The role of firms in retirement decisions*

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Abstract

In general, retirement is seen as a pure labor supply phenomenon, but firms can have strong incentives to send expensive older workers into retirement. Based on the seniority wage model developed by Lazear (1979), we discuss steep seniority wage profiles as incentives for firms to dismiss older workers before retirement. Conditional on individual retirement incentives, e.g. social security wealth or health status, the steepness of the wage profile will have different incentives for workers as compared to firms when it comes to the retirement date. Using an instrumental variable approach to account for selection of workers in our firms, we find that conditional on individual retirement incentives, firms with higher labor costs for older workers are associated with lower retirement age.

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1 Introduction

A lot of industrialized countries face substantial demographic changes with an aging population and increasing life expectancy. These changes also raise important questions for the design of (public) pension systems and particularly challenges the funding of public pension systems which are progressively under considerable funding strain. The understanding of the determinants of retirement decisions is therefore indispensable and helpful for economists and policy-makers.

Existing literature on retirement is extensive, determinants of individual retirement, or incentive effects of social security systems are well-studied. Typically, the individual retirement decision is mostly seen as a labor supply phenomenon and most scholars have focused on individual retirement incentives. There is consistent evidence that health at older ages has a positive effect on the labor supply of older workers.[1] Burtless (2013) finds that more productive workers stay in the workforce longer than less productive workers, Blekesaune and Solem (2005) and Siegrist *et al.* (2007) find that bad working conditions and lower well-being are associated with early retirement. Most labor supply studies, however, deal with the relationship between retirement behavior and the financial incentives of pensions, social security wealth and earnings, as well as incentive effects of social security systems and the consequences of public policy changes. Fields and Mitchell (1982), for example, find that people with higher incomes retire earlier and people who gain more from postponing retirement will also retire later.[2] Samwick (1998), Van Soest and Vonkova (2013) or Hanel (2010) show that lower financial incentives lead to postponed retirement. With respect to public policy incentives, Börsch-Supan (2000) concludes that European countries provide strong incentives to retire early and there is widespread redistribution from late to early retirees through actuarially unfair pension regulations. Mastrobuoni (2009) for the US or Staubli and Zweimüller (2013) for Austria

[1] E.g. Currie and Madrian (1999) provide a survey of health effects on labor supply and retirement for the US, Cai (2010) or Bound *et al.* (2010) are other very recent examples.

[2] Mitchell and Fields (1981) provide a literature review of the effects of pensions and earnings, and conclude that higher wage levels do not have a strong impact on retirement, whereas higher wage streams tend to encourage later retirement. Moreover, retirement is ambiguously affected by social security eligibility, social security wealth or by the change of social security wealth.

document positive employment effects due to increased retirement age.[3] Finally, another strand of this literature focuses on the joint retirement behavior of married couples.[4]

The role of firms in the retirement decision is often neglected, but firms can push their workers into retirement or at least facilitate the decision of workers. This might be particularly true if older workers are expensive relative to their productivity and low-skilled, or if firms are exposed to negative demand shocks. Firm pensions and buyouts are an indicator that firms do care about the retirement of their workers and see retirement as a legitimate way to lay older workers off. Also age discrimination against older workers might influence worker's retirement decision. Johnson and Neumark (1996) show that workers reporting age discrimination are more likely to separate from their employer even with the existence of mandatory retirement provisions on the current job.[5] But apart from anecdotal evidence, the literature on the role of firms in retirement decisions is, in contrast to the labor supply literature, manageable. One reason may be that individual retirement decisions, health status, pension provisions, financial incentives of social security systems are observable and we can thoroughly analyze determinants and incentive effects affecting retirement. However, the impact of the firm is in most cases not observable and identifying this impact is difficult. Dorn and Sousa-Poza (2010) use the ISSP survey data and analyze the determinants of voluntary and involuntary retirement. Overall, 26 percent of respondents claimed not to have retired voluntarily. Hutchens and Grace-Martin (2006) analyze which employers are willing to provide their workers with phased retirement, a gradual reduction of work hours and effort.[6] Employers are often willing to permit phased retirement as part of an informal arrangement and is more common in firms which employ part-time white collar workers or allow job sharing. Hutchens (2010) deepens this analysis and particularly stresses that phased retirement offers are

[3]Precisely,Mastrobuoni (2009) considers an increase of the normal retirement age, Staubli and Zweimüller (2013) look at early retirement age.

[4]see e.g. Zweimüller *et al.* (1996), Blau (1997),Blau (1998),Gustman and Steinmeier (2000),Hurd (1990),Coile (2004)

[5]Adams (2004) shows that age discrimination legislation boosts employment of older individuals. Neumark and Stock (1999) show that age-earnings profiles steepen following stricter age discrimination laws.

[6]Van Soest and Vonkova (2013) report for a Dutch survey that older workers have a preference for gradual retirement schemes.

very selective with higher performing employees having bigger opportunities.

Theoretically, Hutchens (1999) explicitly models the firm's impact on the early retirement decision of their workers and emphasizes the role of a social security system. He develops an implicit contract model, where firms use the social security system as a form of unemployment insurance. In the presence of negative demand shocks early retirement benefits subsidize workforce reductions and lower firm cost. Potential utility loss of workers due to early retirement are compensated by offers that workers cannot refuse. A key result of this model is that social security early retirement benefits can cause an increase in the incidence of socially inefficient early retirement, particularly under actuarially unfair pensions systems.[7] Bellmann and Janik (2010) empirically test this model and provide supportive evidence that negative demand shocks are associated with a higher early retirement probability. They also stress the importance of firms in the discussion about early retirement and public policy reforms.

Methodologically most convincing are two studies from Scandinavian countries. For Finland, Hakola and Uusitalo (2005) analyze the introduction of an experience-rating of early retirement benefits and find a significant and causal reduction of early job exits of older workers. The firm's impact is evident as workers need to be laid off before obtaining early retirement benefits at all. For Sweden, Hallberg (2011) shows how exogenous variation in non-wage costs affects early retirement probabilities. With an instrumental variables approach he finds that a 1 percentage point increase in non-wage costs increases retirement by 6 percent.

This paper contributes to this strand of literature and tries to identify the influence of the firm on worker's retirement decision by focusing on the delayed payment contracts model (seniority wage model) developed by Lazear (1979). We analyze whether workers' retirement age is affected by firms' wage growth profiles. We argue that higher wage growth is associated with higher costs for firms and consequently higher incentives to lay off older workers. We use a comprehensive Austrian employer-employee matched dataset covering private sector firms and retirements between 2000 and 2008. Similarly to Hakola and

[7] A system is actuarially fair if the present value of expected social security benefits is invariant to retirement age - it compensates later retirees for foregone early retirement benefits.

Uusitalo (2005) and Hallberg (2011), we aim at identifying a causal relationship leaving us with a new instrumental variables approach to resolve endogeneity problems.

The paper proceeds as follows: We present the underlying theoretical considerations of our empirical setup in section 2, describe the institutional background in Austria and data in section 3, followed by the derivation of our firm incentive measures (section 4.1), the empirical model (section 4.2) and identification (section 4.3). Section 5 presents our preliminary results.

2 Theoretical considerations

Firms' influence on the worker's retirement decision is often difficult to observe. Therefore, setting the motivation for our empirical model on theoretical grounds can be useful in the derivation of an appropriate incentive measure. The seniority wage model developed by Lazear (1979) and the idea that pensions can be seen as a form of severance pay (Lazear (1982), Lazear (1983), Lazear (1986)) provide a useful framework for an intuitive measure of firm incentives to push workers into retirement.[8] The model links voluntary and mandatory retirement, wages and earnings. We discuss the model in the context of social security systems and shed light on the incentive effects of generous social security systems on firm behavior.

The basic idea of the model is captured by Figure 1. Suppose a worker has a constant marginal product $VMP(t)$ over lifetime[9] and a reservations wage function $\bar{W}(t)$ which represents the worker's value of time. The efficient retirement age for the worker is given when the value of time $\bar{W}(t)$ crosses the marginal product $VMP(t)$. This would also be the voluntary retirement age if the worker was paid the marginal product. Workers receive a pension $P(t)$ between retirement age t^R and time of death t^D. Now consider a wage path $W(t)$ which is below the marginal product in early years and above $VMP(t)$

[8]Lazear's model also yields empirically consistent predictions, as shown in e.g. Hutchens (1987)

[9]Precisely, the level of marginal product is determined by the level of effort where the disutility of additional effort equals the marginal revenue of additional effort.

between time t^* and t^R. The wage path is set such that the present value of $W(t)$ from $t = 0$ to t^R equals the present value of $VMP(t)$ from $t = 0$ to t^R. Workers will be indifferent between wage paths $W(t)$ or $VMP(t)$, but it would require mandatory retirement if the voluntary retirement age exceeds mandatory retirement age t^R. A wage path $W(t)$ might be beneficial for incentive reasons. Workers will provide effort $VMP(t)$ before time t^* in order to benefit from the higher wages after t^*. However, the high wages after t^* also create sufficient incentives for workers to provide the optimal effort to stay with the firm until retirement age t^R.[10]

Between time t^* and t^R, the firms pays wages above the marginal product and has therefore an incentive to dismiss the worker before the mandatory retirement age t^R. Clearly the incentive increases with the amount owed to the worker. Suppose the firm wants to get rid of the worker at time t_0. A dismissal will save the firm wage payments in the size of ABt_0t^R. Consider a steeper earnings profile $W'(t)$ where the firm incentive $A'B't_0t^R$ outweighs the incentives under wage path $W(t)$. A higher wage growth relative to the marginal product is therefore associated with higher firm incentives to dismiss workers before retirement age. Under perfect information and an infinite time horizon, however, firms will face reputation costs and new workers in the next periods will incorporate a potential deviation from the wage contract in the wage bargaining process leading to even steeper earnings profiles. The cost savings from the dismissal will eventually disappear.[11] Reputation costs can be removed if workers get compensated for the loss of income. Suppose a firm wants to fire the worker at time t_0 and the value of time of the worker exogenously jumps to $\bar{w}(t_0)$.[12] Workers will accept early retirement if their value of time exceeds the marginal product, otherwise an early leave would be inefficient with respect to the initially chosen effort. If the worker receives a pension $P(t)$ at time t^R equal to the present value of $P(t)(t^D - t^R)$, then the worker will accept leaving the firm at t_0 if

[10] If the workers gets fired because of low effort, he would gain $\bar{W}(t)$ but lose $W(t)$. Typically $W(t)$ also far exceeds outside alternatives. Therefore the measure of inducement for workers is exactly ($W(t)$-$\bar{W}(t)$).

[11] dismissals could also be exogenous in the case of e.g. bankruptcy. Moreover, the impact of reputation costs declines with increasing asymmetric information about firm behavior.

[12] Stochastic value of time means that the reservation wage $\bar{w}(t)$ unexpectedly changes. Such changes might arise either for health reasons, better outside options or through an increase in the value of leisure.

the firm pays $ABCD + P(t)(t^D - t^R)$.[13] If the worker stays, he receives wage payments $ABCD + VMP(t)[t^R - t_0]$ plus pension payment $P(t)(t^D - t^R)$, but if he leaves he gets firm payment $ABCD + P(t)(t^D - t^R)$ plus $\bar{w}(t_0)(t^R - t_0)$ as leisure or unexpectedly better outside offer. As long as the efficiency criterion $\bar{w}(t_0) > VMP(t_0)$ is met, workers get more from leaving than from staying with the firm.

As this paper is about a country with a public pension system, it is worthwhile to analyze the interrelations between firm incentives and social security systems.[14] Clearly, in the presence of a social security system, the expected pension payment $P(t)(t^D - t^R)$ can be rolled over to the social system, so that the firm payment reduces to the amount of $ABCD$. The possibility of early retirement offered in a social security system might be a valuable outside option for the worker leading to an unexpected upwards shift of the value of time (leisure). Furthermore, the generosity of a social system is also crucial from both firm and individual point of view. On the one hand, more generous social security systems result in higher expected pension payments, the provision of early retirement or less actuarially fair pensions, and provide a more beneficial outside option to the worker. Therefore, greater financial incentives are typically associated with lower retirement age; a finding that is confirmed in a lot of empirical studies, i.e. Blundell *et al.* (2002), Börsch-Supan (2000), Hanel (2010) for financial incentives, or Staubli and Zweimüller (2013) for the early retirement age in Austria. On the other hand, the generosity also affects the incentives of firms to fire their workers before retirement age t^R. Not only that workers accept early retirement offers more easily due to higher individual retirement incentives, but it allows the firm to transfer a part of the compensation payment to the social security system. Such a scenario is highlighted in figure 2. Typically, public pension payments are often linked to earnings at older ages in order to allow workers to maintain a certain accustomed standard of living. Expected pension payments will therefore be relatively high. Suppose a worker can expect a pension payment $P'(t)$ at retirement age t^R which

[13] Lazear (1982) therefore argues that pensions are used as a severance pay in such an efficient compensation scheme

[14] see the theoretical model developed by Hutchens (1999)

is above the marginal product $VMP(t^R)$. Retirement as outside option becomes attractive and will shift the value of time up to $\bar{w}(t_0)$. Given the social security system allows early retirement at time t_0, a firm compensation payment of $ABEF$ would suffice for accepted early retirement. As firms know the entire earnings profile of the worker and the legal regulations for pensions are publicly available, firms can in fact compute $\bar{w}(t_0)$ with certainty. It follows that they can eventually reduce their compensation payment to the minimum of $ABEF$ and the worker would still accept early retirement. The sum of $EFCD$ is now implicitly borne by the social security state. As in the Austrian case, such a share of costs between firms and social system is not unusual (see section 3).

To sum up, based on this intuitive theoretical model we can derive a useful measure for firm incentives which is given by the wage growth relative to productivity growth. Firm incentives for firing the worker increase if *ceteris paribus* the wage growth increases. At the same time, however, wage growth and generous public pension systems also affect the individual retirement decision. Only considering individual wage growth to identify firms' incentive does not suffice in the empirical model. Also individual retirement incentives induced by wages close to retirement and by expected social security benefits after retirement need to be addressed properly in order to separate firm impact on retirement from the individual retirement decision.

3 Institutional background and data

Among OECD countries, Austria is exhibited with a relatively low retirement age and high pension levels. The average pension in Austria for men and women is 73 percent of the average worker earnings. This value is only exceeded by Denmark, Hungary, Iceland, Netherlands and Italy where with the exception of Italy and Hungary all other countries have a higher average retirement age instead (OECD, 2013). With a statutory retirement age of 65 for men and 60 for women, Austrian men retire on average at 59.4 and women at 57.4 (values for 2012). If invalidity pensions are ignored[15], average retirement age for males is still below 62 for men and below 60 for women. An average monthly old-age pension for men amounts to €1,497 for blue collar workers and €2,121 for white collar workers. Female retirees get on average €741 (blue collars) and €1,236 (white collars)[16](Hauptverband der Österr. Sozialversicherungsträger, 2013). Hofer and Koman (2006) conclude that the low labor force participation among the elderly can be attributed to some extent to disincentives of the Austrian pensions system which provides to many incentives to retire early. In fact, lowering the replacement rate and increasing the retirement age could potentially have strong labor market effects in Austria (Keuschnigg and Keuschnigg, 2004). In a recent study, Hanappi (2012) computed the social security wealth and accrual rates for Austria. He finds that the social security wealth peaks at age 63 for men and at 58 for women, hence creating huge disincentives to work longer than 63 (58). Also, there are substantial discontinuities in the annual changes of the social security wealth, emphasizing the importance of the retirement planning horizon[17]. A stronger emphasis on financial incentives, i.e. bonuses for later and deductions for early retirement, could reduce out-of-labor force ratios of individuals by 13.4 percent for men and by 16.3 percent for women. The generosity of the Austrian pension system also appears in other relevant dimensions: Early retirement schemes due to long periods of insurance[18] provide full pensions without any deductions even in case of early retirement. This retirement scheme, however, expires with the beginning of 2014. In order to smooth the transition to retirement, the labor agency subsidizes phased retirement schemes for older employees, where the compensation of the employee is split between firm and labor agency. Although this program intends a continuous reduction of working hours over 4 years, employees often continue working fully and retire after 2 years. Special severance payments (Golden Handshakes) paid to the worker in case of leaving the job bring along

[15] Average invalidity retirement age is 53.8 for men and 50.3 for women; 9 percent of all pensions paid out in 2012 are invalidity pensions (Hauptverband der Österr. Sozialversicherungsträger, 2013).

[16] Fewer social security contribution years and substantial fraction of part-time work explain a part of the very low level of female pension payments. Females also receive a second pension, such as widow pensions, more often;

[17] In other words, working for one more year might not be very beneficial as the social security wealth does not increase sufficiently, but working for 3 years more might be excessively beneficial for the worker.

[18] This type of early retirement is also well-known as "Hacklerregelung"

tax advantages to the employee and employer.

For our analysis we use data from the Austrian Social Security Database (ASSD) containing comprehensive information on daily wages, tenure, experience, social security contributions for workers, as well as detailed information on workforce, sectors, blue/white collar employees or location for firms and industries from 1971 to 2012 (Zweimüller *et al.*, 2009). We currently use all male blue-collar workers aged 57 to 65 who retire in the period 2000 to 2008 and work in private sector firms. We exclude workers from small firms with less than 15 workers and from firms without workers below age 25. We do not explicitly look at the age at actual retirement but consider the age at the exit from the last job before retirement but restrict to a maximum time between job exit and retirement of 2 years.[19]. We also condition on a firm tenure of at least 2 years, leaving us with approximately $39,000$ blue collar retirees. Table 1 shows that blue-collar workers leave the last job at 59.7 on average and retire 56.5 days on average later. Their average tenure is roughly 16 years and have collected approximately 35 social security contribution years until retirement. In the last year before actual retirement, workers spent on average 24 in unemployment and 52 on sick leave.

Austria is provided with a strong and generous social security system and thanks to the data availability, individual incentive effects of the Austrian pension systems are already well-documented (E.g.Hofer and Koman (2006)). Out of anecdotal evidence we know that firms do play a role in Austria.[20] Looking at the mere retirement age distribution within firms and sectors, we can already detect substantial variation among principally comparable firms. Figure 3 shows for Austrian male blue collar workers the boxplots over job exit before retirement for the twenty largest firms in the most relevant sectors for blue collar workers. The upper-left panel, for example, shows the retirement age distribution of the twenty largest firms in the construction sector, where firm size is measured by

[19] Workers might become unemployed and receive unemployment benefits for 52 weeks before retiring. This opportunity, however, could be part in retirement policies of firms

[20] Buyouts, so-called "golden handshakes", are relatively common in Austria

the number of retirement starts in that firm between 2000 and 2008. These firms are relatively homogeneous but still firm-specific variation in the retirement patterns can be observed. This variation is substantially more pronounced in the steel or machine building sector. As these firms in each sector are comparable in size and production technologies, it is doubtable that these patterns are exclusively created by a respective selection of workers in firms. Instead, at least some variation in retirement behavior across firms is probably due to different firm policies with respect to retirement. Figure 4 is the equivalent picture for male white collar workers, where firm-specific differences are even much more pronounced compared to blue collar workers (e.g. in the wholesale and energy supply sector).

4 Empirical strategy

Our empirical model is based on the theoretical considerations described in section 2. It consists of the two necessary components of firm wage growth relative to productivity growth and individual retirement incentives measured by the social security wealth. While the latter is a well-defined concept continuously used in the retirement literature, the construction of the firm incentive measure is novel.

4.1 Constructing firm incentive measure

The identification of firms that have higher incentives to dismiss older workers and send them to retirement is pivotal. We propose a measure that is grounded on the idea that a firm wage growth relative to the growth of the marginal product is a feasible incentive measure because a positive difference between wage growth and productivity growth is associated with higher costs relative to the benefit of older workers to the firm. As we want to measure the effect of the firm, we refrain from using individual wage growth but construct the incentive measures on the firm level which should also reflect the firms' cost structure more precisely. An additional complication is generated by the lack of data availability about the marginal product. Instead, we suggest to use industry wage growth. Although industry wage growth does not exactly reflect productivity, the incentive effects can be mapped similarly. The industry wage growth represents the overall industry-specific incentive to dismiss older workers. A larger positive difference between firm wage growth and industry wage growth - a positive wage growth gradient - is associated with higher layoff incentives for those particular firms compared to their direct competitors. It is clear, however, that the use of industry wage growth incorporates a potential measurement error of the true firm incentive.

We propose three different definitions of the incentive measure, which are denoted as wage growth gradients. For estimating these wage growth gradients, we use the daily wages of all male blue collar workers between 15-65 years between 1997 and 2008 in order to compute a firm wage growth and the respective industry wage growth of all firms from our $39,076$ retirees.

We split up the workforce into 10 age groups, where age group 1 refers to age $15-20$ and age group 10 to age $61-65$ respectively.. Let w_{naijt} be the daily wage of worker $n = 1, ..., N$ in age group $a = 1, ...10$, firm $i = 1, ..., I$, industry $j = 1, ..., J$ and year $t = 1997, ..., 2008$.

Let

$$w_{aijt} = \frac{1}{N} \sum_{n=1}^{N} w_{naijt} \tag{1}$$

be the average daily wage of age group a, firm i in industry j and year t, and

$$w_{ajt} = \frac{1}{I} \sum_{i=1}^{I} w_{aijt} \tag{2}$$

the average daily wage of age group a in industry j and year t.

The difference of these two variables gives us a firm and age group specific deviation of average wages[21] from the industry average wage. A positive deviation of firm i signals a higher average daily wage compared to the industry average daily wage. Deviations

[21] from now on we denote daily wages as wages

are calculated for each age group, so some firms have higher wages across all age groups, other firms only for some specific age groups. Based on these variables we define three different wage growth gradients:

1. $$Wage - Grad^1_{ijt} = \frac{1}{2}\sum_{a=9}^{10}(w_{aijt} - w_{ajt}) \tag{3}$$

   which is the difference between the average firm wage and the respective industry wage for age groups 9 and 10 - the oldest age groups. A positive $Wage - Grad^1_{ijt}$ implies higher costs of older workers for firm i relative to their competitors, and consequently signals a higher incentive to lay older workers off.

2. In order to reflect wage growth, we subtract the firm-industry wage difference of the young workers from the wage difference of the older workers:

   $$Wage - Grad^2_{ijt} = \frac{1}{2}\sum_{a=9}^{10}(w_{aijt} - w_{ajt}) - \frac{1}{2}\sum_{a=1}^{2}(w_{aijt} - w_{ajt}) \tag{4}$$

   A positive $Wage - Grad^2_{ijt}$ signals an increasing firm wage growth relative to industry wage growth, the incentive to dismiss older workers increases with a higher wage growth gradient. A one-€increase implies that firm wage growth increases relative to industry wage growth by 1-EUR over 40 years.

3. In a regression-based approach, we compute the wage growth gradient directly by estimating the following OLS-regression separately for each firm and year:

   $$(w_{aijt} - w_{ajt}) = \beta_{0,ijt} + \beta_{1,ijt} * age_{ijt} + \epsilon_{ijt} \tag{5}$$

   with age_{ijt} as the mean age of each age group. Equation 5 gives us an age coefficient for each firm and year. A positive $\beta_{1,ijt}$ can be interpreted as an age-specific firm wage growth deviation from the industry wage growth. Hence,$\beta_{1,ijt}$ can be directly defined as a wage growth gradient.

   $$Wage - Grad^3_{ijt} = \beta_{1,ijt} \tag{6}$$

In fact, $Wage-Grad^3_{ijt}$ is very comparable to $Wage-Grad^2_{ijt}$ with the only difference that $Wage-Grad^3_{ijt}$ takes the entire age distribution into account whereas $Grad^2_{ijt}$ only considers the difference between the oldest and youngest age groups. Similarly, a higher and positive $Wage-Grad^3_{ijt}$ increases the incentives for firms to send older workers into retirement but a 1-€ increase now reflects a firm wage growth increase relative to industry wage growth by 1-€ for one year (compared to 40 years).

The upper part of table 2 summarizes the distribution of the three definitions of the wage growth gradients. For our sample, $Wage-Grad^1_{ijt}$ has a mean deviation of € 6.94, $Wage-Grad^2_{ijt}$ is on average € 2.87 and the regression-based $Wage-Grad^3_{ijt}$ is on average € 0.076.

4.2 Empirical model

Based on our theoretical considerations, we can derive the following empirical model:

$$R_{nij} = \alpha^0 + \alpha^1 * (Wage - Grad^x_{ijt}) + \alpha^2 * SSW_{nij} + \alpha^3 * X_{nij} + t + ind_j + \epsilon_{nij} \quad (7)$$

where R_{nij} is the retirement age of worker n in firm i of industry j between 2000 and 2008 and $Wage-Grad^x_{ijt}$ corresponds to one of the three firm incentive measures. Then α^1 measures the effect of the difference between average firm and average industry wage growth. From our theory, we expect α^1 to be negative, as a greater gap increases firm incentives and consequently lowers retirement age of their workers. As workers are only willing to accept an offer that makes them indifferent and firms are not willing to accept reputation costs in the future, individual retirement incentives, measured by the social security wealth (SSW) need to be unchanged. Therefore, controlling for these individual retirement incentives is fundamental and α^2 measures the impact of social security wealth on retirement age. Then, conditional on the social security wealth, α^1 should only capture firm effects. We further control for additional individual characteristics X, i.e. tenure, health status or collected social security contributions, as well as retirement year and industry fixed effects.

Firms with higher wage growth gradients have a higher incentive to substitute older workers with younger workers. A good way to dismiss these workers is sending them into retirement. Therefore we would expect retirement age to be lower in firms where older workers are disproportionately expensive. However, as seniority wages are likely to be correlated with unobserved individual propensity to retire, the coefficient of our treatment variable is likely to be biased. Wage growth gradients automatically depend on hiring and firing patterns of the firm, and a lower retirement age therefore affects wage growth gradients as well (reversed causality). If a lower retirement age is associated with lower wage growth gradients as the more expensive workers are sent into retirement, this positive correlation would then lead to a downward bias towards zero in an OLS-regression. A further relevant source of endogeneity arises from selection of workers into firms, as well as peer effects.

4.3 Identification

The endogeneity of the wage growth gradients makes it impossible to identify a causal relationship between retirement age and wage growth gradients. In order to control for unobserved heterogeneity and reversed causality, we implement an instrumental variable approach. The instrument needs to influence the wage growth gradients, hence the cost structure of the firm, but should not directly affect the retirement age of the workers. The exclusion restriction also requires that the instrument has to be independent from any individual propensity to retire (that is not captured by the individual retirement incentives). Based on the idea of Beaudry and DiNardo (1991), we use lagged local age-specific unemployment rates as instruments, providing us with exogenous variation in firm wage growth but they should be uncorrelated with today's individual retirement decision. There are several studies showing that wages depend on the business cycle, e.g Bils (1985) shows that a fall in the unemployment rate by one percentage point increases real wages by 1.5 to 2 percent. A higher unemployment rate enables firms to pay lower wages. Bils (1985) also finds that wages of those who stay are only slightly procyclical whereas wages from job changes (or new entrants) are very procyclical (see also Haefke *et al.* (2008)). This indicates that wages are rigid to a certain extent. Consequently, in the presence of rigid wages, past labor market conditions also determine the wage structure of the firm today (see e.g. Beaudry and DiNardo (1991)). Hagedorn and Manovskii (2013) theoretically replicate the results of Beaudry and DiNardo (1991) and Bils (1985), and find empirical evidence that past labor market conditions have explanatory power for current wages through the match quality of firm and worker.

Rigid wages allow us to use lagged unemployment rates. The use of past labor market conditions is also important, because current labor market conditions also affect individual retirement incentives directly. In case of worse labor market conditions, retirement becomes more attractive to older workers. Coile and Levine (2007) find that downturns in the labor market increase retirement transitions significantly. A three percentage point increase in the unemployment rate increases the retirement rate by roughly 5 percent. Therefore, using current unemployment rates would clearly violate the exclusion restriction. However, there is no evidence that labor market conditions 5 or 10 years ago should somehow influence today's retirement incentives. Still, to strengthen the validity and the exclusion restriction, we use age-specific unemployment rates. Unemployment rates for young workers (below 25) affect the wage policy only for young workers, but is unrelated to retirement incentives and labor market situation of older workers. A higher youth unemployment rate should lead to lower wages for young workers and hence, ceteris paribus, increase the wage growth gradient. Higher unemployment rates for prime age and older workers, however, are expected to reduce wage growth gradients.

The variation of the instrument is explained by regional and time variation. As we control for years, the only variation that is left in the instrument is the regional variation in unemployment rates. This implies that the variation of the wage growth gradients in the 2SLS-estimator is only explained by the regional variation of the instruments. The local average treatment effect is the effect of a 1-€ increase of the wage growth gradient on retirement age for those who are sent into retirement because of higher wage growth gradients due to the local labor market situation in firm's district, but would not have been sent into retirement if the firm was located in a different district. This should be completely unrelated with any unobserved firm characteristics, worker selection or unobserved individual propensity to retire.

The lower part of table 2 summarizes the instrumental variables measured for districts where the firms are located. Austria has a traditionally low youth unemployment rate of approximately 7 percent, while the unemployment rates for older workers are twice as large as the unemployment rates of the younger cohorts.

Following this, we estimate a 2SLS-model where the first stage is:

$$Wage{-}Grad^x_{ijt} = \gamma^0 + \gamma^1 * UR^{young}_{ij,t-5} + \gamma^2 * UR^{prime}_{ij,t-5} + \gamma^3 * UR^{old}_{ij,t-5} + \gamma^4 * SSW_{nij} + \gamma^5 * X_{nij} + t + ind_j + \mu_{nij} \tag{8}$$

$UR^{young}_{ij,t-5}$ is the local unemployment rate for young workers five years before retirement, $UR^{prime}_{ij,t-5}$ and $UR^{old}_{ij,t-5}$ are the local unemployment rates for prime-age and older workers. The second stage is then given by:

$$R_{nij} = \alpha^0 + \alpha^1 * (Wage \hat{-} Grad^x_{ijt}) + \alpha^2 * SSW_{nij} + \alpha^3 * X_{nij} + t + ind_j + \epsilon_{nij} \tag{9}$$

The validity of the instruments requires for all three variables $Cov(IV_{ijt}, \epsilon_{nij}) = 0$. α^1 is expected to be negative and can be interpreted as the causal effect of a 1-€ increase of the wage growth gradient on retirement age.

5 Preliminary results

Tables **??** to **??** summarize our main estimation results on retirement age four the three different definitions of the wage growth gradients for male blue collar workers. We find that accounting for endogeneity is very crucial for the results and the 2SLS results suggest that higher wage growth gradients are associated with a statistically significant lower retirement age. This result is robust across definitions of wage growth gradients. The first two columns of tables **??**, **??** and **??** show the first stage results. They suggest that the local unemployment rates five years before retirement have the expected sign and are statistically significant with the exception of the unemployment rate of older workers. This might be reasonable because those older workers whose wages have been affected by this unemployment rate are already retired today and therefore are not an element of the current wage growth gradients anymore. A higher youth unemployment rate allows firms to lower wage offers which leads to to higher wage growth gradients. Higher unemployment rates for prime-age workers lowers their wages and thus also the wage growth gradients. A Cragg-Donald Wald F-statistic of roughly 200 indicates a significant impact of the instrument on the wage growth gradients.

Apart from "$Wage - Grad^1$", the OLS-estimates are insignificant and basically zero. This does also not change if we control for individual retirement incentives. One plausible explanation could be the reversed causality problem of lower retirement age leading to lower wage growth gradients. This positive reversed correlation could potentially bias the coefficients downwards toward zero. Once we account for endogeneity, the 2SLS estimates become significant at the 1-percent level and are negative throughout the specifications. Interestingly, the effects do not vary substantially if we control for individual retirement incentives. For the second and third definition of the gradient, the wage growth effect decreases slightly if we include social security wealth and other individual characteristics. While the first two definitions of the gradient are relatively comparable because both measure an increase over 40 years, the third regression-based definition only measures a yearly increase. Table **??** now compares the three definitions by rescaling the effect of "$Wage - grad^3$". First, it turns out that all three measures give us very comparable results also in effect size, which underlines the consistency and robustness of our estimates. Second, a 1-€ increase of the wage growth gradients reduces retirement age on average by 0.06 to 0.086 years. This is equivalent to a reduction between approximately 22 to 31 days. As we also control for individual retirement incentives, this effect can be attributed to the firms. This suggests that firms play a quite substantial role in the retirement decision of workers. The size of the effect is additionally underpinned if we look at the beta effect. There, an increase of the wage growth gradient by one standard deviation (i.e. approximately 16 Euros for "$Wage - Grad^2$") reduces retirement age by 0.57 of a standard deviation ($1,68$ years), which is equivalent to a reduction of almost 11 months.

6 Conclusions and outlook

We examine the role of firms in individuals' retirement decision. Based on the delayed payment contract model developed by Lazear, we derive three firm incentive measures to lay off older workers by relating firm wage growth to industry wage growth. We control for endogeneity and reversed causality by implementing an instrumental variable strategy, where we exploit exogenous variation in past labor market conditions. According to our theoretical predictions we find that higher wage growth gradients lead to a lower retirement age. This effect is substantial in size and robust across definitions of wage growth gradients. As we control for individual retirement incentives, we interpret this effect as a significant role of firms in individual retirement decisions.

In next steps we want to extend our analysis to white collar workers and women. We would also like to analyze how the wage growth gradients affect the probability of phased retirement, the probability of early and disability pension as well as the probability of receiving special severance payments ("Golden Handshakes") before transition to retirement. We also want to look at firm size heterogeneity and study the firm impact dependent on whether the economy is in a boom or recession.

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7 Figures and tables

Figure 1: Seniority wage model and firm incentives

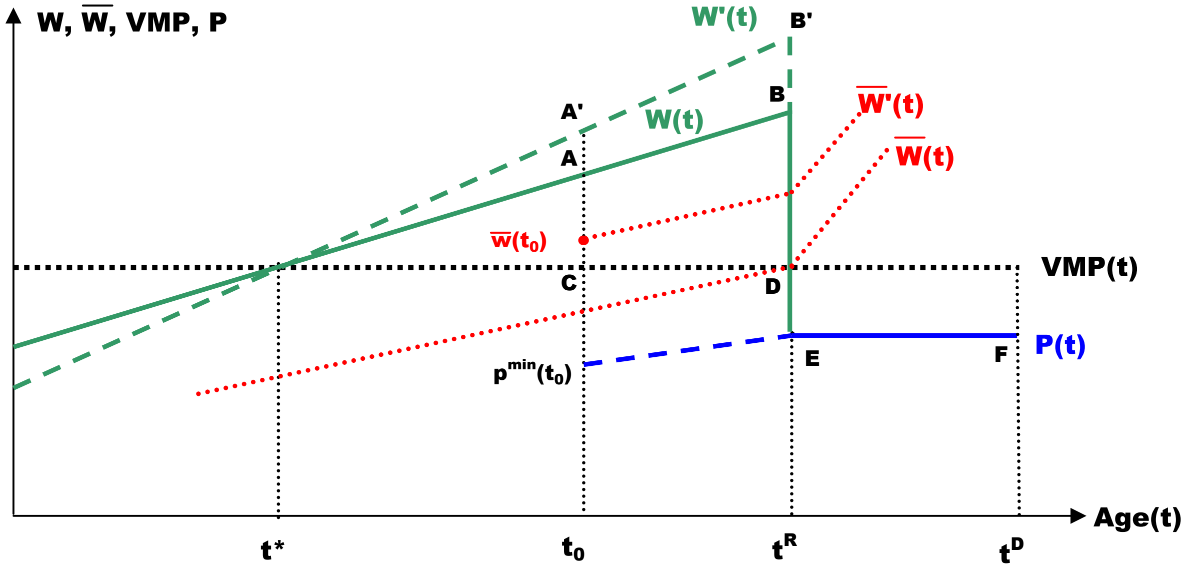

Figure 2: Seniority wages, firm incentives and generous social security systems

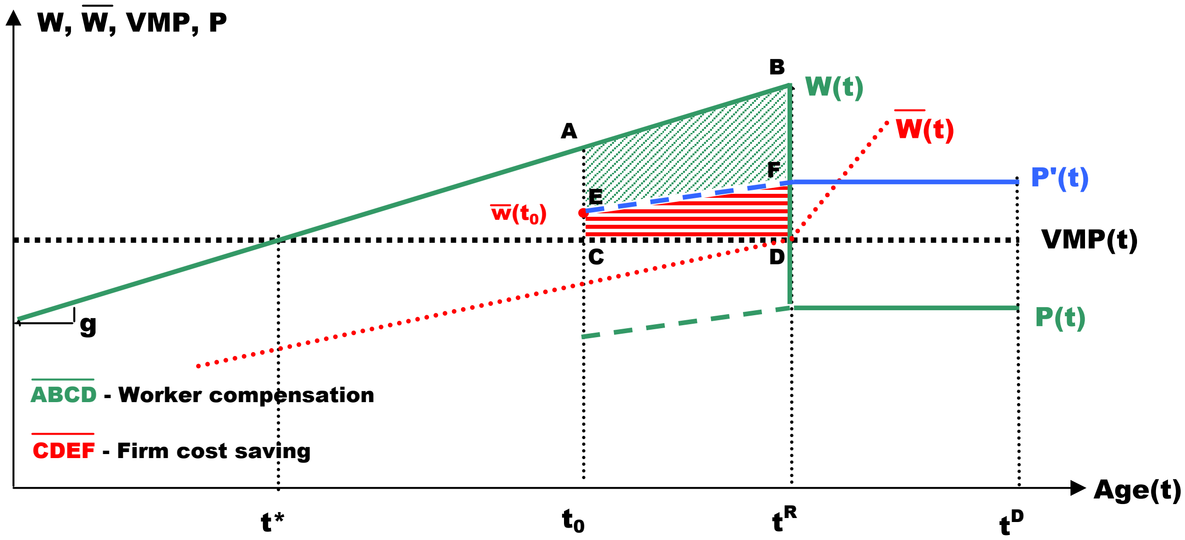

Figure 3: Retirement age of male blue collar workers

Figure 4: Retirement age of male white collar workers

Table 1: Descriptive statistics

	Mean	Std.Dev.	Min.	Max.
Age at last job exit	59.68	1.68	57.00	65.96
Duration (exit until retirement)	56.5	143.2	0	730
Assessment base for pension (SSW, in €)	444,792	102,156	18,864	1,770,545
Pension contribution months	415	86.8	18	570
Tenure in firm (years)	16.17	10.31	2	36.95
Last year before retirement				
days worked	314	119	0	365
days sick	52	205	0	365
days unemployed	24	85	0	365
40 years before retirement				
days worked	12,660	2,654	146	16,314
days sick	324	1,100	0	14,367
days unemployed	348	518	0	13,420
Observations		39,076		

Own calculations, based on *ASSD*

Table 2: Summary statistics for wage growth gradients and IV's

	Mean	Std.Dev.	Min.	Max.
Wage growth gradients:				
$Wage - Grad^1$	6.94	17.60	-103.86	88.80
$Wage - Grad^2$	2.87	16.42	-106.90	107.19
$Wage - Grad^3$	0.076	0.370	-2.81	2.65
IV: Regional unemployment rates on district level (lag 5):				
$young(15-25)$	7.23	1.93	3.21	16.44
$prime(25-50)$	7.49	2.54	2.22	18.04
$old(50-65)$	14.57	6.656	2.86	51.18
Observations		39,076		

Own calculations, based on *ASSD*

Table 3: Blue Collar workers: The effect of the wage growth gradient on job exit age

	(1) OLS	(2) First stage	(3) 2SLS
Wage growth gradient 2	0.070***		-1.494**
	(0.024)		(0.632)
No. of weeks worked at age 55	0.001	-0.005***	-0.006
	(0.012)	(0.002)	(0.015)
No. of weeks on sick leave at age 55	-0.001	-0.005***	-0.008
	(0.012)	(0.002)	(0.015)
No. of weeks out of work at age 55	-0.002	-0.007***	-0.013
	(0.013)	(0.003)	(0.017)
Tenure (in years)	0.010***	0.009***	0.024***
	(0.002)	(0.001)	(0.006)
Social security wealth (in 1,000)	-0.001***	0.002***	0.002
	(0.000)	(0.000)	(0.001)
Social security contribution months	0.005***	-0.000***	0.004***
	(0.000)	(0.000)	(0.001)
No. of male blue collar workers	-0.000**	-0.000	-0.000***
	(0.000)	(0.000)	(0.000)
Firmsize	0.000	0.000*	0.000*
	(0.000)	(0.000)	(0.000)
Unemployment rate (lag 1)	-0.013	0.021***	0.011
	(0.013)	(0.008)	(0.015)
Unemployment rate (lag 5)	0.014	0.005	-0.006
	(0.011)	(0.006)	(0.012)
Prime-Age unemployment rate (lag10)		-0.029***	
		(0.008)	
Year of job exit FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Regional FE	Yes	Yes	Yes
Number of observations	37400	37400	37400
R-squared	0.26	0.12	-0.04
Mean of dependant variable	59.62	0.12	59.62
S.d. of dependant variable	1.64	0.61	1.64
Mean of wage growth gradient	0.12		0.12
S.d. of wage growth gradient	0.61		0.61
Mean of unemployment rate (Lag10)		7.29	
S.d. of unemployment rate		2.46	
F-test of weak instrument			14.579

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: White Collar workers: The effect of the wage growth gradient on job exit age

	(1) OLS	(2) First stage	(3) 2SLS
Wage growth gradient 2	0.015***		-0.185***
	(0.004)		(0.066)
No. of weeks worked at age 55	0.043***	0.001	0.043***
	(0.010)	(0.009)	(0.010)
No. of weeks on sick leave at age 55	0.038***	-0.004	0.037***
	(0.010)	(0.008)	(0.010)
No. of weeks out of work at age 55	0.043***	-0.003	0.043***
	(0.010)	(0.010)	(0.011)
Tenure (in years)	0.008***	0.014***	0.011***
	(0.001)	(0.003)	(0.001)
Social security wealth (in 1,000)	0.001***	0.005***	0.002***
	(0.000)	(0.000)	(0.000)
Social security contribution months	-0.003***	-0.002***	-0.003***
	(0.000)	(0.000)	(0.000)
No. of male blue collar workers	-0.000***	0.000	-0.000
	(0.000)	(0.000)	(0.000)
Firmsize	0.000**	-0.000	0.000
	(0.000)	(0.000)	(0.000)
Unemployment rate (lag 1)	-0.026***	0.030	-0.027**
	(0.009)	(0.027)	(0.011)
Unemployment rate (lag 5)	0.019**	0.120***	0.023**
	(0.008)	(0.034)	(0.010)
Prime-Age unemployment rate (lag10)		-0.158***	
		(0.028)	
Year of job exit FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Regional FE	Yes	Yes	Yes
Number of observations	41777	41777	41777
R-squared	0.38	0.04	0.26
Mean of dependant variable	60.63	0.22	60.63
S.d. of dependant variable	1.63	2.94	1.63
Mean of wage growth gradient	0.22		0.22
S.d. of wage growth gradient	2.94		2.94
Mean of unemployment rate (Lag10)		6.61	
S.d. of unemployment rate		2.50	
F-test of weak instrument			32.991

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: The effect of the wage growth gradient on job exit age: Robustness

	Gradient 1	Gradient 2	Gradient 3
Blue collar workers			
IV: Unemployment rate (lag 10)	-0.037**	-1.494**	-0.585**
	(0.017)	(0.632)	(0.261)
F-test of weak instrument	11.968	14.579	12.575
Number of observations	37,411	37,400	39,262
IV: Unemployment rate (lag 15)	-0.033***	-1.226***	-0.746**
	(0.013)	(0.443)	(0.308)
F-test of weak instrument	16.717	21.829	8.026
Number of observations	36,263	36,252	38,090
Mean of dependant variable	59.63	59.63	59.65
S.d. of dependant variable	1.65	1.65	1.65
Mean of wage growth gradient	4.51	0.12	-0.14
S.d. of wage growth gradient	29.93	0.61	3.87
White collar workers			
IV: Unemployment rate (lag 10)	-0.005***	-0.185***	-0.404
	(0.002)	(0.066)	(0.429)
F-test of weak instrument	23.561	32.991	1.156
Number of observations	41,791	41,777	44,028
IV: Unemployment rate (lag 15)	-0.004*	-0.159*	-0.242
	(0.002)	(0.082)	(0.213)
F-test of weak instrument	12.564	20.396	1.808
Number of observations	39,830	39,816	41,988
Mean of dependant variable	60.68	60.68	60.67
S.d. of dependant variable	1.63	1.63	1.62
Mean of wage growth gradient	8.13	0.21	0.43
S.d. of wage growth gradient	142.74	3.00	16.17

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: The effect of the wage growth gradient on alternative outcomes

	Gradient 1		Gradient 2		Gradient 3	
	Lag 10	Lag 15	Lag 10	Lag 15	Lag 10	Lag 15
Blue collar workers						
Invalidity	0.002	0.000	0.065	0.010	0.019	-0.009
	(0.003)	(0.002)	(0.120)	(0.090)	(0.049)	(0.057)
Mean of dependant variable	0.32	0.33	0.32	0.33	0.32	0.33
S.d. of dependant variable	0.47	0.47	0.47	0.47	0.47	0.47
Phased Retirement	-0.002	-0.000	-0.065	-0.012	-0.034	-0.020
	(0.004)	(0.003)	(0.160)	(0.120)	(0.067)	(0.081)
Mean of dependant variable	0.17	0.17	0.17	0.17	0.17	0.17
S.d. of dependant variable	0.37	0.38	0.37	0.38	0.37	0.38
Golden Handshake	0.005***	0.003*	0.199***	0.096*	0.060*	0.043
	(0.002)	(0.001)	(0.073)	(0.053)	(0.033)	(0.036)
F-test of weak instrument	11.968	16.717	14.579	21.829	12.575	8.026
Mean of dependant variable	0.08	0.08	0.08	0.08	0.08	0.08
S.d. of dependant variable	0.27	0.27	0.27	0.27	0.27	0.27
Number of observations	37,411	36,263	37,400	36,252	39,262	38,090
White collar workers						
Invalidity	0.000	-0.000	0.005	-0.002	0.014	0.006
	(0.000)	(0.000)	(0.010)	(0.014)	(0.024)	(0.021)
Mean of dependant variable	0.09	0.09	0.09	0.09	0.09	0.09
S.d. of dependant variable	0.28	0.28	0.28	0.28	0.28	0.29
Phased Retirement	-0.000	-0.001*	-0.019	-0.052*	-0.051	-0.084
	(0.001)	(0.001)	(0.028)	(0.030)	(0.070)	(0.066)
Mean of dependant variable	0.21	0.22	0.21	0.22	0.21	0.22
S.d. of dependant variable	0.41	0.42	0.41	0.42	0.41	0.42
Golden Handshake	0.001**	0.001	0.042**	0.035	0.093	0.060
	(0.001)	(0.001)	(0.020)	(0.026)	(0.095)	(0.048)
F-test of weak instrument	23.561	12.564	32.991	20.396	1.156	1.808
Mean of dependant variable	0.15	0.14	0.15	0.14	0.15	0.14
S.d. of dependant variable	0.36	0.35	0.36	0.35	0.36	0.35
Number of observations	41791	39830	41777	39816	44028	41988

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$