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A Micro-simulation Study

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Abstract

This paper provides a micro-simulation study on the long-run effects of career interruptions in Germany, extending earlier work which generally only focuses on the first few years after an interruption. Using data of the German Socio-Economic Panel, it finds that career interruptions will, for the average individual, have lifelong effects on incomes and labor-force participation. It quantifies these effects for the average affected individual as well as on the entire society and therefore provides additional information on the total cost of career interruptions.

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1 Introduction

While it is well known that career interruptions have a lasting, though diminishing, negative impact on wages after reentry, much less is known about the size and the timing of these costs and on how the length of an interruption influences reentry in the first place. Career interruptions affect the entire future career path, as employment and wages will be heavily influenced by experience in the long run. There are however, to the best of our knowledge, no studies that are quantifying the lifetime cost of career interruptions. This paper intends to fill this gap.

Previous studies either empirically estimate the effects of career interruptions or use micro-simulation to quantify the life-time consequences of policy changes. Spivey (2005), for example, shows that the effects of career interruptions are still detectable long after a reentry. Geyer & Steiner (2014), on the other hand, simulate the effects of pension legislation reforms and variation in employment patterns on the pension income.

We contribute to the literature by combining both strands and hence provide a tool based on German micro-data to quantify the cost of a career interruption, which not only calculates the consequences of an employment break on an individual level, but which is also capable to compute aggregated results for the entire society. In counter-factual simulations, we present the effects of an interruption length reduced by one year and thereby assess the lifetime effect of this employment break. This analysis is also carried out for

subgroups divided by sex and age. Specifically, the simulations suggest that an interruption's long-term consequences are, in spite of (slowly) diminishing effect sizes, substantial: The study shows that as much as 40 percent of the average total interruption cost can occur in the second half of the time period between reentry and retirement underlining the significance of the lifetime perspective.

This lifetime perspective in connection with the possibility to evaluate effect sizes allows us to gather insight not only into the life-time consequences of employment breaks but, directly related, also into its influence on old-age income. Thereby, this study contributes also to the ongoing discussion on poverty among the elderly as well as to that on gender differences in old-age income ("Gender Pension Gap", see, for example, Hänisch & Klos (2014)).

The remainder of this paper is structured as follows: Section 2 discusses the literature both on the career interruptions as well as on simulation studies. In the following chapter, we introduce the model. Specifically, we present the data base, discuss the basic estimation equations, the updating process in the simulation study as well as first results of the baseline model. Section 4 quantifies the lifetime cost of career interruptions by means of counter-factual simulations. Section 5 concludes.

2 Literature

This paper draws from two strands of economic literature - that on simulation of life-time earnings often in the context of pension reforms as well as

on that on the effects of career interruptions. In this section, a brief overview on both is provided:

Since Mincer's influential work on the relations between education, experience and earnings (Mincer (1974)) a vast amount of research on the effect of employment histories on income has been conducted. Interruptions in employment histories are likely to influence individual earnings because of manifold reasons: Mincer & Polachek (1974); Mincer & Ofek (1982) or Light & Ureta (1995), for example, extend Mincers work by taking human capital depreciation due to skill loss as a consequence of reduced experience and not keeping up with new relevant developments into account, which can lead to lower wages at re-entry. On the other hand, it is possible that catch-up effects can counteract the consequences of human capital depreciation (see, for example Licht & Steiner (1992)). Also further results of interruptions are discussed in the literature - it might, for example, be the case that earnings are affected by career interruptions with a significant time lag. Spivey (2005) uses longitudinal data to investigate if there is a difference between past and more recent interruptions regarding the effect on earnings. She finds that although recent interruptions are of importance, past interruptions, even at the beginning of a working life, do still matter, especially for women.

Ejrnaes & Kunze (2013) discuss the effect of first childbirth on women in the West German labour market. They come to the conclusion that women with large wage losses due to childbirth are more likely to return to full-time employment while returns to experience are lower after childbirth in com-

parison to those of women without children. It has to be noted that these findings seem only to apply for Germany. Gupta & Smith (2002) use panel data to investigate the effect of career interruption on women's earnings in Denmark. Contrary to similar studies in the United Kingdom or the United States, they get the result that in Denmark, children do not negatively affect the mother's wage.

Microsimulation models have manifold applications and a long tradition - for example, Orcutt *et al.* (1986) discuss 'Microanalytic Simulation Models' to support social and financial policy. In a more recent contribution, O'Donoghue *et al.* (2009) describe a generalized framework for dynamic microsimulation models that can be used as a guideline for constructing these models. It provides insight in the methodology of dynamic simulation models and how modularization and dynamization can be implemented. Another detailed overview on the methodology of dynamic simulation models can be found in Favreault & Smith (2004) - their 'dynamic simulation of income model' is used to simulate how changes in social security legislation affect future retirement benefits of various socio-demographic groups.

Only a relatively small number of studies employs microsimulation models to predict expected future employment biographies in the context of life cycles and retirement. Leombruni & Richiardi (2006) use an agent-based discrete choice microsimulation model to investigate the effects of an aging society on labour supply in Italy. They find that an expected sharp decline in labour supply due to rapid population aging and low participation rates

can be offset by recent reforms in retirement legislation as well as changes in education and the participation behavior of future retirees. Michaud & Rohwedder (2008) employ a dynamic simulation model to forecast retirement patterns and old-age incomes for early US baby boomers.

Westermeier *et al.* (2012) take a closer look at the German baby boomers and their expected old-age provision. They use older birth cohorts to project employment histories of baby boomers by matching similar biographies. They find that baby boomers are expected to have on average lower pension entitlements than older cohorts. On a broader scope, Geyer & Steiner (2014) examine effects of changes in employment patterns and pension legislation for different age groups. They employ a microsimulation model to project employment and income biographies for future German retirees. They come to the conclusion that younger birth cohorts are more likely to face significantly reduced pension entitlements due to recent reforms and longer unemployment periods. Furthermore, the German Federal Ministry of Labour and Social Affairs regularly conducts the 'Altersvorsorge in Deutschland' report using specifically designed survey data to simulate expected future pension entitlements (for further information see for example Heien *et al.* (2005)).

There are, to the best of our knowledge, no studies that use microsimulation to quantify life cycle effects of career interruptions on pension entitlements. Potrafke (2007) conducts an empirical investigation with some similarities to our research: He discusses how the timing of career interruptions affects pension entitlements by looking back at West Germans retirees

of 2004. He explains that unemployment spells of men are more important in the middle part of an employment history, while women's incomes do not exhibit significant effects of unemployment. However, parental leave in early parts of an employment history showed significant negative effects for women. But by looking at recent retirees, it is not possible to draw conclusions for people that are still in the working part of their life. Additionally, this approach is not feasible to quantify scenarios for different lengths of interruptions. Therefore, a simulation based prediction of future retirees can give further insights on the cost of career interruptions.

3 The Model

The purpose of the simulation model is to quantify the effects of career interruptions on lifetime income. A career interruption is expected not only to have negative effects in the short but also in the long run. This is due to the fact that interruptions will have negative consequences with regard to future incomes and the probability of re-entering the labour market (see Geyer & Steiner (2014)). This paper provides methods to quantify these effects and to distinguish their sizes between groups, especially between men and women.

Using biography data and socio-economic characteristics, we apply binary panel data regression methods to estimate the probability of transitions between employment and unemployment and use those predictions to simulate the future employment biography (see also O'Donoghue *et al.* (2009)). This enables us to project an individual's employment biography until retirement using updated biographical information for each year. Additionally,

we estimate the effects of career interruptions on working hours as well as gross hourly wages which allows us to calculate yearly gross incomes. This approach enables us to determine how employment status and income depend for each predicted year on past employment breaks. Counter-factual scenarios allow us to quantify the life-time cost of career interruptions.

3.1 Model Description

The simulation process consists of four steps: Data preparation, regression, prediction and evaluation: In the first step the necessary information on the length of employment spells, the duration of the last career interruption as well as the time since this interruption are calculated. Based on this data, the effects of career interruptions and other characteristics on employment status, working hours and wages are estimated. These estimated effect sizes are, in a next step, used to predict the future employment biography. This is done by iteratively updating employment status, working hours and wage for each year until retirement. After predicting biographies, lifetime income as well as other relevant measures are calculated. In scenarios the length of a completed or current interruption is changed and the employment biographies are predicted based on these altered initial conditions. To evaluate the effects career interruptions, the outcome of the scenario is compared with the baseline prediction.

In the next sections, the four necessary steps are explained in greater detail:

3.2 Data and Descriptive Results

The model uses data of the German Socio-Economic Panel (SOEP). The SOEP is a representative survey of private households in Germany since the year 1984 with around 30,000 respondents in roughly 11,000 households in 2012. It provides information on a wide range of topics like employment biographies, earnings or socio-demographic characteristics of the household members[1].

The sample is restricted to people over 40 and younger than 65 who have been employed for at least one year. This restriction is made for two reasons: Firstly, it is not within the scope of this paper to estimate the occurrence of career interruptions due to childbirth, which can, at least to a large degree, be avoided by setting an age limit. Secondly, we intend to predict biographies until retirement while keeping the prediction horizon within a relatively short time frame. In the estimations, the SOEP waves from 2003 to 2012 are used, as this provides a reasonably large sample size as well as recent data. The SOEP-members of the 2012-wave form the basis for all predictions.

We use the activity biographies of the SOEP-respondents as the major source of information on employment histories. The activity biographies provides yearly retrospective information on every respondent from the age of 15 up to the current age. Therefore, for some respondents information back until 1965 is available. We aggregate this spell-data in four states: Employment,

[1]For an overview see for example Wagner *et al.* (2007)

no employment, education and retirement. Furthermore, we rank years with overlapping spells in a manner following Westermeier *et al.* (2012). Specifically, we assume that education and retirement are a person's main activities and additional employment and unemployment spells will be ignored. We use this data to calculate the duration of past employment breaks, the duration of the current employment break for unemployed respondents as well as the time elapsed since the last interruption for employed respondents. In addition, to the biography data, we use SOEP data on socio-economic characteristics, most importantly on income, working hours, working experience and education.

Table 1 provides an overview on the relevant dependent and independent variables for the considered age group: The average sample member is, as of 2012, about 50 years old, and works, if employed, about 34 hours a week. He has about 20 years of full-time work experience and has interrupted an employment for three years. About 80 percent of the sample members are employed.

The differences between the sexes are immediately apparent - women earn significantly less, work fewer hours and are less likely to be employed. It seems hard believe that this differences will vanish within the next years. It is instead most likely that these differences will remain and will further affect lifetime income. As expected, the employment biographies between those employed in 2012 and those not employed do also vary considerably.

TABLE 1
Descriptive results (SOEP, 2012)

	(Sex)		(Employment status)		
	Men	Women	Not employed	Employed	Total
Employment (percent)	84.9	75.9	0	100	80.3
	(35.8)	(42.7)	(0)	(0)	(39.4)
Working hours	39.09	29.53	.	34.34	34.34
	(4.694)	(10.67)	(.)	(9.516)	(9.516)
Hourly gross wage	20.62	15.89	.	18.27	18.27
	(10.53)	(9.150)	(.)	(10.15)	(10.15)
Duration last interruption	1.414	4.665	7.275	2.040	3.070
	(2.992)	(6.582)	(8.220)	(3.779)	(5.394)
Time since interruption	10.04	11.20	.	10.85	10.85
	(9.393)	(9.315)	(.)	(9.363)	(9.363)
Number of children	1.430	1.662	1.656	1.522	1.548
	(1.160)	(1.129)	(1.271)	(1.117)	(1.150)
Age	50.49	50.42	51.18	50.28	50.45
	(6.484)	(6.389)	(6.925)	(6.298)	(6.436)
Full-time exp.	25.77	15.09	15.61	21.48	20.33
	(8.622)	(10.63)	(10.57)	(10.88)	(11.07)
Part-time exp.	0.831	7.135	3.769	4.110	4.043
	(2.565)	(7.995)	(6.166)	(6.899)	(6.762)
Observations	8220				

mean coefficients; sd in parentheses

Source: SOEP (2012)

As career interruptions and their timing are in the focus of this study, those will be discussed in greater detail: Table 1 suggests that the average woman's interruption lasts more than three times longer than that of the average man - men interrupted their employment for less than 1.5 years while this number approaches 5 years for women with an interruption. Figure 1 provides information on the distribution of the length of the last career interruption. It is apparent that the share of men with no interruption at all - about 50 percent - is substantially larger compared to that of women (about 20 percent). Long interruption periods are also a lot more common for women as men rarely interrupt employment for more than three years. Therefore, the negative effect on life-time and old-age income for women has to be substantial.

The average career interruption dates back approximately the same amount of time for men and women (10 vs. 11 years). From figure 2, we see, however, that the distribution of the interruption timing exhibits dissimilar patterns. Men's interruptions frequently date back only a short period of time while this distribution is more even for women. This indicates that men's biographies - if they interrupt at all - tend to be more volatile but that their interruptions also tend to be shorter than those of women.

3.3 Estimation Results

The results of three groups of regressions are the main driving forces of the model, determining the forecast of the employment biographies for each

FIGURE 1
Duration of career interruptions

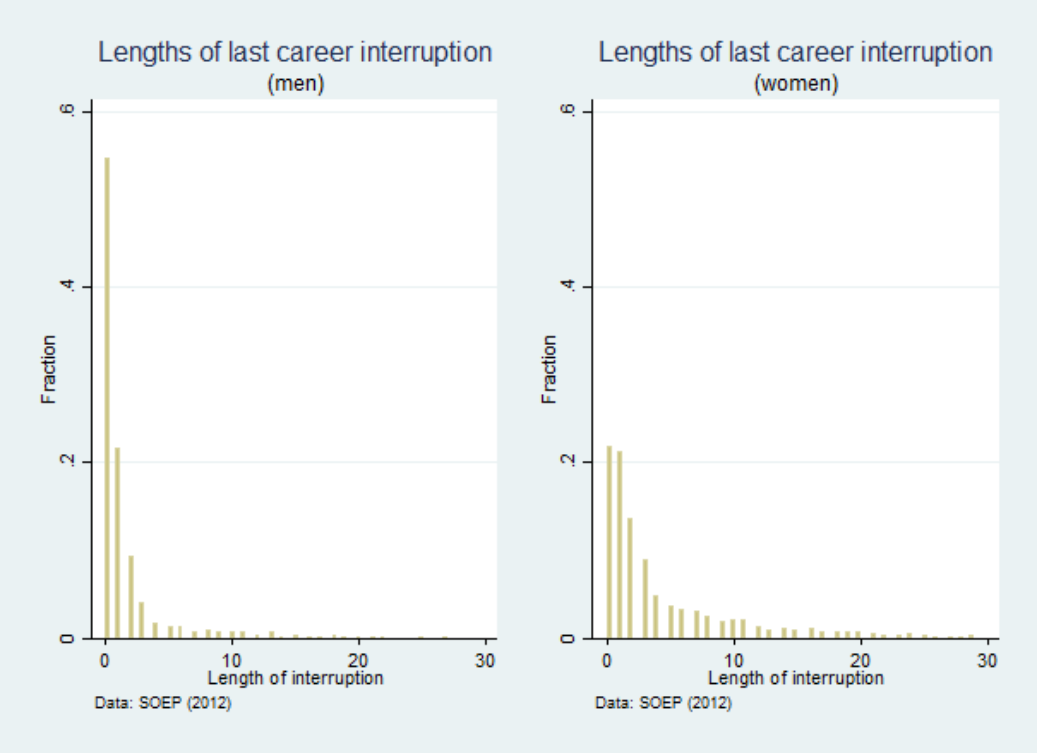
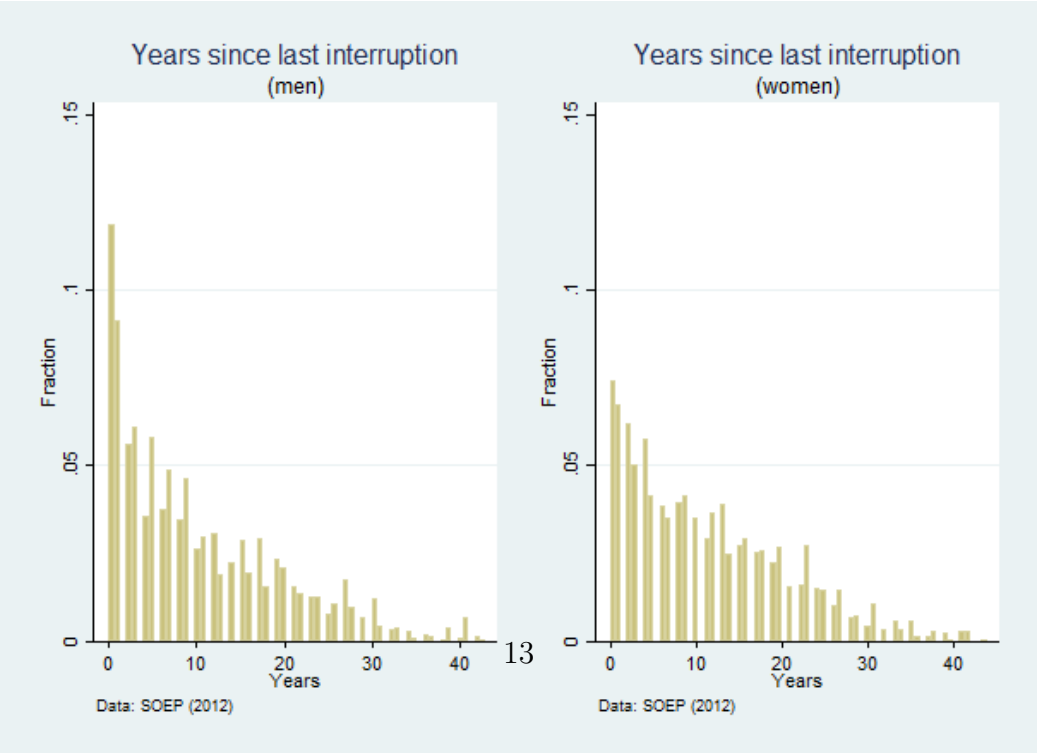


FIGURE 2
Years since last interruptions



individual until retirement. These regressions control the transition between spells of employment and phases without economic activity, the working hours and the relative deviation from the average hourly wage and therefore all gross wages until retirement. The regressions are carried out separately for men and women. Independent regressions determine employment status, working hours and wages - this approach allows different explanatory factors to influence these three processes. To avoid endogeneity problems and to emphasize the dynamic nature of the setting, all independent variables enter the regressions as first lags. The following sections will discuss the setup of the three regression groups and their results in greater detail.

3.3.1 Employment

Beginning and leaving an employment will be influenced by past career interruptions as well as many other factors. Their effects will be determined by separate panel probit regressions for those currently working and those who are currently not employed (where emp_t is equal to one if a person is employed in period t while $nemp_t$ being equal to one indicates that a person has left an employment):

$$emp_t^i = c + \beta X_{t-1}^i + \mu_t + \nu_i + \epsilon_t^i \text{ if } emp_{t-1}^i = 1 \tag{1}$$

and

$$nemp_t^i = c + \beta X_{t-1}^i + \mu_t + \nu_i + \epsilon_t^i \text{ if } nemp_{t-1}^i = 1 \tag{2}$$

Explanatory variables are denoted as X, μ describes time fixed effects and ν individual fixed effects, which we assume to be uncorrelated with the ex-

planatory variables X. ϵ is a $\mathcal{N}(0,1)$ distributed error term.

Table 11 and table 12 show that a longer time since the last career interruption will, for both men and women, heavily reduce the risk to leave the employment again. As expected, greater employment experience reduces the risk of becoming unemployed. Experience effects are more pronounced for men, while the effect of young children in the household is only of significance for women. Higher education creates better perspectives on the employment market for both sexes.

The determinants influencing those not working to reenter are very similar to the effects describing the opposite direction (see table 13 and table 14). These results indicate that career interruptions will negatively affect employment in the long run - either immediately through the negative effects of the interruption but also indirectly because of reduced experience.

3.3.2 Working hours

The determinants of the number of weekly working hours h (for those being employed) are estimated in a linear random effects panel data model:

$$h_t^i = c + \beta X_{t-1}^i + \mu_t + \nu_i + \epsilon_t^i \tag{3}$$

Again, all explanatory variables are included as their first lags.

Regression results are presented in tables 15 and 16. Both, the time since

the last interruption as well as its duration, strongly influence the number of working hours, though with a diminishing rate. The negative effect of interruptions on working hours is particularly strong for women. The same holds for the presence of young children, which is also a major influence on whether a career is interrupted for a longer period in the first place. Part-time experience, on the other hand, only has a negative effect for men. Consequently, interruptions will also have long-lasting effects on working hours, wages, lifetime earnings and finally old-age income.

3.3.3 Wages

Hourly wage rates hw are determined in a two-step procedure. At first, the change in the average hourly wage rate is estimated in a first-order auto-regressive model for men and women. While women's wages are substantially lower as of 2012, we estimate a faster wage increase for women. In spite of this faster increase, the change rate differences are not large enough to lead to equal hourly wages by 2035.

In the second step, the relative deviation of the hourly wage rate dev_{hw} from the average hourly wage $\bar{hw}$ is regressed on explanatory variables in a random effects linear panel data model. This two-step procedure follows the approach of Geyer & Steiner (2014). Table 17 and table 18 present the results of the second-stage regression. As expected, wages are mainly driven by education and employment experience. But also career interruptions on their own are of substantial importance. Consequently, it is already apparent at this stage, that career interruptions (and their timing) will negatively

influences hourly wages also in the long run.

3.4 Prediction and Results from Baseline Scenario

Using an iterative process, we update employment status, working hours and wages for each individual in the sample based on the regression results described in section 3.3.

First, propensities for employment and non-employment are calculated using the explanatory variables of period $t-1$ and the estimated regression coefficients. The actual employment status in current period t is then determined by the realization of random variable, distributed uniformly on $[0,1]$.[2] If, for example, for certain levels of the explanatory variables, we receive an 80 percent probability of staying in the labor force, but the realization of the random variable is 0.9, this individual will, in our model setup, end the employment. If this procedure predicts an employment in period t, working hours in t are updated using the characteristics of period $t-1$. Here, we assume that an employment of less than 35 hours per week constitutes a part-time work. The development of the average wage rate change is estimated in an auto-regressive model separately for men and women and the resulting change rates are assumed to be constant throughout the prediction period. Deviations from this average wage rate are predicted based on the explanatory variables of period $t-1$. This procedure leads to a monthly

[2]To achieve a consistent prediction in the baseline and the counter-factual scenario, the same random draws are used in both.

gross wage gw of

$$gw_i^t = emp_i^t * h_i^t * \bar{wh}_t * (1 + dev_{hw,i}^t) * 4.34 \tag{4}$$

with an average month having 4.34 weeks. After determining the employment characteristics, all relevant explanatory variables are updated based on the predicted outcomes in period t (time since interruption, duration of interruption, employment experience as well as age and the number of young children). Based on the updated explanatory variables, this procedure is repeated until retirement is reached. As the timing of a retirement is not in the focus of this study, we assume a fixed retirement age of 65 for the entire population. We restrain ourselves from calculating the exact effects of the employment biographies on the amount of pension, as this would, due to the complexity of German pension scheme (see, for example, Börsch-Supan & Wilke (2004)), require additional assumptions as well as the prediction of the biographies of all current and future employees. As in the German pension system, lifetime income and pension are closely related, the accumulated gross wages can serve as a sensible proxy for old-age income.

The baseline scenario constitutes the foundation for all further analysis and serves as a benchmark for the counter-factual scenarios. To reduce the element of chance of a single projection, the prediction process is repeated 20 times and the results are averaged. Robustness checks show that the results described below are not sensitive with respect to the specific time frame of the estimation sample. Using, for example, only data from 2008 to 2012 for

estimation does not significantly change the outcomes.

The described method allows an yearly evaluation of the relevant variables in the prediction process. Figure 3, for example, depicts the projected employment rates for the sample members under 65 up to the year 2035 in the baseline scenario. It can be seen that men's employment rates drop from about 87 to about 82 percent in 2035. This is mainly due to the fact, that the population is aging and that older cohorts tend to have lower employment rates than younger ones. For women, this effect is not visible: Their employment rates approximately stay at a constant, though lower, level. We interpret this as an indication for a further increase in participation rates of women in the coming years.

Taking the mean over all projected employment biographies, it turns out that the average sample member will be employed for about 12 years and will be out of employment for approximately 2.5 years. But differences between the sexes are standing out - women spend 50 percent more time out of an employment than men (see table 2). These differences can also be found in the number of working hours. The average woman works about 10 hours less compared to her male counterpart. These results and lower wage rates of women immediately translate to a substantial differential in gross life-time income, which is in line with recent literature on the gender pension gap in Germany (see, for example, Hänisch & Klos (2014)).

FIGURE 3
Projected employment rates for men and women

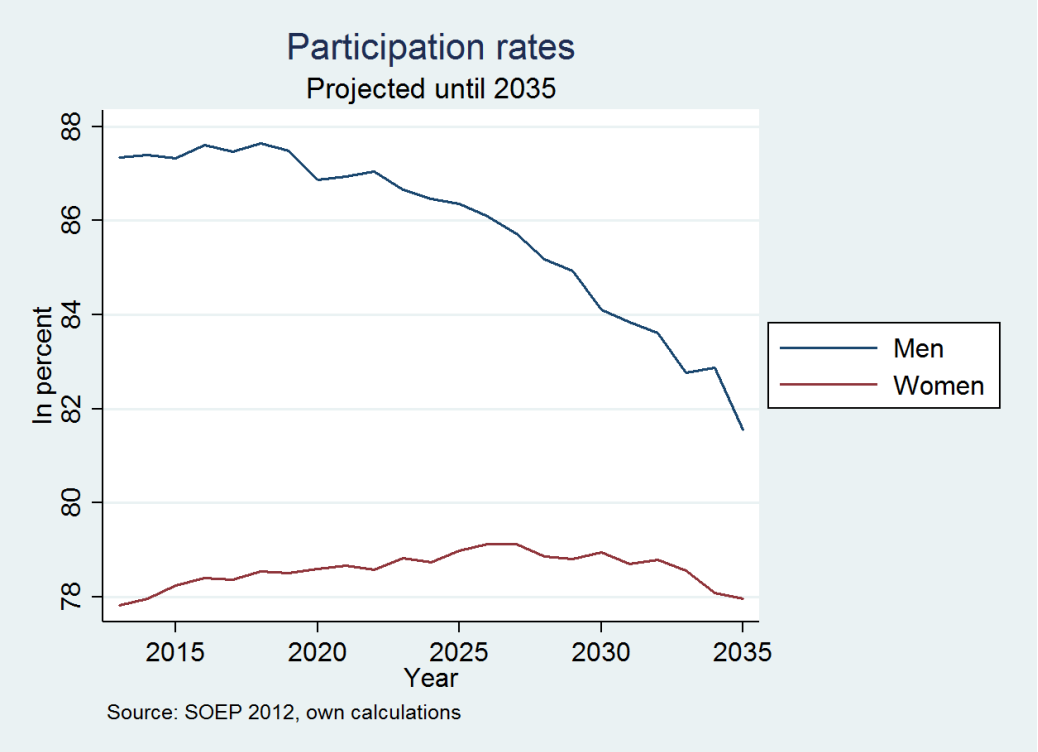


TABLE 2
Predicted average outcomes for all sample members in baseline scenario

Sex:	Interruption (years)	Employment(years)	Working hours	Lifetime income
Men	1.92	12.41	37.69	659,415
Women	3.07	11.25	26.25	320,758

Source: SOEP (2012), own calculations

4 Scenarios: Results

In two scenarios, we quantify the long-term cost of career interruptions. In each of these scenarios it is established how the entire future employment biographies - employment, working hours and wages - of each sample member would react to an assumed change in the completed part of the career path, i.e. to a reduced length of a past interruption period. We are in particular not interested in the additional income in the assumed extra employment year and we do not assume that, due to some unlikely policy, all employment breaks will stop immediately. We are merely interested in the effects of an improved starting position for the future employment path due to a shorter interruption, as we focus on the complete future life-cycle cost of such a break. Therefore, we quantify the cost of one year of interruption by comparing the average lifetime income of the projected employment biographies with and without the reduced interruption length at the starting point. As this procedure is carried out for each individual in the sample, aggregation and weighting will provide approximate society-wide cost of non-employment.[3] To capture all relevant aspects of interruption cost and to cover the most important affected groups, the following scenarios will be discussed:

- Scenario 1: Current employment break starts one year later
- Scenario 2: Just completed career interruption ends one year earlier

In the following sections, these scenarios will be discussed in greater detail:

[3]The model is not designed as an equilibrium model and effects of labor demand are ignored. Throughout this paper, it is assumed that additional labor supply will find the respective demand at predicted prices.

4.1 Scenario 1 - No Employment

Different groups will be affected by interruptions to a varying extent: Those who are currently not working might find it easier to re-start an employment and to discover a way back to an uninterrupted biography, resulting in an increased lifetime income and security at an old age. Thereby, this scenario is directly linked to the discussion on poverty among the elderly and its avoidance which is not only ongoing in Germany, as this group will be particularly at risk of suffering from inadequate income at an older age.

To quantify the lifetime effects of an assumed shortened interruption, this scenario counter-factually supposes that those who are as of 2012 interrupting an employment for more than one year did, in fact, continue their employment for an additional year, i.e. that their current interruptions are one year shorter. The vulnerability of this group to old-age poverty is immediately apparent when comparing their average projected income (in the baseline scenario) with that of the population as a whole: They are not only expected to be working less hours in employment phases, but the projection also suggests, that the average duration of future unemployment periods is substantially longer. Not surprisingly, this group is only able to obtain a fraction of the income of the entire population until retirement (see table 3).

The simulation suggests that the effect of an additional employment year in the past biography is substantial - the improved starting position leads to almost one additional employment year in the future and will be worth

Table 3
Predicted average outcomes for affected sample members in scenario 1 - baseline

Sex:	Interruption (years)	Employment(years)	Working hours	Lifetime income
Men	8.04	3.79	33.66	132,112
Women	8.74	4.42	20.16	85,651

Source: SOEP (2012), own calculations

about 30,000 Euros for men and 25,000 Euros for women. Though these effect sizes do not differ heavily between men and women in absolute numbers, the relative improvements for women are clearly more substantial as they are accumulating less income compared to men. As women are more prone to career interruptions, this amount of money should, especially for women, not be underestimated with regard to its effects on old-age poverty and on closing the gender pension gap (see table 4). This number is particularly remarkable considering the fact that the assumed extra employment year in the past is not part of this calculation.

Not surprisingly, the youngest cohort's (aged from 40 to 45 as of 2012) accumulated profit of a shortened interruption is the largest, though the gain of the second youngest group is, for a shorter period of time, only slightly lower, leading to the conclusion that employment breaks between the ages of 45 and 50 - a period with rather high wages - are particularly costly (see table 9). It is well known that, that career interruptions continue to have an effect over long time periods but that this effect is a diminishing one. The simulations acknowledge that this effect is, in fact, diminishing for the average affected individual, but they also suggests that this diminishing pro-

ceeds with a fairly slow rate (see table 9). For example, the effects of the interruption only tends to drop substantially only shortly before retirement. Actually, the simulation study shows that about 40 percent of the gain of an additional employment year is realized in the second half of the remaining employment biography, revealing how severe the long-term effects of career interruptions and thus reduced experience really are.

Table 4
Predicted average outcomes for affected sample members in scenario 1 - alternative

Sex:	Interruption (years)	Employment(years)	Working hours	Lifetime income
Men	7.18	4.66	34.43	163,363
Women	7.74	5.42	21.24	109,806

Source: SOEP (2012), own calculations

The effect of the shortened employment break on the aggregate, society wide, income is relatively small (see table 5) - the increase amounts to about one percent. Keeping in mind that only a relatively small part of the population is affected by the hypothesized change and that no immediate reentry is assumed, these social effects should still be considered. For the affected group and the average individual, the cost of career interruptions are however substantial and persistent.

4.2 Scenario 2 - Recent Reentry

But not only those currently interrupting their career, also people having already restarted an employment should benefit from a more continuous

Table 5
Predicted average outcomes for all sample members in scenario 1 - alternative

Sex:	Interruption (years)	Employment(years)	Working hours	Lifetime income
Men	1.84	12.49	33.66	662,109
Women	2.90	11.43	26.28	325,006

Source: SOEP (2012), own calculations

employment biography by having more experience and less time out of employment leading to higher wages and an increased security of employment. Therefore, the second scenario assumes that those who have newly begun an employment in 2012, did already restart their careers one year earlier. Interruptions of not more than one year are excluded from the analysis as these cases are likely to be related to search unemployment which might have different effects compared to other causes for not working.

This group differs substantially from the one discussed in scenario 1: While the affected persons of the first scenario often have left workforce for good, scenario 2 regards recent returners - hence, it does not come as a surprise that this group is expected to collect more income and to accumulate a larger number of employment years (see table 6). Compared to the entire population (see table 2), this group of people, particularly the men, is also still worse off and more likely to be susceptible to poverty after retirement.

The simulation results show that the improvements caused by a shorter interruption are of similar magnitude compared to the group of scenario 1, though at an higher income level. Yet, the effect sizes are switched between the sexes - the average man gains about 25,000 Euro while this number in-

Table 6
Predicted average outcomes for affected sample members in scenario 2 - baseline

Sex:	Interruption (years)	Employment(years)	Working hours	Lifetime income
Men	3.08	10.64	35.91	418,989
Women	3.12	13.56	21.33	299,983

Source: SOEP (2012), own calculations

creases to approximately 30,000 Euro for women. With this increase the average reentering woman reaches the income level of the entire female population and closes the gap towards the male population by about three percentage points. This underlines that long-term gains of early reentry should not be underestimated. These life-time improvements originate to a large degree from increased wages due to a less interrupted career, while the growing number of hours and employment years also has an influence, which is, however, considerably smaller than in the first scenario.

Going beyond the aggregate figures, the detailed investigation by age-group shows interesting characteristics in the projected income improvements. In this scenario, the aggregated improvement of the youngest cohort is clearly the largest, both in absolute as well as in relative terms, while the relative differential between the older groups are small (see table 10). But most notably and contrary to the results of scenario 1, the positive effects of an additional employment year are not only slowly decreasing, the youngest cohort's income change does actually increase over a period of time. This stems from the fact that in particular this age-group is disproportionately highly expanding its working hours as an implication of a more continuous

career path.

Table 7
Predicted average outcomes for affected sample members in scenario 2 - alternative

Sex:	Interruption (years)	Employment(years)	Working hours	Lifetime income
Men	2.74	10.98	36.19	441,950
Women	2.89	13.81	22.21	328,611

Source: SOEP (2012), own calculations

The effect of the changes in scenario 2 on the society's aggregated and accumulated income is small (see table 7) - this is essentially a consequence of the fact that the number of people starting an employment after a break is small in comparison to the entire population. Still, one has to consider that the scenario is a snapshot at one point in time and that many people will be restarting an employment at one point or another of an employment biography. But in contrast, the positive and long-lasting effects of an early reentry for the regarded group are immediately apparent.

Table 8
Predicted average outcomes for all sample members in scenario 2 - alternative

Sex:	Interruption (years)	Employment(years)	Working hours	Lifetime income
Men	1.91	12.42	37.70	659,831
Women	3.07	11.26	26.27	321,450

Source: SOEP (2012), own calculations

5 Conclusion

In combining micro-simulation based on SOEP-data with econometric methods for the evaluation of the consequences of career interruptions, this paper provides a tool to quantify the cost of employment breaks by projecting, comparing and aggregating individual employment biographies. In scenarios, the positive effects on life-time income of a reduced interruption duration are evaluated for different subgroups and the consequences of a variation in the interruption's occurrence in time are examined. Going beyond the implications for the average affected individual, the model enables us to calculate the society-wide cost of interruptions.

The projected future income increase as a consequence of a one year reduction of the interruption length are of a similar order of magnitude for those who recently reentered and those who are currently not employed. This improvement amounts to about 25,000 Euros for both groups, though the causes of this increase are not identical. While it is well known that employment breaks will continue to have an effect long after the end of an interruption, this paper shows how substantial this aftermath can be. In fact, the simulations suggest that as much as 40 percent of the effect of an interruption can be effective in the second half of the period between reentry and retirement. As a result of the relative smallness of the affected group, aggregate society-wide income raises tend to be small, too. But despite of their size, these effects are still not neglectable.

By not only providing qualitative but quantitative measures for the cost of career interruptions and the benefit of reentry, the presented methods provide useful information in matters of the current discussion on old-age poverty and place additional knowledge on the gender pension gap and its closure at the disposal. As such, a model of this kind is a valuable instrument in the assessment of long-ranging gains of policies encouraging the restart of an employment.

Certainly, various types of interruptions, like being unemployed or being out of the workforce, will affect biographies in different ways. Beblo & Wolf (2002), for example, point out that interruptions caused by unemployment are especially harmful for men while women's income seems to be mainly influenced by parental leave periods or being out of the workforce. At this point, interruption types are not incorporated in the model, as it is our intention to primarily provide a comprehensible and fundamental model that focuses on the main effects. However, first steps to include these reasons for interruptions are made - in a study for the German Federal Ministry for Family Affairs the life-cycle cost of care-related employment breaks are considered.

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TABLE 9

Predicted changes to baseline results in scenario 1 for affected group by age-group and year

Year	Cumulated income difference					Difference in weekly working hours				
	Age (in 2012)									
	40-44	45-49	50-54	55-59	60 and older	40-44	45-49	50-54	55-59	60 and older
2013	2493	3715	2494	2640	1668	3.22	4.66	2.89	3.23	2.15
2014	4609	6453	4634	4754	3100	2.65	3.51	2.48	2.64	1.87
2015	6607	8867	6655	6722	4354	2.39	3	2.24	2.41	1.56
2016	8382	11058	8504	8567	5043	2.03	2.61	2.01	2.22	0.82
2017	10091	13279	10263	10379	5522	1.88	2.52	1.84	2.14	0.56
2018	11782	15383	12052	12127	5522	1.79	2.31	1.82	2	0
2019	13460	17397	13827	13493	5522	1.72	2.19	1.75	1.47	0
2020	15201	19358	15518	14546	5522	1.73	2.1	1.63	1.1	0
2021	16850	21322	17187	15369	5522	1.6	2.06	1.56	0.83	0
2022	18567	23186	18732	15861	5522	1.61	1.93	1.43	0.41	0
2023	20232	25027	20272	15861	5522	1.5	1.85	1.41	0	0
2024	21951	26770	21637	15861	5522	1.52	1.72	1.19	0	0
2025	23739	28438	22728	15861	5522	1.55	1.62	0.87	0	0
2026	25383	30153	23525	15861	5522	1.42	1.63	0.65	0	0
2027	27078	31768	23628	15861	5522	1.42	1.52	0.1	0	0
2028	28675	33393	23628	15861	5522	1.31	1.52	0	0	0
2029	30254	34658	23628	15861	5522	1.25	1.2	0	0	0
2030	31767	35540	23628	15861	5522	1.18	0.84	0	0	0
2031	33302	36182	23628	15861	5522	1.19	0.57	0	0	0
2032	34813	36451	23628	15861	5522	1.15	0.21	0	0	0
2033	36263	36451	23628	15861	5522	1.09	0	0	0	0
2034	37396	36451	23628	15861	5522	0.83	0	0	0	0
2035	38283	36451	23628	15861	5522	0.65	0	0	0	0

Source: SOEP (2012), own calculations

TABLE 10
Predicted changes to baseline results in scenario 2 for affected group by age-group and year

Year	Cumulated income difference					Difference in weekly working hours				
	Age (in 2012)									
	40-44	45-49	50-54	55-59	60 and older	40-44	45-49	50-54	55-59	60 and older
2013	1791	1491	1480	1076	1011	1.25	1.13	1.24	0.87	0.81
2014	3602	2882	2682	2532	1917	1.3	1.11	1.03	1.3	0.73
2015	5296	4316	4025	3796	2646	1.21	1.19	1.16	1.13	0.7
2016	7026	5776	5504	5027	3311	1.2	1.17	1.4	1.08	0.57
2017	8609	7255	6877	6349	4041	1.08	1.21	1.28	1.17	0.41
2018	10293	9034	8480	7925	4041	1.13	1.48	1.49	1.51	0
2019	11772	10728	9927	9155	4041	0.98	1.43	1.32	1.08	0
2020	13464	12115	11328	10293	4041	1.1	1.11	1.3	1.03	0
2021	15223	13453	12875	10640	4041	1.1	1.01	1.42	0.36	0
2022	16960	14876	14334	10738	4041	1.1	1.08	1.24	0.08	0
2023	18833	16331	15696	10738	4041	1.18	1.17	1.22	0	0
2024	20815	17734	16823	10738	4041	1.31	1.09	0.93	0	0
2025	22939	19094	17960	10738	4041	1.46	1.06	0.98	0	0
2026	25091	20444	18463	10738	4041	1.39	1.03	0.41	0	0
2027	27240	21824	18887	10738	4041	1.37	1.04	0.33	0	0
2028	29314	23348	18887	10738	4041	1.33	1.14	0	0	0
2029	31455	24846	18887	10738	4041	1.38	1.13	0	0	0
2030	33715	26112	18887	10738	4041	1.38	0.96	0	0	0
2031	35855	26929	18887	10738	4041	1.25	0.59	0	0	0
2032	37804	27645	18887	10738	4041	1.11	0.51	0	0	0
2033	39723	27645	18887	10738	4041	1.09	0	0	0	0
2034	41190	27645	18887	10738	4041	0.81	0	0	0	0
2035	42358	27645	18887	10738	4041	0.66	0	0	0	0

Source: SOEP (2012), own calculations

TABLE 11
Out of Employment, Men

	(1) Out of Employment
Age	0.0263
Age^2	-0.000175
Number of children	0.0186
Duration last interruption	0.0120
Time since last interruption	-0.0468***
Time since last interruption^2	0.000740***
Qualification	-0.0745***
Experience full-time	-0.0265*
Experience part-time	0.0650**
Experience full-time^2	0.000519*
Experience part-time^2	-0.00719*
Married	-0.100*
East Germany	0.202***
Constant	-2.181***
Observations	26324

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

TABLE 12
Out of Employment, Women

	(1) Out of Employment
Age	-0.160***
Age^2	0.00176***
Number of children	-0.124***
Duration last interruption	0.00315
Time since last interruption	-0.0501***
Time since last interruption^2	0.00100***
Qualification	-0.0446***
Experience full-time	-0.0209**
Experience part-time	-0.0314***
Experience full-time^2	-0.0000189
Experience part-time^2	0.000560*
Married	0.00547
East Germany	0.0452
Constant	2.589***
Observations	24698

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

TABLE 13
Reentry work force, Men

	(1) Reentry work force
Age	0.0284
Age^2	-0.00114*
Number of children	-0.0197
Duration last interruption	-0.0452***
Qualification	0.202***
Experience full-time	0.0435**
Experience part-time	0.0361
Experience full-time^2	0.0000380
Experience part-time^2	-0.00141
Married	0.282***
East Germany	-0.175**
Constant	-0.206
Observations	3387

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

TABLE 14
Reentry work force, Women

	(1) Reentry work force
Age	0.145***
Age^2	-0.00217***
Number of children	-0.0479*
Duration last interruption	-0.0213***
Qualification	0.0778***
Experience full-time	0.0130
Experience part-time	0.0802***
Experience full-time^2	0.000623*
Experience part-time^2	-0.00165***
Married	0.0183
East Germany	-0.0933*
Constant	-3.027***
Observations	8366

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

TABLE 15
Working hours, Men

	(1) Working hours
Age	-0.00695
Age^2	-0.00313***
Number of children	-0.0294
Duration last interruption	-0.145*
Duration last interruption^2	-0.00116
Time since last interruption	0.0231*
Time since last interruption^2	-0.0000705
Qualification	0.290***
Experience full-time	0.204***
Experience part-time	-0.277***
Experience full-time^2	0.00106
Experience part-time^2	0.0228***
Married	0.139
Constant	38.74***
Observations	22433

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

TABLE 16
Working hours, Women

	(1) Working hours
Age	-0.0328
Age^2	-0.00437***
Number of children	-1.883***
Duration last interruption	-0.543***
Duration last interruption^2	0.0194***
Time since last interruption	0.300***
Time since last interruption^2	-0.00574***
Qualification	0.811***
Experience full-time	0.536***
Experience part-time	0.0511
Experience full-time^2	-0.00287**
Experience part-time^2	0.00589***
Married	-2.346***
Constant	30.74***
Observations	22512

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

TABLE 17
Wage deviation, Men

	(1) Wage deviation
Age	-0.00663
Age^2	0.000222***
Number of children	0.0214***
Duration last interruption	-0.0443***
Duration last interruption^2	0.00201***
Time since last interruption	0.00343***
Qualification	0.0916***
Experience full-time	0.00582
Experience part-time	-0.0251***
Experience full-time^2	-0.000411***
Experience part-time^2	-0.000184
Married	0.0360***
Constant	-0.503***
Observations	22241

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

TABLE 18
Wage deviation, Women

	(1) Wage deviation
Age	0.0154***
Age^2	-0.000162**
Number of children	0.0291***
Duration last interruption	-0.0102***
Duration last interruption^2	0.000108
Time since last interruption	0.00488***
Qualification	0.104***
Experience full-time	0.0107***
Experience part-time	-0.00147
Experience full-time^2	-0.000231***
Experience part-time^2	-0.0000317
Married	0.0203*
Constant	-0.930***
Observations	22287

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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