Publikation: „Wirtschaftspolitische Herausforderungen des demografischen Wandels“, Herausgeber: Thomas Salzmann, Vergard Skirbekk, Mirjam Weiberg, In: Doblhammer, G. & Vaupel, J.W. (Eds.): Demografischer Wandel – Hintergründe und Herausforderungen, Reihe in VS-Research, VS-Publishing Company, Wiesbaden

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Do older workers earn more than they deserve?

Laura Romeu Gordo, Antje Mertens

1. Introduction

Over the past decades, life expectancy in OECD countries has increased strongly, a fact that is obviously beneficial for OECD citizens. However, combined with decreasing birth rates this development has led to the well-known problem of population ageing. Sustainability of pension systems, and – linked to this problem – the employability of older workers, are issues that need to be dealt with in the years to come. Germany is no exception: the *Statistisches Bundesamt* has estimated that by 2050, 40% (10 percentage points more than currently) of the working-age population will be 50 to 64 years old (Statistisches Bundesamt, 2006). While increases in the official retirement age have already been introduced, firms still often prefer younger workers over older ones, especially in recruitment (see for example Eichhorst, 2006; Heywood et al., 2008). One of the main problems in German labour markets is early exit. Participation rates decline rapidly after the age of 60, dropping to 25% for men at an age of 63 and to 10% for women (OECD, 2005). Moreover, not only are the labour-force participation rates of those between 55 and 64 lower, but the unemployment and long term unemployment rates in that age group are also higher than on average.[1]

As a result, an important segment of the working population is not working. The OECD (2005) has estimated that 11.7% of the German working-age population are 'mobilisable labour resources'; and two-thirds of this percentage is attributable to excess non-employment of older workers. Quite a few studies have investigated the factors which affect the employment of older workers, all showing that the institutional context is of high relevance. On the labour supply side the generosity of unemployment compensation and pension systems influence participation and employment decisions (Schmidt, 1995; Riphahn/Schmidt, 1997; Eichhorst et al., 2004). On the labour demand side companies have to deal with relatively non-transparent age-specific regulations (Pfarr et al., 2005; Brussig et al., 2006; RWI/ISG, 2005).

Wage rigidity and increasing age-earnings profile have also been identified as a

[1] See Figure A1 in the Appendix.

possible determinant of low employment rates of older workers in Germany. Wages for older workers could be higher due to wage bargaining and /or the prevalence of delayed payment contracts[2], potentially leading to age-earning profiles which differ from age-productivity profiles. This paper uses cognitive abilities as an indicator of productivity potential in order to see whether productivity decreases with age and how wages adapt to this profile. Moreover, we will decompose wage differentials between older and younger workers in explained and unexplained components in order to test whether older workers earn more or less than younger workers, controlling for a standard set of covariates known to influence wages and our cognitive ability variables. Section 2 below gives a brief overview of the literature to date and discusses evidence on age-productivity and age-earnings profiles. In section 3 our data, the German Socio-economic Panel Study and our methodology is described. Section 4 presents our results and the final section 5 concludes.

2. Age-earnings and productivity profiles

2.1 Age-productivity profiles

The main difficulty in establishing the relationship between age and productivity is the measurement of productivity. Skirbekk (2004) offers an extensive review of productivity measurement and age productivity profiles. The most common measurement used in the studies on age and productivity are supervisors' ratings of employees' productivity. These studies show little or no relationship between productivity and the age of employees. However, this measurement of productivity may be biased, since supervisors may evaluate older workers more generously as a reward for past achievements or as a reward for loyalty (Salthouse/Maurer, 1996). Furthermore, there is a selection problem, since poorly rated individuals may lose their job before reaching older ages.

Early studies from the 1950s and 1960s are based on more objective measures of productivity like production records. In this case productivity is measured counting the number of items produced by an individual within a given time. Analyses based on this measurement of productivity show increase in performance with age until the middle of the working life and decline of productivity after this peak (Mark, 1957; Kutscher/Walker, 1960). The problem with this measurement is that output is not always easy to measure for all employees.

Some recent studies are based on employer-employee datasets and analyse the impact of the age structure of a firm's labour force on the firm's output (Crepon et

[2] Implicit contracts between employer and employees, which imply that employees are underpaid at the beginning and overpaid at the end of the contract. The purpose of such contracts is to discourage worker shirking (Lazear, 1979).

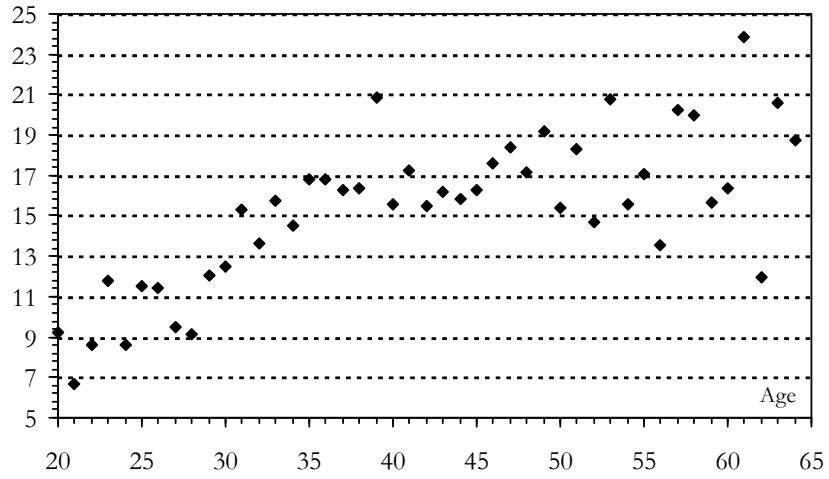
al., 2002; Ilmakunnas et al., 2004). These studies show that firms with an older age structure are less productive than firms with a younger age structure. However, it is difficult to isolate the effect of age structure on the firm's output from other components. Productivity for exceptional performers (like scientists and writers), also suggest an inverted U-shaped productivity function. The peak of the productivity function is between 20 and 40 varying according to the discipline (Jones, 2005; Lehman, 1953; Simonton, 1997).

As we see, productivity is difficult to measure and this constrains the analysis of the relationship between productivity and wages. Instead of analysing the effects of productivity on wages, the empirical labour economics literature has therefore often focused on the relationship between age and wages. This is perhaps the closest possible related link as productivity seems to be correlated with age. The next section will present some of the most important evidence from that literature with special reference to interpretations linking age earnings profiles and productivity.

2.2 Age earnings profiles and productivity

In empirical research the link between age and wages has been investigated innumerable times. The standard way of analysing this relationship is based on Becker's human capital model (Becker, 1962) and Mincer's application of the theoretical human capital framework in the form of wage regressions (Mincer, 1962, 1974). In its original form a wage regression explains earnings as a function of education and experience, with experience in practice often being proxied by age. According to the theory of human capital an increase in wages with experience is explained by the acquisition of general skills (and therefore increasing productivity) while working. Positively sloped experience-earnings profiles are interpreted as being caused by increases in worker productivity. However, the increase is usually found to decline with further experience. Hurd was the first to propose that there is an inverse U-shaped age earnings profile (Hurd, 1971). However, it has not been clarified whether the negative effect of age at the end of the working life is due to the decline in cognitive abilities or to other factors (Myck, 2007).

Figure 1: Average hourly earnings



Source: SOEP (own calculations)

Along the same lines wage regressions usually include tenure, which is typically found to have a positive effect on wages as well (holding experience constant). This is sometimes explained by the acquisition of skills on the job, with workers building up firm (and/or job) specific human capital. Within the context of human capital models the problems surrounding the financing of transferable skills may lead to problems in interpreting the estimated coefficients on the tenure variable. As firm specific skills are not transportable, investments should be shared by the firm and the worker (Becker, 1962; Parsons, 1972; Hashimoto, 1981). The resulting earnings profile will hence be relatively steep and will not reflect productivity.

Moreover, there are also other potential explanations for steep earnings profiles, including matching and efficiency wage theory. In matching models, individuals switch jobs as long as they are able to receive job offers which provide a better fit between their skills and the job (Burdett, 1978; Jovanovic, 1979; Flinn, 1986). Once a good match has been found, tenure starts to increase as there is no further incentive to leave the firm, leading to positively sloped tenure-earnings profiles independent of worker skill. According to Lazear (1979) and Hutchens (1986) there are implicit contracts between employer and employees which imply that employees are underpaid at the beginning and overpaid at the end of the contract. The purpose of such contracts is to discourage worker shirking. The honest worker will remain with the firm in order to receive her reward of a high

wage, while the worker who shirks runs the risk of being caught out and fired before obtaining the high wage. These contracts are more suited to firms where output cannot be costlessly observed. Hutchens (1986) argues that longer contracts are preferred by firms who require such payment schemes so that there is no interest in hiring new older workers.

Freeman (1977) and Harris/Holmstrom (1982) argue that the growth of wages with tenure has an insurance motive. According to the authors, firms insure workers against low productivity later in their careers. The expected value of the wage later in their careers exceeds expected marginal productivity and this gap is financed by an excess of marginal productivity over wages in early periods (Altonji/Shakotko, 1985).

Guasch/Weiss (1980, 1982) argue that increases in wages with tenure help to solve adverse selection problems when recruiting workers. The authors assume that workers know more about their abilities than firms do; therefore, firms may offer wages below marginal product in the period during which workers are evaluated and a wage above marginal product in subsequent periods to those workers who present higher productivity. This wage structure will discourage unproductive workers from applying (Altonji/Shakotko, 1987).

There is also another way of interpreting the increasing cross-sectional wage-tenure profile. It can also be the case that better workers are more likely to remain longer in their jobs, therefore increasing wages with tenure would not be explained by the theories outlined above but by the fact that good labour market matches are related to longer tenures. Altonji/Shakotko (1987) suggest estimation approaches that account for this endogeneity problem and they conclude that indeed job shopping and general labour market experience (as suggested by the human capital theory) account for most wage growth over a career.

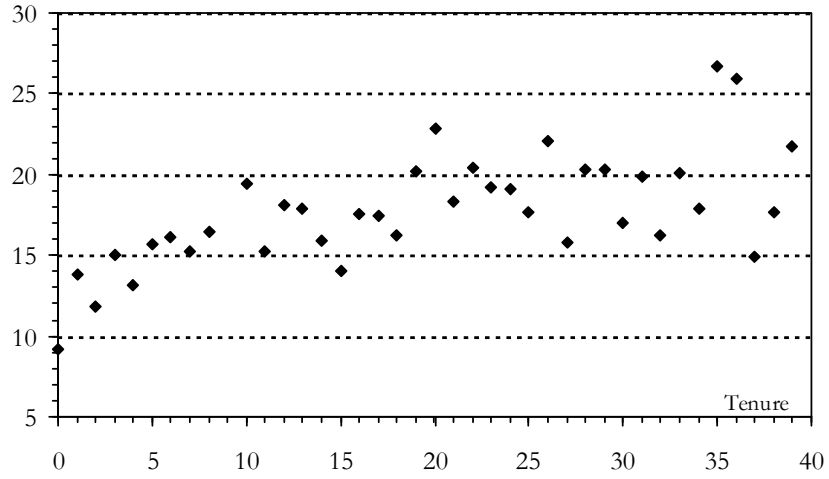
The effect that tenure has on wages can also be country specific. There are several factors that may help German workers in maintaining their earnings (and returns to tenure) when they change jobs in comparison to the US (Couch, 2003).[3] Given that the rate of unionization in Germany is approximately four times that of the US, transportability of tenure premiums might be stronger for German workers. On the other hand, worker displacement in Germany is potentially costly, implying that employers will be more selective when they hire a worker. In this context, workers who lose their jobs may be marked as undesirable, which has an effect on their future earnings.

Figure 2 shows that the wage tenure profile is not as obvious as the wage-age profile. Accordingly the evidence is very mixed. Couch (2003) reports that tenure profiles in Germany peak later than in the U.S. – an incentive for German workers to stay with their firm. Likewise, Zwick (2008) reports that German firms pay

[3] For a recent study on returns to tenure in the US see Shaw/Lazear 2007.

relatively high seniority wages in international comparison. Dustmann/Meghir (2005), however, find returns to tenure for skilled workers only. Using the Altonji-Shakotko approach, Orlowski/Riphahn (2007) are even unable to detect some significant returns to tenure for Germany.

Figure 2: Average hourly earnings



Source: SOEP (own calculations)

In order to have a more complete picture about wage formation, not only returns to tenure (specific skills) and experience (general skills) are necessary but also returns to cognitive skills as an indicator of productivity potential. In this study we analyse whether wage formation responds to cognitive abilities and whether the remuneration of cognitive abilities differs between groups of workers. In this way, we contribute to the debate about how wage formation responds to productivity developments.

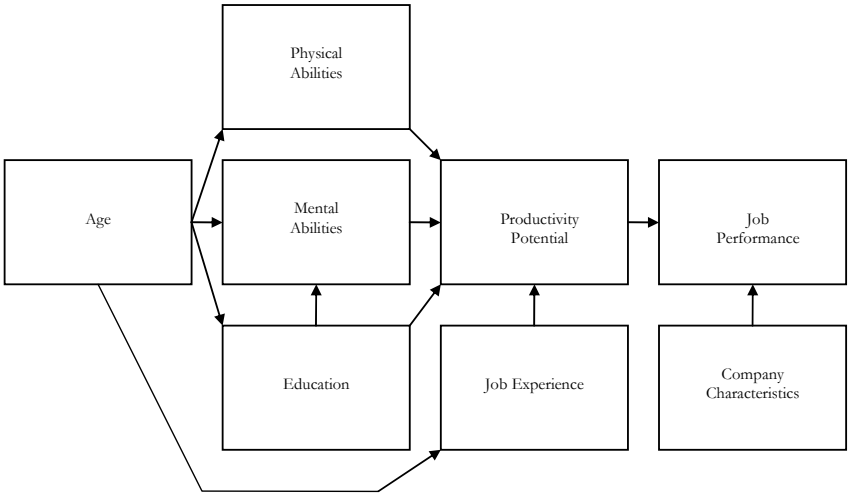
2.3 Cognitive abilities as an indicator of productivity potential

Cognitive or mental abilities refer to broad aspects of intellectual functioning (Skirbekk, 2004). These include reasoning, spatial orientation, numerical capabilities, verbal abilities and problem solving.[4] These abilities together with physical abilities,

[4] The most commonly used measurement of cognitive abilities is the IQ score.

education and job experience determine an individual's productivity potential. This, combined with the company's characteristics, determine job performance.

Figure 3: Outline of Factors Affecting Job Performance



Source: Skirbekk (2004).

In modern societies, where physical strength has lost much of its importance, cognitive skills are a good indicator of productivity (Skirbekk 2008). In most jobs what determines productivity potential is the ability to acquire new knowledge in a rapidly changing workplace. It has been tested in the literature how mental abilities affect job performance. Schmidt/Hunter (1998) analyse how different individual characteristics, such as education, work experience and general mental abilities, relate to job performance. The authors find that mental ability predicts a person's job performance better than any other observable characteristic. Currie/Thomas (1999) and Tyler et al. (2000) find that mental abilities at young ages determine adult income levels after adjusting for socio-economic status.

A large body of evidence supports the idea that cognitive abilities decline from some stage in adulthood (e.g. van Ours, 2009; Czaja/Sharit, 1993; Gelderblom/De Koning, 2002). Verhaegen/Salthouse (1997) present a meta-analysis of 91 studies that describe how mental abilities develop with age. These studies show that important cognitive abilities like reasoning, speed and episodic memory decline significantly by the age of 50. However, not all abilities follow the same pattern.

While fluid abilities (learning, perceptual speed and reasoning abilities) decline considerably over the life cycle, crystallized abilities (vocabulary size and semantic meaning) remain stable (Schaie, 1994). This indicates that during normal ageing there will be a decrease in productivity in certain tasks; but there will be other tasks in which productivity will remain stable or even increase. Furthermore, according to the literature (e.g. Roßnagel 2009; 2010) the right lifelong learning strategies enable workers to maintain the relevant competences over working life.

Skirbekk (2008) in an innovative study estimates changes in productivity potential by analysing not only the age variation in individuals' abilities but also the changing importance of these abilities in the labour market. The assumption of the author is that the age-productivity curve is not static but changes with labour market requirements (e.g. Autor/Siegfried/Dorn, 2009; Spitz-Oener, 2006). The author concludes that taking into account both aspects, the productivity potential decreases in the latter half of the working life. In the next section we will now introduce the data we use to measure cognitive abilities.

3. Analysis

3.1 Data

We use two indicators for cognitive abilities from the German Socio-Economic Panel (SOEP) to analyse whether wages respond to productivity changes with age.[5] The SOEP is a representative, interdisciplinary and longitudinal survey of the German population (SOEP Group 2001). The panel was started in 1984, and has been repeated yearly since then. The only year for which cognitive tests are available is the year 2006. In that year the survey covered a total of some 22,000 individuals from about 12,500 households. Approximately a quarter of all respondents participated in the cognitive tests, of whom almost 40% were older than 50.

Measuring productivity is a difficult task and traditional studies using supervisor ratings, piece rates, employer-employee data sets or simply age specific wage and employment patterns are plagued with the problem that "In general, there does not exist any definite way of estimating how productivity varies by age which does not entail a large degree of uncertainty or where the findings are universally valid" Skirbekk (2004). In order to supply researchers with information on productivity potential, the SOEP study offers two ultra-short tests for application, which use the theoretical framework of life-span psychology (Lang, 2005; Lang et al., 2007). This theoretical framework distinguishes between two components of

[5] It is beyond the scope of the paper to review psychological discussions surrounding the definition and measurement of cognitive abilities. See e.g. Carroll (1993); Lang (2005) and Lang et al. (2007).

intellectual functioning: the mechanics and the pragmatics of intellectual ability, corresponding to the concept of crystallized and fluid abilities. The mechanics of cognition are capacities related to information processing, and the pragmatics of intellectual ability refer to educational and experience-related competences. Both components, taken together, represent the cognitive abilities that are required for performing competently over the life course.

The mechanics of cognition are tested using the Symbol-Digit-Test (SDT) which requires individuals to match numbers with graphical symbols as quickly as possible. The test end after 90 seconds, and the maximum amount of correctly assigned digits provides an estimate of the respondent's perceptual information-processing speed (Smith, 1995; Lang et al., 2007). Knowledge-based word fluency is assessed with the Animal Naming Task. The participants name as many different animals as possible during a 90 second interval (Lindenberger/Baltes, 1995; Lang et al., 2007).

For our analysis, we select only individuals who carry out these tests. Furthermore, selection was restricted to men of working age (20-65) who are in employment. Samples B, D and G of the SOEP were excluded; these are West-German foreigners, immigrants and high income sample respectively. Finally, self employment and public employment were also excluded. These selections were carried out in order to generate a homogenous group in terms of wage formation. In the final sample approximately 1,000 individuals were included. In Table A1, some descriptive of the sample is presented.

In Figures 4 and 5 we plot the relationship between the average results of these tests and the average age of the respondents. We observe that while the results of the SDT decrease dramatically with age, the results of the Animal Naming Test present more variation and the decline with age is not that pronounced.[6] These results fit well with what the literatures says. While fluid abilities decline dramatically with age, crystallized abilities remain more stable over the life cycle.

Anger and Heineck (2006, 2008) were the first to use this data set. They report a positive effect of the fluid intelligence (or mechanics of cognition) on wages that vanishes once occupational status and industry are controlled for. Pragmatics of cognition did not influence earnings positively in their estimations, but they detected a negative relationship between cognitive abilities and unemployment.

[6] Appendix Table A2 reports means and standard deviations for different age groups used later on in our analysis.

Figure 4: Average Symbol-Digit-Test results

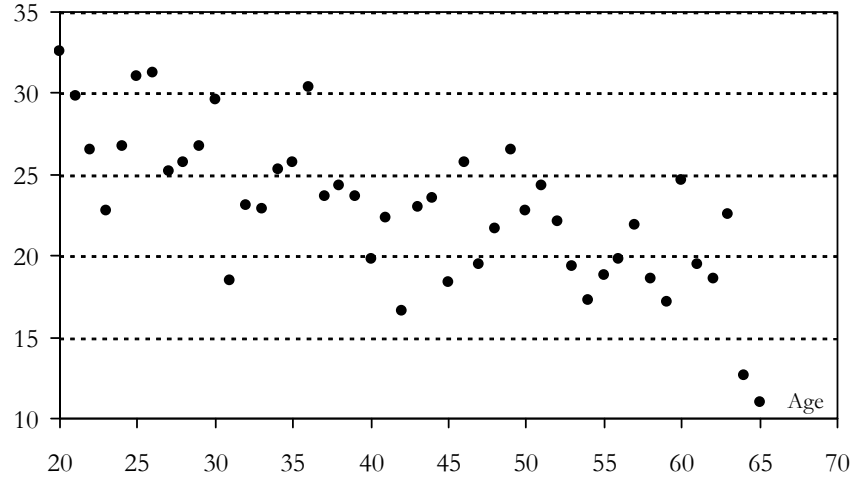
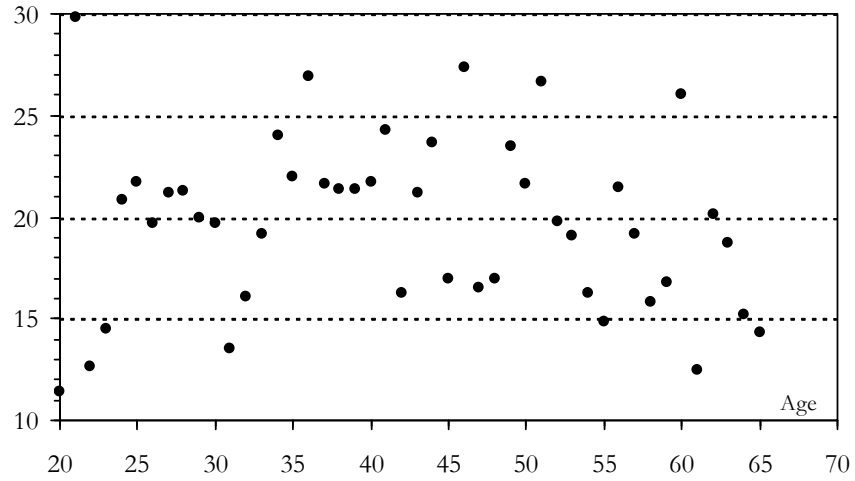


Figure 5: Average Animal Naming Test results



Source: SOEP (own calculations)

3.2 Methodology

In order to investigate whether differentials in wages between younger and older individuals are 'justified', we use the methodology developed by Oaxaca (1973) and Blinder (1973). According to Oaxaca and Blinder, any wage differential between two groups of people (defined by gender, race, ethnicity etc.) can be decomposed into two parts. The first is explained by differences in the human capital endowments of both groups, the second reflects differences in prices, that is the remuneration of these endowments. This latter element is often interpreted as an estimate of wage discrimination (Beblo et al., 2003). According to this differentiation, potential differences in the wages of younger and older individuals may be derived from both differences in human capital endowments and other job-related variables (endowment effect) and from a difference in the values that are assigned to older and younger workers' characteristics (remuneration effect). Among the endowment factors considered in the literature are educational attainment, work experience, tenure, occupational status and firm characteristics. We consider furthermore the cognitive abilities of the individuals. It is important to have a wage determination model which is as precise as possible in order to determine whether there is wage discrimination.

The basic method applies to the determination of wage differentials at the mean, and it was developed for cross-sectional data. Wage regressions of younger and older workers are estimated:

$$\ln W_i^O = X_i^O \beta^O + \varepsilon_i^O \qquad (1)$$

$$\ln W_i^Y = X_i^Y \beta^Y + \varepsilon_i^Y \quad , \qquad (2)$$

where the superscripts O and Y indicate older and younger respectively. The wage at the mean for each group is:

$$\overline{\ln W}^O = \overline{X}^O \hat{\beta}^O \qquad (3)$$

$$\overline{\ln W}^{Y} = \overline{X}^{Y}\hat{\beta}^{Y} \quad .$$

(4)

Where $\overline{\ln W}^{O} = \sum_{i=1}^{N_O} \ln W_i / N_O$ and N_O stands for the number of older workers in the sample. The vector $\overline{X}^{O}$ represents the average human capital characteristics of the older workers. If we assume that the competitive price vector in the market is the wage structure of the younger workers $\hat{\beta}^{Y}$, we can compute the predicted mean wage for older workers with coefficient estimates from the young workers' wage regression and average characteristics of older workers:

$$\overline{\ln W^{1}}^{O} = \overline{X}^{O}\hat{\beta}^{Y}$$

(5)

The wage gap can be decomposed by calculating two differences. The first difference $\overline{\ln W}^{Y} - \overline{\ln W^{1}}^{O}$ indicates by how much the mean wage for young workers exceeds the mean hypothetical wage for older workers in the absence of discrimination. The second term, $\overline{\ln W^{1}}^{O} - \overline{\ln W}^{O}$ shows the distance between the hypothetical wage for older workers and their actual mean wage:

$$\underbrace{\left\{\overline{\ln W}^{Y} - \overline{\ln W}^{O}\right\}}_{wagegap} = \left\{\overline{\ln W}^{Y} - \overline{\ln W^{1}}^{O}\right\} + \left\{\overline{\ln W^{1}}^{O} - \overline{\ln W}^{O}\right\}$$

(6)

$$= \left\{\hat{\beta}^{Y}\overline{X}^{Y} - \hat{\beta}^{Y}\overline{X}^{O}\right\} + \left\{\hat{\beta}^{Y}\overline{X}^{O} - \hat{\beta}^{O}\overline{X}^{O}\right\}$$

$$= \underbrace{\hat{\beta}^{Y}\left(\overline{X}^{Y} - \overline{X}^{O}\right)}_{endowment\ effect} + \underbrace{\overline{X}^{O}\left(\hat{\beta}^{Y} - \hat{\beta}^{O}\right)}_{remuneration\ effect}.$$

The first term of the right side of the equation (6) presents the endowment effect of the wage differential between older and younger workers; it arises from differences in the average characteristics. The second term represents the

remuneration effect due to differences in estimated coefficients (discrimination). If older and younger workers had the same characteristics at the mean, the existing wage gap would only be caused by the difference in the remuneration of these characteristics.

4. Results

4.1 Wage regressions

Before decomposing wage differentials by age, we present wage regression estimates for all workers. Apart from the more or less standard controls, we include the two covariates SDT (Symbol-Digit-Test) and ANT (Animal-Naming-Test). As discussed above, SDT controls for fluid abilities or the mechanics of intellectual ability and ANT controls for crystallized abilities or knowledge based pragmatics. In order to see whether these indicators of productivity potential have different effects for different groups, we also test whether interactions between cognitive abilities and other characteristics (like age, occupational status, tenure, education and unemployment experience) are significant. In Table 1a we present the results of the basic specification (without interaction terms). Being older, living in West Germany, education, tenure and working in a large firm have positive effects on hourly earnings. On the other hand, unemployment history and lower occupational status have a negative effect on wages. In this first model we also observe that cognitive abilities have no significant effect on wages. This corresponds to Anger/Heineck (2008), who report that effects vanish once occupation and industry are controlled for.

Still, it could be possible that cognitive abilities (or our measures thereof) are relevant for some sub-groups only. In order to test this, we run the same model with interactions. In Table 1b we interact cognitive abilities with age, occupational status and tenure. Just a few interactions are significant, which we are going to discuss in turn. We observe that the interaction terms of the Animal Naming Test with our age dummies are positive and significant. Taking into account that the reference category is the youngest age group (20-30 years old) this means that crystallized abilities become more relevant with age. Or in other words, while for the youngest workers crystallized abilities are of less relevance in the determination of wages, older individuals with better crystallized abilities earn more. However, this result is stronger for workers between 31 and 40 than for those between 41 and 65.

Table 1a: Wage regressions for men. Basic model (without interactions)

	Basic Model	
	Coefficient	Std. Error
Age 31-40	0.193***	(0.05)
Age 41-50	0.205***	(0.05)
Age 51-65	0.212***	(0.06)
Region (=1 west)	0.353***	(0.04)
Vocational Training	0.148***	(0.05)
College Education	0.353***	(0.06)
0 < Unemp. experience <=1	-0.038	(0.04)
1 < Unemp. experience <=3	-0.138**	(0.05)
Unemp. experience >3	-0.265***	(0.08)
1 < Tenure <=5	0.115**	(0.05)
5 < Tenure <=10	0.207***	(0.06)
Tenure >10	0.255***	(0.06)
Occ. status (lower professionals)	-0.178***	(0.05)
Occ. status (clerical and service)	-0.306***	(0.05)
Occ. status (skilled manual)	-0.313***	(0.04)
Occ. status (manual)	-0.506***	(0.07)
Firm size >=20 & <200	0.156***	(0.04)
Firm size >=200 & <2000	0.259***	(0.04)
Firm size >=2000	0.300***	(0.04)
Symbol Digit Test	-0.000	(0.00)
Animal Naming Test	0.001	(0.00)
Constant	1.921***	(0.09)
N.	743.000	
r^2	0.505	

Note: Unemployment experience and tenure in years. Reference categories: age 20-30, basic schooling, no unemployment experience, tenure < 1 year, higher professionals, small firm with less than 20 employees.
*** indicates significance at the 1%-level, ** at the 5%-level and * at the 10% level.
Source: Own calculations based on SOEP data for 2006.

The other clearly significant interaction we find is between the Symbol Digit Test and tenure. Once workers have been in the firm for more than a year, they get paid more as their fluid ability increases. We find the largest positive effect of fluid abilities on hourly earnings for workers who have been with their firm for over ten years. It is, however, not possible to tell from these estimations whether the positive interaction is simply the result of individuals with better fluid abilities being more likely to stay in the firm. If more productive individuals stay (which is what we

would expect) they are also likely to be paid more.

Finally, we also observe some significant interactions of both fluid and crystallized abilities with occupational status. Manual workers with higher cognitive abilities earn less than those with lower cognitive abilities. Cognitive abilities seem to be less important in those occupations and potentially even negative for earnings, although the effects are relatively minor. Tentatively, we could also argue that for manual workers other productivity factors apart from cognitive abilities still seem to matter more. Overall, our results confirm that remuneration adapts to productivity potential at least for some groups of workers, with a higher productivity potential leading to higher wages.

We also experimented with interactions between education and unemployment experience. These interaction terms have no significant effect on earnings as can be seen from Table 1c.

Table 1b: Wage regressions for men. Interactions of cognitive abilities with age, occupational status, and tenure

	Interactions with Age	Interactions with Occupational Status	Interactions with Tenure
SDT × Age 31-40	-0.005	.	.
	(0.00)	.	.
SDT × Age 41-50	-0.004	.	.
	(0.00)	.	.
SDT × Age 51-65	-0.001	.	.
	(0.00)	.	.
ANT × Age 31-40	0.012***	.	.
	(0.00)	.	.
ANT × Age 41-50	0.009**	.	.
	(0.00)	.	.
ANT × Age 51-65	0.008*	.	.
	(0.00)	.	.
SDT × Lower professionals	.	-0.004	.
	.	(0.00)	.
SDT × Clerical and service	.	0.001	.
	.	(0.00)	.
SDT × Skilled manual	.	0.003	.
	.	(0.00)	.
SDT × Manual	.	-0.010*	.

Table 1b: Wage regressions for men. Interactions of cognitive abilities with age, occupational status, and tenure (continued)

	Interactions with Age	Interactions with Occupational Status	Interactions with Tenure
	.	(0.01)	.
ANT × Lower professionals	.	-0.002	.
	.	(0.00)	.
ANT × Clerical and service	.	0.000	.
	.	(0.00)	.
ANT × Skilled manual	.	-0.006*	.
	.	(0.00)	.
ANT × Manual	.	0.006	.
	.	(0.01)	.
SDT × Tenure (>1 and <=5)	.	.	0.011**
	.	.	(0.00)
SDT × Tenure (>5 and <=10)	.	.	0.009**
	.	.	(0.00)
SDT × Tenure (>10)	.	.	0.013***
	.	.	(0.00)
ANT × Tenure (>1 and <=5)	.	.	0.002
	.	.	(0.00)
ANT × Tenure (>5 and <=10)	.	.	-0.002
	.	.	(0.00)
ANT ×Tenure (>10)	.	.	-0.004
	.	.	(0.00)
Constant	2.018***	1.911***	2.113***
	(0.10)	(0.09)	(0.11)
N.	743.000	743.000	743.000
r^2	0.512	0.513	0.517

Note: SDT = Symbol-Digit-Test; ANT = Animal Naming Test. For other controls see Table 1a. Standard errors in parentheses. *** indicates significance at the 1%-level, ** at the 5%-level and * at the 10% level.

Source: Own calculations based on SOEP data for 2006.

Table 1c: Wage regressions for men. Interactions of cognitive abilities with education and unemployment experience

	Interactions with Education	Interactions with Unemployment Experience
SDT × Vocational Training	-0.001	.
	(0.00)	.
SDT × College Education	0.005	.
	(0.00)	.
ANT × Vocational Training	0.005	.
	(0.00)	.
ANT × College Education	0.005	.
	(0.00)	.
SDT × Unemp. exp. (>0 and <=1)	.	-0.004
	.	(0.00)
SDT × Unemp. exp.(>1 and <=3)	.	-0.005
	.	(0.00)
SDT × Unemp. exp.(>3)	.	-0.010
	.	(0.01)
ANT × Unemp. exp. (>0 and <=1)	.	0.003
	.	(0.00)
ANT × Unemp. exp. (>1 and <=3)	.	0.004
	.	(0.01)
ANT × Tenure (>3)	.	0.003
	.	(0.01)
Constant	2.005***	1.903***
	(0.11)	(0.09)
N.	743.000	743.000
r^2	0.510	0.508

Note: SDT = Symbol-Digit-Test; ANT = Animal Naming Test. For other included controls see Table 1a. Standard errors in parentheses. *** indicates significance at the 1%-level, ** at the 5%-level and * at the 10% level.

Source: Own calculations based on SOEP data for 2006.

4.2 Oaxaca-Blinder decomposition

Next, we decompose wage differentials between older and younger workers in explained and unexplained components. This decomposition is based on our basic specification without interactions (compare Table 1a above), but now we split up the sample by age groups instead of including age dummies. The results are presented in Table 2. We observe that older individuals (51-65) earn slightly more than younger individuals (aged 31-50). The log wage is 2.77 for older and 2.72 for younger workers, although this difference is not significant. Decomposing the wage differential we find that endowments and remuneration work in different directions.

Table 2: Oaxaca-Blinder decomposition: older workers (51-65) vs. younger workers (31-50)

	Coeffient	Robust Std. Err.	z	P>z
Differential				
Prediction_1	2.732	0.022	126.080	0.000
Prediction_2	2.775	0.039	70.700	0.000
Difference	-0.044	0.045	-0.970	0.330
Decomposition				
Explained	-0.106	0.051	-2.070	0.038
Unexplained	0.063	0.047	1.340	0.179

[a] Prediction_1 = predicted wages of younger workers (31-50).

[b] Prediction_2 = predicted wages of older workers (51-65)

Note: For included controls see Table 1a.
Source: Own calculations based on SOEP data for 2006.

The first explained part of the wage differential reflects the mean change in older workers' wages if they had the same characteristics as younger workers. The effect is negative and significant, showing that with the same characteristics as younger workers, older workers would earn considerably less. As theory predicts, older workers have moved on in their career which leads to higher earnings. The second term quantifies the change in older workers' wages when applying younger workers' coefficients to older workers characteristics. According to our estimate, older workers compensation should be higher if remuneration were the same. By comparing the wages of older workers (51-65) with those of middle aged workers (41-50) we obtain similar results. Older workers earn slightly more, but this difference would be larger if coefficients for older and younger workers were the same. Summing up, we find that although older workers' endowment and wages are

higher, they are still being discriminated against on average and would earn more if treated as younger workers.[7]

Table 3: Oaxaca-Blinder decomposition: older workers (51-65) vs. middle aged workers (41-50)

	Coef.	Robust Std. Err.	z	P>z
Differential				
Prediction_1	2.733	0.030	91.010	0.000
Prediction_2	2.775	0.039	70.690	0.000
Difference	-0.042	0.049	-0.850	0.395
Decomposition				
Explained	-0.130	0.074	-1.77	0.077
Unexplained	0.088	0.064	1.370	0.172

[a] Prediction_1 = predicted wages of younger workers (41-50).

[b] Prediction_2 = predicted wages of older workers (51-65)

Note: For included controls see Table 1a.

Source: Own calculations based on SOEP data for 2006.

5. Conclusions

Older workers have left the German labour market in large numbers over the past decades. Apart from institutional settings, wages paid to older workers are an important determinant of labour market participation. High seniority wages may even lock out older employees from jobs (Zwick, 2008). In this paper we moved one step further in trying to understand the determinants of older workers wages. Based on the theory of human capital and job search, we first use cognitive abilities as indicators of productivity potential in our wage regressions. Certainly, our measures of cognitive abilities and productivity are not undisputed, but the effects we found are plausible and fit in with economic theory, although productivity indicators as available in the German Socio-Economic Panel (SOEP) are only minor determinants of individual wages (compare also Heineck/Anger 2008). By introducing interactions in the wage regressions, we find that cognitive abilities are a significant determinant of worker compensation, but only for certain groups. As

[7] Obviously older workers are more likely to have achieved higher tenure. So we also experimented with our specification, leaving out our tenure dummies (<1 year, 1-5, 5-10, >10). The pattern of results remains the same.

theory and common sense predict, older workers with better crystallized abilities (or knowledge-based word fluency) earn more. Moreover, workers that have been in the firm for more than a year, get paid more the higher their fluid ability.

In a second stage, we analyse wage differentials between younger and older workers using the Blinder-Oaxaca decomposition. What we obtain is that older workers earn slightly more than younger workers. Although this wage differential can be explained by older workers' endowments – considering as endowments standard wage determinants and cognitive abilities – older workers would earn even more if they were paid as younger workers. Our estimates show that returns to endowments differ between both groups to the disadvantage of older workers, even when controlling for productivity. Whether this is really discrimination or still unmeasured ability, we cannot say, as the available data just allows a cross sectional analysis. From what we have learned from the SOEP data, we conclude that older workers have more problems in achieving high returns to their endowments than younger workers. This negative effect of age at the end of the working life does not fit in with the theory of deferred payment. As even better measures of productivity and longitudinal data sets will hopefully become available in the future, we will be able to learn more about the linkages between wages, productivity and old age. Only longitudinal studies that measure abilities and wages over the working life could potentially settle the disputes about seniority wages.

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Appendix

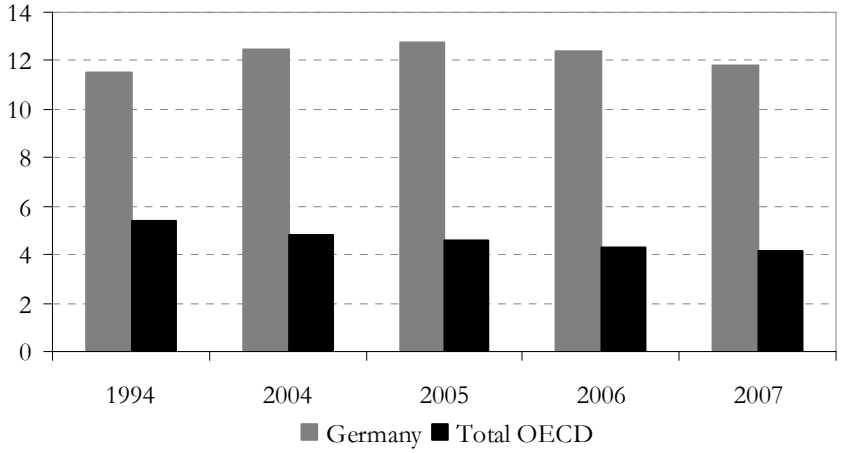
Table A1: Descriptives

	Mean	**Std. Dev.**
Hourly earnings	16.04	9.41
Age	42.20	10.28
Region (=1 west)	83.79	.
No vocational training	9.88	.
Vocational training	71.54	.
College education	18.58	.
No unemployment experience	65.99	.
Unemployment experience (>0+<=1)	21.44	.
Unemployment experience (>1+<=3)	8.38	.
Unemployment experience (>3)	4.19	.
Tenure (<=1)	11.59	.
Tenure (>1+<=5)	23.71	.
Tenure (>5+<=10)	22.21	.
Tenure (>10)	42.49	.
Occ. St. (higher prof.)	21.85	.
Occ. St. (lower prof.)	15.65	.
Occ. St. (clerical and serv.)	12.95	.
Occ. St. (skilled manual)	42.57	.
Occ. St. (manual)	6.98	.
Firm size <20	25.08	.
Firm size >=20 & <200	28.67	.
Firm size >=200 & <2000	22.28	.
Firm size >=2000	23.96	.

Table A2: Descriptives

		Mean	**Std. Dev.**
Symbol-Digit-Tests results	Age 20-30	22,87	18,40
	Age 31-40	24,59	14,12
	Age 41-50	22,86	13,96
	Age 51-65	18,53	14,66
Animal Naming Tests results	Age 20-30	17,00	14,95
	Age 31-40	22,70	14,27
	Age 41-50	21,32	13,28
	Age 51-65	18,47	14,06
Average hourly earnings	Age 20-30	9,17	3,94
	Age 31-40	16,35	6,64
	Age 41-50	16,47	7,20
	Age 51-65	17,64	8,55

Figure A1: Unemployment rates (in %), age 55-64



Source: OECD, both sexes