the following, we further investigate the role of the individual-specific variables and focus on the heterogenous effects of the financial incentives for different subgroups.

5.2. Heterogenous effects

In order to study the heterogeneous effects we split the sample and separately estimate Equation 3 for women in West and East Germany, for women with accumulated pension points below and above the median, and for women without and with children. In Table 4 we only present the estimates of the deduction variable which we obtain from

the most general specification including cohort fixed effects.

We find sizable effect heterogeneity. In more detail, West German women respond to deductions by sizable changes in retirement and employment whereas for East German women we find a strong and significant substitution effect into unemployment but no effect on employment. These differences can be explained by the longer labour market history of East German women. The different effects for women with above (High) or below median pension points (Low) are certainly related to the different working histories but also to different labour market attachments. These two reasons explain why women with above median pension points respond more strongly to all labour market outcomes. For women with and without children, the effects differ in particular with respect to employment and unemployment. We find no significant effect on employment but a strong substitution effect for women without children. The reverse is true for women with children. Again, this can be explained by different employment biografies.

Table 4: Heterogeneity of the direct effect of deductions on labour market behaviour

All	West	East	High	Low	no Children	Children
Retirement						
-1.858**	-1.968**	-1.372**	-2.375**	-1.362**	-1.538**	-1.903**
(0.106)	(0.120)	(0.207)	(0.151)	(0.147)	(0.299)	(0.112)
Employment						
1.004**	1.214**	0.253	1.180**	0.861**	0.395	1.083**
(0.091)	(0.106)	(0.167)	(0.135)	(0.121)	(0.280)	(0.096)
Unemployment						
0.873**	0.820**	0.966**	1.146**	0.594**	1.158**	0.839**
(0.090)	(0.095)	(0.220)	(0.127)	(0.126)	(0.237)	(0.097)
669,840	522,960	146,880	325,920	343,920	71,040	598,800

Notes: High is defined as above median accumulated pension points. Standard errors in parentheses; Significance levels: † p <0.10, ∗ p <0.05, ∗∗ p <0.01. The last row denotes the number of observations.

Source: FDZ-RV – SUFVSKT 2004-2012, own calculations

5.3. Overall effects of the pension reform

The previous empirical analysis of the direct effects provides causal evidence that the introduction of deductions affects retirement and employment behaviour and induces significant substitution effects into unemployment for women above the age of 60. In the following we extend the analysis and study the anticipation effects prior to the age of 60 in addition to the direct effects. As specified in Equation 4 we focus on the effect of maximum deductions on several outcome variables which capture behavioural changes of women between the ages of 55 and 65. In the main text we present the results for the eligible population and again move the results for the full population to Appendix C.

Retirement age and age at employment exit

First, we analyze the effects of deductions on the age at retirement and on the exit age from employment. In Table 5 we present two specifications for each outcome, with and without individual and cohort-specific variables.

Table 5: Overall effects on retirement age and employment exit age

| | Retirement age (in months) | | Employment exit age (in months) | |
	I	II	III	IV
Max Penalty in %	0.998**	0.954**	0.665**	0.529**
	(0.076)	(0.076)	(0.164)	(0.164)
Children		-0.631†		-2.422**
		(0.367)		(0.794)
Pension points		0.206**		1.084**
		(0.042)		(0.091)
West Germany		12.136**		19.961**
		(1.076)		(2.326)
Observations	5,579	5,579	5,579	5,579
Pre-reform mean	59.4		57.4	

Notes: In addition to the reported variables, we control for the employment status at age 45, the cohort-specific share of married women and for the age at first birth (models II, IV and VI). The pre-reform mean denotes the average retirement age or the age at employment exit of cohorts 1938 and 1939 (age in years). Standard errors in parentheses. Significance levels: † p <0.10, ∗ p <0.05, ∗∗ p <0.01

Source: FDZ-RV – SUFVSKT 2004-2012, own calculations

In line with the previous results we find different effects on the retirement age and on the employment exit age. More specifically, according to the estimation an increase in the maximum deductions by 1 percentage point increases the retirement age by about one month. In contrast, the effect on the employment exit age is only half the size (about 0.5 months). These findings are robust to the inclusion of various individual and cohort-specific variables. We omit the discussion of the individual variables; instead we turn directly to the interpretation of the heterogenous effects for the different subgroups.

We find a similar pattern of the heterogenous effects as for the direct effects, although the differences are less pronounced. In particular, differences for East and West Germany are not significant when focussing on the age variables. For both groups the increase in the retirement age is about twice as high as the increase in the exit age from employment. Similarly, we only find modest differences for women with and without children. Only the differences by pension points are striking. For women with a high labour market attachment (above median pension points) there is no difference in the effect on the retirement age and on the exit age from employment. In contrast, for women with a low labour market attachment the retirement age increases but the effect on employment exit age is not significant. This implies that these women do not work longer although they retire later.

Table 6: Heterogeneous effects: Retirement age and age at employment exit

Age at ...	all	west	east	high	low	no kids	kids
retirement	0.954**	0.950**	0.998**	1.155**	0.744**	0.749**	0.998**
	(0.076)	(0.084)	(0.174)	(0.090)	(0.116)	(0.234)	(0.080)
employment exit	0.529**	0.566**	$0.395^{\dagger}$	1.322**	-0.254	0.417	0.498**
	(0.164)	(0.202)	(0.207)	(0.123)	(0.296)	(0.302)	(0.181)

Notes: Standard errors in parentheses; Significance levels: $\dagger$ p <0.10, $*$ p <0.05, $**$ p <0.01.

Source: FDZ-RV – SUFVSKT 2004-2012, own calculations

Duration of retirement, employment and unemployment

In the final set of estimations, we focus on the effect of the maximum deduction on the duration of retirement, employment and unemployment. We study the effect on durations in the different outcomes between the ages of 55 and 60, the ages of 60 and 65 and finally over the full period between the ages of 55 and 65. For the interpretation, we only concentrate on the specifications which include the individual and cohort-specific variables. The key results do not change if all variables except for the maximum deduction variable are excluded.

Table 7: Effect on duration of retirement

	Period: 55-65		Period: 55-60		Period: 60-65	
	I	II	III	IV	V	VI
Max Penalty in %	-0.956**	-0.923**	-0.128**	-0.111**	-0.827**	-0.813**
	(0.058)	(0.057)	(0.035)	(0.035)	(0.041)	(0.040)
Children		-0.002		0.513**		-0.515**
		(0.277)		(0.170)		(0.193)
Pension points		-0.184**		-0.069**		-0.116**
		(0.032)		(0.020)		(0.022)
West Germany		-10.157**		-2.783**		-7.374**
		(0.811)		(0.499)		(0.564)
Observations	5579	5579	5579	5579	5579	5579
Pre-reform mean	61.12		6.97		54.15	

Notes: In addition to the reported variables, we control for the employment status at age 45, the cohort-specific share of married women and for the age at first birth (models II, IV and VI). The pre-reform mean denotes the average number of months in retirement of cohorts 1938 and 1939. Standard errors in parentheses; Significance levels: † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$.
Source: FDZ-RV – SUFVSKT 2004-2012, own calculations

We begin with the results on the duration of retirement (Table 7). Over the full period (between the ages of 55 and 65) we find that an increase in the maximum deduction by one percentage point reduces the duration of retirement by about one month. This overall effect is partly related to an anticipation effect. In more detail, when only focussing on the period before the age of 60 we find a reduction in the retirement duration by 0.12 months. Considering the pre-reform duration of about 7 months (last row of the table) this is a relatively large effect. As mentioned above, before the age of 60 retirement is only possible through disability pensions, thus this result should be interpreted as an effect on disability pensions. Not surprisingly, the direct effect in the period after the age

of 60 is even larger. The estimation suggests that the increase in the deduction reduces the duration of retirement by more than 0.8 months.

Table 8: Effect on duration of employment

| | Period: 55-65 | | Period: 55-60 | | Period: 60-65 | |
	I	II	III	IV	V	VI
Max Penalty in %	0.873**	0.788**	0.291**	0.225**	0.581**	0.562**
	(0.079)	(0.076)	(0.056)	(0.054)	(0.035)	(0.035)
Children		-0.556		-0.585*		0.029
		(0.366)		(0.262)		(0.168)
Pension points		0.605**		0.400**		0.204**
		(0.042)		(0.030)		(0.019)
West Germany		21.724**		15.375**		6.349**
		(1.073)		(0.768)		(0.492)
Observations	5579	5579	5579	5579	5579	5579
Pre-reform mean	35.1		31.1		4.0	

Notes: In addition to the reported variables, we control for the employment status at age 45, the cohort-specific share of married women and for the age at first birth (models II, IV and VI). The pre-reform mean denotes the average number of months in employment of cohorts 1938 and 1939. Standard errors in parentheses; Significance levels: † p <0.10, * p <0.05, ** p <0.01.
Source: FDZ-RV – SUFVSKT 2004-2012, own calculations

In Table 8 we present the results for employment. For the full period we find that an increase in the maximum deduction by one percentage point increases employment by 0.8 months. Turning to the two different sub-periods the results show that the maximum deduction has an effect on both the period before and after the age of 60. In particular the results document a significant anticipation effect: an increase in the maximum deduction by one percent increases employment by 0.23 months between the ages of 55 and 60. The effect is sizable yet clearly smaller than the effect on employment for the ages 60 to 65, in particular relative to the pre-reform mean.

The results of the model estimating the effect on the duration of unemployment in Table 9 underline the importance of the anticipation effect. Interestingly, over the full period the maximum deduction has no significant impact. This is because the duration effects in the different sub-periods cancel out. In more detail, we find a negative effect of an increase on the duration of unemployment for the period 55-60. An increase in maximum deductions by one percentage point reduces the duration of unemployment by about 0.2 months. The opposite is true for period 60-65: For that period an increase in

maximum deductions by one percentage point increases the duration of unemployment by about 0.2 months. These effects are consistent with the incentives induced by the design of the unemployment benefits and the pension system. They show that unemployment is used as a bridge into retirement. At the same time these findings imply that an increase in the deduction for pensions does not lead to an overall increase in unemployment. The documented direct substitution effect (Table 3) for women aged 60 to 65 is thus a pure shifting effect.

Table 9: Effect on duration of unemployment

| | Period: 55-65 | | Period: 55-60 | | Period: 60-65 | |
	I	II	III	IV	V	VI
Max Penalty in %	0.022	0.042	-0.206**	-0.179**	0.228**	0.221**
	(0.050)	(0.049)	(0.045)	(0.044)	(0.017)	(0.017)
Children		-0.250		-0.252		0.002
		(0.238)		(0.214)		(0.084)
Pension points		-0.061*		-0.061*		0.000
		(0.027)		(0.025)		(0.010)
West Germany		-13.398**		-13.229**		-0.169
		(0.698)		(0.628)		(0.247)
Observations	5,579	5,579	5,579	5,579	5,579	5,579
Pre-reform mean	16.49		15.68		0.80	

Notes: In addition to the reported variables, we control for the employment status at age 45, the cohort-specific share of married women and for the age at first birth (models II, IV and VI). The pre-reform mean denotes the average number of months in unemployment of cohorts 1938 and 1939. Standard errors in parentheses; Significance levels: † $p < 0.10$, $* p < 0.05$, $** p < 0.01$.
Source: FDZ-RV – SUFVSKT 2004-2012, own calculations

Finally, we present the heterogenous effects for the subgroups (Table 10). In this table we only show the results for the two sub-periods estimated in the specification with individual and cohort-specific controls. The effects for the different subgroups confirm the previous findings although with some differences. We find significant anticipation effects in retirement for most of the subgroups, yet they are of different magnitudes. The anticipation effects are particularly strong for women from East Germany and for women with a high labour market attachment. For the employment duration we find for all subgroups, except for women with below median accumulated pension points, significant effects before and after the age of 60. For women with a low labour market attachment the anticipation effects are not significant. For the duration of unemployment

the effects before and after the age of 60 cancel out for most groups. Exceptions are found for East German women who on average increase unemployment duration and for women with a high labour market attachment who reduce the duration of unemployment.

Table 10: Heterogeneous effects: duration of retirement, employment and unmemploy-ment

| | Retirement | | Employment | | Unemployment | |
Group	55-60	60-65	55-60	60-65	55-60	60-65
All	-0.111**	-0.813**	0.225**	0.562**	-0.179**	0.221**
	(0.035)	(0.040)	(0.054)	(0.035)	(0.044)	(0.017)
West	-0.051	-0.892**	0.188**	0.638**	-0.222**	0.206**
	(0.037)	(0.048)	(0.063)	(0.043)	(0.048)	(0.020)
East	-0.328**	-0.547**	0.362**	0.301**	-0.023	0.280**
	(0.093)	(0.056)	(0.105)	(0.039)	(0.107)	(0.032)
High	-0.146**	-1.022**	0.575**	0.783**	-0.377**	0.251**
	(0.041)	(0.054)	(0.073)	(0.051)	(0.061)	(0.024)
Low	-0.070	-0.605**	-0.121	0.346**	0.016	0.191**
	(0.055)	(0.057)	(0.078)	(0.047)	(0.063)	(0.025)
No kids	-0.009	-0.769**	0.226	0.336**	-0.280*	0.327**
	(0.118)	(0.114)	(0.163)	(0.102)	(0.142)	(0.047)
Kids	-0.125**	-0.834**	0.229**	0.598**	-0.179**	0.207**
	(0.037)	(0.043)	(0.058)	(0.037)	(0.047)	(0.019)

Notes: Standard errors in parentheses; Significance levels: † p <0.10, ∗ p <0.05, ∗∗ p <0.01.
Source: FDZ-RV – SUFVSKT 2004-2012, own calculations

6. Conclusion

This paper provides novel insights about the causal effect of pension reforms on labour market outcomes. We exploit exogenous cohort-specific variation in the introduction of actuarial deductions for early retirement in Germany. In more detail, we focus on the 1992 pension reform which increased the NRA and introduced deductions for early retirement for women born after December 1939. The estimation is based on high-quality administrative data from the German Federal Pension Insurance.

Our empirical analysis shows that the introduction of actuarial deductions for early retirement leads to sizable labour market effects for women. In particular, for women older than 60 years who are directly affected by the pension reform we find that an increase in the deductions by one percentage point reduces the average retirement rate by about 1.8 percentage points. It leads to an increase of the employment rate by about about 1 percentage point and the unemployment rate is increased by about 0.8 percentage points. Furthermore, the analysis documents that anticipation effects are important. That is, employment behaviour is affected before reaching the pension eligibility age. First, we show that the anticipation effect reinforces the direct effects (after age 60) on retirement and employment. We find that due to the pension reform employment prior to the age of 60 increases whereas during the same period retirement is reduced. Second, when including the anticipation effect the substitution effect into unemployment has a noteworthy pattern. We find that prior to the age of 60 unemployment is reduced whereas after the age of 60 unemployment increases. In fact, the overall effect of the pension reform seems to be positive but close to zero. Hence, our results suggest that the pension reform induces a shifting of unemployment spells to higher ages rather than a stronger substitution into unemployment. This shifting is consistent with previous evidence that unemployment is often used as a bridge into retirement but it also shows that the reform did not induce additional substiution effects. Finally, our analysis documents remarkable effect heterogeneity. The size of the effects differ by East and West Germany, by the previous employment history and by the presence of children.

Based on these estimation results we can calculate the overall effects of the pension reform which introduced maximum deductions for the women's pension of 18 percentage points. According to our estimation the introduction of the deduction increased the retirement age by about 15 months (18×0.828) and the exit age of employment by about 9 months. Furthermore, the overall deduction increased the duration of employment between the ages of 55 and 65 by close to 15 months and reduced the period in retirement by about 16 months. Finally, our analysis suggests that the reform did not have a

significant effect on overall unemployment between the ages of 55 and 65, yet it induced a sizable shifting in the age pattern of unemployment. In this respect our results suggest that the introduction of deductions are an efficient policy to increase employment for the elderly.

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A. Pathways to retirement in Germany

The German public pension system provides different types of pensions depending on different prerequisites. In addition to retirement at the statutory retirement age of 65 and the pension for women there exist several other options to retire before the statutory retirement age: for people with a severe disability[12], for people with long service records, and for people who were unemployed or following old-age part-time. In Table 11 the different options and the requirements for eligibility are described.

Table 11: Pathways to pensions for observed cohorts

Pension type	Earliest age	Years of contribution
Regular	65	5
Women	60	15 (10 after age 40)
Disability II	60	35
Long-term insured	63	35
Unemployed/old-age part-time	60	15 (8 in last 10 years)
Disability	before 60	5 (3 in last 5 years)

Note: The pension for women and the pension because of unemployment or old-age part-time were abolished for cohorts born after 1951. The statutory retirement age of 65 has been increased since 2012 and will be 67 in 2029.

In Table 12 we provide information on the importance of the different pathways for women born between 1938 and 1944. The most important pension types for women during our sample period are the regular pension and the pension for women.[13] Table 12 shows the shares of different pension types by cohort for women born between 1938 and 1944. About 77% of all pensions were either regular pensions or pensions for women. If we focus on old-age pensions and abstract from disability pensions, their share amounts even to about 90%.

In addition to the introduction of deductions for the pension of women, actuarial deductions were also introduced for other types of pensions (Table 13). Note that these reforms only partly affect our population of interest, namely women born between 1938

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[12]Note that this old-age pension differs from the disability pension. The old-age pension for severely disabled people is accessible if the disability status is recognized under German law with a degree of disability of at least 50%. See also footnote 4 and Section 2.3 for more information.

[13]For men the picture is different as by definition they are not eligible for the women's pension. In addition to regular retirement, retirement for long term insured and retirement after unemployment are the most frequent pathways.

Table 12: Share of pension types by cohort

Pension type	1938	1939	1940	1941	1942	1943	1944
Regular	37.3	36.6	35.9	35.3	35.7	36.5	38.3
Women	40.1	42.5	41	42.3	41.3	39.9	36.8
Long-term insured	2.3	2	2	2	2.1	2.2	2.3
Disability II	2	2	3.6	4.5	5.2	6	6.7
Unemployed/old-age part-time	2.7	2	2.9	1.1	0.8	0.8	1.3
Disability	15.6	14.9	14.6	14.7	14.9	14.6	14.6

Note: The table shows the shares of the different types of public pensions by cohort. The statistics refer to the full population and are not conditioned on eligibility for the women's pension.

Source: Deutsche Rentenversicherung (2015)

and 1944. The introduction of deductions for pensions for unemployed/old-age part-time starting with cohort 1937 mainly affected men. As shown in Table 12, only two percent of women enter retirement through this pathway and this fraction remains constant between the cohorts. The same is true for the pension for long-term insured. The fraction of women entering retirement through the pathway for individuals with severe disability status is also low, but slightly increases across the cohorts. Since the deductions for this pension are lower than the deductions for women's pensions this increase might be interpreted as a substitution effect. However, even for the 1944 cohort the fraction is with 6% very small and thus this will not drive our results. Finally, the disability pension scheme was changed in 2001 (see Section 2.3). In the empirical analysis we control for this change in the legislation.

B. Sample

In Table 14 we present detailed information about the number of observations which we use for the empirical analysis. In addition to the cohort-specific number of observation, the table shows the fraction of women who are excluded from the analysis and who are not eligible for the women's pension. We exclude women with special pension schemes who were not affected by the reforms (miners, civil servants and self-employed), people with pensions according to the Foreign Pension Law (*Fremdrentengesetz*), and people with partial pensions. For eligibility women need to fulfill a 15-year waiting period, and have to have accumulated more than 120 months of compulsory contributions after their

Table 13: Deductions for early retirement programmes

Pension type	First cohort affected	Fully phased-in with cohort ...	Shift in NRA
Regular	-	-	-
Women	January 1940	December 1944	60 to 65
Severe health conditions	January 1941	December 1943	60 to 63
Unemployed/old-age part-time	January 1937	December 1941	60 to 65
Long-term insured	January 1937	December 1938	63 to 65
Disability pension	Retirement entry after January 2001		

Note: The reference age for deductions for disability pension is 63. Deductions amount to a maximum of 10.8%. Nearly 100% of these pensions are reduced by maximum deductions since most people claim this pension before age 60 (Deutsche Rentenversicherung, 2015, p.83).

40th birthday.

Table 14: Number of observations

Cohorts	total	excluded		all women		eligible women	
	person	person	%	person	person-months	person	person-months
1938	1,782	358	0.20	1,424	176,160	839	100,680
1939	1,665	348	0.21	1,317	164,520	796	95,520
1940	1,680	324	0.19	1,356	171,360	830	99,600
1941	1,739	294	0.17	1,445	180,120	861	103,320
1942	1,527	274	0.18	1,253	159,960	764	91,800
1943	1,475	253	0.17	1,222	155,760	758	91,080
1944	1,443	247	0.17	1,196	149,400	731	87,840
Total	11,311	2,098	0.19	9,213	1,157,280	5,579	669,840

Notes: The first column contains the total number of observations. We drop about 19% of the observations because these women are subject to special pension regulations, e.g. the Foreign Pension Law (Fremdrentengesetz) or were members of the pension for miners (Knappschaft) or have other missing information. The next two columns denote the number of women who remain in the sample. The last two columns show the number of observations of women eligible for the pension for women. The sum of person-months refers to observations between the age of 55 and 65.

Source: FDZ-RV – SUFVSKT 2004-2012, own calculations

C. Full sample

In the following Tables we present the estimation results for the full sample of women including women who are not eligible for the pension reform. As expected we find that the pattern of the reform effects is very similar when including the non-eligible women yet effects are at a lower level. The only exception is a very small positive effect on overall unemployment (Table 19). This positive effect is consistent with a minor substitution effect of into unemployment. However, we still find that the main effect is a shift of unemployment spells to higher ages.

Table 15: Regression results: Direct effects on labour market behaviour (full sample)

| | Retirement | | | Employment | | | Unemployment | | |
	I	II	III	IV	V	VI	VII	VIII	IX
Penalty in %	-1.282** (0.107)	-1.073** (0.079)	-1.033** (0.075)	1.022** (0.077)	0.672** (0.058)	0.555** (0.061)	0.440** (0.044)	0.422** (0.045)	0.515** (0.056)
West Germany		-0.178** (0.007)	-0.178** (0.007)		0.141** (0.007)	0.139** (0.007)		-0.123** (0.006)	-0.124** (0.006)
Children		-0.004* (0.002)	-0.005** (0.002)		0.005** (0.002)	0.005** (0.002)		-0.000 (0.001)	-0.001 (0.001)
Pension points		0.010** (0.000)	0.010** (0.000)		0.010** (0.000)	0.010** (0.000)		0.002** (0.000)	0.002** (0.000)
Obs.	1,157,280	1,157,280	1,157,280	1,157,280	1,157,280	1,157,280	1,157,280	1,157,280	1157280
Cohort effects X	No	No	Yes	No	No	Yes	No	No	Yes
Variables	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Pre-reform mean	0.332			0.180			0.085		

Notes: Standard errors in parentheses; Significance levels: † p <0.10, ∗ p <0.05, ∗∗ p <0.01. The mean is calculated for pre-reform cohorts 1938 and 1939. The estimated model is described in Section 4.1.
Source: FDZ-RV – SUFVSKT 2004-2012, own calculations

Table 16: Overall effects on retirement age and employment exit age (full sample)

	Retirement age (in months)		Employment exit age (in months)	
	I	II	III	IV
Max Penalty in %	0.779**	0.770**	0.533**	0.424**
	(0.094)	(0.092)	(0.130)	(0.127)
Children		-0.347		1.511*
		(0.439)		(0.604)
Pension points		-0.330**		1.504**
		(0.049)		(0.068)
West Germany		18.668**		20.589**
		(1.379)		(1.898)
Observations	6792		6,792	
Pre-reform mean	59.743		56.633	

Notes: We include only women whose employment exit is observed in the data after age 40. In addition to the reported variables, we control for the employment status at age 45, the cohort-specific share of married women and for the age at first birth (models II, IV and VI). The pre-reform mean denotes the average retirement age or the age at employment exit of cohorts 1938 and 1939 (age in years). Standard errors in parentheses. Significance levels: † p <0.10, ∗ p <0.05, ∗∗ p <0.01

Source: FDZ-RV – SUFVSKT 2004-2012, own calculations

Table 17: Effect on duration of retirement (full sample)

| | Period: 55-65 | | Period: 55-60 | | Period: 60-65 | |
	I	II	III	IV	V	VI
Max Penalty in %	-0.512**	-0.579**	-0.074**	-0.074**	-0.437**	-0.504**
	(0.062)	(0.050)	(0.027)	(0.028)	(0.048)	(0.034)
Children		0.185		0.171		0.013
		(0.228)		(0.126)		(0.157)
Pension points		0.532**		0.052**		0.480**
		(0.028)		(0.016)		(0.020)
West Germany		-15.309**		-4.438**		-10.871**
		(0.862)		(0.477)		(0.595)
Observations	9213	9213	9213	9213	9213	9213
Pre-reform mean	41.96		6.15		35.81	

Notes: In addition to the reported variables, we control for the employment status at age 45, the cohort-specific share of married women and for the age at first birth (models II, IV and VI). The pre-reform mean denotes the average number of months in retirement of cohorts 1938 and 1939. Standard errors in parentheses; Significance levels: † p <0.10, ∗ p <0.05, ∗∗ p <0.01.
Source: FDZ-RV – SUFVSKT 2004-2012, own calculations

Table 18: Effect on duration of employment (full sample)

| | Period: 55-65 | | Period: 55-60 | | Period: 60-65 | |
	I	II	III	IV	V	VI
Max Penalty in %	0.597**	0.499**	0.227**	0.147**	0.370**	0.352**
	(0.061)	(0.054)	(0.045)	(0.039)	(0.024)	(0.024)
Children		0.310		0.128		0.182†
		(0.248)		(0.177)		(0.109)
Pension points		0.987**		0.716**		0.271**
		(0.031)		(0.022)		(0.014)
West Germany		19.069**		13.263**		5.807**
		(0.938)		(0.670)		(0.411)
Observations	9,213	9,213	9,213	9,213	9,213	9213
Pre-reform mean	22.40		19.46		2.94	

Notes: In addition to the reported variables, we control for the employment status at age 45, the cohort-specific share of married women and for the age at first birth (models II, IV and VI). The pre-reform mean denotes the average number of months in employment of cohorts 1938 and 1939. Standard errors in parentheses; Significance levels: † p <0.10, ∗ p <0.05, ∗∗ p <0.01.
Source: FDZ-RV – SUFVSKT 2004-2012, own calculations

Table 19: Effect on duration of unemployment (full sample)

	Period: 55-65		Period: 55-60		Period: 60-65	
	I	II	III	IV	V	VI
Max Penalty in %	0.101**	0.087**	-0.086**	-0.093**	0.187**	0.180**
	(0.035)	(0.034)	(0.031)	(0.029)	(0.013)	(0.013)
Children		0.086		-0.009		0.094
		(0.154)		(0.132)		(0.060)
Pension points		0.108**		0.077**		0.031**
		(0.019)		(0.016)		(0.008)
West Germany		-13.376**		-13.105**		-0.271
		(0.583)		(0.501)		(0.229)
Observations	9,213	9,213	9,213	9,213	9,213	9,213
Pre-reform mean	10.53		9.76		0.77	

Notes: In addition to the reported variables, we control for the employment status at age 45, the cohort-specific share of married women and for the age at first birth (models II, IV and VI). The pre-reform mean denotes the average number of months in unemployment of cohorts 1938 and 1939. Standard errors in parentheses; Significance levels: † p <0.10, ∗ p <0.05, ∗∗ p <0.01.
Source: FDZ-RV – SUFVSKT 2004-2012, own calculations