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Variations in Steepness of Age-Earnings Profiles

A Cross-Country Analysis Focusing on two Age Groups



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**Variations in Steepness of Age-Earnings Profiles:
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Abstract

This study aims at explaining the observed variations in the age-earnings profiles across countries and over time by focusing on the ratio of the average wage rate in the age group 60-64 to that in the age group 25-29. Accordingly, a panel data set of seventeen OECD countries over 1980-2005 is employed, and four explanatory variables are identified to play a significant role in explaining the dependent variable based on random effects econometric estimations.

The first explanatory variable is Average Relative Replacement Rate, which is a rough indicator constructed to approximate the severeness of biased withdraw toward low-skilled elder workers. The second one is Relative Strictness of Employment Protection, which calculates the differences in the level of the strictness of EPL between the old and young to indicate their comparative bargaining powers. Trust Index, the third regressor, provides an indirect interpretation for the different steepness of age-earnings profiles simply through the logics behind the Lazear's incentive theory and the theory of specific human capital. And the last one is Difference in Higher Education Attainment Rate, which is applied to reflect the productivity differences between the two age groups.

In our macro-econometric analysis, around 51 percent of the variations of dependent variable can be explained by the four independent variables. Nevertheless, model's explanatory capabilities would be further improved if micro factors are also taken into account, which could be a topic for future studies.

Keywords: Age-wages profiles, public pensions, early retirement schemes, employment protection, trust index, standard life-cycle model, panel data analysis

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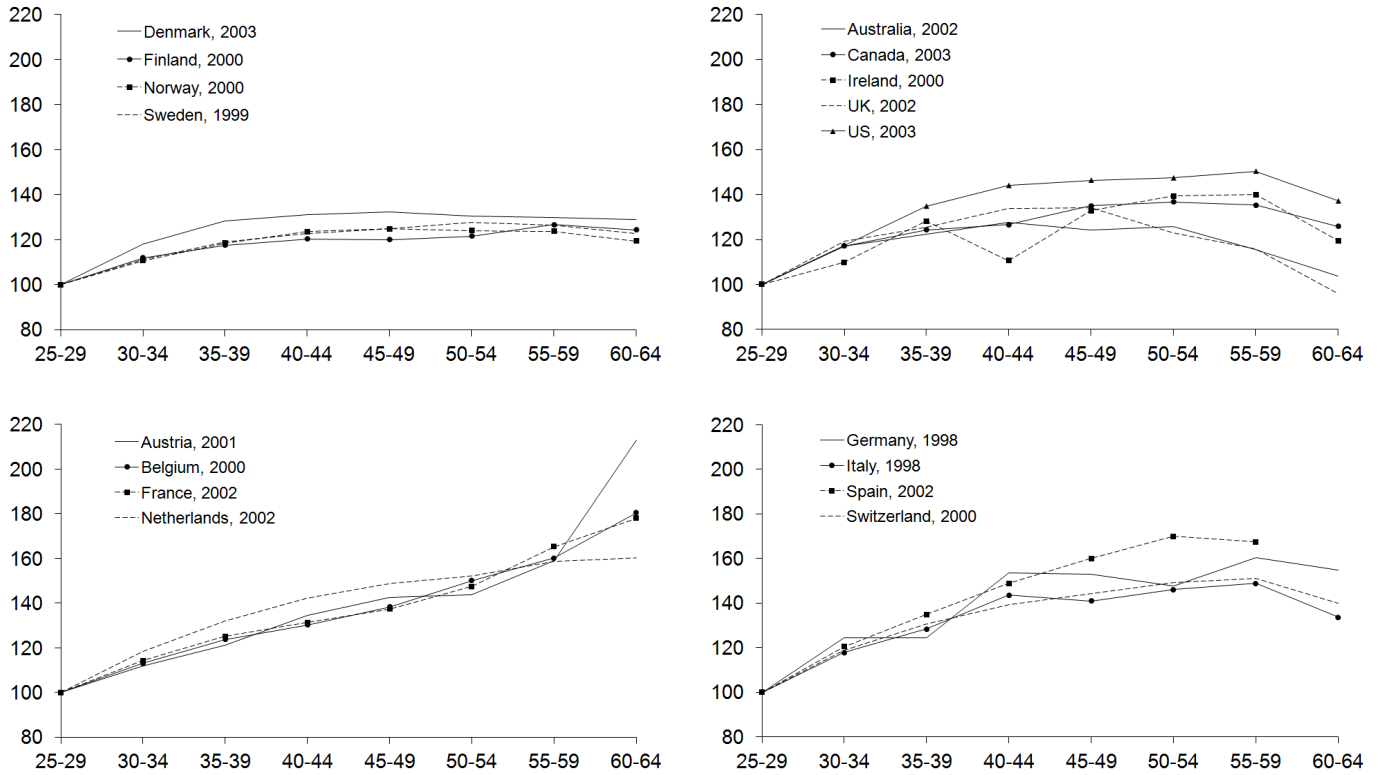
1 Introduction

Population ageing is widespread across the world. Potential challenges implied by changes in the age-structure consist of an increase in the relative size of economically inactive population, rising expenditures on health care and other cares for the elderly, and financial infeasibility of the government pension systems, etc. Moreover, a rather direct consequence of the ageing workforce concerns the fact that employers expect to pay a different total amount of wage bills than before. For instance, a survey conducted in 2005 reports that seventy-six percent of Dutch employers anticipate that their ageing labor force will cause a higher amount of wage bill, although only seven percent of them expect a rise in workers' average productivity level (Van Dalen et al., 2008; Euwals et al., 2009). For this reason, we are motivated to study how individual wage rates develop with age in different countries, which, as mentioned before, results in various expectations by employers on future wage expenditures.

In this article, attentions are only paid to full-time male workers aged between 25 and 64, who are categorized into eight different groups each with a five-year age band. Additionally, the so called age-wages profiles are depicted with the purpose of presenting how the average wage rate varies with age groups in different selected countries. In order to be more illustrative and internationally comparable, the values of the first age group, 25-29, are standardized to be one hundred for all countries, and the following numbers in the age-wage profiles are standardized through being divided by the average wage rate of the age group 25-29 and multiplied by one hundred. For example, the value corresponding to people aged between 60-64 is calculated as: (average wage rate for workers in the age group 60-64/average wage rate for workers of ages between 25-29)*100. Below, in Figure 1, the age-earnings profiles for male workers in seventeen OECD countries are presented, and the corresponding reference years vary over the period 1998-2003.

From Figure 1, differences in the shape of life-time wage profiles in Scandinavian, Anglo-Saxon and Continental European countries are not very difficult to identify. In particular, the age-earnings profiles in Scandinavia, as depicted in the top-left panel, are considerably flatter than elsewhere, while much steeper profiles are observed in some Continental European countries including Austria, Belgium, France and the Netherlands where, as can be seen in the bottom-left panel, the average wage rate continuously rises with age. Also, in some other Continental European countries like Germany, Italy and Switzerland and Anglo-Saxon countries, the profiles involve a decline after age 60 and consequently the values of the profiles for the oldest

Figure 1: Age-earnings profiles for males in Scandinavian, Anglo-Saxon and Continental European countries by using OECD data set.



Source: OECD (2006)

age group shown in the right-hand side panels are substantially lower than those shown in the bottom-left one. In view of that, the aim of this article is to provide some explanations on the cross-country variations of the shape of age-earnings profiles by focusing on why the relative levels of average wage rates between the oldest age group, 60-64, and the youngest one, 25-29, which basically correspond to the points where the age-earnings profiles in Figure 1 end up, are among the highest in some Continental European countries and not very high in the other places.

In fact, a large number of previous studies, either theoretical or empirical ones, have been involved in analyzing the shapes of age-earnings profiles,

and correspondingly in this section we provide a brief overview. First, there exists a sequence of articles concentrating on the effects of human capital investments. For instance, as has been indicated in Mincer (1970; 1997), age-earnings profiles are at least for a long time upward sloping at a diminishing rate, and more investments in human capital would result in a steeper profile which has its maximum occur at a later time. In spite of that, Mincer's argument does not seem to provide any insight into our research topic since it does not clarify why a different amount of investment is actually made. Besides, a few of articles do shed light on the determinants of investment quantities by applying the concept of hold-up (Groux, 1984) or turnover cost (Euwals et al., 2009), whereas no obvious reason can be relied on to demonstrate why the issues of hold-up and hiring costs are not similarly relevant across countries.

Moreover, investments in general and firm-specific skills are distinguished in the human capital theory (Becker, 1964), and the former leads to experience premium and the latter tenure premium (Acemoglu and Pischke, 1999). Concerning the idea of tenure premium, which refers to the increase in wage for the elderly owing to the accumulation of specific human capital, Euwals et al. (2009) prove that employing different types of contracts would imply variations in the magnitude of tenure effects. In particular, A 'firm set wage' contract does not produce any tenure effect since in that case employers capture all the returns to investments in specific human capital. On the contrary, with an 'employee set wage' contract, all the returns are captured by employee themselves and therefore wages rise with tenure largely. What is more, the positive tenure effect appears to be much smaller when a 'fixed wage' contract is employed since neither employers nor employees are willing to invest efficiently when there exists a possibility of renegotiation. Although magnitudes of tenure effects may vary across types of contract, with the difficulty of identifying which type of contract is more relevant in each country, it is still not possible to explain the cross-country variations in tenure effects and steepness of age-earnings profiles.

Besides the theory of human capital, another strand of literature also aims at elucidating the shapes of age-earnings profiles. In particular, incentive theories, which focus on employees' working incentives, are developed to validate a payment structure that is often observed in reality, namely workers are underpaid at the beginning of employment while payments are rising over the life-cycle. The corresponding arguments, which are based on the assumptions that workers' efforts cannot be verified by third parties and can only be imperfectly assessed by the firm, are as follows. First, Shapiro and Stiglitz (1984) demonstrate that by offering a higher wage than worker's

outside option and meanwhile threatening the worker with dismissal in case shirking or malperformance is detected, workers are stimulated to maximize their products. This theory has been empirically supported by Krueger and Summers (1988) and Krueger (1991). In addition, Becker and Stigler (1974) advocate postponing the wage premium till the final periods of a worker's career life in order to enhance retention. By doing so, firms are more able to save their turnover costs and capture the returns to their specific human capital investments.

The explanations above corroborate a relatively high wage for the elderly, while the theory of Lazear style implicit contracts (LSICs) justifies a lower wage rate earned by newly hired workers (see, e.g., Lazear, 1979, 1981, 1983). More specifically, when expecting to obtain a wage premium in later periods, young people who just enter the labor market are eager to pay an entrance fee in order to be hired, and a reduction of wage in the early periods of employment *de facto* functions as an integrated entrance fee.

Up to now, the practical relevances of the two theorems, i.e. human capital and incentives theorems, have been repeatedly examined, although sometimes conflicting conclusions are derived in different empirical works. For instance, it has been verified in numerous studies that the accumulation of general human capital plays an essential role in raising salaries (see, e.g., Abraham and Farber, 1987; Altonji and Shakotko, 1987; Hellerstein et al., 1999). However, such an effect has not been confirmed by Medoff and Abraham (1980, 1981), Bishop (1987), Kotlikoff and Gokhale (1992) and Flabbi and Ichino (2001). Additionally, no agreement has been reached yet over the magnitude of the effect of specific human capital. In particular, a strong positive relationship between wages and tenure is found in Topel (1991), whereas the influence is only modest according to Altonji and Shakotko (1987) and Altonji and Williams (1997) and even close to zero in Dostie (2005) and Abowd et al. (2006). Besides, the effect of specific human capital appears to vary across firms (Abowd et al., 1999; 2006), education levels (Yamaguchi, 2007; Dustmann and Meghir, 2005) and countries (Buchinsky et al., 2005; Beffy et al., 2006). What is more, evidence in favor of Lazear's incentive theory can be found in a large body of empirical papers including Lazear and Moore (1984), Hutchens (1987), Clark and Ogawa (1992), Kotlikoff and Gokhale (1992), Abowd et al. (1999), Lazear (2000), Crepon et al. (2003); Hellerstein and Neumark (2004); Huck et al. (2004); and Dostie (2006). Conversely, criticisms of incentives theory are also observable in Brown (1989) and Hellerstein et al. (1999). Last but not least, a complementary role of both theorems is also advocated by Baker et al. (1994), Seltzer and Merrett (2000), Shaw and Lazear (2007) and Dustmann

and Meghir (2005).

In addition to human capital and incentives theories, a variety of alternative theories are also available for explaining the shapes of age-earnings profile, such as the theorem of self-selection (Salop and Salop, 1976), job searching (Jovanovic, 1979; Farber, 1999), insurance (Bovenberg and Teulings, 2008), collective bargaining (Weiss, 1985; Tracey, 1986), worker preferences (Loewenstein and Sicherman, 1991; Frank and Hutchens, 1993) and job security (Leonardi and Pica, 2007).

As we have just shown, existing theoretical and empirical researches on age-earnings profiles are fairly abundant. Even so, however, heterogeneities of the profile's shape across countries, as illustrated in Figure 1, have hardly been studied yet. As a result, we are motivated to provide explanations to the variations in the profile's steepness in this article. In particular, from sections 2 to 5 below, efforts are made on identifying appropriate explanatory variables from four different perspectives, namely reservation wage, bargaining power, specific human capital/incentives theorems, and education level. Afterwards, in section 6, a panel data econometric model is constructed to examine the explanatory powers of the selected variables. And section 7 concludes this article.

2 Reservation Wages

2.1 The Theoretical Framework

In a competitive labor market, the market equilibrium price of labor service is simultaneously determined by the function of labor demand and supply. The schedule of labor supply, in turn, relies on the varying levels of individual reservation wage, which is defined as the minimum amount of salary at which an individual agrees to work and thus is equivalent to the benefits that must be forgone by accepting a job offer. Accordingly, the implied aggregate labor supply scheme is monotonically increasing with the market wage rate since a higher market wage rate induces a larger proportion of working age individuals whose reservation wages are lower than the market wage rate to enter the job market.

Given the potential influences of reservation wage, in this section, we are particularly interested in how exactly the level of reservation wage plays a role in determining the value of relative average wage rates between the old and young groups. In particular, in order to simplify the situation, two competing assumptions are made here, based on which two extreme cases are analyzed which are associated with opposite implications. Later on, the

validity of models and assumptions will be examined with the help of real world data sets.

More specifically, in the first extreme case, employer's demands for old and young workers are assumed to be comparable to the case that a customer demands for two non-substitutable products. Although supposing that the employment of the young and old are not substitutable does not seem to be quite plausible at first sight, this hypothesis has been empirically supported by a variety of studies (see, e.g. Kalwij et. al. (2009)). One possible explanation for this may relate to the fact that the rapid changes of technology in the last half century have generated ample requirements by the employers for newly developed skills, which often are mastered by the young generation only. Moreover, some positions can only be taken by older workers whenever a wealth of experience is indispensable.

With the above assumption, the labor markets for older and younger workers turn out to be two separate markets, in which the equilibrium wage rate for the old is simply determined by the interaction of the supply and demand functions of the old, and the same holds for the young. As a consequence, it is not difficult to see that the relative levels of reservation wage between the old and young would have a positive impact on the relative wage rates of the two age groups. In particular, a higher amount of reservation wage of the old with respect to the young would cause the supply curve in the old labor market shift up more than that in the market of the young, which in the end leads to an increase in the ratio of average wage rate between the two groups.

Without assuming that the markets for older and younger workers are separate, in the second extreme case, it is alternatively assumed that old labors and young labors are perfect substitutes. Additionally, we introduce heterogeneities by assuming that workers in the market can be distinguished by their level of skills, i.e. high level or low level, whereas workers with a certain level of skills are assumed to be identical. In other words, the employers are indifferent with hiring an old or young employee as long as both of them are high-skilled or low-skilled.

The assumptions in the second case imply an opposite conclusion than those in the first one. Specifically, the relative level of reservation wage between the old and young is not relevant anymore for explaining the value of relative wage rate. Instead, the relative level of reservation wage between the low and high-skilled workers in the older age group plays an essential role. To be more precise, we show the conclusion in a mathematical way. Notice that for the reason of simplicity, more assumptions about the supply and demand curves have to be made. However, the intuition behind the

simplified model can be easily generalized to other cases as well.

First, the law of diminishing marginal returns is temporarily ignored and thus the demand curves of the employers are assumed to be horizontal. That is, there is a horizontal demand curve for high-skilled employees and also a horizontal one for the low-skilled. Obviously, the former is higher than the latter since high-skilled people are more productive. Accordingly, the payments to each high-skilled worker are equivalent to their marginal productivity, which can be denoted by a constant number, w^h . And the same implies to the low-skilled labors, whose wage rate is w^l , where $w^l < w^h$.

Then, assume that the supply function of a certain group of people, i , is influenced by a factor, denoted by R_i , that determines the aggregate level of reservation wage in that group as a whole. In particular, we have $w = R_i * L$, which indicates that with a certain amount of salary, a group with a higher aggregate level of reservation wage would include a smaller proportion of labors who are willing to participate in the labor market.

With the purpose of examining the effect of relative level of reservation wage between the old and young, i.e. $\frac{R_o}{R_y}$, we assume that the supply curve for both the high-skilled and low-skilled old workers is $w = R_o * L$ and the high-skilled and low-skilled young workers is $w = R_y * L$. Then, in the market equilibrium, the quantity of high-skilled old, low-skilled old, high-skilled young and low skilled young workers are respectively $\frac{w^h}{R_o}$, $\frac{w^l}{R_o}$, $\frac{w^h}{R_y}$ and $\frac{w^l}{R_y}$. As a consequence, the ratio of the average wage rate of old people to the average wage rate of young people is simply:

$$\frac{\bar{w}^{old}}{\bar{w}^{young}} = \frac{\frac{w^h * (\frac{w^h}{R_o}) + w^l * (\frac{w^l}{R_o})}{\frac{w^h}{R_o} + \frac{w^l}{R_o}}}{\frac{w^h * (\frac{w^h}{R_y}) + w^l * (\frac{w^l}{R_y})}{\frac{w^h}{R_y} + \frac{w^l}{R_y}}} = 1 \quad (1)$$

which thus does not depend on the value of $\frac{R_o}{R_y}$.

Nevertheless, from the economic point of view, it would be reasonable to argue that in the age group of 60-64, there might be policies or factors inducing the low-skilled workers to have a different amount of incentive to quit from their jobs or retire early than the high-skilled. Therefore, by allowing $R_{ho} \neq R_{lo}$, we have the following:

$$\frac{\bar{w}^{old}}{\bar{w}^{young}} = \frac{\frac{w^h * (\frac{w^h}{R_{ho}}) + w^l * (\frac{w^l}{R_{lo}})}{\frac{w^h}{R_{ho}} + \frac{w^l}{R_{lo}}}}{\frac{w^h * (\frac{w^h}{R_y}) + w^l * (\frac{w^l}{R_y})}{\frac{w^h}{R_y} + \frac{w^l}{R_y}}} = \frac{w^h(w^h + w^l)}{(w^h)^2 + (w^l)^2} \frac{1}{1 + \frac{w^l}{w^h} \frac{R_{ho}}{R_{lo}}} + \frac{w^l(w^h + w^l)}{(w^h)^2 + (w^l)^2} \left(1 - \frac{1}{1 + \frac{w^l}{w^h} \frac{R_{ho}}{R_{lo}}}\right) \quad (2)$$

Then, the first older derivative of $\frac{\bar{w}^{old}}{\bar{w}^{young}}$ with respect to $\frac{R_{ho}}{R_{lo}}$ is

$$\frac{\partial \frac{\bar{w}^{old}}{\bar{w}^{young}}}{\partial \frac{R_{ho}}{R_{lo}}} = \frac{w^l}{w^h} (w^h + w^l) \frac{1}{(w^h)^2 + (w^l)^2} \frac{1}{\left(1 + \frac{w^l}{w^h} \frac{R_{ho}}{R_{lo}}\right)^2} (w^l - w^h) \quad (3)$$

which is negative since $w^l < w^h$.

To summarize, under the assumption of perfect substitute between young and old labors, there exists a positive effect of the relative aggregate level of reservation wage of low-skilled old workers to high-skilled old workers on the relative value of the average wage rates of the old to the young. This is not difficult to understand since it is quite common to observe that a large number of workers in the age group 60-64 withdraw from the labor market, and if the low-skilled old people who earn less than the high-skilled counterparts have to sacrifice a larger proportion of their salaries by continued working, they are then more motivated to drop from the labor market, and correspondingly the average wage rates for the old age group rises.

Then, not surprisingly, the next step is to test which assumption is more relevant in reality. To do that, we are interested in developing a variable that indicates the relative aggregate level of reservation wage rate between age groups 60-64 and 24-29 for testing the assumption of no substitution, as well as a variable indicating the relative aggregate level of reservation wage rate between low-skilled and high-skilled old workers to examine the hypothesis of perfect substitution. As will be seen in the following, the former concerns the variable of implicit taxes on continued work (Section 2.2.1), and the latter regards to the variable of average relative replacement rates (Section 2.2.2).

2.2 Explanatory Variables

2.2.1 Implicit Taxes on Continued Work

Old age pension systems and other early retirement schemes may be eligible to people in the age group 60-64. When benefits from these programmes cannot be combined with full-time jobs, continuing working implies forgoing the

entitled payments and thus may impose an implicit tax on continued work. In a variety of early studies (e.g. Blöndal and Scarpetta, 1998; Johnson, 2000; Duval, 2003), the idea of implicit tax/subsidy has been explored to capture changes in the present value of the future stream of entitled benefits by working for a longer time.

To be more precise, retiring from the job market one year earlier can avoid one-year contributions to pension and other social transfer programmes. If the savings of contribution payments plus the one-year eligible receipts, if there is any, from (early) retirement schemes outweigh the potential increase in future benefits generated by remaining working, the (early) retirement system is called "actuarially non-neutral" and provides workers monetary incentives to (early) withdraw. Notice that the incentives considered here are only relevant to the old labors since these incentives are embedded either in the old-age pension system or in a scheme that in fact functions as an early retirement route, for instance, unemployment benefits without the obligation of job searching, and disability benefits granted not on the basis of health condition, etc. Therefore, the variable, implicit tax on continued work, developed to measure the (early) retirement incentives, represents the extra opportunity costs of working implied only to the old rather than the young and thus can be applied to indicate the difference in the level of reservation wage between the two age groups.

In the following, the corresponding formulas used for calculating the implicit tax on continued work for five additional years at age 60 are presented². First, assume an illustrative individual withdrawing from the labour market at age τ . Then his or her total entitled benefits as a proportion of earnings can be approximated by computing the present value of future payments, generated by both old-age pension and early retirement schemes whenever relevant, obtained from age τ to age 105, adjusting it by the probability of being alive at a particular age, and dividing it by the level of earnings just prior to retirement. Mathematically, we have

$$EBE_{\tau} = \left(\sum_{\kappa=\tau}^{105} \frac{P_{\kappa}}{(1+r)^{\kappa-\tau}} * S_{\kappa} \right) / E \quad (4)$$

where EBE_{τ} refers to entitled benefits as a proportion of earnings for an individual retiring at age τ , P_{κ} is the payments from old-age pension and early retirement schemes received at age κ , S_{κ} is the value of country-specific survival functions at age κ , which measures the probability of being alive

²For more details including assumptions and caveats of using this variable, please refer to Duval (2003).

at age κ conditional upon being alive at age τ , E is the amount of annual wage earned right before retiring, and finally r is the real discount rate.

Moreover, working for five additional years at age 60 also requires an individual to pay contributions, denoted by C , annually to the pension system and social transfer programmes. After taking that into account, for an individual at age 60, changes in total entitled benefits from working for five years longer are calculated as:

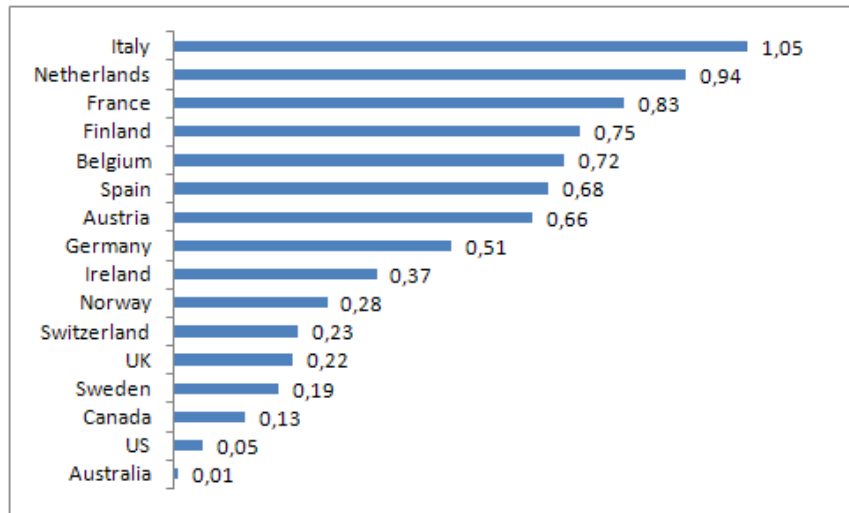
$$DEBE_{60} = \frac{EBE_{65} * S_{65}}{(1+r)^5} - EBE_{60} - \left(\sum_{\kappa=60}^{64} \frac{C_{\kappa}}{(1+r)^{\kappa-60}} * S_{\kappa} \right) / E \quad (5)$$

Obviously, when this change is negative, the pension system provides an incentive of quitting and thus a positive implicit tax on continued work. Therefore, according to the definition introduced by Duval (2003), a negative sign is involved in the formula for calculating the average implicit tax (AIT) on continued work over a 5-year span for an individual at age 60:

$$AIT_{60} = -\frac{DEBE_{60}}{5} \quad (6)$$

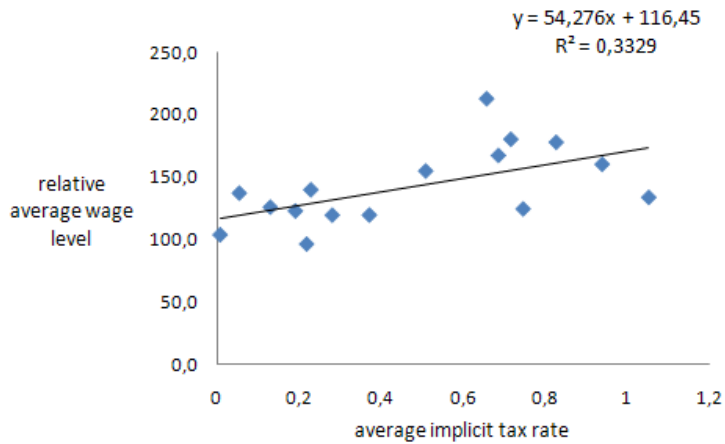
To provide an impression on the average implicit tax rates imposed in the seventeen OECD countries, countries are ranked in Figure 2 from high to low in terms of their values of tax in 1999, which were embedded in the early retirement and old-age pension schemes for a single worker with average earnings at age 60. As can be seen from Figure 2, the dispersions in implicit tax rate on continued work across OECD countries are noticeable. More specifically, the tax rates are fairly high in most Continental European Countries including Italy, the Netherlands, France and Belgium, whereas the levels are comparatively low in both Scandinavian and Anglo-Saxon countries. In fact, this general picture suggests a positive correlation between the implicit tax on continued work and the relative wage rates of the old to the young since the wage profiles over life-cycle appear to be relatively steeper in Continental European Countries compared with Nordic and English-speaking countries, as have been shown in the introduction section. This positive effect can also be observed by running a simple regression for the two variables, which suggests a positive pairwise correlation coefficient as indicated below in Figure 3.

Figure 2: Cross country comparison: average implicit tax on continued work for five more years implied by the old-age pension and early retirement schemes in 1999, single worker with average earnings at age 60.



Source: Duval (2003)

Figure 3: Relative average wage levels between the age groups 60-64 and 25-29 and average implicit tax rates on continued work at age 60.



Sources: Duval (2003); OECD (2006)

2.2.2 Average Relative Replacement Rates

The aim of this subsection is to develop an estimator to approximate the relative aggregate levels of reservation wage between the low-skilled workers and the high-skilled ones in the age group 60-64. In order to do so, notice that the amount of benefit received at age τ , P_τ , which is employed in Equation 4 for calculating the average implicit tax rates, is a number averaged across six different situations, namely three earning levels: 60%, 100% and 140% of average production workers' (APW) earnings, and two marital situations: single worker and married couple with dependent spouse. Therefore, one of the natural choices here is to calculate the ratio of the average implicit tax rates of low-income earners who earn 60% of APWs' earnings to that of high-income earners who earn 140%, both of which are the average numbers over the two types of household composition.

Nevertheless, it is unfortunate that these ideal variables are not accessible to the author at the moment.³ Therefore, the only possibility here is to construct a rough indicator under the constraint of limited information. In particular, we are interested in comparing the average replacement rates faced by the two groups of people, which are embedded in the retirement schemes including old-age pension, early pension, and benefits for the older unemployed. Remind that the unemployment-related programmes for the old considered here are different from those eligible for younger individuals in the sense that the job-seeking requirement is removed during the time right before pensionable age. Therefore, it is *de facto* an early pathway into retirement and should be taken into account when estimating the level of reservation wage for the elderly.

Due to the absence of many data, computations are only feasible as long as more assumptions are made to simplify the situation, among which a "hypothetical early withdrawal route" is assumed to be followed by an illustrative old worker and specified as follows: whenever an early pension is available, old workers are tempted to use that as the mean to retire early. Prior to that period, unemployment-related benefits, if available, can be used to bridge the time until workers are entitled to the early pension. Furthermore, it is assumed that neither the early pension nor the unemployment-related benefit can be combined with full-time jobs, and the receipts of them do not affect the amount of ultimate pension payments.

³An author who used to conduct research on this topic in OECD stated that more than 300 STATA programs have been used for modeling the different pension systems in OECD countries over time. Thus, extracting the required data for the six situations separately involves tremendous work and cannot be supported by OECD.

Regarding to the data source, we obtain the data of net pension replacement rates by using OECD Pension Models, which provide information of both workers with one half of APWs' earnings and workers with two times of APWs' earnings. Besides, the relevant policies of reduction rates for pension benefits received during the time in which pensions are claimed earlier can be summarized by using the EU's Mutual Information System on Social Protection (MISSOC) for EU countries plus Norway and Switzerland, and Social Security Programs Throughout the World for Australia, Canada and the U.S. These files are published either yearly or biennially. What is more, the net unemployment replacement rates for workers receiving 67% of APWs' earnings and those obtaining 150% of APWs' earnings are achievable from OECD Tax-Benefit Models, and the values are averaged across six different family types⁴. For periods prior to the time when these data become available, background information provided in Blöndal and Scarpetta (1997) and Duval (2003) are also taken into account.

In table 1, the net replacement rates of both early pension and unemployment related programmes are presented for illustrative earners with low and high incomes. Noticeably, in a majority of cases, the incentives of early withdrawal by old workers who earn a smaller amount of money are comparatively large since the net replacement rates attached to both early pension and unemployment benefits are higher for low-income people, whereas net pension replacement rates in Italy and Sweden are the only exceptions here.

In order to construct an internationally comparable indicator for the relative magnitude of incentives of (early) withdrawing from the labor market by older workers, the "hypothetical early withdrawal route" is applied to identify that at ages between 60 and 64, whether and which benefits have to be forgone if staying in the labor market for one additional year: unemployment-related benefits, early pension benefits, old-age pension benefits or no entitlement to benefits. Mathematically, the hypothetical route implies that the net replacement rate, r , for a typical individual at an age, τ , between 60 and 64 with an earning level, i , which is either high or low, i.e. $i \in \{h, l\}$, can be expressed as follows:

$$r_{i,\tau} = P_i * \mathbb{1}_{\{\tau \geq p\}} + E_i * \mathbb{1}_{\{e \leq \tau < p\}} + U_i * \mathbb{1}_{\{u \leq \tau < e\}} \quad (7)$$

where P_i , E_i and U_i respectively indicate net replacement rates embedded

⁴Six family types considered in OECD Tax-Benefit Models are single person without children, one-earner married couple without children, two-earner married couple without children, lone parents with two children, one-earner married couple with two children and two-earner married couple with two children.

in old-age pension, early pension, and old-age unemployment benefit for an individual with earning level i , and the entitlement age to each of the programmes is accordingly denoted by p , e and u .

Table 1: Net pension and unemployment benefit replacement rates by levels of earning in OECD countries.

Individual earnings, multiple of mean	Early pension		Unemployment benefit	
	0,5	2	0,67	1,5
Australia	80,2	36,8	62	39
Austria	90,5	64,8	70	53
Belgium	78,7	41,2	76	48
Canada	89,1	30,9	73	56
Denmark	137,0	77,7	89	58
Finland	73,2	64,5	79	57
France	76,2	57,5	78	71
Germany	59,2	44,4	76	68
Ireland	68,4	24,4	65	41
Italy	74,8	78,7	71	55
Netherlands	105,0	95,5	82	61
Norway	76,7	52,8	80	55
Spain	82,1	72,2	81	55
Sweden	79,3	85,9	84	51
Switzerland	68,8	33,4	84	75
UK	63,8	22,8	67	39
US	57,9	33,3	66	45

Sources: OECD pension models (2009); OECD tax-benefit models (2007)

To obtain a more concrete overview of the "hypothetical early withdrawal route" in OECD countries, the specific pathways according to Equation 7 implied by rules and regulations in 2009 are illustrated in Table 2.

As can be seen from Table 2, different routes are applied in different nations. For instance, early pensions are employed in Belgium, Canada and Italy; unemployment-related benefits are offered in the Netherlands; old-age pensions are available in France; and no scheme can be counted on in some Anglo-Saxon countries like Australia, Ireland and UK.

Furthermore, after the values of replacement rate, $r_{i,\tau}$, in Equation 7 have been computed for each possible i and τ , the final indicator is determined by averaging the ratios of the replacement rate of the low to high-

income earners, $\frac{r_{l,\tau}}{r_{h,\tau}}$,⁵ across the ages between 60 and 64. So we have,

$$ARR = \frac{1}{5} \sum_{\tau=60}^{64} \frac{r_{l,\tau}}{r_{h,\tau}} \quad (8)$$

where ARR refers to the average relative replacement rate, which provides us a rough estimation to the relative levels of reservation wage faced by low and high-skilled workers in the age group 60-64.

Table 2: Current routes of early withdrawal in OECD countries.

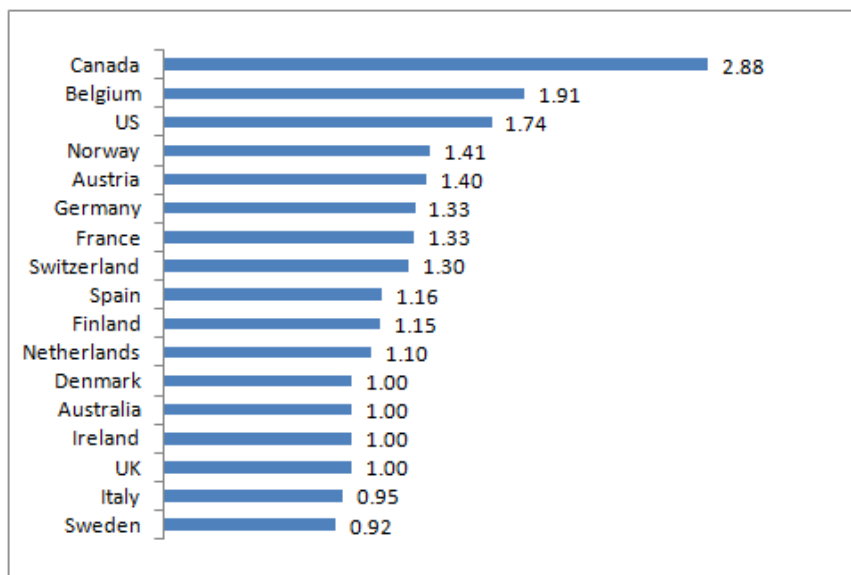
Age	60	61	62	63	64
Australia	no benefit				
Austria	no benefit		early pension benefits		
Belgium	early pension benefits				
Canada	early pension benefits				
Denmark	no benefit				
Finland	no benefit		early pension benefits		
France	old age pension				
Germany	no benefit			early pension benefit	
Ireland	no benefit				
Italy	early pension benefit				
Netherlands	benefits for older unemployed				
Norway	no benefit				benefits for older unemployed
Spain	no benefit	early pension benefit			
Sweden	no benefit	old age pension			
Switzerland	benefits for older unemployed				early pension benefit
UK	no benefit				
US	no benefit		early pension benefits		

Sources: the EU's Mutual Information System on Social Protection (MISSOC); Social Security Programs Throughout the World.

Finally, we present the values of ARR achieved in OECD countries in 2002 in Figure 4, in which considerable variations of the variable can be observed. In particular, the net replacement rates faced by low-skilled workers are substantially higher than those faced by high-skilled labors in countries like Canada, Belgium and US, whereas low-income earners are entitled to the same or even a lower level of replacement rates in Australia, Denmark, Ireland, UK, Italy and Sweden.

⁵Whenever replacement rates to both the low and high-income earners are zero, the ratio is set to be one to indicate that the replacement rates to the two groups of people are equal.

Figure 4: Cross country comparison: average relative replacement rate in 2002.



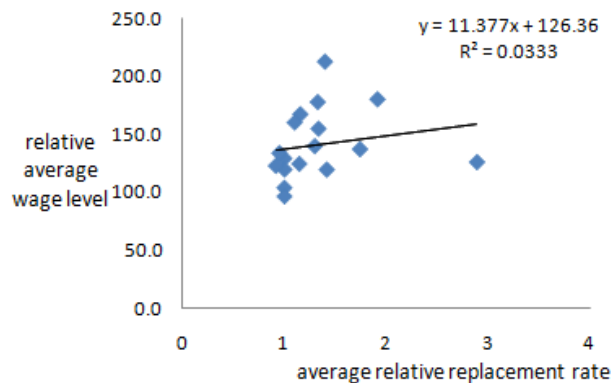
Source: author's calculation

As mentioned above, ARR is expected to have a positive influence on the dependent variable even if the existence of substitutability between the old and young workers is assumed. Indeed, when running a single-variable regression, a slightly positive pairwise correlation is suggested by the scatter plot in Figure 5. In fact, the positive relationship between the two variables has been significantly dampened by including Canada whose ARR attains an extremely high value despite its relative average wage rate is fairly low. Consequently, after excluding the outlier, a much steeper linear trendline fits in, as can be seen in Figure 6.

2.2.3 Standard and Early Retirement Ages

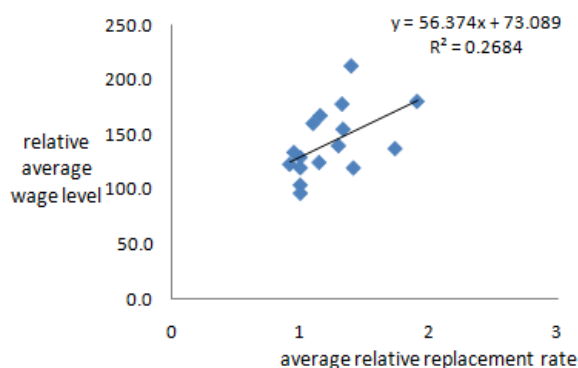
Standard and early ages of eligibility to pension benefits affect individuals' retirement decisions via changing their financial incentives to retire. This can be easily seen if recalling that we have already taken into consideration of both the standard and early retirement ages when computing the above mentioned two variables to capture the relative levels of retirement incentives between the old and young as well as between the low and high-skill older workers. According to the standard life-cycle model, official ages,

Figure 5: Relative average wage levels between the age groups 60-64 and 25-29 and average relative replacement rates in OECD countries.



Sources: OECD (2006); author's calculation

Figure 6: Relative average wage levels between the age groups 60-64 and 25-29 and average relative replacement rates in OECD countries besides Canada.



Sources: OECD (2006); author's calculation

besides their indirect effect through monetary incentives, should not have further impacts on the effective age at which workers withdraw from the labor market. To put it another way, the theory states that forward-looking individuals are capable to figure out their optimal time of retiring, which is not necessarily equal to the official age of retirement, so that their total welfare is maximized through borrowing and lending in the capital market. Nevertheless, this is rarely the case in reality: the econometric estimation outcomes in Duval (2003) serve as a counter example, which show that even after controlling the level of financial retirement incentives for the age group 60-64 through including the average implicit tax rate as an explanatory variable in the regression, the standard retirement age still generate a statistically significant impact on the magnitude of older worker outflows from the labor market.

A powerful explanation to the inconsistency between the life-cycle model's implications and real-world data's estimations stresses that in reality people are neither information-unconstrained nor capital-unconstrained, both of which are assumed by the standard life-cycle model. In particular, the absence of information and knowledge hinders people from correctly identifying their optimal options. Alternatively, they may simply choose to retire

at the earliest stage when pension benefits are accessible or at the standard age since this is the custom followed by the majority. Worse still, liquidity constraint restricts the amount can be borrowed and thus may prevent individuals from retiring before pensions are available.

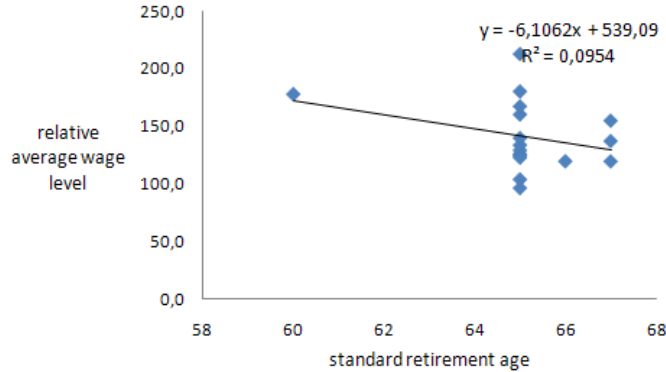
All in all, we include the variables of early and standard retirement ages in regressions with the purpose of checking whether the assumptions of life-cycle model hold. If the assumptions are not satisfied, a significantly negative effect of the official entitlement ages on the dependent variable, which is the relative average wage rate between the old and young, is expected to be detected, no matter case one (i.e. no substitution between old and young workers) or case two (i.e. perfect substitution between the old and young) is being considered, although explanations for the negative impact are slightly different. In case one, by assuming two separate markets for the old and young, a smaller pensionable age implies that the shrink of old labor supply occurs earlier, and thus the average wage rate for the old workers rises. In case two, since the knowledge and capital constraints are more likely to be faced by low-skilled labors than high-skilled ones, a smaller pensionable age implies that the biased withdraw of low-income earners happens earlier, which also induces an increase in the average wage rate of older labors. In Figures 7 and 8, the single-year cross-country scatter plots are depicted and negative pairwise correlations between the dependent variable and the early/standard retirement age are shown, although it is possible that the negative relationships will fade away after controlling the effect of implicit taxes on continued work in model one and average relative replacement rates in model two.

2.2.4 Time Dummies

Two factors are essential for determining the level of reservation wage. One regards to the amount of income that must be forgone by participating in the labor market, which is what we have only considered so far. However, people's preference of leisure over consumption is also an aspect that influences reservation wage. In particular, as has been repeatedly shown in many empirical studies, for instance, Costa (1997), an increasing preference for leisure has a negative impact on individual work hours and labor force participation rates.

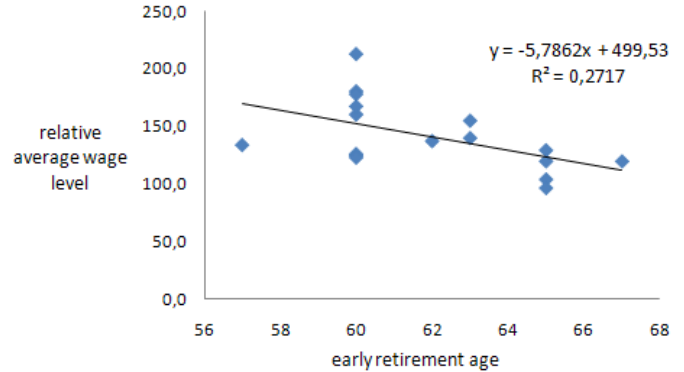
In spite of that, it is hard to directly take into account of this psychological factor in our analysis. In various previous studies, the unobservable upward trend of people's preference for leisure has been approximated by some observable tendencies including the improving quality and reducing

Figure 7: Relative average wage levels between the age groups 60-64 and 25-29 and standard ages of entitlement to old-age pension benefits.



Sources: Duval (2003); OECD (2006)

Figure 8: Relative average wage levels between the age groups 60-64 and 25-29 and early entitlement ages to old-age pension benefits.



Sources: Duval (2003); OECD (2006)

prices of leisure products. However, since everyone benefits from the lower price and higher quality of recreation goods no matter they are young, old, high-skilled or low-skilled, capturing the dissimilar reactions to the development of leisure environment across categories of people remains an unsolved problem.

Nevertheless, it might be reasonable to assume a common stochastic trend on this perspective in OECD countries over time given that economy and social cultures nowadays are world-widely closely integrated. As a consequence, in the regression analysis, time dummies are included with the purpose of capturing the evolution of departures of preference to leisure between the old and young people (for the first case) and the low and high-skilled elder labors (for the second case).

3 Bargaining Power

In the previous section, the foundation of our analysis is set on a competitive labor market in which the level of wage rate is determined by the market equilibrium. Nevertheless, notice that in the real world, the presence of labor market institutions may introduce a wedge between the highest salary

an employer is willing to pay and the lowest wage an employee is willing to accept. Then, an agreement on how the rents are divided would be reached through employer and employee's negotiation, in which the comparative amount of bargaining powers between the two parties is a crucial factor.

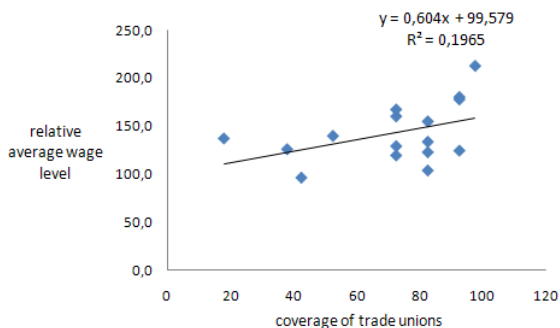
Therefore, differences in bargaining powers between the elderly and young are expected to play an essential role in determining the relative levels of their wage rates. As a result, the next step is to search for an appropriate variable indicating the unobservable differences in bargaining powers between the two age groups. The two candidates we found are presented in Sections 3.1 and 3.2.

3.1 Collective Bargaining Coverage

Collective bargaining coverage measures the proportion of employees whose contract is regulated by collective agreements signed by unions, and in many previous studies, it is regarded as a good cross-country comparable indicator for assessing union's bargaining powers (see, e.g. Nickell, 1997). Moreover, Boeri and van Ours (2008) indicate that unions seem to be aging more quickly than the labor force and facing difficulties in involving young people in union activities, while no data directly supporting this argument is provided in their study. If it can be confirmed that in a country, the more powerful trade unions are, the better its order labors are protected comparing to the younger ones, a conclusion could be drawn that the coverage of trade unions has a positive impact on the relative levels of wage rate between the old and young. Nonetheless, a solid quantitative evidence supporting this statement has not been found in previous papers, as far as we are aware of. Therefore, whether union coverage has an explanatory power on the dependent variable awaits further investigations in later analysis. Still, to perform a quick check, simply regressing the dependent variable on the indicator of collective bargaining coverage does reveal a positive pairwise correlation between these two, as Figure 9 illustrates.

As an alternative, in the next subsection attentions are shifted to employment protection legislations (EPL), and the differences in the level of EPL between the old and young are calculated to approximate their relative amounts of bargaining powers.

Figure 9: Relative average wage levels between the age groups 60-64 and 25-29 and union coverage in OECD countries.



Sources: OECD (2004a); OECD (2006)

3.2 Relative Strictness of Employment Protection Legislation

Employment protection legislation refers to the rules and regulations to be imposed when workers are dismissed. An important purpose of EPL is to provide the employees with more job securities and income insurances, which might be welfare-improving in the sense that investments in firm-specific human capitals would be accordingly increased. Nonetheless, a heated debate over the desirable level of EPL is undertaking due to a variety of its potential drawbacks, for instance, lowering the transition probability into employment in case of layoff, enlarging the likelihood of free riding and shirking by workers, and causing inequality between insiders and outsiders.

Moreover, inequality between the young and old could also arise since the strictness of EPL to different age groups varies. So far, one of the most frequently used measures of the strictness of EPL is an index constructed by OECD. Through reviewing 18 basic items, the index can be utilized to summarize and compare the overall strictness of EPL in OECD countries through different years. However, for the purpose of simplification, the OECD index only analyzes a representative case per country without considering any heterogeneities among people, and therefore no conclusion about the differences in the strictness level of EPL between the old and young can be drawn based on this index.

Fortunately, however, inspired by the Deelen and Bourmpoula (2009)

paper, in which an age-dependent EPL indicator is developed, we consider two of the eighteen basic items used to construct the overall OECD indicator, namely length of notice period (item 3) and severance pay (item 4), since both of them are related to age in some countries according to the national legislations and the others are age-invariant.

In order to compare the level of the strictness of EPL between the two age groups 25-29 and 60-64, we need to relax the simplification assumption made by OECD that a worker was at the age of 35 when started to work. Instead, we consider two illustrative workers who are separately assumed to be dismissed at the age of 27 and 62. Then, the next step is to determine the number of days required for notice and severance pay based on the detailed descriptions of country specific age-dependent regulations. However, the relevant information are available for only three points in time: the late 1980's, late 1990's and 2003. And as mentioned in Deelen and Bourmpoula's (2009) paper, the sources of the information are respectively Table 1.B, Annex 1, in Grubb and Wells (1993), Table 2.A.2 in OECD (1999) and Table 2 in OECD (2004b).

In particular, there are six countries in which the formulas for calculating the length of notice and severance pay period are age dependent, namely Australia, Ireland, the Netherlands, Norway, Switzerland, and United Kingdom. Take the Netherlands as an example. In the late 1980's, the regulations of notice period are different for the blue-collar and white-collar workers. Concerning the former, they are not entitled to notice period if their tenure is less than 2 months. And thereafter, one additional year of service generates one more week of notice period up to a maximum of 13 weeks. And on top of that, their notice period increases by one week per year of age over 45, with a separate maximum of 13 weeks. For the later, similarly they are not eligible for notice if the length of working is less than 2 month. For longer tenures, the same regulations to blue-workers apply here as well, but with a one month minimum.

Moreover, as you may have realized, regulations of notice period and severance pay are also related to the length of tenure. When constructing the summary OECD index, three different tenure lengths are considered, which are 9 months, 4 years and 20 years, and basically we follow the same methodology here. Accordingly, based on the above mentioned regulations for the Netherlands, a worker aged 27, who represents individuals in the age group 25-29, on average is entitled to a notice period of 18.5 days (7 days for a blue-collar worker and 30 days for a white-collar worker) if her tenure is 9 months, 29 days (28 days for a blue-collars worker and 30 days for a white-collar worker) with a tenure of 4 years, and 91 days (91 days

for a blue-collar worker and 91 days for a white-collar worker) for a 20-year tenure. Similarly, it can be calculated that for a worker aged 62 representing individuals of ages 60-64, the average entitled notice period is 98, 119 and 182 days for tenures of 9 months, 4 years and 20 years respectively. To summarize, data on notice and severance pay period for the three possible lengths of tenures and two different age groups in OECD countries over the three period points are presented in Tables 3 and 4, in which bold numbers correspond to legislations that are age-dependent⁶.

Table 3: Notice and severance pay for no-fault individual dismissals by tenure categories: age group 25-29.

Tenure	Notice period after									Severance pay after								
	9 months			4 years			20 years			9 months			4 years			20 years		
	Days																	
	Late 1980s	Late 1990s	2003	Late 1980s	Late 1990s	2003	Late 1980s	Late 1990s	2003	Late 1980s	Late 1990s	2003	Late 1980s	Late 1990s	2003	Late 1980s	Late 1990s	2003
Australia	7	7	7	21	21	21	28	28	28	0	0	0	30	30	30	30	30	30
Austria	30	30	30	36	36	36	75	75	75	0	0	0	60	60	0	270	270	0
Belgium	60	60	63	81	81	84	300	300	330	0	0	0	0	0	0	0	0	0
Canada	7,2	7,2	7,2	24	24	24	57	57	57	0	0	0	12,6	12,6	12,6	63	63	63
Denmark	48	54	54	84	90	90	150	127,5	127,5	0	0	0	0	0	0	45	45	45
Finland	60	30	15	60	60	30	180	180	180	0	0	0	0	0	0	0	0	0
France	30	30	30	60	60	60	60	60	60	0	0	0	12	12	18	81	81	120
Germany	30	30	30	30	30	30	135	210	210	0	0	0	0	0	0	0	0	0
Ireland	6	9	9	15	15	15	60	60	60	0	0	0	10,5	10,5	12,6	38,5	38,5	56,7
Italy	9	9	9	33	33	33	66	66	66	0	0	0	0	0	0	0	0	0
Netherlands	18,5	15	15	29	15	15	91	45	45	0	0	0	0	60	60	0	300	300
Norway	30	30	30	30	30	30	90	90	90	0	0	0	0	0	0	0	0	0
Spain	30	30	30	90	30	30	90	30	30	15	15	15	78	78	78	360	360	360
Sweden	30	30	30	120	90	90	180	180	180	0	0	0	0	0	0	0	0	0
Switzerland	30	30	30	60	60	60	90	90	90	0	0	0	0	0	0	0	0	0
UK	7,2	7,2	7,2	27	27	27	84	84	84	0	0	0	14	14	14	70	70	70
US	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Sources: author's calculation based on Grubb and Wells (1993) and OECD (1999, 2004)

Notice that when estimating the values of items 3 and 4, the OECD simply assigns an equal weight to the three possibilities of tenure length and accordingly calculate the arithmetic mean. However, in reality, it is more likely that older workers achieve relatively long tenures, and the incidence of short tenures is comparatively high for the young. As a consequence, in

⁶Very detailed calculations for numbers presented in Tables 3 and 4 are available under request from the author.

Table 4: Notice and severance pay for no-fault individual dismissals by tenure categories: age group 60-64^a .

Tenure	Notice period after									Severance pay after								
	9 months			4 years			20 years			9 months			4 years			20 years		
	Days																	
	Late 1980s	Late 1990s	2003	Late 1980s	Late 1990s	2003	Late 1980s	Late 1990s	2003	Late 1980s	Late 1990s	2003	Late 1980s	Late 1990s	2003	Late 1980s	Late 1990s	2003
Australia	7	7	7	28	28	28	35	35	35	0	0	0	30	30	30	30	30	30
Ireland	6	9	9	15	15	15	60	60	60	0	0	0	17,5	17,5	12,6	73,5	73,5	56,7
Netherlands	98	15	15	119	15	15	182	45	45	0	0	0	0	120	120	0	600	600
Norway	30	30	30	30	30	30	180	180	180	0	0	0	0	0	0	0	0	0
Switzerland	30	30	30	60	60	60	90	90	90	0	0	0	0	0	0	75	75	75
UK	7,2	7,2	7,2	27	27	27	84	84	84	0	0	0	21	21	21	70	105	105

^a Data for countries where regulations are age-independent are the same as those in the above table and thus omitted here

Sources: author's calculation based on Grubb and Wells (1993) and OECD (1999, 2004a, 2004b)

order to obtain a more convincing comparison of the levels of the strictness of EPL between the old and young, it is advisable to take into account the frequency of occurrence of the three tenures in the two age groups and weight the days of notice period and severance payment accordingly.

Nevertheless, it is reasonable to argue that the size of job tenure weights might not be independent of the length of notice and severance pay period. For example, when the protections against dismissal in terms of notice period and severance payment increase faster with tenure, there is a larger probability for the elderly to keep long tenures as workers become less willing to frequently switch jobs in order to maintain their eligibility to high employment protections. And as a consequence, endogeneity problem may arise. In particular, there exists a possibility that the length of notice periods and severance pay are not measured accurately, which might be caused by, e.g. simply taking the average of the entitlements to notice period and severance pay of the white and blue-collar workers, and therefore the measurement error is included in the error term. Then, if the length of notice period and severance pay (also the part included in the error term) is correlated with tenure distributions, which are taken into account when constructing the explanatory variable, a classical measurement error problem appears.

In order to address the problem, we simply calculate the average value of the incidence of each tenure length over all the years when data are available. By doing so, we expect that the period-by-period responses of tenure distribution to regulation changes in notice period and severance pay can be eliminated. In fact, the safest alternative would be to utilize

the tenure distributions before late 1980's, whereas the OECD labor force statistics data set only covers years between 2000 and 2008. As a result, in order to check whether applying the mean values of tenure frequencies can avoid the appearance of endogeneities, we conduct a sensitivity analysis by averaging the incidences of tenure length over all of the seventeen OECD countries and years between 2000-2008 and employing the unique averaged tenure distribution to all the countries and periods. Thereafter, a Hausman test is performed to examine the hypothesis of exogeneity and consistence (the corresponding results are reported in Section 6.3). Below, in Table 5, the mean values of tenure incidence from 2000 to 2008 in the seventeen OECD countries are presented. It is not surprising to observe from Table 5 that the interval of shorter tenures, 6-12 months, achieves a higher incidence in the younger group, which is on average 0.11, than in the older group, which is on average 0.02, while a much larger proportion of the elderly end up with the category of longer tenures, 10 years and over, with an average proportion of 0.68 comparing to the young, to whom the average number is only 0.06.

Accordingly, by using the weights reported in Table 5 and the number of days of notice period and severance pay presented in Tables 3 and 4, the weighted sum of notice period and severance pay can be easily calculated, as has been shown below in Table 6.

In the next step, we combine the length of notice period and the number of days of severance pay by assigning a weight of 3/7 to notice period and 4/7 to severance pay, which is the same weighting procedure followed by OECD when developing a sub-indicator for the overall EPL index. The logic behind assigning different weights concerns the fact that the employees still offer some services during the notice period but not during the period of receiving severance pay. Therefore, although the employers have to pay regular salaries in both the notice period and severance pay period, the former is less costly to the employers. Accordingly, the values of weighted average are illustrated in Table 7 (columns 2-4 for the age group of 60-64 and columns 8-10 for the age group of 25-29).

Furthermore, remind that only employment with permanent contracts are eligible for the protections against dismissal in the form of notice period and severance pay, and the incidence of permanent employment is not equivalent for the two age groups. Thus, with exactly the same reasoning as analyzing the distributions of job tenures in the two age groups, we average the frequency of permanent contracts for each country over the periods from 2000 to 2009, and also the mean values of permanent employment proportion across countries and over periods are used in the robustness test. For

Table 5: Incidence of job tenures between 6-12 months, 3-5 years, and 10 years and over: average values from 2000 to 2008 for age groups 25-29 and 60-64 in OECD countries^a .

job tenure	age group 25-29			age group 60-64		
	6 to 12 months	3 to 5 years	10 years and over	6 to 12 months	3 to 5 years	10 years and over
Australia	0,13	0,17	0,04	0,04	0,11	0,50
Austria	0,09	0,19	0,14	0,02	0,06	0,75
Belgium	0,09	0,22	0,04	0,02	0,06	0,78
Canada	0,15	0,18	0,04	0,06	0,09	0,52
Denmark	0,13	0,20	0,04	0,02	0,08	0,64
Finland	0,11	0,21	0,03	0,02	0,04	0,74
France	0,09	0,24	0,03	0,02	0,05	0,75
Germany	0,10	0,18	0,11	0,02	0,05	0,77
Ireland	0,10	0,22	0,06	0,02	0,08	0,65
Italy	0,07	0,22	0,08	0,02	0,05	0,75
Netherlands	0,09	0,24	0,05	0,02	0,05	0,73
Norway	0,11	0,22	0,03	0,01	0,07	0,72
Spain	0,13	0,20	0,04	0,03	0,05	0,72
Sweden	0,10	0,19	0,04	0,02	0,06	0,70
Switzerland	0,10	0,21	0,08	0,02	0,06	0,73
UK	0,12	0,22	0,08	0,04	0,12	0,50
Average	0,11	0,21	0,06	0,02	0,07	0,68

^a Tenure distribuion for the US is not available. But this is not an issue here since the length of notice period and severance pay in the US is zero for all the time periods.

Source: OECD labor force statistics

the average numbers of permanent employment incidence in the two age groups, please see columns 6 and 12 in Table 7.

After adjusting by the proportions of permanent employment, we subtract the adjusted values for age group 25-29 from the values calculated for age group 60-64. By doing so, we finally obtain an indicator which represents the differences in the strictness of EPL in terms of notice period and severance payment between the old and young. The relevant numbers are listed in the last three columns of Table 7.

All in all, stricter EPL would imply a threat for the employers and a larger bargaining power for the employees in the sense that a higher amount of compensation need to be paid from the employers to the employees in case of dismissal. For that reason, the above constructed indicator of the

Table 6: Length of notice period and severance pay adjusted by tenure distributions in OECD countries for the age group 25-29 and age group 60-64

	Age group 25-29						Age group 60-64					
	Notice Period			Severance Pay			Notice Period			Severance Pay		
	Late 1980s	Late 1990s	2003	Late 1980s	Late 1990s	2003	Late 1980s	Late 1990s	2003	Late 1980s	Late 1990s	2003
Australia	6	6	6	6	6	6	21	21	21	18	18	18
Austria	20	20	20	48	48	0	59	59	59	205	205	0
Belgium	35	35	37	0	0	0	239	239	262	0	0	0
Canada	8	8	8	5	5	5	32	32	32	34	34	34
Denmark	30	31	31	2	2	2	104	90	90	29	29	29
Finland	24	20	13	0	0	0	137	137	135	0	0	0
France	19	19	19	6	6	9	48	48	48	61	61	90
Germany	23	31	31	0	0	0	106	164	164	0	0	0
Ireland	8	8	8	5	5	6	41	41	41	49	49	38
Italy	13	13	13	0	0	0	52	52	52	0	0	0
Netherlands	14	7	7	0	31	31	140	34	34	0	442	442
Norway	13	13	13	0	0	0	132	132	132	0	0	0
Spain	25	11	11	32	32	32	70	24	24	264	264	264
Sweden	33	27	27	0	0	0	134	132	132	0	0	0
Switzerland	23	23	23	0	0	0	70	70	70	55	55	55
UK	13	13	13	9	9	9	45	45	45	37	55	55
US	0	0	0	0	0	0	0	0	0	0	0	0

differences in the level of EPL between the elderly and young is considered to represent the relative bargaining powers of the two groups and thus is an important explanatory variable for the relative levels of wage rate. In particular, it is expected that a higher level of employment protection for the old with respect to the young would empower a potential advantage for the elderly on the bargaining table and therefore induce a relatively higher wage rate for the age group of 60-64. Once again, as has been shown in Figure 10, the positive sign of the coefficient in the single variable regression for the seventeen OECD countries corresponds to what the economic theory predicts.

Table 7: Weighted average of notice period (3/7) and severance pay (4/7); proportions of permanent contracts in two age groups; and differences in the strictness of EPL between the old and young in OECD countries.

	Age group 60-64					Age group 25-29					Differences				
	Late 1980s	Late 1990s	2003	*	Prop. ^a	-	Late 1980s	Late 1990s	2003	*	Prop. ^b	=	Late 1980s	Late 1990s	2003
Australia	19	19	19	*	0.96	-	6	6	6	*	0.96	=	13	13	13
Austria	142	142	25	*	0.97	-	36	36	8	*	0.97	=	104	104	16
Belgium	102	102	112	*	0.97	-	15	15	16	*	0.95	=	85	85	94
Canada	33	33	33	*	0.90	-	6	6	6	*	0.92	=	24	24	24
Denmark	61	55	55	*	0.96	-	14	14	14	*	0.95	=	46	40	40
Finland	59	59	58	*	0.94	-	10	9	5	*	0.91	=	46	47	50
France	55	55	72	*	0.95	-	12	12	13	*	0.91	=	42	42	57
Germany	45	70	70	*	0.95	-	10	13	13	*	0.92	=	34	55	55
Ireland	46	46	39	*	0.97	-	6	6	7	*	0.97	=	39	38	31
Italy	22	22	22	*	0.94	-	6	6	6	*	0.92	=	16	16	16
Netherlands	60	267	267	*	0.95	-	6	21	21	*	0.91	=	52	234	234
Norway	57	57	57	*	0.98	-	5	5	5	*	0.95	=	50	50	50
Spain	181	161	161	*	0.88	-	29	23	23	*	0.73	=	138	125	125
Sweden	57	57	57	*	0.93	-	14	11	11	*	0.90	=	41	43	43
Switzerland	61	61	61	*	0.95	-	10	10	10	*	0.95	=	49	49	49
UK	41	51	51	*	0.95	-	11	11	11	*	0.96	=	28	38	38
US	0	0	0	*	0.97	-	0	0	0	*	0.97	=	0	0	0

^a proportion of permanent employment in the age group 25-54

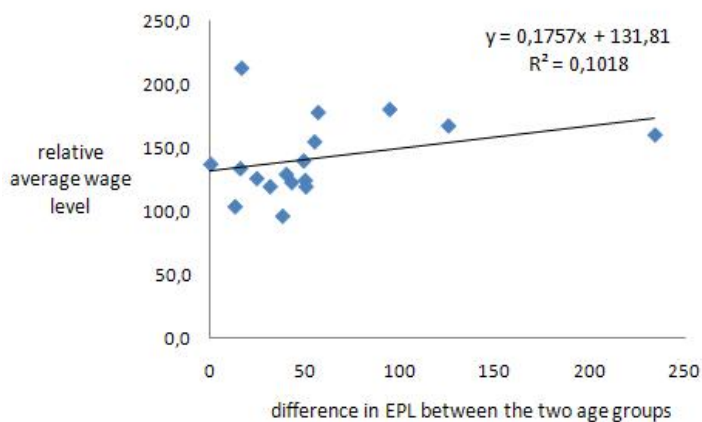
^b proportion of permanent employment in the age group 55-64

Source: Data on incidence of permanent employment are obtained from OECD labor force statistics

4 Incentives Theorem and Specific Human Capital Investment

As interpreted in the introduction section, although an ever-rising age-wages profile can be supported by Lazear's incentives theorem, and a tenure premium can be entailed by specific human capital investments, neither the incentives theorem nor the investment behaviors seem to be able to shed light on the variations of profile shape across countries and over periods. Nonetheless, a cultural factor, namely Trust Index, is considered in the current section, which may provide an indirect interpretation for the different steepness of age-earnings profiles simply through the logics behind the in-

Figure 10: Relative average wage levels between the age groups 60-64 and 25-29 and difference in the strictness of EPL between the old and young.



Sources: OECD (2006); author's calculation

centive theorem and investment behaviors.

In particular, the values of Trust Index can be derived from a series of international surveys conducted by the World Values Survey (WVS) and European Value Study (EVS). More specifically, with the purpose of examining the level of interpersonal trust across countries and over periods, these surveys contain a question which is phrased in the following way: *Generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people?*

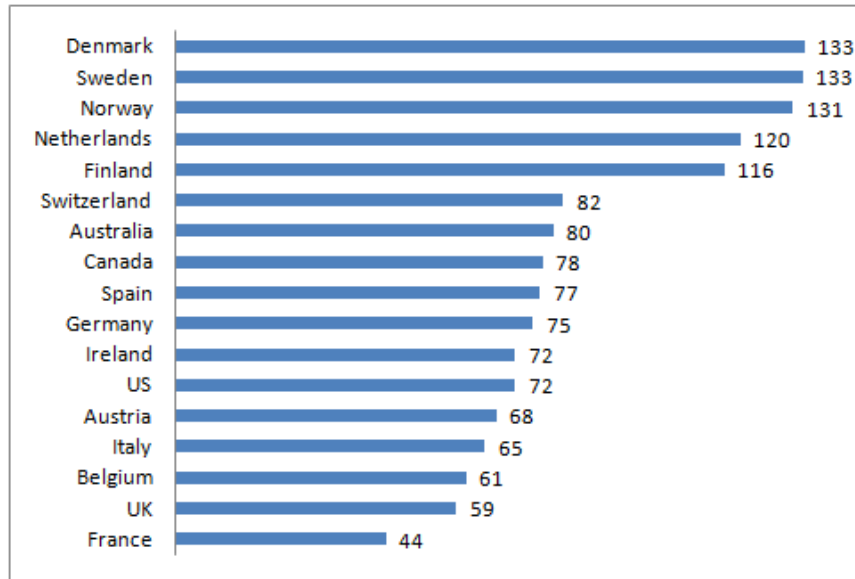
Additionally, in order to make the survey outcomes more comparable, the World Values Survey and European Value Study have developed an index based on the following formula: $Trust\ Index = 100 + (\% \text{ Most people can be trusted}) - (\% \text{ need to be very careful})$. As a consequence, an index higher than 100 indicates that a majority of people in the country trust each other, whereas an index below 100 corresponds to countries where most people believe that they need to be very careful in dealing with people.

In order to gain insight in the trust levels of OECD countries, Figure 11 presents the values of Trust Index derived from a variety of international surveys in 1999.⁷ As can be read from Figure 11, the level of trust index is

⁷Surveys corresponding to Canada and Finland are in 2000, Norway and Switzerland in 1996, and Australia in 1995.

the highest in Scandinavian countries and the Netherlands, whereas in the rest places, the majorities do not trust each other.

Figure 11: Values of Trust Index in 1999 in OECD countries.



Source: World Values Survey Association (2009)

From an economic point of view, it might be reasonable to propose a nonlinear correlation between the relative amount of average wage rates of the two age groups and the level of interpersonal trust. In particular, if the relative wage rate is on the y-axis and trust index on the x-axis, it might be appropriate to use an inverted U-shaped profile to describe their relationship.

First of all, the inverted U-shaped correlation is justifiable by applying the incentives theorem. This is because, on the one hand, an important assumption made for the deferred payment scheme requires the employees to believe that their behaviors will be fairly evaluated by their employers, who can overcome the temptation of dishonestly punishing their workers and keeping the wage premium for themselves. Alternatively, without holding sufficient trust, cautious individuals will only agree to pay a small amount of entrance fee, if there is any. For this reason, the relative wage rates of the old compared to the young tend to be lower in a less-trust society. On the other hand, the validity of incentive theories possibly diminishes as well in countries with a large extent of interpersonal trust. Since a firm uses

deferred payments only when worrying about disloyalties and shirking of the employees as well as the correspondingly high costs of monitoring, the motivation of offering wage premiums may be reduced in societies where the level of trust is high, and thus a limited wage difference between the old and young is induced. To conclude, the Lazear style implicit contract (LSICs) in medium-trust countries appears to be more relevant than in little-trust or plentiful-trust ones, which gives an explanation to the hump-shaped pattern of their relationship.

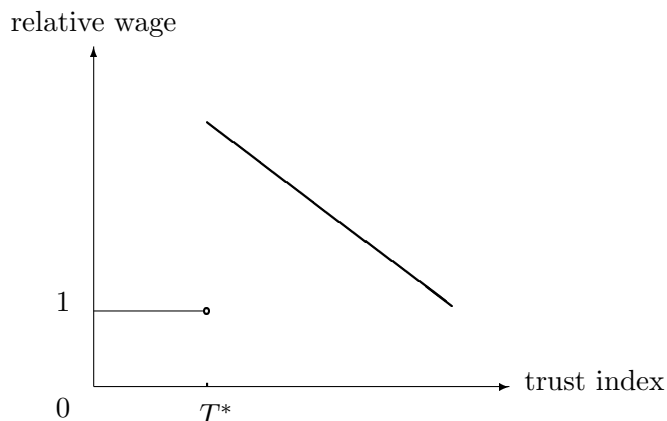
Secondly, the hump-shaped correlation is also verifiable by taking into account of the mechanism of investing in specific human capitals. To better explain the intuition, firstly consider a firm facing an investment opportunity. Then, the firm may refuse to invest anything if the level of interpersonal trust in the society is too low: provided that the commitments between employers and employees are few, workers are keen on switching jobs very frequently so that investment returns cannot be captured by the employers. In this case, if no other factors further influencing the age-wage profiles are considered, the relative wage rate between the old and young remains at one, which corresponds to the line segment in Figure 12 where Trust Index is below T^* . However, as long as the index is higher than a threshold, investments are being made. With a relatively small amount of trust, employees will be required to make investments jointly with the employers in order to strengthening their commitment of staying with the job. Although risk averse employees are in general more willing to diversify their risks by investing in the capital market rather than in a single firm, they may accept to do so only for obtaining the job offers. And the requirement would be lessened when people trust each other more, and therefore the relative wage rate between the old and young reduces with the Trust Index, as has been illustrated in Figure 12.

Moreover, it would be natural to assume that the psychological threshold, T^* , is heterogeneous across employers, and consequently, by summing up all the individual cases, the aggregate final profile depicts a hump-shaped relationship.

5 Differences in Higher Education Attainment Rate

The last variable considered in this analysis focuses on the differences in the percentage of the old and young population attained at least tertiary education, which serves as an indicator reflecting the productivity differences between the two age groups.

Figure 12: Impact of interpersonal trust levels on steepness of age-earnings profiles: consider investments in firm-specific capitals by an individual firm



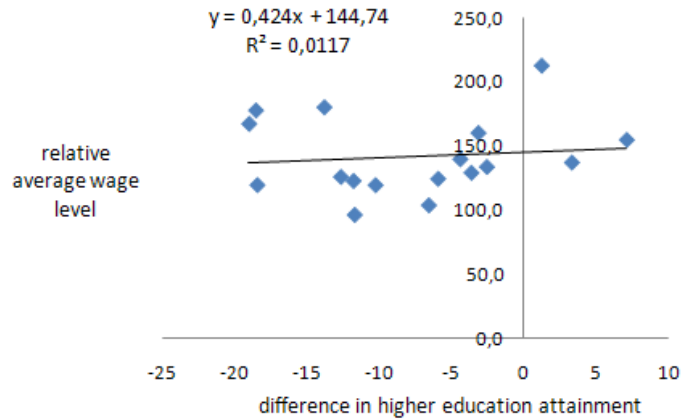
In fact, it is important to note that the attainment rates of higher education are calculated for the population as a whole at certain ages rather than for the income earners only, although both the population data and workforce data are accessible and the latter might be more capable to reflect the productivity differences behind wage variations comparing to the former. The main concern here regards to the issue of multicollinearity, which refers to the fact that a high correlation between variables may lead to unrealistic estimates with unexpected sign and magnitude. Indeed, an indicator of the differences in higher education attainment rate between the old and young calculated based on working labors without considering the non-employed must be correlated with the regressor, *ARR*, which determines the severity of biased withdraw toward low-income earners, whose education levels, on average, are relatively low, and thus determines the higher education attainment rates of the workforce. Accordingly, it is not possible to draw a conclusion from the model on the individual effect of *ARR* by keeping the other variables, which includes differences in higher education attainment rate in workforce, constant. Thus, a population-based exogenous indicator is more appropriate in this case.

Below, the higher education attainment rate in the age group 25-34 is subtracted from the one in the age group 55-64⁸, and the positive pairwise correlation with the dependent variable as predicted by intuitions is

⁸The relevant data found in Education at a Glance (OECD, 2005) are only available for the age groups 25-34 and 55-64 rather than 25-29 and 60-64. The same situation holds for data in other years as well.

illustrated in Figure 13.

Figure 13: Relative average wage levels between the age groups 60-64 and 25-29 and differences in higher education attainment rate between the old and young.



Sources: OECD (2005); OECD (2006)

6 Empirical Analysis

Previously, as can be seen in Figures 3, 5, 6, 7, 8, 9, 10 and 13, a variety of single-period one-regressor linear estimations are performed, while rather limited information can be derived from these regressions. This is because, without controlling the influences of other variables and unobserved heterogeneity of countries, estimated coefficients are prone to be inconsistent and inefficient. In order to address the problem, a panel data set of the seventeen OECD countries covering the period 1980-2005 has been exploited, and the corresponding econometric estimations and analysis are presented in the following.

6.1 Data

In the above sections, a data set of age-earnings profiles, which is directly collected by OECD and thus might be considered as being more representative and reliable than those from other sources, has been employed. Nev-

ertheless, a drawback of using the OECD data set concerns the fact that information of profiles is available for only one time per country. Therefore, a larger data set in which variables vary not only over countries but also over time appears to be more desirable. As a consequence, in this section, we apply the Luxembourg Income Study (LIS) micro-database for the panel data analysis. By using LIS, the age-earnings profiles can be repeatedly calculated⁹, and the corresponding graphs of the profiles are presented in the appendix.

As can be seen from Figures 15, 16 and 17, the age-wages profile in each country can be observed for, on average, 5.3 points in time during the period 1980-2005, and the over-time variations appear to be relatively large in countries like France and Germany and limited in some other places. With the purpose of checking whether the data collected by LIS corresponds to that gathered by OECD, the age-earnings profiles for the seventeen OECD countries computed by using the LIS database for the years when or close to when the data from OECD are also available are presented in Figure 14. Comparing Figures 1 and 14, some patterns seem to be qualitatively similar. Roughly speaking, in both Figures 1 and 14, the profiles depicted in the bottom-left panel are relatively steeper than elsewhere, and the profiles in other panels appear to be inverted U-shaped. Moreover, the relative average wage rates between the oldest and youngest age groups are, on average, the highest in the bottom-left panel, and then the bottom-right one, and then the top-left panel, and finally the top-right one, which is the order supported by both the LIS and OECD databases, although the age-earnings profiles calculated by using the LIS database in general end up with a relative low level¹⁰.

Furthermore, for the independent variables introduced in Sections 2-5, a macro data set is constructed to cover the years when the dependent variable is accessible, and imputation techniques are occasionally applied when observations are missing. Below, in Table 8, the corresponding data sources and imputation methodologies are briefly summarized.

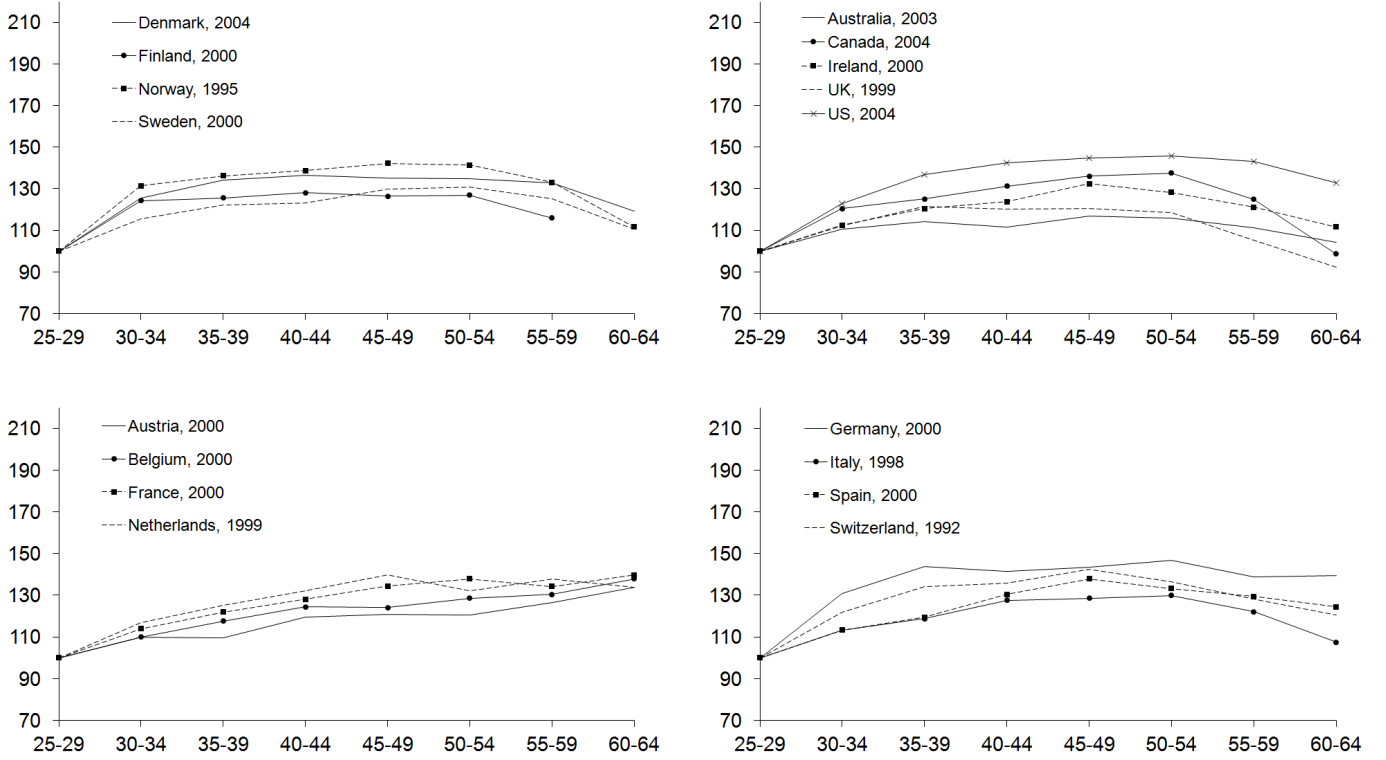
⁹The corresponding STATA codes used for computing the age-wages profiles based on the LIS remote-access system are available under request from the author. Note that the extreme values of the annual wage rates, which are either below the 5th percentile or above 95th, are excluded from the calculations when the average wage rates for each age group of male workers are computed.

¹⁰Based on the OECD database, the values of the age-wages profiles corresponding to the age group 60-64 are, on average, 182.90, 142.75, 123.87 and 116.43 in the bottom-left, bottom-right, top-left and top-right panels respectively. The corresponding values from the LIS database are 136.25, 122.92, 113.78 and 107.84.

Table 8: Data sources and corresponding imputation methods for the explanatory variables.

Explanatory variables	Data sources and imputation methods
<i>AIT</i> : average implicit tax rate on continued work for five additional years at age 60	Yearly data from 1980 to 1999 are obtained from Duval (2003). Afterwards, assume <i>AIT</i> attains the same value as in 1999.
<i>ARR</i> : average relative replacement rate embedded in the early retirement and old-age pension schemes between low-skilled and high-skilled workers in the age group 60-64	Yearly data from 1980-2005 are estimated based on information from MISSOC, Social Security Programs Throughout the World, OECD tax benefit models, OECD pension models, Blöndal and Scarpetta (1997) and Duval (2003). For more details, please refer to Section 2.2.2. Notice that <i>ARR</i> in Canada over the period 1986-2005 obtains an abnormally large value and thus qualitatively influences the estimation outcomes. As a result, the following panel data analysis is conducted after the extreme values have been deleted. This same issue has also been met in Section 2.2.2 and solved in the same way.
<i>CBC</i> : collective bargaining coverage	In OECD (2004a), values of <i>CBC</i> are accessible for three points in time, namely 1980, 1990 and 2000. These three observations are respectively extended to the periods 1980-1984, 1990-1994 and 2000-2005. Observations in the period 1985-1989 are imputed as the average values of 1980-1984 and 1990-1994; observations in the period 1995-1999 are imputed as the average numbers of 1990-1994 and 2000-2004. Data for Ireland are missing in OECD (2004a). Data from Belot and van Ours (2004) are used instead.
<i>REPL</i> : relative strictness of EPL between the old and young	Values of the indicator, <i>REPL</i> , are estimated for three points in time in Section 3.2: late 1980s, late 1990s and 2003. The one for late 1980s is extended to the period 1985-1989, the one for late 1990s is extended to the period 1995-1999, and the one for 2003 is extended to the period 2000-2005. Values before 1985 are assumed to be the same as those in late 1980s, and values in the period 1990-1994 are imputed as the average numbers of 1985-1989 and 1995-1999. This same imputation method is followed in Blanchard and Wolfers (2000).
<i>TI</i> : trust index	Values of <i>TI</i> are obtained on average 4.5 points in time per country during 1980-2006 based on World Value Survey (1981-2008). Missing observations are imputed by using linear interpolation.
<i>EDU</i> : difference between the old and young in the higher education attainment proportion	Values of <i>EDU</i> are accessible biennially from 1996 to 2005 by using Table A.1.2b in OECD (1998), Table A.2.2c in OECD (2000), Table A.2.2c in OECD (2001), Table A3.1c in OECD (2003), Table A.1.3b in OECD (2005) and Table A.1.3b in OECD (2007). Values before 1996 are assume to be the same as in 1996, and missing values from 1996 to 2005 are imputed by using linear interpolation.
<i>ERA</i> : early retirement age	Yearly data from Duval (2003) for earlier time and MISSOC for later years.
<i>SRA</i> : standard retirement age	Yearly data from Duval (2003) for earlier time and MISSOC for later years.

Figure 14: Age-earnings profiles for males in Scandinavian, Anglo-Saxon and Continental European countries by using the Luxembourg Income Study Database.



Source: Luxembourg Income Study Database

6.2 Model Specification

In the following, the fundamental regression model for the econometric analysis is presented,

$$y_{it} = \alpha_i + RW_{it} + BP_{it} + TI_{it} + TI_{it}^2 + EDU_{it} + (ERA_{it} + SRA_{it}) + \sum_{yr=1981}^{2005} d_{t,yr} + \varepsilon_{it} \quad (9)$$

where, $RW_{it} \in \{AIT_{it}, ARR_{it}\}$ and $BP_{it} \in \{CBC_{it}, REPL_{it}\}$.

Particularly, in Equation 9, y_{it} refers to the dependent variable, namely relative average wage rate between the old and young, where $i = 1, 2, \dots, 17$ is

the country suffice, and $t = 1, 2, \dots, T_i$ indicates the number of times that the dependent variable has been repeatedly observed in country i . Given that the total number of observation, T_i , of the dependent variable varies over countries, the analyzed panel is not a balanced one.

Moreover, RW represents factors related to the amount of reservation wages and in the current context refers to either AIT or ARR . The former stands for average implicit tax rate on continually working for five more years at age 60, and it indicates the relative level of reservation wage between the old and young. Thus, it is expected to play an essential role on the dependent variable if assuming that the elderly and younger labor force are not substitutable. On the contrary, the latter refers to average relative replacement rate embedded in the early retirement and old-age pension schemes between low-skilled and high-skilled workers in the age group 60-64, which specifies the relative amount of reservation wage between the low and high-skilled elderly and thus signifies the severeness of biased withdraw toward the unskilled among the aged. Accordingly, it is expected to be a powerful explanatory variable in the regression analysis even if the no substitution assumption is relaxed, in which case, however, AIT does not play a role anymore. As a consequence, the two indicators are taken in the regression one by one to examine which assumption would be more relevant in reality.

Similarly, a factor determining the relative level of bargaining powers between the old and young is denoted by BP , which, as described in Section 3, can be chosen from collective bargaining coverage (CBC) and relative strictness of EPL between the old and young ($REPL$).

In addition, TI denotes Trust Index, and the square of the variable, TI^2 , is also incorporated since the hump-shaped relationship between the dependent variable and TI needs to be tested. What is more, the effect of the difference in the higher education attainment ratio between the two age groups, which is symbolized by EDU in Equation 9, is also controlled for. And the two indicators in the parenthesis, namely standard retirement age (SRA) and early retirement age (ERA), are only taken into account after variables have been appropriately selected and the model has been finalized. The only purpose of including SRA and ERA is to investigate whether the assumptions behind the standard life-cycle model are violated.

Last but not least, $d_{t,yr}$ is a dummy variable which is equal to one if the t th observation of the dependent variable occurs in year yr and zero otherwise. The base category of the dummy variable regards to $yr = 1980$.

So far, all the variables discussed above are varying over time. However, there might be some unobserved country-specific effects constant over time

influencing the dependent variable as well. One example might be related to the different cultural traditions in countries in terms of age discriminations or respecting the elderly. In order to capture the country specific effects, a time invariant regressor, α_i , is added in, and the assumptions on α_i are crucial for selecting a proper method of estimation.

In particular, if α_i is assumed to be independent of i , which suggests that the country effects do not exist, then a standard OLS estimation would be sufficient. Otherwise, an assumption that α_i is independent from all the other regressors is indispensable for applying the random effects estimation, while no such an assumption is required for the fixed effects one. In the following, choosing between cross-section and panel data models relies on the outcomes of the standard F-tests, while Hausman tests are conducted for selecting between the fixed and random effects estimations.

6.3 Estimation Results

Before discussing the estimation outcomes, we first perform standard F-tests to examine whether panel-data estimation techniques are *de facto* needed for analyzing the data set. The null hypothesis of the F-test refers to that α_i is indifferent over i , which has been rejected with a p-value close to zero for all the specifications considered in this paper, as can be read from Table 9 under models A to J.

As a consequence, the unobserved time-invariant country specific effects should be taken in consideration by either applying the fixed effects (FE) estimations, which delete the unobserved heterogeneity of countries, α_i , through within transformations, or the random effects (RE) ones, which correct for the autocorrelations of the error term within countries based on feasible generalized least squares (FGLS).

If all assumptions hold, the RE estimation is more efficient than the FE one since the former considers both cross-country and within-country variations while the latter only within-country ones. This distinction is particularly relevant for our analysis given that the panel being employed is rather short: on average, only 5.3 observations are available for each OECD countries. Worse still, since both the dependent and independent variables are macro data which change only slightly over time, the within-country variations are quite limited. Therefore, RE estimation is much more preferable than the FE one in our case, and thus only RE estimation outcomes are reported in the following. To check the additional assumption required by the RE estimation, a formal test is conducted afterwards.

The first step of model building aims at determining which variable in the

Table 9: Panel data estimates.^a

Dependent variable	Model A	Model B	Model C	Model D	Model E	Model F	Model G	Model H	Model I	Model J
implicit tax on continued work	5.07 (0.599)	-14.68* (0.052)								
relative average replacement rate			23.55*** (0.009)	17.82** (0.043)	17.82** (0.041)	17.63** (0.044)	19.04** (0.032)	19.58** (0.027)	20.52** (0.019)	20.05** (0.019)
(low skilled vs high skilled) collective bargaining coverage	-0.06 (0.673)		0.01 (0.943)							
relative strictness of EPL (60-64 vs 25-29)		0.24*** (0.000)		0.14*** (0.008)	0.14*** (0.007)	0.15*** (0.007)	0.14*** (0.007)	0.17*** (0.004)	0.15*** (0.005)	0.14*** (0.007)
trust index	-0.46 (0.506)	-0.64 (0.299)	-0.25 (0.699)	-0.19 (0.740)	-0.20*** (0.008)	-0.22** (0.011)	-0.16* (0.082)	-0.23*** (0.004)	-0.14* (0.100)	-0.19** (0.011)
squared trust index	0.00 (0.711)	0.00 (0.606)	0.00 (0.898)	0.00 (0.992)						
diff. in higher edu. attainment (60-64 vs 25-29)	0.97** (0.049)	1.75*** (0.000)	0.80* (0.091)	1.21** (0.010)	1.21*** (0.008)	1.29*** (0.007)	1.17** (0.011)	1.36*** (0.004)	1.19*** (0.008)	1.23*** (0.007)
early retirement age						0.37 (0.589)		1.04 (0.302)		
standard retirement age							-0.99 (0.457)		-2.25 (0.105)	
overall R-squared	0.36	0.48	0.45	0.51	0.51	0.51	0.52	0.52	0.53	0.51
F-test	7.02***	5.59***	6.84***	5.89***	5.27***	5.18***	5.10***	5.03***	4.82***	5.26***
number of countries	16 ^b	16 ^b	17	17	17	17	17	17	17	17
number of observations	92	92	90 ^c	90	90	90	90	90	90	90

^a The numbers in parentheses are p-values.

Statistically significant * at 10% level ** at 5% level *** at 1% level.

All regressions contain a constant term.

^b Only 16 countries are included in the regressions since the values of AIT are not accessible for Denmark

^c Less observations are available even when one more country is involved is because seven observations for Canada corresponding to the extreme values of ARR are deleted, whereas only five more observations are added in after including Denmark

Source: author's estimates

category *RW* and *BP* possess explanatory powers to the dependent variable. In particular, the four possible combinations, (*AIT*, *CBC*), (*AIT*, *REPL*), (*ARR*, *CBC*) and (*ARR*, *REPL*) are separately examined by Models A, B, C and D, and the corresponding outcomes are recorded in Table 9.

Consider the category *RW* first. In Table 9, whenever the variable *ARR* is included, it is always significantly positive at a 5% significance level. However, the variable *AIT* is either significantly negative, which contradicts to what the theory predicts, or not statistically significant at all. Therefore, the fact that *AIT* fails to explain the variations of the dependent variable signifies the inappropriateness of assuming two separate markets for the old and young. Instead, it would be more sensible to focus on the biased withdraw toward the unskilled older workers rather than the elderly as a whole, and the important role played by *ARR* as shown in Table 9 verifies this statement.

Similarly, concerning the category *BP*, at any reasonable level of significance, the variable *CBC* is never statistically significant, whereas *REPL* is always significantly positive. As a consequence, the irrelevance of *CBC* indicates that there is no sufficient evidence to support the hypothesis that trade unions represent the interests of the elderly more. On the contrary, the newly developed estimator, *REPL*, has successfully captured the relative strictness of EPL between the old and young, which in turn reflects the comparative amount of bargaining powers between these two and thus holds a positive impact on the relative wage.

In the second step, the variable Trust Index is concentrated on, and it turns out that the hump-shaped relationship predicted by economic theories has not been supported by real world data: the squared term, TI^2 , is not statistically significant in any of the Models A to D. As an alternative, a significantly negative correlation is observed after the assumption of non-linearity is removed from the model by excluding the squared variable in Model E. This indicates that, from the perspective of incentive theorem, worrying about being deceived by their employers is not the case to induce the employees to pay a less amount of entrance fee in the seventeen OECD countries, which is comprehensible provided that firms have reasons to care about their reputations (see, e.g. Klein and Leffler, 1981; Shapiro, 1983). Also, from the perspective of investment in specific human capital, it would be possible that the level of trust in every society we considered is higher than the largest T^* held by firms, which means that distrusting the employees is not an issue that stops employers in the seventeen OECD countries investing in firm-specific capitals. Accordingly, the predicted hump-shaped relationship might come into sight if developing countries, where trust levels

are generally low, were also taken into account in the analysis.

As a consequence, model E in Table 9 is the most attractive one which selects the variable *ARR* from the category *RW* and *REPL* from *BP* and excludes squared *TI*. The estimates in Model E are all statistically significant, and the corresponding interpretations are provided below. First, the estimated coefficient of *ARR* indicates that if the replacement rates embedded in (early) retirement schemes for low-income earners aged between 60-64 increase by the amount of the replacement rates applied to high-income earners and *ceteris paribus*, the relative average wage rate between the two age groups will, on average, rise by 17.82 percentage points. Moreover, if the value of *ARR* in the Netherlands in 2003 is increased from 1.1 to 1.9, which is the value of *ARR* in Belgium in the same year, then the expected increase in the relative average wage rate is 14.26 percentage points. Second, according to the detailed methodologies followed to impute the variable *REPL*, the parameter estimate, 0.14, implies that extending the notice period (severance pay period) for the age group 60-64 for all tenure lengths by 100 days would result in an increase in the relative average wage rate by 4.39 (5.85) percentage points¹¹. In addition, if the value of *REPL* in Netherlands in 2003 is reduced from 234 to 38, which is the value of the indicator in UK in 2003, then the relative average wage rate in the Netherlands would on average be lowered by 27.44 percentage points. Third, if the Trust Index is increased by 10, which might be caused by the fact that 5% population switch to believe that most people can be trusted rather than that they need to be very careful in dealing with people, then the dependent variable is expected to decrease by 2. In particular, if the level of interpersonal trust in the Netherlands is declined to the level achieved by the US, where *TI* is 75.6 in 2003, then on average an increase in the relative average wage rate of 5.4 percentage points is implied. Finally, a ten percentage point increase in *EDU*, which might be caused by an increase in the higher education attainment rate for the oldest age group by 10 percentage points, or a decrease in the higher education attainment rate for the youngest age group by 10 percentage points, or somewhere in between, would lead to, on average, a rise in the dependent variable by 12.1. Particularly, reducing the value of *EDU* in the Netherlands from -3.18 to -19.06, which is the value obtained in Spain in 2003, would correspond to a reduction in the relative average wage rate by, on average, 19.21 percentage points.

¹¹Similarly, extending the notice period (severance pay period) for the age group 25-29 for all tenure lengths by 100 days, on average, results in a reduction in the relative average wage rate by 2.12 (2.83) percentage points.

In next step, the standard and early retirement ages are introduced in Models F and G to examine the relevances of information and capital constraints in real life. As can be seen from Table 9, neither estimate is statistically significant, which *de facto* corresponds to what the standard life-cycle model predicts and contradicts to the empirical outcomes given by Duval (2003). One explanation would be that the number of observations in our analysis is much less than that in Duval's (2003), and thus no sufficient evidence is found in our analysis to reject the assumptions made by the standard life-cycle model. Another explanation, however, claims that the standard life-cycle model is indeed reliable, and the significant effect of retirement age observed in Duval's (2003) analysis is due to the fact that the variable, implicit tax on continued work, has not fully captured the financial incentives of withdrawing from the labor market induced by the retirement ages. Nevertheless, which explanation is more realistic still awaits future investigations.

In addition, notice that having the retirement age one year earlier if it is already less than 60 or one year later when it is larger than 65 is supposed to not generate any impact on the average wage rate of the age group 60-64. Therefore, the standard/early retirement ages less than 60 are set to be 60 and larger than 65 are set to be 65 in Models H and I, which, however, does not change the conclusions drawn from the previous discussion.

Last but not least, as explained in Section 3.2, a response of the tenure distributions and permanent contract proportions to the adjustments in the strictness of EPL in terms of the period of notice and severance pay may give rise to the issue of endogeneity and thus inconsistent estimates. Accordingly, in order to check if endogeneity is indeed a problem in our case, unique tenure distribution and permanent contract proportion across countries are applied when imputing the variable *REPL* in Model J, and a Hausman test with the null hypothesis that no endogeneity problem arises is conducted. Notice that under the null hypothesis, both Model E and Model J are consistent and the former is more efficient than the latter, while under the alternative, Model J is still consistent but Model E is inconsistent, and thus Hausman test is an appropriate test in this situation. As can be seen from the fourth column in Table 10, all the test statistics are smaller than the critical value of the chi-squared distribution with one degree of freedom at any reasonable significance level, and thus the no endogeneity hypothesis is not rejected by the data, and Model E is concluded to be preferable to Model J.

Similarly, a Hausman test is performed to check the additional assumption made by the RE estimations but not the FE ones: the country specific effects, which are represented by α_i in Equation 9, should be independent

of ε_{it} , the idiosyncratic error terms. Consequently, as can be read from the last column of Table 10, the RE assumption is indeed supported by our data.

Table 10: Hausman tests.

	Model E vs Model J			RE vs FE		
	$\hat{\beta}_E - \hat{\beta}_J$	$\widehat{Var}(\hat{\beta}_J) - \widehat{Var}(\hat{\beta}_E)$	test statistic	$\hat{\beta}_{FE} - \hat{\beta}_{RE}$	$\widehat{Var}(\hat{\beta}_{FE}) - \widehat{Var}(\hat{\beta}_{RE})$	test statistic
relative average replacement rate	-2.231	-2.852	-1.745	87.749	3797.866	2.027
relative EPL	-0.001	0.000	0.023	-0.077	0.013	0.435
trust index	-0.009	0.000	-1.275	0.197	0.078	0.498
diff. in higher edu. attainment	-0.023	0.003	0.180	-0.001	0.508	0.000

Note: the critical value of the chi-squared distribution with one degree of freedom is 3.841 at the 5% significance level and 2.706 at the 10% significance level.

Source: author's estimates

7 Conclusion

This study aims at providing explanations to the identified variations in steepness of age-earnings profiles across countries and over time. And it focuses on the ratio of the average wage rate in the age group 60-64 to that in the age group 25-29. By using a panel data set of seventeen OECD countries over 1980-2005, during which each country has been repeatedly observed for, on average, five times, the random effects econometric estimations identify four explanatory variables that play a significant role in explaining the dependent variable.

The first one is Average Relative Replacement Rate, which is a rough indicator constructed to approximate the severeness of biased withdraw toward low-skilled elder workers. The second variable is Relative Strictness of Employment Protection, which calculates the differences in the level of the strictness of EPL between the old and young to indicate their comparative bargaining powers. Trust Index, the third regressor, provides an indirect interpretation for the different steepness of age-earnings profiles simply through the logics behind the Lazear's incentive theorem and the investment behaviors in specific human capitals. And the last one is Differ-

ence in Higher Education Attainment Rate, which is applied to reflect the productivity differences between the two age groups.

Moreover, no sufficient evidence is found to approve the explanatory capabilities of the other four variables, namely Implicit Tax on Continued Work, Collective Bargaining Coverage, and Standard and Early Retirement Age, which separately shows us the inappropriateness of assuming that young and old labors are not substitutable and stating that trade unions represent the interests of the elderly more, and it provides a positive evidence to the reliability of the standard life-cycle model.

This study is a pure macro-econometric analysis, in which the random effects econometric outcomes suggest that around 51 percent of the variations of dependent variable can be explained by the four statistically significant independent variables. To further improve the explanatory powers of the model, it would be suggested to take some micro factors into account as well.¹² Also, it could be much more efficient if information on the complete age-wage profiles is exploited rather than only two age groups are concentrated on and if analysis is extended to include female workers as well.

¹²One possibility would be to directly construct a micro-econometric cross-section model based on the LIS database, and then employ macro regressors to explain the dummy variable representing the age group 60-64 in the micro model. Afterwards, within transformations or feasible generalized least squares (FGLS) can be applied to deal with the unobserved specific country effects just as what a regular FE or RE estimation does.

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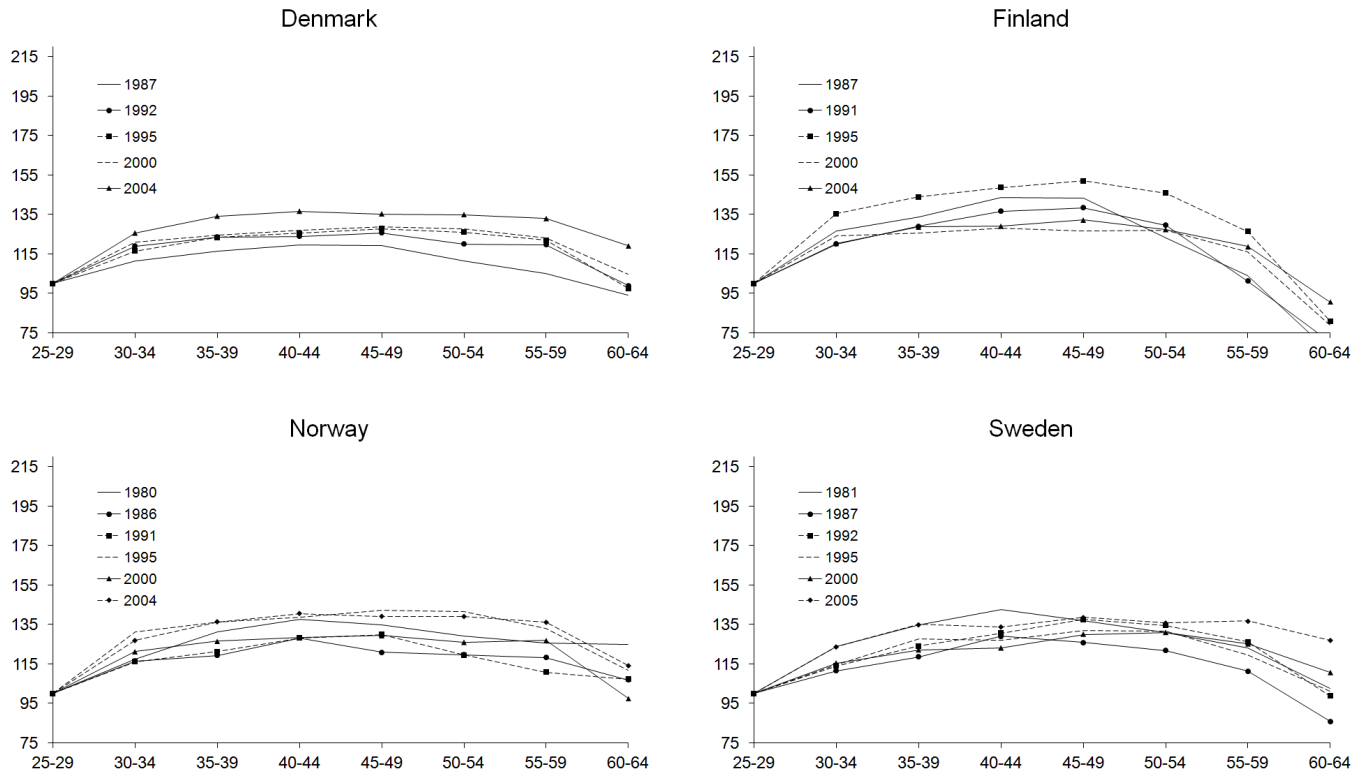
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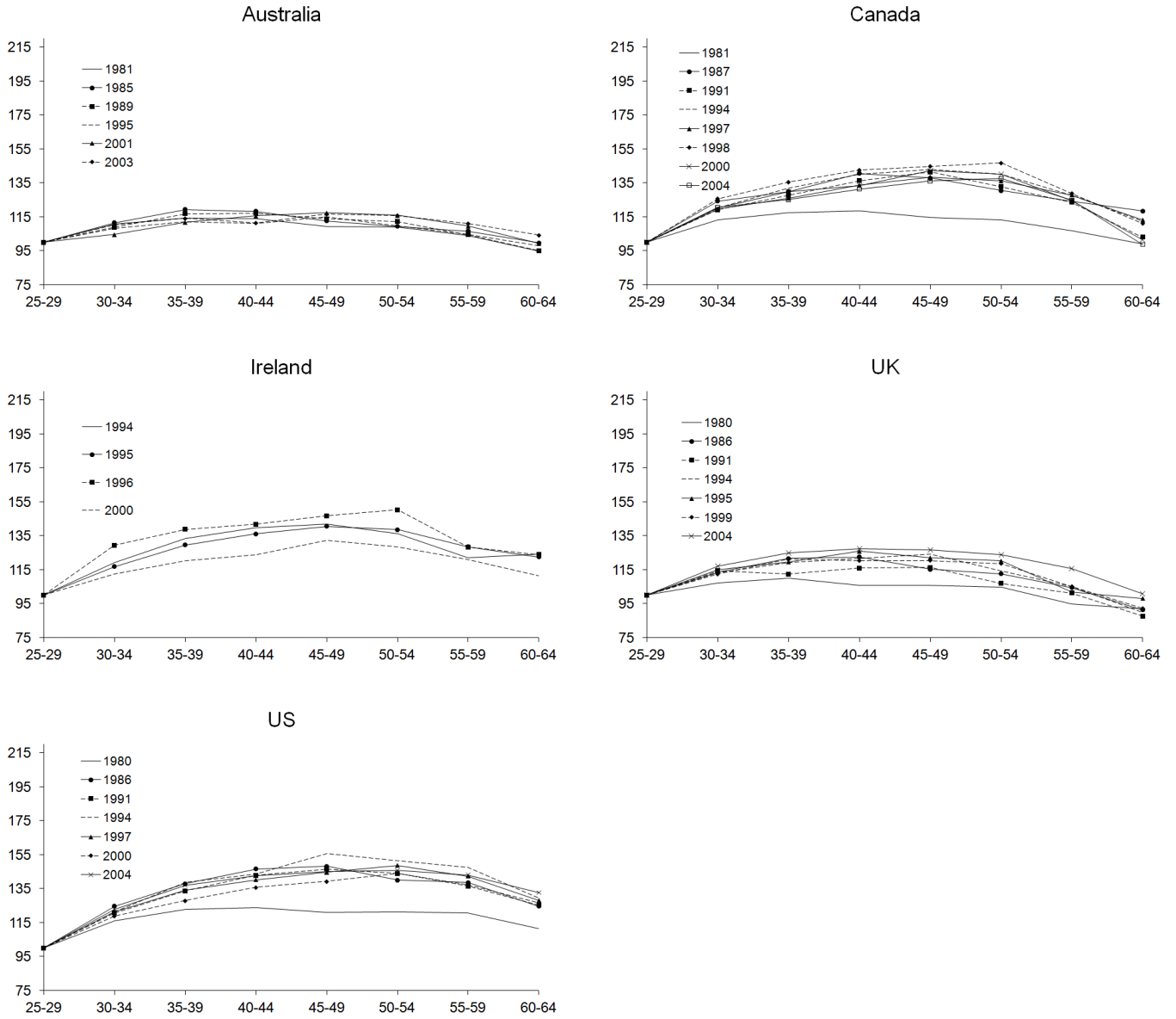
Appendices

Figure 15: Age-earnings profiles for males in Scandinavian countries.



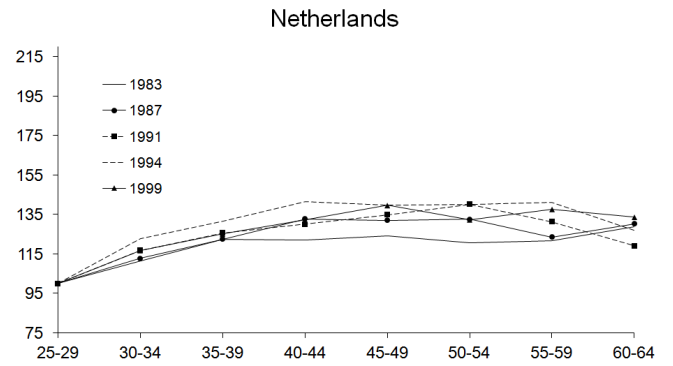
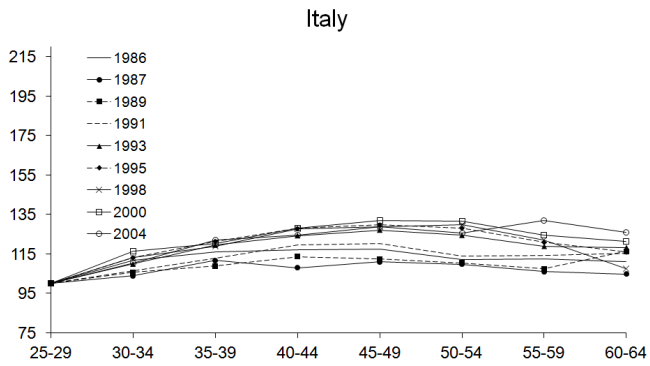
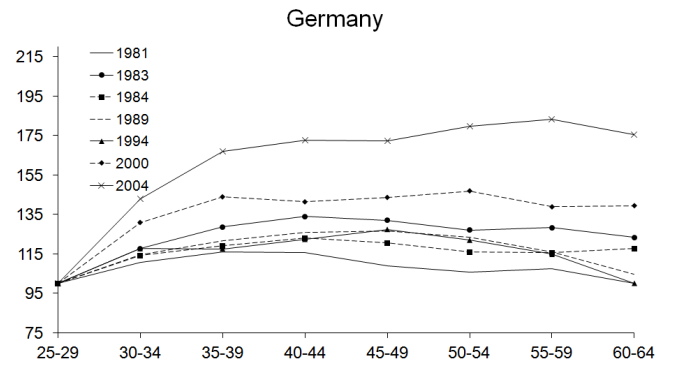
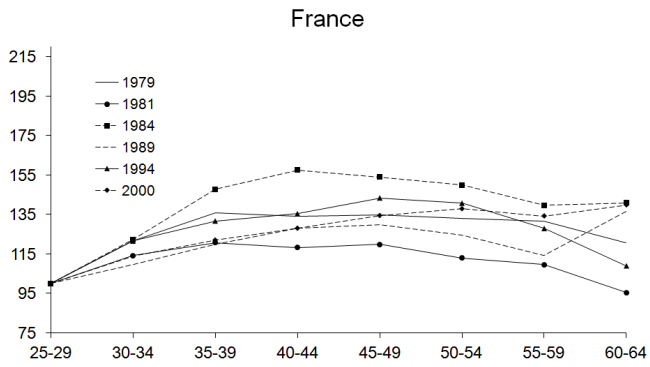
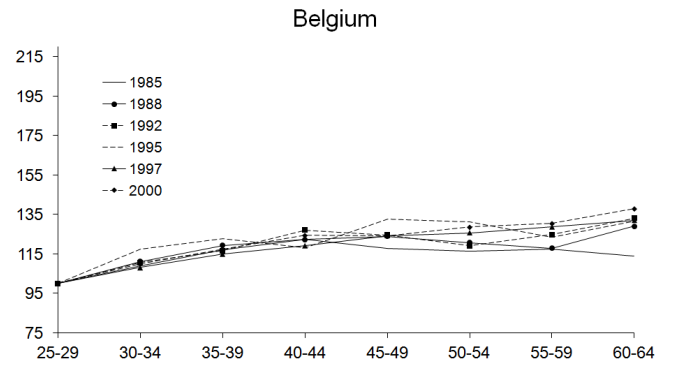
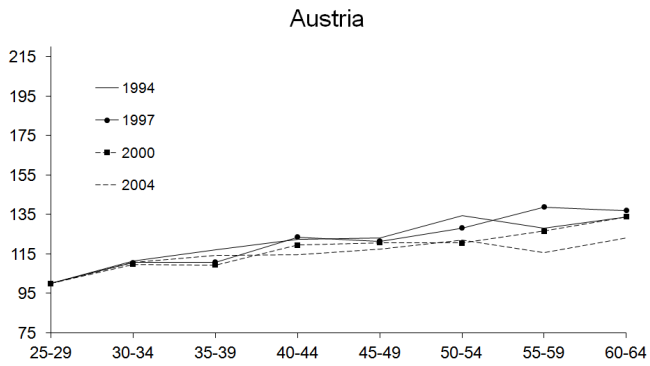
Source: Luxembourg Income Study (LIS) Database

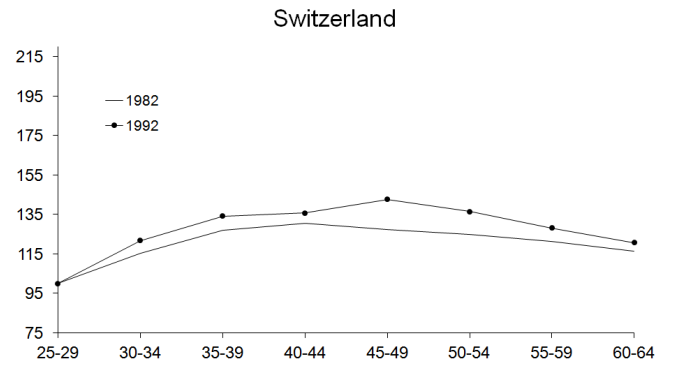
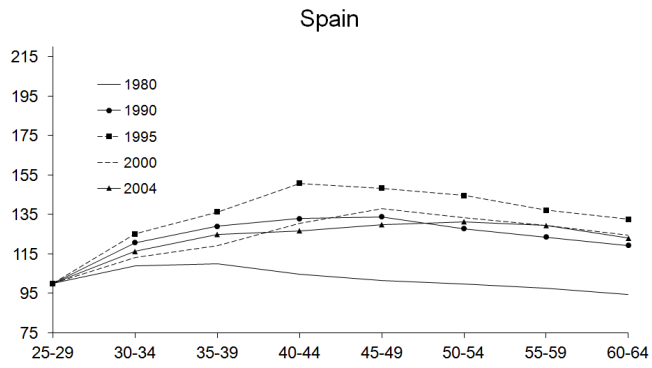
Figure 16: Age-earnings profiles for males in Anglo-Saxon countries.



Source: Luxembourg Income Study (LIS) Database

Figure 17: Age-earnings profiles for males in Continental European countries.





Source: Luxembourg Income Study (LIS) Database