WORKING PAPER

No: 13-06
May, 2013

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Declining bargaining power of workers and the rise of early retirement in Europe*

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January 2013

Abstract

We offer an alternative explanation for the decline in labor force participation of senior workers. Typically, tax and transfer explanations have been proposed. On the contrary, a model with imperfectly competitive labor market allows to consider as well the effects of a drop in bargaining power, which would not be possible in a purely neoclassical framework. We find that a decline in the bargaining power of workers, which has taken place in the last four decades, has largely contributed to the rise in inactivity in Europe. However, we need a combination of these two explanations, along with population aging and a fall in the matching efficiency, in order to correctly reproduce the joint evolutions of other labor market variables such as the employment and unemployment rates.

Keywords: Overlapping Generations, Search Unemployment, Labor Force Participation, Ageing, Labor Market Policy and Institutions

JEL-Code: E24, H55, J26, J64

*We are grateful for comments received from the participants of workshops at BCL, UCL and PSE, and annual meetings of SOLE, EEA and EALE.

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1 Introduction

Many European countries have been concerned about the low participation levels of older workers. In particular, while population ageing is raising crucial questions about the sustainability of the current generous social security system, low participation rates make it more difficult to provide for the retired and pre-retired. Specifically, in two largest European economies, France and Germany, the participation rate of 45-64 year old men has declined from 86 to 69% and from 87 to 81% (OECD (2008)) since the end of the 60s.[1]

Traditionally, the culprit behind this unfavorable development has been the European tax and transfer system which, by taxing labor income too much and by providing generous retirement and early retirement transfers, discourages old workers from staying on in the labor market. Tax and transfers, combined with very low retirement and preretirement age, lead to very high implicit tax rates on continued activity and increasingly induce people into pre-retirement (Gruber and Wise (1998)). Theoretical models of Hu (1979) or Heijdra and Romp (2007), for example, are in line with this empirical finding.

Models featuring competitive labor markets succeed well enough in justifying the tax and transfer hypothesis. In this paper, we investigate a possible role of another factor — the decline in the bargaining power of labor in the last decades. This decline, which is well documented, along with the resulting downward pressure on wages, may have possibly induced the older workers out of the labor market. One direct factor behind the decline in the bargaining power of workers has been the dissolution of unions. In France and Germany, see for instance Nickell (2003), the index of union density fell from 20 to 10 and 34 to 27 respectively between the 60s and the end of the 90s. The decline in the bargaining power of labor broadly vis-à-vis capital has been thought to be reflected by the decline in the labor share (ILO reporting by Lubker (2007)). Bentolila and Saint-Paul (2003) and Daudey and Decreuse (2006) analyze the evolution of the labor share for a cross-section of countries and find evidence that the labor share has been shifted, *inter alia*, by a shift in factor productivity (capturing technological progress) and bargaining arrangements. The effects of globalization on labor share are also documented by Harrison (2002) and Guscina (2006), reflecting the weaker labor market position of workers vis-à-vis firms.

To evaluate the importance of this argument, we introduce the imperfect labor markets *à la* Pissarides (2000) into the standard olg model (de la Croix and Michel (2002)). This allows us to model specific labor market outcomes and to consider the variable bargaining power of labor. Ours is an economy populated by three generations of agents — junior, senior and retired — who allocate resources between consumption, saving and bequest. In the labor market firms and workers engage in costly search for partners and, when matched, bargain over wages. Firms decide on the number of vacancies. Job destruction is kept exogenous. While all juniors are search active, central to our analysis is the labor force participation choice of the senior workers who face a trade-off between being search active and pre-retiring. Being search active involves a cost in the form of disutility of search but it carries an expected gain from potential employment. Being inactive, on the other hand, allows to enjoy full leisure and pre-retirement income form social programs.

[1] We find similar evolutions in most continental European countries as Belgium, Luxembourg or The Netherlands.

We show that a drop in the bargaining power of workers leads to lower willingness of the seniors to participate in the labor market. Lower labor costs, on the other hand, induce vacancy expansion, which to an extent counteracts the disincentive to pre-retire. However, as long as the supply effect is stronger than the demand effect, the decline in the bargaining power results in higher inactivity. A quantitative exercise to evaluate the weight of the bargaining power explanation compared to the tax and transfer scenario shows that both the bargaining power and the transfer scenario alone can reproduce the observed rise in inactivity but fail to reproduce the evolution of some other labor market variables, such as for instance the unemployment rates. On the other hand, a combination of these two scenarios, along with the ageing of the population and a fall in the matching efficiency, successfully matches the most of labor market data for France and Germany. Finally, we find that the rise in the longevity observed in the last decades has had a mitigating effect on the decline in the labor force participation. Precisely, ageing has forced some elderly into work in order for them to save for longer future.

Compared to models with perfect labor market, our set-up permits to consider the impact of labor market institutions on participation. Moreover, introducing imperfect labor markets allows for the analysis of labor market outcomes such as unemployment, variable labor shares and seniority premia. The Related Literature section below discusses other models of life cycle with labor market frictions, for example, by Hairault, Langot, and Sopraseuth (2006), Chéron, Hairault, and Langot (2007), and Chéron, Hairault, and Langot (2008), and explains how their focus is different than ours.

Related Literature

The first group of papers models the life cycle (i.e. different stages in life) with retirement choice, and competitive labor markets, and establishes the link between capital accumulation and retirement decision. Labor supply in OLG framework has been studied by Hu (1979), Michel and Pestieau (1999) and de la Croix, Mahieu, and Rillaers (2004). Hu (1979) focuses on the effect of social security on capital accumulation and labor supply in a PAYG case. Retirement decision in the second period of life is endogenous — individual chooses the fraction of time devoted to leisure. The short-run effects of pensions depend on the elasticities of demand and supply of labor. The long-run effects are influenced by the elasticities of savings and bequest. In the short-run, retirement takes place earlier but this can be reversed in the long-run because of capital accumulation. Moreover, if the tax and pension levels are tied to the individual retirement decision, the system causes distortions in the labor market. Michel and Pestieau (1999) have a similar endogenous labor participation choice. The fraction of time spent working in the second period declines when the size of the social security increases. For first-best optimum to be achieved, both PAYG social security tax and the retirement age must be controlled for. With zero taxes, and if there is under-accumulation, a mandatory early retirement might be optimal since it stimulates saving. de la Croix, Mahieu, and Rillaers (2004) analyze the consequences of demographic change and the impact of social security reforms (lower pensions, higher contributions, postponing retirement) with the focus on the optimal allocation of resources (consumption, leisure, capital). The effect on the optimal retirement age of a drop in fertility depends on the parameters of preferences and technology.

In fact, since Auerbach and Kotlikoff (1987) a vast literature has developed with the aim to analyze the economic implications of demographic changes by means of OLG general equilibrium models. An elaborate study of retirement and relevant policies in the presence of demographic change, in a model with competitive labor market, is Heijdra and Romp (2007). They present an OLG model with mortality process for a small open economy in which agents choose the optimal retirement age. Early retirement provisions provide incentives for workers to retire before the normal retirement age. The optimal retirement age is affected by mortality rates and the features of the pension and fiscal systems. A reduction in the disutility of work postpones the retirement age. A shift in the age profile of wages (positive substitution and negative income effects) has an ambiguous effect, so does increased longevity. With realistic pensions, implicit taxes on continued activity are high and agents choose to retire at early retirement age. Lump sum tax reduces retirement age, hence retirement is shown to be a normal good. Labor income tax has ambiguous effect (negative substitution and positive income effects). Higher benefits decrease retirement age. An increase in the slope of benefit curve leads to an increase in retirement age due to positive substitution effect. In a general equilibrium — agents are stuck at the early retirement kink. Another study of social security policy changes in an OLG set-up, but with the focus on incomplete financial markets and inequality, is Hairault and Langot (2008). They show that lower replacement rates are detrimental to the consumption of the retirees, while higher labor taxes can lead to a broader consumption inequality since liquidity constraints may adversely affect the low-productivity workers. Borsch-Supan, Ludwig, and Winter (2006) build a multi-country OLG model with demographic projections. They show that neglecting international capital flows may bias the estimation of the effects of pension reforms due to the linkage between ageing and saving behavior. In their scenario, ageing economies will start at some point to de-cumulate the capital, while pension reforms towards pre-funding will reverse this de-cumulation and increase labor supply. Attanasio, Kitao, and Violante (2007) (published, among other papers with OLG models and demographics, in the 54th volume of the Journal of Monetary Economics) confirm such a prediction, but present a more detailed treatment of fiscal variables.

A new way of thinking about labor supply is proposed by Prescott, Rogerson, and Wallenius (2007). They observe that hours worked decline little with age, as opposed to the fraction of people working and employment rates. The key in their framework is a nonlinear mapping from hours of work to labor services. In an economy populated by a continuum of identical individuals, where individuals live for many periods and the horizon of the economy is finite, optimal choice of consumption, fraction of lifetime in employment and hours worked when employed is made. The model implies a large aggregate labor supply elasticity, and a small elasticity of hours worked, with respect to tax and transfers. Constraints on one margin of labor supply affect labor supply on the other, and hence carry implications for social security. Rogerson and Wallenius (2007) extend this to a continuous time OLG to account for life cycle effects and to pin down the timing of work. While productivity varies exogenously, hours worked vary over the life-cycle and hours drop to zero at the age that is endogenous. The model can account for differences in hours of work across countries and to reconcile micro and macro labor supply elasticities. There is no inconsistency between small micro and large macro elasticities. Micro elasticity is virtually irrelevant for the aggregate response to tax changes. Macro elasticities are large. In the latter case, taxes account for a large share of differences in market work between countries (in terms of employment to population ratios and hours of work per person in employment) and the difference in employment to population ratios are dominated by the differences of those rations for the young and old.

Finally, there are empirical studies based on the model à la Heckman (Flinn and Heckman (1982b), Flinn and Heckman (1982a), Heckman and MaCurdy (1980), Heckman and MaCurdy (1981)) aimed at estimating the effect of tax on continued activity, for example Friedberg (1999). As explained by Eckstein and van den Berg (2007), Heckman's selection model allows to handle the endogenous determination of labor market outcomes and wages in a static setting. On the other hand, dynamic optimization theory presents a framework to explain both the short and long run behavior of decision-making agents. Structural estimation of a model's parameters can be then carried out using the data. Such an estimation remains consistent with the theory, allows to test for the adequacy of the theory, and is not subject to the Lucas-critique allowing for the evaluation of policies. Eckstein and van den Berg (2007) demonstrate how the estimation of numerous search models has proven fruitful for the understanding of labor market dynamics. Hence in the similar vain comes a need to build a model of search with embodied participation decision. In particular, when the implicit tax on the continuation of labor market activity is high, workers might choose to leave the labor force entirely, affecting in this way job creation behavior and employment-unemployment outcome of those remaining in the labor force. Distinguishing the three possible labor market outcomes — employment, unemployment and non-participation — seems therefore important. A first step in this direction is Ravn (2006). He introduces labor force participation into a standard labor market matching model à la Pissarides, with homogenous agents, but no age structure. Participation choice is modelled in a similar way to ours as a trade-off between the cost and benefit of actively searching.

The second group of papers combines the life-cycle features with search, although often neglecting the participation choice, thus establishing the link between life cycle and labor market outcomes. This is an important step towards a more realistic representation of the labor market in models with age structure. To start with, Hairault, Langot, and Sopraseuth (2006) consider a one-sided search model of McCall (1970) with exogenous wage distribution, in a life cycle framework, thus focusing on the effect of the distance from the retirement age on the incentives to invest into search. Their participation decision is endogenous and this framework predicts that implicit tax on the continuation of activity along with the early retirement age lead to lower participation and employment rates of the elderly. Subsequent papers replace the assumption of exogenous wages by considering the set-up of Mortensen and Pissarides (1994) with job creation, job destruction and Nash bargaining of wages. In Chéron, Hairault, and Langot (2007) the focus is on employment, while labor force participation is not endogenous. The model predicts that the employment rate decreases with age due to lower hiring and higher firing of the old. In particular, a shorter working life horizon deters firms from searching for older workers. The search behavior of the unemployed reinforces the mechanism at work as, with the approaching retirement, job duration falls and so the value of the match, and individuals search less. With human capital accumulation, the model can account for a hump-shaped profile of wages. Labor market is segmented by age and with this feature the efficiency is obtained if Hosios condition holds. On the contrary, non-segmented labor market is considered in Chéron, Hairault, and Langot (2008).

The above models of life cycle with search forgo capital accumulation, that is they do not consider the decision to save. On the other hand, the third group of papers featuring both capital formation and search allows to establish a link between capital accumulation and unemployment. The causality from accumulation to unemployment is most commonly seen as occurring via two channels — capitalization

(Pissarides (2000)) and reallocation (Aghion and Howitt (1993)). The capitalization effect arises when a higher growth rate increases the present value of profits from job creation, leading to lower unemployment. The reallocation effect arises in the presence of creative destruction and acts in the opposite direction. Low-productivity jobs are replaced by high-productivity jobs, increasing the inflow into unemployment. On the other hand, the causality from unemployment to accumulation is also possible, for example through the reduced level of saving and investment when unemployment is high, or the learning-by-doing channel whereby the long-term unemployed lose skills. Of particular interest to us are OLG models with labor market frictions. In fact, these are very few. The seminal work is by Bean and Pissarides (1993) who explore the first of these channels in an endogenous growth model with labor-augmenting technological progress driven by the economy-wide investment decisions. In their model, agents do not save for older age. Bhattacharya and Reed (2003) also present an OLG model with search à la Pissarides (2000), but with no saving instruments. On the other hand, Bettendorf and Broer (2003) have a life-cycle model with saving but a reduced version of Mortensen and Pissarides (1994) search framework. The equilibrium labor market flows are ignored and hence they do not affect the job creation and destruction. Non-OLG models with search are more common and help to see further the linkages between capital accumulation, or growth, and unemployment. For example, both disembodied and embodied technological progress is studied by Pissarides and Vallanti (2007) or Moreno-Galbis (2006). The focus on disembodied growth can be found in Prat (2007) or Postel-Vinay (2002). On the other hand, Postel-Vinay (1998) or Chen, Mo, and Wang (2002) look at unemployment and accumulation in endogenous growth frameworks.

Based on the existing literature, there is a link between (i) life cycle, accumulation and retirement, (ii) life cycle and labor market outcomes (unemployment and possibly retirement), and (iii) accumulation and unemployment. Hence it is of special interest to see in one model the interaction between the three: life-cycle features, accumulation and labor market imperfections, for the purpose of better understanding of the joint determination of unemployment and retirement.

2 The Model

Time is discrete and runs from zero to infinity. The economy starts with initial conditions bearing on the capital stock and on employment. At each date a single good is produced from labor and capital, and is used as numeraire.

2.1 Demographics

We consider an overlapping generation model where each cohort lives for three periods (junior, senior, old). The size of a cohort borne at time t is equal to 1. Each of the three periods of life coincides with a different participation decision:

- all junior members of a cohort do participate to the labor market and seek actively for a job; these junior workers may be be employed or unemployed. The total junior population is thus split in two groups:

$$1 = N_t^j + U_t^j \, ; \tag{1}$$

- senior people may choose to participate or not to the labor market; those who withdraw from the labor market are on early retirement schemes; the early retirement decision is based on intertemporal welfare considerations, given the labor market environment. The total senior population is thus split in three groups:

$$1 = N_t^s + U_t^s + I_t^s \, ; \tag{2}$$

- only a fraction σ of a cohort reaches old age; old people are all inactive ('retired"):

$$\sigma = I_t^o \, . \tag{3}$$

2.2 Labor Market Flows

We use a Mortensen-Pissarides representation of search frictions on the labor market. We assume an exogenous job destruction rate χ and a constant returns to scale matching function. The total number of job seekers at time t, denoted Ω_t, is equal to:

$$\Omega_t = 1 + (1 - I_t^s) \left\{ 1 - (1 - \chi) \, N_{t-1}^j \right\} \, , \tag{4}$$

where lower case letters i and n represent inactivity and employment rates respectively. The pool of job seekers at a time t is equal to the new population of junior workers normalized to 1, plus the currently active unemployed senior workers (i.e. those participating now that separated from their jobs in the previous period). It is assumed implicitly that the initial employment status of senior people does not affect their choice regarding inactivity (early retirement). Given a matching function:[2]

$$M_t = M(V_t, \Omega_t) \, , \tag{5}$$

the probabilities of finding a job and filling a vacancy will be respectively given by:

$$p_t = \frac{M_t}{\Omega_t} \qquad \text{and} \qquad q_t = \frac{M_t}{V_t} \, . \tag{6}$$

The probabilities that a vacancy is filled by a junior vs a senior worker are:

$$q_t^j = \frac{1}{\Omega_t} \, q_t \qquad \text{and} \qquad q_t^s = \frac{\Omega_t - 1}{\Omega_t} \, q_t \, . \tag{7}$$

[2]Although firms may have a preference between the two types of workers (young *vs.* old), they never turn down an application as long the asset value of a job is positive. For a similar reason, imposing exogenously a segmented labor market (two matching functions) would be unrealistic because the firm would have no incentive to refuse a worker from the other segment. It is worth noting that these results would not hold with another kind of production function (workers no more substitutes) and/or with no free entry condition for the firms (see also Pissarides (2000) for a related discussion).

The number of employed junior workers is then equal to:

$$N_t^j = q_t^j V_t , \tag{8}$$
$$= p_t . \tag{9}$$

For senior workers, we have from the firm's and the worker's point of view respectively:

$$N_t^s = q_t^s V_t + (1-\chi) N_{t-1}^j (1 - I_t^s) ; \tag{10}$$
$$N_t^s = \Big[(1-\chi) N_{t-1}^j + p_t \Big\{ 1 - (1-\chi) N_{t-1}^j \Big\} \Big] (1 - I_t^s) . \tag{11}$$

These two equations mean that senior employment is the sum of the remaining junior employment from the previous period and the newly created jobs with senior job-seekers.

2.3 Household Behavior

Each generation forms a household. Each household is equipped in perfect foresight. Let c_t, d_{t+1}, e_{t+2} denote the consumption levels per household member in each of the three periods of life of a generation borne at time t. We allow for bequests, denoted b_{t+2}, also defined per household member. By this we assume the joy of giving, rather than dynastic altruism. The agents have a probability σ of surviving into the last, retirement, period. The objective function of a representative household is then written as follows:

$$W_t^H = \max_{c_t, d_{t+1}, e_{t+2}, b_{t+2}, I_{t+1}^s} \left\{ P(c_t) + \beta \Big[P(d_{t+1}) - D(N_{t+1}^s) - D(U_{t+1}^s) \Big] + \sigma \beta^2 \Big[P(e_{t+2}) + V(b_{t+2}) \Big] \right\} \tag{12}$$

where $P(.)$ is utility of consumption, and $D(N)$ and $D(U)$ are disutilities associated with work and unemployment/search activities respectively[3]. Disutility of inactivity is nil. The household maximization problem is subject to (2) and the following employment flow (13) and budget constraints (14)-(16) of the generation in the three periods of life:

$$N_{t+1}^s = (1 - I_{t+1}^s) \Big[(1-\chi) N_t^j + p_{t+1} \Big\{ 1 - (1-\chi) N_t^j \Big\} \Big] ; \tag{13}$$
$$c_t + s_t = \sigma R_t b_{t-1} + (1 - \tau_t^j) w_t^j N_t^j - T_t ; \tag{14}$$
$$d_{t+1} + z_{t+1} = R_{t+1} s_t + b_{t+1}^i I_{t+1}^s + (1 - \tau_{t+1}^s) w_{t+1}^s N_{t+1}^s - T_{t+1} ; \tag{15}$$
$$\sigma e_{t+2} + \sigma b_{t+2} = R_{t+2} z_{t+1} + \sigma b_{t+2}^r - \sigma T_{t+2} . \tag{16}$$

R_t is the gross rate of interest in the current period. s_t, z_{t+1} and b_{t+2} stand for savings in each of the three periods of life. Bequests b_{t+2} are passed on to the next generation. Inactive senior workers receive an early retirement (or inactivity) benefit equal to b_{t+1}^i. Old workers receive a retirement benefit b_{t+1}^r. Taxes on wages are τ^j and τ^s. T is a lump sum tax per household member and we assume that this tax level does not depend on the generation. Taxes are set to keep the government budget in equilibrium

[3]For simplicity we assume the disutilities of work and search only for the senior since the participation decision concerns only that age group. What in fact matters is the difference between disutilities of work and search when old and young. In this spirit we do as if disutilities of the young were normalized to zero. We represent the utility of consumption by $P(.)$, instead of the usual $U(.)$, to avoid confusion with unemployment.

(see section 2.5 for further explanation). Equation (13), the law of motion of senior employment, is not customary in standard Walrasian OLG models. Here it reflects the constraint laid on the agents by the frictional labor market, and hence is crucial to the seniors' participation decision. Equation (16) reflects the perfect insurance within the household (generation). It is synonymous with the postulate of an annuity market by the means of which the wealth of those who die with probability $1-\sigma$ is redistributed among their brothers and sisters. The first order optimality conditions associated to this optimization programme are:

$$P_{c_t} = \beta\, R_{t+1}\, P_{d_{t+1}}\ ; \tag{17}$$

$$P_{d_{t+1}} = \beta\, R_{t+2}\, P_{e_{t+2}}\ ; \tag{18}$$

$$P_{e_{t+2}} = V_{b_{t+2}}\ ; \tag{19}$$

$$b^i_{t+1} = \pi^s_{t+1}\left[(1-\tau^s_{t+1})\, w^s_{t+1} - \frac{D_{N^s_{t+1}}}{P_{d_{t+1}}}\right] + (1-\pi^s_{t+1})\left[b^{u_s}_{t+1} - \frac{D_{U^s_{t+1}}}{P_{d_{t+1}}}\right]. \tag{20}$$

(17)-(18) describe the optimal consumption profile over life. (19) represents the tradeoff between utility from old-age consumption and joy of giving bequest. Equation (20) determines the participation rate of the seniors. We define $\pi^s_t = \frac{N^s_t}{1-I^s_t}$ as the probability of a senior to be employed. The seniors compare the cost against the gain from being active. The cost is the pre-retirement benefit receipt forgone while exiting inactivity. The gain is the expected income from being active — the weighted average of income from employment and unemployment. The former includes the wage after tax, less the disutility of work. The latter is the unemployment benefit less the disutility of search.

The values for the household of an additional junior or senior job, calculated from (12) subject to constraints (13)-(15), are as follows:

$$\frac{\partial W^H_t}{\partial N^j_t}\,\frac{1}{P_{c_t}} = (1-\tau^j_t)\, w^j_t + \tilde{\beta}_{t+1}\,(1-p_{t+1})(1-\chi)(1-I^s_{t+1})\left[(1-\tau^s_{t+1})\, w^s_{t+1} - \frac{D_{N^s_{t+1}} - D_{U^s_{t+1}}}{P_{d_{t+1}}}\right]; \tag{21}$$

$$\frac{\partial W^H_{t-1}}{\partial N^s_t}\,\frac{1}{P_{d_t}} = \left[(1-\tau^s_t)\, w^s_t - \frac{D_{N^s_t} - D_{U^s_t}}{P_{d_t}}\right], \tag{22}$$

where the discount factor $\tilde{\beta}_{t+1}$ is defined by:

$$\tilde{\beta}_{t+1} = \beta\,\frac{P_{d_{t+1}}}{P_{c_t}}\ . \tag{23}$$

The value of an additional junior job, as in (21), can be interpreted as follows. The first term of (21) means that in the current period the household gains the after-tax wage earned on the job. The second term of (21) represents the value of being employed today that carries into the next period. If a worker is not separated with probability χ or does not pre-retire with probability I^s_{t+1}, hence remains on the same job, he earns the after-tax wage less the disutility of work, when senior. The value of being employed today is lower when the probability of getting matched again in the second period p_{t+1} is high, that is when the gain from employment when senior can be obtained with higher probability by taking part in matching again, rather than by holding on to the old match. (22) is straightforward. It represents the after-tax wage earned by a senior worker.

Both values will be needed later to compute the outcome of the wage bargaining problem.

2.4 Firm Behavior

There are two productive factors, labor and capital. Senior workers are more productive than junior workers by a factor λ. Firms rent capital at cost R_t. The representative firm maximizes the discounted value of all the dividends (profits) that will be distributed to her shareholders. Profits at time t are given by:

$$\Pi_t = F(K_t, N_t^j + \lambda N_t^s) - (1+\zeta_t^j)\, w_t^j\, N_t^j - (1+\zeta_t^s)\, w_t^s\, N_t^s - R_t\, K_t - a\, V_t \tag{24}$$

The value of the firm can thus be written as:

$$\begin{aligned} W_t^F = \max_{K_t, V_t} \Big\{ F(K_t, N_t^j + \lambda N_t^s) \;&-\; (1+\zeta_t^j)\, w_t^j\, N_t^j - (1+\zeta_t^s)\, w_t^s\, N_t^s \\ &-\; R_t K_t - a V_t \Big\} + \tilde{\beta}_{t+1}\, W_{t+1}^F \end{aligned} \tag{25}$$

subject to (8), (10). The firm's discount factor, given by (23), maximizes household welfare. $F()$ is a CRTS production function, ζ stands for employer taxation, a is per period vacancy cost. The first-order optimality conditions yield:

$$R_t = F_{K_t}\,; \tag{26}$$

$$\begin{aligned} a = \;& q_t^s \left[F_{N_t^s} - (1+\zeta_t^s)\, w_t^s \right] + \\ & q_t^j \left[\left(F_{N_t^j} - (1+\zeta_t^j)\, w_t^j \right) + \tilde{\beta}_{t+1}\, (1-\chi)(1-I_{t+1}^s) \left(F_{N_{t+1}^s} - (1+\zeta_{t+1}^s)\, w_{t+1}^s \right) \right]. \end{aligned} \tag{27}$$

While (26) is standard, (27) is a vacancy creation condition. The firm sets the cost of opening a vacancy equal to the expected gain from it being filled either by a senior or junior worker. Employing a junior has a dynamic component since, by the means of equations (8) and (10), next period employment of the seniors depends on current level of vacancies. By (10) senior employment depends on current junior employment. By (8) current junior employment depends on the number of current vacancies.

From the firm's problem, the values for the firm of an additional junior or senior job can be calculated as follows:

$$\begin{aligned} \frac{\partial W_t^F}{\partial N_t^j} = \;& \left[F_{N_t^j} - (1+\zeta_t^j)\, w_t^j \right] \\ & + \tilde{\beta}_{t+1}(1-\chi)(1-I_{t+1}^s) \left[F_{N_{t+1}^s} - (1+\zeta_{t+1}^s)\, w_{t+1}^s \right]; \end{aligned} \tag{28}$$

$$\frac{\partial W_t^F}{\partial N_t^s} = F_{N_t^s} - (1+\zeta_t^s) w_t^s\,. \tag{29}$$

They will be used later in the wage bargaining problem.

2.5 The Government

We assume that retirement and inactivity (early retirement) benefits are respectively equal to a fraction ρ^r and ρ^i of current senior wages. Total public transfer expenditures are then equal to $\rho^i\, w_t^s\, I_t^s + \rho^r\, w_t^s\, I_t^o$.

We assume that the government balances its budget in every period. This is feasible since a period in this set-up is long. Labor taxes are set at observed values (see section 3.1 for calibration details) and the lump sum tax is thus calculated in every period such that total tax revenues are equal to total government expenditures:

$$\rho^i\, w_t^s\, I_t^s + \rho^r\, w_t^s\, I_t^o = (\zeta_t^j + \tau_t^j)\, w_t^j\, N_t^j\, + (\zeta_t^s + \tau_t^s)\, w_t^s\, N_t^s + (2+\sigma) T_t\,. \tag{30}$$

2.6 Wages

Wages are renegotiated in every period. They are determined by a standard Nash bargaining rule, for junior and senior workers separately.

Senior Worker Wage

The generalized Nash product for a senior wage bargaining is:

$$\max_{w_t^s} \left(\frac{\partial W_t^F}{\partial N_t^s}\, P_{d_t} \right)^{1-\eta} \left(\frac{\partial W_{t-1}^H}{\partial N_t^s} \right)^{\eta} \,.$$

The first-order optimality condition can then be written:

$$(1-\eta)\, \frac{1}{P_{d_t}}\, \frac{\partial W_{t-1}^H}{\partial N_t^s} = \eta\, \frac{1-\tau_t^s}{1+\zeta_t^s}\, \frac{\partial W_t^F}{\partial N_t^s}\,. \tag{31}$$

Marginal employment values have been defined in equations (22) and (29). After substitution, one obtains:

$$(1-\eta)\, \left[(1-\tau_t^s)\, w_t^s - \frac{D_{N_t^s} - D_{U_t^s}}{P_{d_t}} \right] = \eta\, \left[\frac{1-\tau_t^s}{1+\zeta_t^s}\, F_{N_t^s} - (1-\tau_t^s)\, w_t^s \right] . \tag{32}$$

Let us denote $\mathcal{S}_t^s$ the total surplus (net of wage taxes) associated to the employment of a senior worker:

$$\mathcal{S}_t^s = \frac{1-\tau_t^s}{1+\zeta_t^s}\, F_{N_t^s} - \frac{D_{N_t^s} - D_{U_t^s}}{P_{d_t}}\,. \tag{33}$$

Using this definition in (32) and rearranging yields:

$$(1-\tau_t^s)\, w_t^s = \frac{D_{N_t^s} - D_{U_t^s}}{P_{d_t}} + \eta\, \mathcal{S}_t^s\,, \tag{34}$$

that is, the net wage of a senior worker can be written as the sum of the reservation wage plus a fraction η of the total surplus. The firm's share is $(1-\eta)$.

Junior Worker Wage

The Nash product for a junior worker is:

$$\max_{w_t^j} \left(\frac{\partial W_t^F}{\partial N_t^j} \, P_{c_t} \right)^{1-\eta} \left(\frac{\partial W_t^H}{\partial N_t^j} \right)^{\eta} ,$$

The first-order optimality condition can then be written:

$$(1-\eta)\,\frac{1}{P_{c_t}}\,\frac{\partial W_t^H}{\partial N_t^j} = \eta\,\frac{1-\tau_t^j}{1+\zeta_t^j}\,\frac{\partial W_t^F}{\partial N_t^j} \,. \tag{35}$$

Marginal employment values have been defined in equations (21) and (28). After substitution, one obtains:

$$\begin{aligned}
&(1-\eta)\left\{ (1-\tau_t^j) w_t^j + \tilde{\beta}_{t+1}\,(1-p_{t+1})\,(1-\chi)\,(1-I_{t+1}^s)\,\eta\; S_{t+1}^s \right\} \\
&= \eta \left\{ \left[\frac{1-\tau_t^j}{1+\zeta_t^j}\, F_{N_t^j} - (1-\tau_t^j)\, w_t^j \right] + \tilde{\beta}_{t+1}\,(1-\chi)(1-I_{t+1}^s) \frac{1-\tau_t^j}{1-\tau_{t+1}^s}\, \frac{1+\zeta_{t+1}^s}{1+\zeta_t^j}\,(1-\eta)\; S_{t+1}^s \right\} .
\end{aligned}$$

Let us denote by $\mathcal{S}_t^j$ the current total surplus (net of wage taxes) associated to the employment of a junior worker:

$$\mathcal{S}_t^j = \frac{1-\tau_t^j}{1+\zeta_t^j}\, F_{N_t^j} \,. \tag{36}$$

Using this definition in the previous expression and solving for the net wage yields:

$$(1-\tau_t^j)\, w_t^j = \eta\, \mathcal{S}^j + \eta\,(1-\chi)(1-I_{t+1}^s) \frac{(1-\eta)\mathcal{S}_{t+1}^s}{R_{t+1}} \left[\left(\frac{(1+\zeta_{t+1}^s)/(1-\tau_{t+1}^s)}{(1+\zeta_t^j)/(1-\tau_t^j)} - 1 \right) + \, p_{t+1} \right] . \tag{37}$$

The net wage of the employed junior worker is equal to his reservation wage (which is equal to 0 in this case, since there is no unemployment benefit and no working disutility) plus a fraction η of the current surplus $\mathcal{S}^j$, plus a fraction η of the discounted value of the surplus that the firm expects to obtain tomorrow with the same worker if it remains employed with the firm, weighted by a measure of the distortion between senior and junior labor taxes, plus the employment probability of an unemployed worker p_{t+1}.

The intuition is as follows. If the tax wedge is larger for senior workers, firms make more profits, ceteris paribus, when they hire a junior worker instead of a senior one. This has a positive impact on junior wages. Let us now turn to the effect of tomorrow's employment probability p_{t+1}. We first consider the extreme case where p_{t+1} is equal to 1, so that having a job today adds nothing to the expected future income of the junior worker, although its brings extra positive value for the firm, to the extent that the job will survive till next period ($(1-\chi)(1-i_{t+1}^s) > 0$). Wage bargaining then gives to the junior worker a fraction η of that extra value. At the other extreme, if the worker's future employment probability is zero ($p_{t+1} = 0$), having a match today gives expected future benefits tomorrow for both the firm and the worker. Given the bargaining process that will take place tomorrow, these extra future gains turn out to be the same for both parties (see (32)), and so would not affect the current bargained wage. In general though, the worker's future employment probability is positive and smaller than 1 ($0 < p_{t+1} < 1$), so that the future expected surplus associated to a job affects the junior worker's wage.

"Seniority Wage"[4] Premium

The previous wage equations can be combined to explicit the determinants of the seniority premium. Taking the difference between senior and junior wages and focusing on stationary state values (to simplify the notation), one obtains after a few rearrangements:

$$\begin{aligned}(1-\tau^s)w^s - (1-\tau^j)\,w^j = {} & \left[\frac{D_N - D_U}{P_d}\right] - \eta\left(\mathcal{S}^j - \mathcal{S}^s\right) \\ & - \eta\,(1-I^s)(1-\chi)\frac{(1-\eta)\,\mathcal{S}^s}{R}\left[\left(\frac{(1+\zeta^s)/(1-\tau^s)}{(1+\zeta^j)/(1-\tau^j)} - 1\right) + p\right].\end{aligned} \tag{38}$$

The premium is made of three components. The first and most important one is the difference in reservation wages. The second is related to the difference between the shared surpluses. This term is not very important and reflects again differences in reservation wages and in wage taxes. The last term corresponds to the fraction of the senior surplus that is already included in the junior's wage. It is mostly affected by the probability of finding a job p and the participation rate $(1 - I^s)$.

Bargaining Power

Below we show how the bargaining power may affect wages of young and senior workers. For exposition assume no taxes and steady state. Then senior and junior wages as in (35) and (38) simplify respectively to:

$$w^s = \eta\;\lambda\;F_N + (1-\eta)\frac{D_N - D_U}{P_d}, \tag{39}$$

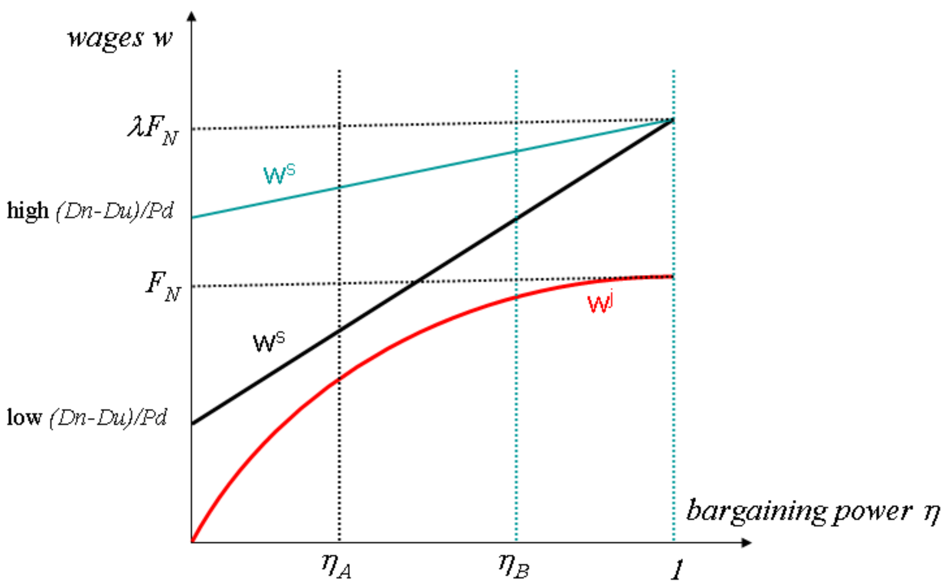
$$w^j = \eta\;F_N + \beta\;\eta\;(1-\eta)(1-\chi)(1-I^s)p\left(\lambda F_N - \frac{D_N - D_U}{P_d}\right). \tag{40}$$

Wages are drawn in Figure 2.6. For a given inactivity rate I^s and a job finding probability p (or effectively for a market tightness $\theta = \frac{V}{\Omega}$ as $p(\theta)$), both wages are increasing in the worker's bargaining power η: $\frac{\partial w^s}{\partial \eta} > 0$ and $\frac{\partial w^j}{\partial \eta} > 0$. When $\eta = 0$, wages are equal to the work disutility (no disutility is assumed for junior workers). When $\eta = 1$, wages are equal to labor productivity (by calibration, labor productivity is assumed higher for senior workers). It is worth noting that a change in the bargaining power

[4] Not strictly in conventional sense, as not due to experience or human capital accumulation.

(for instance an increase from η_A to η_B) has an ambiguous effect on the seniority premium. Figure 2.6 shows that when the disutility is low, such a change increases the seniority premium, whereas when the disutility is high, the same change decreases the premium. Finally, note that for some bargaining power values, the seniority premium might even be negative, which is in the case of very low disutility or λ close to 1 (that is, the productivity of senior workers being not much higher than the productivity of junior workers).

Figure 1: Wages (drawn for $\lambda > 1$ as in the calibration)



2.7 Equilibrium

Let Q_t denote the total financial value of firms at time t. In our deterministic setup, the return on equities must be equal to market interest rate. In other words, the value of equities must be such that:

$$\frac{Q_{t+1} + \Pi_{t+1}}{Q_t} = R_{t+1}\,. \tag{41}$$

Equilibrium on the capital market then implies (we implicitly assume that the capital depreciation rate is equal to 1):

$$K_{t+1} + Q_t = s_t + z_t + \sigma b_t \,. \tag{42}$$

3 Model Predictions

Over the last decades, European labor markets have been hit by different shocks: (i) a widespread use of early retirement schemes, (ii) a decline in the bargaining power of labor, (iii) an ageing of the population, and (iv) an increase in the heterogeneity of workers and jobs. At the same time, while the participation of senior workers has decreased, it has not led to lower unemployment rates but rather to lower employment rates. We perform a number of numerical simulations for French and German economies between 1968 and 2007 to understand if the mentioned shocks, individually or together, can explain the observed evolutions of the labor market variables. First, we calibrate our model economy both on French and German data from the year 1968 (the initial steady state). Second, we look how the model behaves in reaction to individual shocks. Third, we quantify to what extent the presence of the four shocks simultaneously can account at the same time for a decline in the labor market participation and the fall in employment rates for both age groups.

3.1 Calibration : The year 1968

We use the following functional forms: Cobb-Douglas forms for the matching and production functions, logarithmic forms for the utilities of consumption and bequest, and linear forms for the disutilities of work and search — reflecting a perfect risk-sharing in the household.

$$\begin{aligned}
M(V_t, \Omega_t) &= \bar{m}\; V_t^{\alpha} \Omega_t^{1-\alpha}, \\
F(K_t, N_t) &= \epsilon\; K_t^{\mu} N_t^{1-\mu}, \\
P(.) &= \ln(.), \\
V(b_t) &= \vartheta \ln(b_t), \\
D(N_t) &= D^n N_t \\
D(U_t) &= D^u U_t.
\end{aligned}$$

By simplicity, we abstract from wage taxation ($\zeta_t^j = \tau_t^j = \zeta_t^s = \tau_t^s = 0, \forall t$). We calibrate the model for France and Germany in 1968. A period is 20 years, 80 quarters. One can think of generations of 25-45 (junior), 45-65 (senior) and 65-85 (retired) years old. Then the pre-retirement concerns the second half of the second period (55-65) and so the data pertaining to pre-retirement can be easily averaged out over the 20-year period. The calibrated parameters fall into three categories: (i) the standard values found in all models of this type (2 parameters: the elasticity of matches with respect to vacancies α and the discount rate β); (ii) the parameters specific to this particular model for which we have some empirical information (4 parameters: two replacement ratios ρ^i and ρ^r, the survival probability σ and the productivity differential λ); (iii) the parameters specific to this model for which we do not have direct information or which we fix so that the model reproduces the steady states similar to the French and German economies (7 parameters: the matching efficiency $\bar{m}$, the job separation rate χ, the vacancy cost a, the elasticity of output with respect to capital μ, the bargaining power η, the parameters in the disutility of work and search $D^n - D^u$, and the bequest share in savings ϑ). Table 3.1 summarizes the parameters.

Table 1: Calibration — The year 1968

Parameters	**France**						
(i) Standard	α	β					
	0.5	0.99^{80}					
(ii) Empirical	ρ^i	ρ^r	σ	λ			
	0.215*	0.75	0.62	1.1			
(iii) Implied	$\bar{m}$	χ	a	μ	η	$D^n - D^u$	ϑ
	0.98	0.9	3.23	0.31	0.79	0.94	0.30
Steady state							
Variables	U^j	N^s	I^s	K/F	LS	w^s/w^j	
Model	0.02	0.84	0.14	0.14	0.65	1.3	
Data	0.02	0.84	0.14	0.14**	0.65	1.3	

Parameters	**Germany**						
(i) Standard	α	β					
	0.5	0.99^{80}					
(ii) Empirical	ρ^i	ρ^r	σ	λ			
	0	0.6	0.6	1.1			
(iii) Implied	$\bar{m}$	χ	a	μ	η	$D^n - D^u$	ϑ
	0.99	0.9	5.38	0.29	0.75	0.042	0.23
Steady state							
Variables	U^j	N^s	I^s	K/F	LS	w^s/w^j	
Model	0.01	0.87	0.125	0.13	0.65	1.1	
Data	0.01	0.87	0.125	0.13***	0.65	1.1	

***0.43 over 10 years for 55-64, **2.8 on annual basis, ***2.6 on annual basis**

Labor Share $LS = (w^j N^j + w^s N^s)/GDP$**, with** $GDP = F - aV$

The standard calibrated values (i) are the following. The elasticity of matches with respect to vacancies, α, is set at the usual value used in literature, 0.5. The discount factor β is 0.45 so that it corresponds to the quarterly discount factor of 0.99.

The data driven parameters (ii) are as follows. The pre-retirement and retirement replacement ratios, ρ^i and ρ^r, are set respectively to 0.43 and 0.75 for France and 0 and 0.6 for Germany, based on Duval (2003). In 1968 the survival probability at 65 for the next 20 years was $\sigma = 0.62$ for France and $\sigma = 0.6$ for Germany (life tables by Vallin and Meslé (2001) and MaxPlanckInstitute (2009)). We assume that in both countries the old are 10% more productive than the young ($\lambda = 1.1$), based on Aubert and Crépon (2003) and Skirbekk (2003).

Finally, in the category (iii), we match the junior unemployment rates in 1968 at 0.02 in France and 0.01 in Germany by setting the matching efficiency parameters $\bar{m}$ to 0.98 and 0.99 respectively. The 20-year period job separation rate χ is set to 0.9 in both cases to match the senior employment rate of 0.84 in France and 0.87 in Germany. The vacancy cost per period $a = 3.23$ in France and 5.38 in Germany allows us to obtain by equation (27) the senior inactivity rates of 0.14 in France and 0.125 in Germany. All demographic data come from OECD (2008) for men. Note that the senior employment and inactivity rates imply senior unemployment rates of 0.02 and 0.01 in France and Germany respectively. The elasticity of output with respect to capital, μ, is set at 0.31 in France and 0.29 in Germany to match the capital-output ratios of 2.8 and 2.6, respectively, on the annual basis. Worker's bargaining power η is 0.79 and 0.75. It allows to match the labor share of 0.65 in France and Germany (Bentolila and Saint-Paul (2003)). Regarding disutility, what matters is the difference between the marginal disutility of work and search. $D^n - D^u$ is 0.94 in France and 0.04 in Germany, calculated to reproduce the ratios of old to young wages — the seniority premia — of 1.3 and 1.1 respectively (Kramarz and Perez-Duarte (forthcoming) and Fitzenberger, Hujer, MaCurdy, and Schnabel (2001)). Last, the budget constraint for households implies $\vartheta = 0.30$ in France. This means that the retired devote 30% of their last period net resources (after tax) to bequest. In Germany, the same budget constraint implies $\vartheta = 0.23$.

3.2 Baseline Simulations

Before looking at the simulation for France and Germany between 1968 and 2007, we wish to analyze how individual shocks affect the calibrated economies in the presented model.

To mirror the rise of early retirement schemes, we assume a rise in the pre-retirement replacement ratio ρ^i. We represent a decline in the bargaining power of labor by a fall in η. The ageing of the population is accounted for by an increase in the survival rate σ. Finally, a natural representation of the increase in the heterogeneity of workers and jobs is through a reduction in the matching efficiency $\bar{m}$.

For each shock, we consider deviations from the initial steady state value. Shocks are unanticipated and permanent. We assume changes in lump-sum taxation T_t to keep a balanced government budget. Table 2 shows the new long run equilibria.

Table 2: Long-run effects of individual shocks

France	$\rho^i : +1\%$	$\eta : -0.1\%$	$\sigma : +1\%$	$\bar{m} : -1\%$
senior part. rate	-0.8	-0.4	+0.5	+2.2
senior unemp. rate	-0.3	-0.42	+0.0	+2.2
senior emp. rate	-0.5	-0.05	+0.5	+0.2
junior emp. rate	+0.4	+0.46	-0.0	-2.4
labor share	-0.0	-0.02	+0.0	+0.0
seniority premium	-0.0	+0.12	-0.0	-0.2
Germany	$\rho^i : +1\%$	$\eta : -0.1\%$	$\sigma : +1\%$	$\bar{m} : -1\%$
senior part. rate	-1.6	-0.07	+0.5	+0.1
senior unemp. rate	-0.1	-0.27	-0.1	+1.8
senior emp. rate	-1.5	+0.17	+0.6	-1.5
junior emp. rate	+0.1	+0.3	+0.1	-2.0
labor share	+0.0	-0.02	+0.0	-0.0
seniority premium	+0.0	-0.0	-0.0	+0.0

Results are expressed in percentage point deviation from the initial steady state. ρ^i is the early retirement benefit ratio, η is the worker bargaining power, σ is the survival probability, $\bar{m}$ is the matching efficiency; senior part. rate = $1 - I^s$, senior unemp. rate = $U^s/(1 - I^s)$, senior emp. rate = N^s, junior emp. rate = $1 - U^j$, labor share = $(w^j N^j + w^s N^s)/(F - aV)$, seniority premium = w^s/w^j.

Early retirement benefit

We assume a 1% increase in early retirement benefits.[5] As expected, the seniors choose to participate less in the labor market. As the elderly fall out of the labor force, their unemployment and employment rates fall as well. Due to lower job competition from the seniors, the employment of the young rises. The effects on wages, for both the senior and the junior workers, are weak and the labor share remains almost unchanged. Note that different calibrations for France and Germany (for instance, initially, there are no early retirement benefits in Germany whereas they represent 22% of the senior wage in France) imply the results are quantitatively different.

Bargaining power of workers

We look at the effect of a 0.1% decrease in the the worker's bargaining power.[6] This causes a direct fall in wages which reduces senior participation. At the same time, it stimulates the opening of new vacancies and hence increases total employment. However, we see that the decomposition of this employment

[5] For Germany, we assume ρ^i moves from 0 to 0.01.

[6] A 1% shock would imply changes which are too large and some values, e.g. the senior unemployment rate, becoming negative.

effect is different between France and Germany. This is due to the behavior of wages. Senior workers in France have high disutility of work (high $Dn - Du$, see the calibration section). It means that they have a higher reservation wage and are less likely to bargain into lower wages. In other words, the w^s curve for France is rather flat in Figure 2.6. Conversely, senior workers in Germany have low disutility of work (low $Dn - Du$) and their wage curve in Figure 2.6 is steeper. As a result, a lower bargaining power mainly reduces junior wages in France whereas it reduces all wages in Germany, as shown by the respective evolutions of the seniority premium. Since retirement benefits are indexed on senior wages, the generosity of the French pension system is almost unaffected and the senior have less incentives to work. Put differently, the vacancy increase mainly benefits the junior workers. In Germany, lower pensions prompt the seniors to work and new jobs are filled by both the junior and the senior workers.

Life expectancy

We assume a 1% increase in the survival probability so that the proportion of retired workers in the total population increases. This generates two main effects. First, households save more for the future, thereby increasing the capital stock and stimulating *labor demand*. Second, the seniors need to work longer to save for the future thereby increasing their *labor supply*. As a result, senior employment rate unambiguously increases. The effect on the junior unemployment rate is ambiguous and depends on the calibration. On one hand, the juniors benefit from the higher labor demand. On the other, they are crowded-out by the higher labor supply of the seniors. In France, the second effect is stronger than the first, and junior employment rate slightly decreases. In Germany, the first effect is stronger and junior employment rate increases.

Matching efficiency

We assume a 1% decrease in the matching efficiency. This reduces the probability to fill a job, and hence the expected return of vacancy opening for firms, thereby lowering labor demand. As a result, this leads to an unambiguous fall in the junior employment rate. The story is more complex for the seniors. On one hand, they are also negatively hit by the lower demand. On the other, they are encouraged to increase their participation rate. Note that this increase is much stronger in France than in Germany. The reason is that lower wages associated with lower matching efficiency imply lower early retirement benefits in France (but not in Germany since there are no benefits), and hence reinforce the French participation rate. Consequently, the senior employment rate increases in France (the negative demand effect smaller than the positive supply effect) and decreases in Germany (the negative demand effect larger than the positive supply effect).

3.3 The rise in inactivity

While the first column of Table 3 recalls the levels of key labor market variables in 1968, the second column "Data (1968–2007)" shows that the labor market both in France and Germany has underwent dramatic changes over the four decades. The participation rate of the senior workers fell, as well as their employment rate. Contrary to the common wisdom, this exit from the labor force did not permit to reduce the unemployment rate neither of the senior nor the junior workers. At the same time, a fall in the labor share but an increase in the seniority premium were observed. In this section, we wish to assess to what extent the simultaneous introduction of the four shocks (to early retirement, bargaining power, life expectancy and matching efficiency) is able to reproduce these changes.

Table 3: Simulations and Sensitivity

		Data/Model	**Data**	**Model**	**No change in barg. power**
		1968	**1968-2007**	**1968-2007**	**1968-2007**
France	senior part. rate	0.86	**-17**	**-13**	-11
	senior unemp. rate	0.02	+3	+3	+3
	senior emp. rate	0.84	**-19**	**-15**	-13
	junior emp. rate	0.98	**-5**	**-4**	-3
	labor share	0.65	-5	-5	-0
	seniority premium	1.30	**+10**	**+16**	-4
Germany	senior part. rate	0.88	**-6**	**-6**	+1
	senior unemp. rate	0.01	+12	+12	+12
	senior emp. rate	0.87	**-15**	**-16**	-9
	junior emp. rate	0.99	**-8**	**-13**	-13
	labor share	0.65	-3	-3	+0
	seniority premium	1.10	**+5**	**-0**	-0

Results expressed in percentage point deviation from the initial steady state; senior part. rate = $1 - I^s$**, senior unemp. rate =** $U^s/(1-I^s)$**, senior emp. rate =** N^s**, junior emp. rate =** U^j**, labor share =** $(w^jN^j + w^sN^s)/(F - aV)$**, seniority premium =** w^s/w^j**,** η **is the worker bargaining power.**

Calibrating the shocks 1968-2007

To carry out the simulation between 1968 and 2007, and to assess the contribution of various factors to the rise in the inactivity rate of the elderly, we consider the two economies being subjected to four shocks: the rise in pre-retirement benefits and longevity, and the fall in the bargaining power and matching efficiency. Among these four exogenous variables, only the first two are directly observable. The pre-retirement replacement rates ρ^i increased from 0.43 in 1968 to 0.64 in 2007 (or from 0.215 to 0.32 if taken over a 20-year period) in France and from 0 to 0.15 (or from 0 to 0.075 over a 20-year period) in Germany, based on Duval (2003). The longevity, σ, measured in our case as the survival probability at 65 over the following 20 years, rose by 46% in France and 42% in Germany (Vallin and Meslé (2001) and MaxPlanckInstitute (2009)). In the second step, we use the model to identify the two unobserved exogenous variables. In this step, the bargaining power and matching efficiency are selected in such a way that the labor share and the unemployment rate are matched exactly by the model in 2007. More precisely, we set the decline in the bargaining power η of 24% in France and 11% in Germany to match the decline in the labor share over time from 0.65 to 0.6 and from 0.65 to 0.61, respectively (Bentolila and Saint-Paul (2003), Daudey and Decreuse (2006)). We set the decline in the matching efficiency $\bar{m}$ of 36% in France and 21% in Germany to reproduce the rise in the senior unemployment rate to 5% in France and 12% in Germany. Table 4 summarizes the evolutions of the four shocks.[7] All other parameters remain at the same values. We assume changes in lump-sum taxation T_t to keep a balanced government budget over the different periods.

Table 4: Exogenous shocks : 1968-2007

France	**1968**	**2007**	**Change**
ρ^i	0.215	0.32	+51%
σ	0.62	0.91	+46%
η	0.79	0.60 / 0.79*	-24% / 0%*
$\bar{m}$	0.98	0.63 / 0.89*	-36% / -9%*

Germany	**1968**	**2007**	**Change**
ρ^i	0	0.075	+0.075
σ	0.60	0.85	+42%
η	0.75	0.67 / 0.75*	-11% / 0%*
$\bar{m}$	0.99	0.78 / 0.90*	-21% / -9%*

ρ^i is the early retirement benefit ratio, η is the worker bargaining power, σ is the survival probability, $\bar{m}$ is the matching efficiency.
***corresponds to simulations with a fixed η.**

Simulation results

Column "Model (1968–2007)" in Table 3 summarizes the results for the simulation when all four shocks have been included. We see that the shocks allow to reproduce rather correctly the evolutions of the different labor market variables, for both the French and the German economy. The model only misses the seniority premium rise observed in Germany.[8] Hereafter, we conduct sensitivity analysis to check how far we need the four shocks together to reproduce data.

First, on the basis of Table 2, it is clear that individual shocks cannot reproduce all evolutions. For

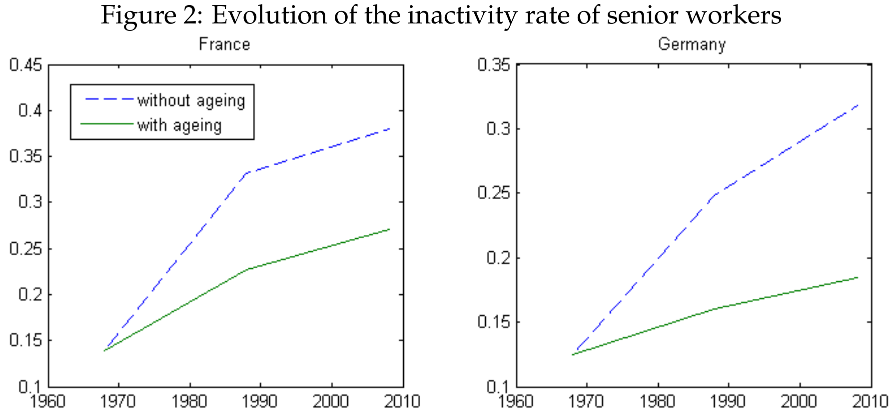
[7] Technically, we assume unanticipated and permanent shocks from period 1 onwards.

[8] Note again that the senior unemployment rate as well as the labor share are automatically matched by the way we calibrate the free shocks ($\bar{m}$ and η).

instance, early retirement benefits or bargaining power can account for the rise in inactivity but not for the rise in senior unemployment rates. On the other hand, longevity σ and matching efficiency $\bar{m}$ can partially help match the unemployment rates, but cannot reproduce the increase in inactivity. Second, we question how a subset of the four shocks can reproduce the evolutions observed in the data. A natural subset includes shocks to early retirement benefits and ageing, since these shocks are directly measurable. Such a combination allows to reproduce a reduction in inactivity, but it also leads to a reduction in the senior unemployment rate. This can be directly inferred from Table 2. Third, to shed more light on this problem, we add a third shock and calibrate the matching efficiency $\bar{m}$ to match the senior unemployment rate. The obtained values of $\bar{m}$ are given in Table 4 (marked with *) and the results of simulation are displayed in the last column of Table 3. For the French economy, the three shocks do a good job in reproducing the employment data, but they fail to match the fall in the labor share and the increase in the seniority premium. For the German economy, the three shocks are simply not able to explain the fall in the activity rate. In fact, without a decline in the bargaining power, the model predicts that the senior participation rate actually increases in Germany. Forth, and as a conclusion, only the four shocks together (column "Model (1968–2007)") are able to reproduce most evolutions observed both in French and German data.

As mentioned in the introductory sections, the related literature usually do not look at the role the worker bargaining power and the matching efficiency play in explaining the decline in labor force participation, because most authors assume perfectly competitive labor markets and cannot distinguish between inactivity and unemployment. Moreover, it is worth noting that increasing further the number of free shocks (limited to $\bar{m}$ and η in our simulations) would improve the match between artificial and real data. At the extreme, a full identification scheme, meaning that the number of free shocks is equal to the number of observables (variables we wish to reproduce), would generate a perfect match. This is beyond the scope of this paper.

Figure 2: Evolution of the inactivity rate of senior workers



Finally, our model allows us to gauge a potential evolution of elderly inactivity, had longevity not increased. Figure 2 shows that the increase in inactivity would have been much higher, by 24 rather than 13 percentage points in France and by 20 rather than 6 percentage points in Germany, had life expectancy not risen substantially over the four decades in question. In reality, aging has forced some elderly into work in order for them to save for longer future.

4 Conclusions

We have presented an OLG model with labor market frictions, which can be used to explain the age-related labor market outcomes, in particular the labor market participation decision of the elderly, and to study the effects of various shocks on the economy. In particular, we have offered an alternative explanation for the decline in the labor force participation of senior workers. Typically, tax and transfer explanations have been proposed. Here, a model with an imperfectly competitive labor market allows to consider as well the effects of a fall in the bargaining power and the matching efficiency, which would not be possible in a purely neoclassical framework. We have found that the decline in the bargaining power of workers, which has taken place in the last four decades, has largely contributed to the rise of inactivity in Europe. However, we need a combination of these two factors (transfers and bargaining power), along with population aging and a fall in the matching efficiency, in order to correctly reproduce the joint evolutions of other labor market variables such as the employment and unemployment rates.

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