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Job Ladder and Wealth Dynamics in General Equilibrium

Abstract

This paper develops a macroeconomic model that combines an incomplete-markets overlapping-generations economy with a job ladder featuring sequential wage bargaining, endogenous search effort of employed and non-employed workers, and differences in match quality. The calibrated model offers a good fit to the empirical age profiles of search activity, job-finding rates, wages and savings, so that we use the model to examine the role of age and wealth for worker flows and for the consequences of job loss. We further analyze the impact of unemployment insurance and progressive taxation for labor market dynamics and aggregate economic activity via capital, employment and labor efficiency channels. Lower unemployment benefits or a less progressive tax schedule bring about welfare losses for a newborn worker household.

JEL-Codes: E210, E240, H240, J640, J650.

Keywords: search and matching, job-to-job transitions, incomplete markets, overlapping generations, wealth accumulation.

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1 Introduction

The objective of this paper is to analyze the joint dynamics of wages, match quality and wealth over the life cycle and their implications for aggregate outcomes. To this end, we develop a macroeconomic model that allows us to quantify these relationships and to conduct counterfactual experiments of policies that affect the motives to search, to accept and quit jobs, and to save. In a nutshell, this paper bridges the gap between macroeconomic incomplete-markets models (Bewley, 1977; Imrohoroğlu, 1989; Huggett, 1993; Aiyagari, 1994) and frictional job-ladder models with sequential bargaining (Cahuc, Postel-Vinay and Robin, 2006). In doing so, our paper makes three contributions.

First, our theory provides new insights for macroeconomics with heterogeneous households. Within an aggregate production function relationship of the form $F(K, AL)$, all three inputs capital K, employment L and labor efficiency A are *jointly* determined by asset and labor market choices of firms and heterogeneous households in equilibrium. Search frictions in the labor market coupled with job mobility and differences in match quality take an impact on aggregate employment L and labor efficiency A, while the aggregate capital stock K results from firms' investment and households' savings decisions in an incomplete asset market. By combining these ingredients, our model incorporates novel linkages between the labor and the capital market. On the one hand, workers' endogenous labor market risks affect their saving motives and therefore the aggregate demand for assets, while the firms' supply of assets depends on the number and quality of matches in the labor market. On the other hand, the distribution of assets held by households matters for their job search effort, job acceptance and quitting decisions, which, together with the equilibrium interest rate, determine firms' labor demand and hence aggregate employment and labor efficiency. Our model helps to understand and quantify the role of these linkages for aggregate and distributional outcomes.

Second, our model sheds light on the relationship between household wealth, labor market transitions and earnings over the life cycle. Households of different ages decide about search effort, job acceptance and saving, so that our model has implications for the interaction between savings and labor market dynamics. We document empirically that search activity of employed and non-employed workers declines with age and with the wealth position of the household. Our model is consistent with these patterns, as well as with the age and wealth profiles of job-finding rates, and we explore the mechanisms behind these relationships.

The third contribution is to analyze the macro and labor market effects of two policies: lower unemployment benefits and a less progressive income tax schedule. Both policies change the saving and labor market decisions of heterogeneous households and therefore influence aggregate activity through the capital, employment and labor efficiency channels as described above. We explain the differential effects of the policies across the age and wealth distribution, how firms' capital and labor demands amplify or mitigate the policy effects in general equilibrium, and we determine the policy impact on the welfare of a newborn household.

In Section 2, we begin by presenting selected empirical findings that motivate the key ingredients of our model. We use data from Germany's Panel Study Labour Market and Social Security (PASS) and show that search effort of employed and non-employed workers strongly declines in age and in wealth, conditional on a number of individual and household controls. In line with the U.S. evidence of Faberman et al. (2022), employed workers exert lower search effort than non-employed workers, while active search boosts job-finding prospects relatively more for employed workers. While other studies also find that search effort and job-finding rates of the unemployed decline with savings or better access to credit,[1] we obtain a similar negative relationship between savings, search effort and job-finding rates also for employed workers.[2]

Our model is presented in Section 3. It integrates a random-search job-ladder model with sequential wage bargaining into an overlapping-generations economy with risk-averse worker households and incomplete financial markets where households can save in a risk-free asset subject to a borrowing limit. Workers choose between active and passive search, both on and off the job, as key ingredients to link savings and labor market transitions. Workers typically move to jobs of better quality, unless they are hit by reallocation shocks that may involve a loss of match quality. Workers separate into non-employment either voluntarily (with or without a reallocation shock) or exogenously in response to a layoff shock. Wages follow a standard surplus-splitting rule and are renegotiated whenever one party has a credible threat to quit. Different from job-ladder models with directed search, our random-search environment features search intensity and selectivity (job acceptance and quitting) as two important margins governing job mobility.

The model further includes unemployment benefits, progressive income taxation, and a public pension system. We close it with firms choosing capital investment and job creation, a balanced budget of the government and an endogenous interest rate equilibrating demand and supply of the risk-free asset. Solving the stationary equilibrium of the model is computationally tractable due to the bargaining structure with surplus sharing which entails that

[1] See e.g. Rendon (2006); Chetty (2008); Lentz (2009); Herkenhoff et al. (2016); Huang and Qiu (2022).

[2] Although this relationship is robust to adding many individual and household controls, it has no causal interpretation. Our structural model allows us to examine the joint determinants of savings and search effort.

only the current wage and match productivity, next to assets and age, enter the worker's value function so that standard global solution methods can be applied.

In stationary equilibrium, transitions between non-employment and employment and across jobs, as well as wages and savings, are endogenous outcomes. Nonetheless, the model is parsimonious and straightforward to calibrate, which we do in Section 4. We target selected data moments for the German economy and evaluate the fit of the model in non-targeted dimensions. Although none of the calibrated parameters – except worker productivity in the pre-retirement age group – depend on worker age, the model delivers a good fit to the life-cycle profiles of employed and non-employed workers' job-finding rates (NE and EE rates), wages and wealth. It also captures the declining age profile of active job search among non-employed workers and some of the age decline of active search among employed workers. The calibration targets the steep negative relationship between search effort and wealth that we observe in our data, and it does a good job in generating negative relationships between wealth and NE/EE rates.

In Section 5 we investigate the role of age and wealth for labor market transitions. We first decompose the age profiles of NE and EE rates into three effects governing lower search effort and greater selectivity with worker aging: A *horizon effect* which reflects the shortening of the work life, a *wealth effect* which captures the impact of life-cycle wealth accumulation, and a *selection effect* which stands for the role that a higher position on the job ladder plays for search effort and job acceptance. We find that the wealth effect plays a particularly important role for the decline of NE and EE rates early in life. Second, we examine the earnings and consumption consequences of a layoff shock. Generally, older workers suffer from more long-lasting earnings losses after displacement, while young and wealth-poor households experience faster earnings recoveries. Unsurprisingly, wealthier households of all ages can buffer the initial consumption decline after job loss better. However, poorer prime-age households, who suffer from a larger consumption decline on impact, catch up to their more wealthy peers as they return to employment faster. For older workers, however, consumption does not recover and a persistent gap between wealth-poor and wealth-rich workers remains.

Our policy results are presented in Section 6. In response to a cut of unemployment benefits by 10%, our economy experiences a long-run rise of aggregate output by 3.4% which is driven by increases of employment by 3.8% and aggregate capital by 6.2% and a mitigating decline of aggregate labor efficiency by 1.4%. The latter arises since non-employed workers and workers hit by a reallocation shock are willing to accept more low-productivity jobs. The aggregate effects are amplified by enhanced job creation in general equilibrium and by rising precautionary savings and job search effort, with stronger responses among wealth-poor households. Widening productivity dispersion between acceptable jobs results in more wage inequality. Despite rising aggregate income and employment, a newborn household dislikes the policy regime with weaker public insurance, greater wage risk and higher job search effort, which together result in a welfare loss equivalent to 1.2% lower consumption.

In our second policy experiment we reduce the tax progressivity parameter from the German to the U.S. value, adjusting the tax level parameter to maintain budget balance. While high earners benefit from less progressive income taxes, the majority of workers end up with lower after-tax earnings. As a result, some jobs at the bottom of the productivity distribution cease to be viable, so that the economy ultimately experiences a decline of aggregate employment by 1.9% in combination with an increase of aggregate labor efficiency by 1.1%. The negative employment effects are stronger for young and wealth-poor workers who are most likely to take low-productivity jobs. Although job search effort of employed and non-employed workers goes up slightly, weakened job acceptance and higher job quitting reduces firms' labor and capital demands, so that aggregate output declines by 0.6% in general equilibrium. In spite of higher average wages and lower (before tax) wage inequality, a newborn household suffers from the weakened labor market, experiencing a welfare loss equivalent to 0.76% lower consumption.

Related Literature

Our labor market modeling builds on the sequential auction models of Postel-Vinay and Robin (2002) and Cahuc et al. (2006) which are able to generate endogenous earnings dynamics with transitions between unemployment and employment, job-to-job flows and wage changes on and off the job. At the same time, these early approaches have risk-neutral workers and exogenous matching rates. Bringing these models closer to the macro-labor literature, Robin (2011) includes aggregate productivity risk and Lise et al. (2016) add a job-creation condition with an aggregate matching technology. To study richer wage dynamics within and between jobs, Bagger et al. (2014) introduce human capital accumulation to which Ozkan et al. (2023) add a life-cycle structure with ex-ante worker heterogeneity in order to analyze the determinants of lifetime earnings inequality. To describe wage processes with a tractable log-linear structure, these two papers have risk-averse workers with logarithmic utility, yet rule out savings. As in our work, Lentz (2010) and Bagger and Lentz (2019) consider a sequential bargaining model with endogenous search intensity. While their models have no savings or capital, they feature sorting of workers and firms of different skill and productivity types. In our model, jobs differ in match-specific productivity, but there is neither permanent (ex-ante) heterogeneity of workers and firms, nor accumulation of human capital. Adding these features would be interesting directions for future research.

Early contributions featuring a worker's consumption-saving choice in job search models are Acemoglu and Shimer (1999) and Lentz and Tranaes (2005) which abstract from search on-the-job. Lise (2013) considers a model with search on and off the job, and studies saving and search effort choices at different positions on the job ladder, while the wage-offer distribution is exogenous. More recently, Hubmer (2018), Kuhn and Ploj (2020) and Larkin (2019) also consider precautionary savings in job-ladder models with exogenous wage distributions.

The first paper that embeds a frictional labor market into a macroeconomic incomplete-markets model with heterogeneous households is Krusell et al. (2010). In their model, the labor market has a standard Diamond-Mortensen-Pissarides structure with random search, endogenous job creation, wages set via Nash bargaining and no job-to-job transitions. In subsequent work, Krusell et al. (2017) consider a richer labor market structure with on-the-job search, a labor force participation margin, and aggregate risk, yet their model has exogenous wages and an exogenous interest rate. Recently, Cajner et al. (2022) consider an incomplete-markets model with a life-cycle structure and search on-the-job, but matching rates are exogenous functions of age and wages are exogenously linked to productivity. Chaumont and Shi (2022) develop a directed search model with job ladders, savings and incomplete markets. Different from our paper, the interest rate is exogenous, workers do not choose search effort, job acceptance or job quitting, and there is no life cycle – ingredients that we consider essential for the micro and macro implications of economic policies. Griffy (2021) analyzes a similar model as Chaumont and Shi (2022), adding a life cycle and human capital accumulation, while keeping search effort and the interest rate exogenous. In ongoing work, Griffy and Rabinovich (2022) and Krusell et al. (2019) study similar directed-search job-ladder models with aggregate risk. Birinci et al. (2023) build a HANK model with on-the-job search, yet without search effort, job acceptance or job quitting into non-employment. Abstracting from search on-the-job and building on Krusell et al. (2010), Lalé (2019) studies the impact of severance payments on endogenous job separations, while Eeckhout and Sepahsalari (2023), Herkenhoff et al. (2016) and Huang and Qiu (2022) analyze match productivity and sorting with permanent heterogeneity of firms and/or workers.

Related to our policy analysis is the literature on unemployment insurance in general-equilibrium settings with search frictions and precautionary savings (e.g. Young, 2004; Mukoyama, 2013; Popp, 2017; Piguillem et al., 2021).[3] Our work contributes to this literature by considering a model with richer earnings dynamics due to search on-the-job and a selectivity

[3] There is also a literature that considers the effects of unemployment insurance in settings with search frictions and precautionary savings (with an exogenous interest rate). Acemoglu and Shimer (2000) show that more generous unemployment benefits can help financially constrained agents to search for better jobs, which may eventually raise output. This mechanism is also effective in Eeckhout and Sepahsalari (2023) who consider a richer setup that is closer to ours but abstracts from job-to-job transitions.

margin, which are key for the aggregate and welfare effects of unemployment benefits.

Next to the large literature on progressive taxation and (intensive margin) labor supply in macroeconomics (e.g. Heathcote et al., 2017), our work is related to research studying the relationship between income taxation and the allocation of labor in a frictional market (see e.g. Gentry and Hubbard, 2004; Kreiner et al., 2015; Bagger et al., 2018, 2021). Our work complements these studies in that we consider an incomplete-markets economy with savings, endogenous search effort, and a selectivity margin that determines job acceptance and job quitting which is central for our policy findings.[4]

2 Empirical Facts

We begin by presenting selected empirical relationships motivating the key ingredients of our theoretical model. In particular, we show how job search varies with age and with the household's financial wealth, and how active search matters for labor market transitions of employed and non-employed workers over the life cycle.

We utilize the Panel Study Labour Market and Social Security (PASS) which is provided by Germany's Institute for Employment Research (IAB). The PASS is an annual household panel survey which covers about 10,000 households during the years 2007–2019 with interviews of all household members aged 15 and older.[5] From the household questionnaire, we use information about financial wealth and debt (excluding mortgages) of the household.[6] From the person questionnaire, we use information about job search activity in the past four weeks which is reported by employed and non-employed individuals. For post-interview labor market transitions, we use information from the biography spell module of the PASS which includes information about the employment and non-employment histories of the person. We only consider individuals of ages 25–66 who are closely attached to the labor force. Specifically, we remove all persons with less than 70% of their worklife (after age 25) in paid employment, or who are currently in education, in parental leave, childcare leave or sick leave. Appendix A.1 reports various household and worker statistics about this sample.

Figure 1 shows quarterly transition rates into new jobs for non-employed and employed workers (NE and EE rates), by age and job search status. Job-finding rates (NE rates)

[4] Pizzo (2023) examines the welfare effects of tax progressivity in a model combining incomplete markets and search frictions, yet abstracting from on-the-job search.

[5] While the PASS oversamples households with unemployment benefit recipients, it also provides sampling weights to the German residential population which are applied in our analysis.

[6] Financial wealth includes savings accounts, stocks, mutual funds, and life assurances among others (yet excluding deposit accounts). Both financial wealth and non-mortgage debt is reported in eight categories ranging from zero to over €50,000.

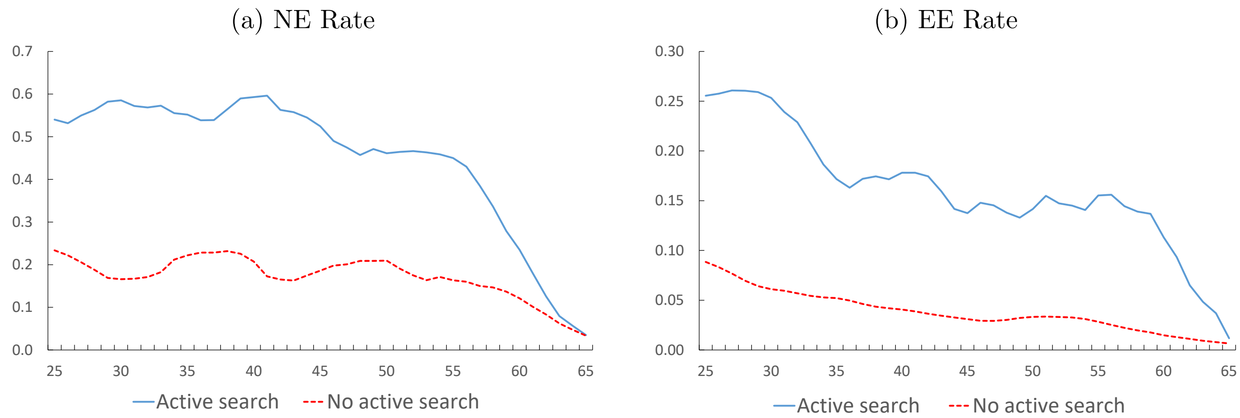


Figure 1: Quarterly job-finding and job-to-job transition rates by age and search

NOTES: For each age-time cell in PASS, we divide NE and EE flows three months after the interview by the respective stocks, applying the cross-sectional population weights. After taking out time fixed effects, the age profiles are smoothed with centered moving average (7 years).

generally exceed job-to-job transition rates (EE rates) more than twice, both for individuals reporting active search and those who do not. Active searchers find jobs more than twice as often as non-active searchers when non-employed, while the transition rates into new jobs of employed active searchers exceed those of non-active searchers by a factor three or more.[7] All four rates shown in Figure 1 exhibit declining trends in the worker's age. While the EE rate of active searchers quickly drops after age 30, all other rates in panels (a) and (b) decrease more slowly until about age 55 after which they approach zero.

A worker's choice to search actively depends on various personal and household characteristics. Figure 2 shows how search activity of employed and non-employed workers varies with age and with the financial wealth position of the household. Employed workers are generally less likely to search than non-employed workers in our sample (6.3% versus 32.6%; see Table A.4). The age profiles in panel (a) show that both search proportions are decreasing over the life cycle after age 30–35, where the NE exhibits a modest trend decline until age 55 and a fast drop thereafter which may be due to these workers expecting to enter (early) retirement in the near future. Panel (b) further shows that active search is strongly decreasing in the financial wealth of the household. In comparison to workers with zero or low financial safety net, the search proportions of employed and non-employed workers with

[7]In Appendix A.1 we further document that active non-employed searchers exert higher search effort than employed workers, as measured by the number of search channels, time spent on job search, broadness of search, or number of applications sent, which is consistent with the U.S. evidence provided by Faberman et al. (2022).

financial wealth above €20,000 are only about half as large.

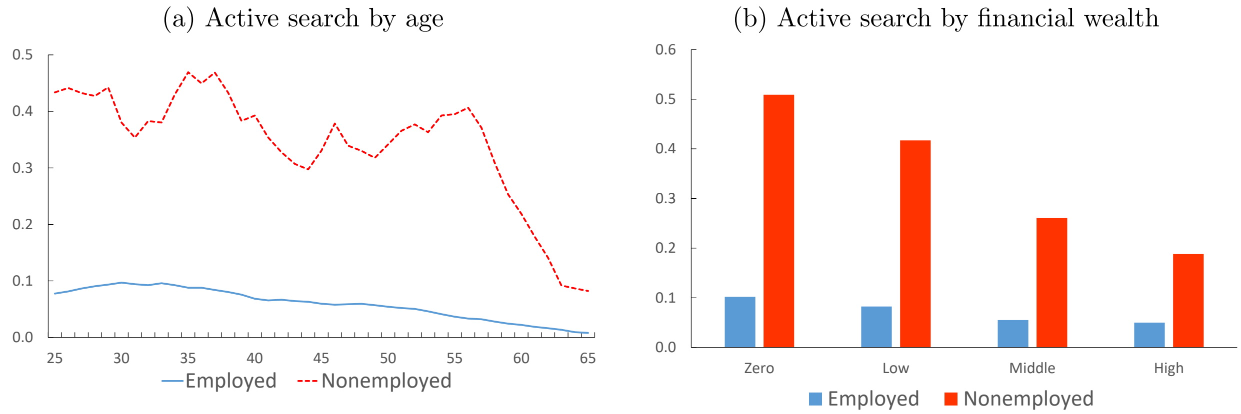


Figure 2: Active search by age, financial wealth and employment status

Notes: Age profiles in panel (a) are smoothed with centered moving average (7 years). In panel (b), "Low" is positive financial wealth up to €2,500, "Middle" is wealth €2,500-20,000 and "High" is wealth over €20,000.

Clearly, household wealth and the age of working-age household members are positively correlated, and both also correlate with other household or personal characteristics that may impact a worker's job search behavior. In Table 1 we regress the active search dummy on age, financial wealth and a number of personal and household characteristics as listed in the table notes.[8] As shown in columns (1) and (2), active search is less likely if the person is older or more wealthy, with economically meaningful coefficient estimates: Compared to the zero wealth reference category, workers with high financial wealth have a 2.7 percentage point (pp) lower probability to search actively when employed and a 10.6 pp lower probability to search when non-employed. Columns (3) and (4) further include controls for household debt (excluding mortgages). While the negative relationships with age and wealth continue to hold (the latter with somewhat smaller coefficients), we find that higher indebted workers are more likely to search (except for high-debt non-employed workers where the difference to zero-debt individuals is statistically insignificant).[9]

In sum, we document that job search of employed and non-employed workers varies over the life cycle and with the financial position of the household. Moreover, active search strongly predicts job-finding chances of workers on and off the job which are themselves

[8]Using an alternative probit specification leads to no meaningful differences in results.

[9]In Appendix A.3 we present results for the U.S. from the Survey of Consumer Expectations where we also find that search activity is decreasing in age and financial wealth and increasing in household debt, conditional on other individual and household characteristics.

Table 1: Active search of employed and non-employed workers

	(1) Employed	(2) Non-employed	(3) Employed	(4) Non-employed
Low wealth	-0.0135**	-0.00287	-0.0123**	-0.00657
	(0.00425)	(0.0170)	(0.00427)	(0.0171)
Middle wealth	-0.0275***	-0.0677**	-0.0223***	-0.0679**
	(0.00438)	(0.0217)	(0.00443)	(0.0220)
High wealth	-0.0269***	-0.106***	-0.0177***	-0.101***
	(0.00511)	(0.0284)	(0.00522)	(0.0288)
Age	-0.00118***	-0.00624***	-0.00116***	-0.00611***
	(0.000143)	(0.000630)	(0.000143)	(0.000632)
Low debt			0.0205***	0.0524**
			(0.00326)	(0.0171)
High debt			0.0293***	0.00338
			(0.00323)	(0.0173)
Observations	43,061	4,119	42,761	4,084
R^2	0.042	0.218	0.044	0.221

Notes: OLS regressions of the active search dummy. Further controls include education (years), gender, household size, household income, duration of the current spell, number of previous employers, hours worked, earnings, and year fixed effects. Zero financial wealth is the reference category, "Low wealth" is up to €2,500, "Middle wealth" is €2,500-20,000, "High wealth" is over €20,000. In columns (3) and (4), zero debt is the reference category, "Low debt" is up to €5,000, "High debt" is over €5,000. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

declining in age conditional on the search status of the worker. These facts motivate the key ingredients of the equilibrium model presented in the next section, featuring overlapping generations of individuals who decide each period about consumption and saving, job search and job acceptance.

3 The Model

3.1 The Environment

We consider a stationary equilibrium of a closed economy which is populated by households, firms and a government. Time is discrete.

Households. There are overlapping generations of households which stochastically transit through age groups $j = 1, \ldots, J$. The probability to age from $j < J$ to $j + 1$ is μ_j. In ages $j = 1, \ldots, J - 1$, the household includes an individual of working age supplying one unit of indivisible labor. In the following we refer to these individuals as *workers of* *age j*.[10] Age group $j = J$ is retirement during which the retired worker receives pension income. Retired households die with probability μ_J, and a constant inflow μ_0 into the first working-age group $j = 1$ ensures that the mass of households is constant and normalized to unity.[11]

Each period households enjoy utility from consumption c with strictly increasing and concave utility function $u(c)$. Future utilities are discounted with factor $\beta < 1$. Households have the possibility to save in a riskfree asset at real interest rate r. Asset holdings are denoted by a, and borrowing is not permitted. Newborn households enter the economy with initial assets drawn from distribution Φ which are paid from the accidental bequests of dying households.

Workers may undergo transitions between employment and non-employment, as well as transitions between jobs. Workers entering the economy at age $j = 1$ are initially non-employed. Both employed and non-employed workers can search actively or passively. Active search entails higher search efficiency than passive search, such that the probability to receive a job offer (described below) is proportional to search efficiency. Specifically, s^1_ℓ (s^0_ℓ) is search efficiency under active search (passive search, resp.) with $s^0_\ell < s^1_\ell$, where $\ell = e, n$ is the employment status.[12] Active search comes at a fixed additive utility cost ξ_ℓ which depends on employment status. Additionally, there are idiosyncratic additive utility shocks $\varepsilon_i/\gamma_\ell$ when searching actively ($i = 1$) or passively ($i = 0$), where $\gamma_\ell > 0$ are parameters that depend on employment status, and ε_i are type-I extreme-value distributed, and i.i.d. across workers and over time.[13] Search effort (like savings) is a private choice of households and not part of the employment contract, unlike in Lentz (2010) and Bagger and Lentz (2019).

Firms. There is a continuum of identical firms using capital and labor to produce output with constant-returns production function $F(K, E)$. The labor input E is measured in efficiency units which reflect match-specific productivity in worker-job pairs. Specifically, a given worker-job pair draws productivity (labor efficiency) p upon match formation from distribution H. Match productivity remains constant for the duration of the match, so that the output of the worker-job pair is equal to ωp where $\omega = F_E(K, E)$ is the marginal product

[10] We use both terms "household" and "worker" interchangeably, as each of them connects to a specific dimension of our analysis (respectively asset and labor market choices), although there is no difference between them in our model.

[11] Therefore, $\mu_0 = (\sum_{j=1}^{J} \frac{1}{\mu_j})^{-1}$ is the inflow of new households and the measure of workers of age j is equal to μ_0/μ_j which sums to one.

[12] The active vs. passive search distinction of the non-employed can be interpreted as the labor-force participation margin in our model which entails higher job-finding chances for unemployed workers in comparison to non-employed workers who do not report active search.

[13] This specification smoothes out the active search choice among similar household types, a key element of our calibration strategy in Section 4, while permitting a simple closed-form solution.

of labor efficiency. Every period, a firm rents capital K at per-period user cost $r + \delta$ where δ is the depreciation rate. This implies that all firms use capital in the same proportion to their labor efficiency input so that ω is identical for all firms. To hire workers, the firm posts vacant jobs at per-period cost k per vacancy. All firms are held by a mutual fund and maximize their contribution to the value of the mutual fund.

Government. The government pays a transfer b to every non-employed worker and public pension income to every retired worker $w^r(w)$ which is increasing in the worker's last wage w prior to retirement.[14] The government finances these transfers by collecting a progressive labor income tax that is modeled by the parametric function $T(w) = w - \tau_0 w^{1-\tau_1}$ with parameters τ_0 and τ_1, where w is gross wage income of the household.[15] The government sets the scale parameter τ_0 to maintain budget balance. The government also collects the remaining accidental bequests which are not paid out to newborn households.

Labor market matching. Workers and vacant jobs are paired together with a matching technology such that the probability that a worker with search efficiency s meets a vacancy is $\lambda(\theta)s$, where λ is an increasing and concave matching function of market tightness θ which is the ratio between the number of vacant jobs and aggregate search efficiency. The probability that a firm with a vacant job meets a worker is $\lambda(\theta)/\theta$.

Wage negotiations. We adapt the wage negotiation mechanism of Cahuc et al. (2006) to our setting. That is, wages are negotiated upon hiring and can only be renegotiated by mutual agreement. If a non-employed worker meets a firm, the firm-worker pair observes match productivity p, and the wage is set such that the worker's surplus is a fraction $\eta \in [0, 1]$ of the surplus that would be obtained if the firm paid the marginal product ωp where η is a worker bargaining power parameter. If an employed worker meets another firm, match productivity in the new match is observed, and the worker either changes jobs when the new job is more productive or remains at the incumbent employer when the job at the poaching firm is not more productive. While the firm with the less productive job bids its wage up to marginal product, the worker negotiates with the employing firm a wage such that the worker obtains fraction η of the surplus that would be reached if the more productive job paid the marginal product.

In other circumstances, the wage can only be renegotiated if one party has a credible threat to leave the match. Since we consider a stationary environment and match productivity is constant over time, firms can never initiate wage renegotiations. Workers can only

[14] Linking retirement income to the last wage is a simplified modeling of a contribution-based pension system that avoids keeping track of another continuous state variable in the household's recursive problem.

[15] We assume that capital income is not taxed which is a reasonable approximation to the German institutional setting where capital income is taxed at a flat rate with rather generous tax exemptions and imputed rents are not taxed.

initiate renegotiations if they receive a good enough outside offer or if they have a credible threat to quit into non-employment. In the latter case, we assume that the firm responds with a wage rise that makes the worker indifferent between quitting and staying, whenever this wage does not exceed the marginal product of the worker.[16] If the firm cannot retain the worker without incurring losses, the worker quits.

Separations. Worker-job matches are destroyed with probability $\rho + \kappa\lambda(\theta)$. Here, ρ refers to a layoff shock, where the worker is sent into non-employment. By contrast, $\kappa\lambda(\theta)$ refers to a reallocation shock where the worker is offered a job at another firm with match productivity drawn from distribution H which the worker can either accept or reject in which case the worker becomes non-employed.

Capital market. There is a competitive capital market where the risk-free interest rate r adjusts to equate the households' demand for assets to the supply of shares in a mutual fund that holds all capital and owns all firms.

Timing. Within the period, events proceed as follows. First, households with employed and non-employed workers realize utility shocks and decide whether to search actively or not. Second, employed workers produce and receive wage income, non-employed and retired workers receive their transfer income, and all households make consumption and saving decisions. Third, separation shocks arrive, firms create vacancies which are matched with job seekers, workers may take (new) jobs, renegotiate with their employer, or quit the job exogenously or voluntarily. Fourth, age transitions and death events take place. Figure 3 shows the time line of events and the notation of household value functions at the different stages which are further described below.

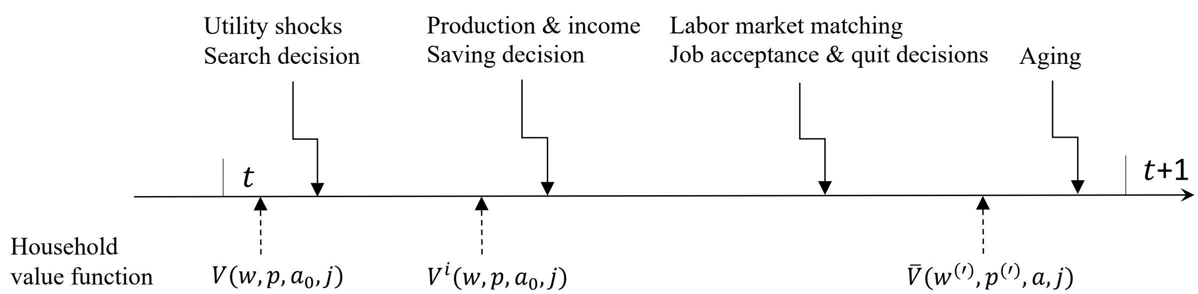


Figure 3: Events within a period and household value functions

[16] See Lise et al. (2016) for a similar assumption in a setup with productivity shocks. In our model, workers may have a credible threat to quit due to changes in asset holdings or due to aging.

3.2 Wage Negotiations

At the wage negotiation stage, the discounted utility of a household of age j with an employed worker earning wage w in a job of match productivity p and assets a is denoted by the value function $\bar{V}(w, p, a, j)$. Note that $w \leq \omega p$, because the firm would make losses otherwise.

Now suppose the employed worker receives an outside offer from another firm where match productivity is higher (i.e. $p' > p$). Then the worker quits and the bargaining process with the poaching firm results in a wage w' defined as the solution to the equation[17]

$$\bar{V}(w', p', a, j) = (1 - \eta)\bar{V}(\omega p, p, a, j) + \eta \bar{V}(\omega p', p', a, j) \ . \tag{1}$$

In words, the incumbent firm bids the wage to ωp, and the worker negotiates with the poaching firm the wage w' that gives the household a fraction η of the surplus that the poaching firm would be maximally willing to deliver, $\bar{V}(\omega p', p', a, j) - \bar{V}(\omega p, p, a, j)$.[18]

If the match at the poaching firm is not more productive than the job at the incumbent ($p' \leq p$), the bargaining process with the incumbent firm results in a wage w' that solves

$$\bar{V}(w', p, a, j) = (1 - \eta)\bar{V}(\omega p', p', a, j) + \eta \bar{V}(\omega p, p, a, j) \ . \tag{2}$$

Here the poaching firm bids up to $\omega p'$, and the worker negotiates fraction η of the surplus $\bar{V}(\omega p, p, a, j) - \bar{V}(\omega p', p', a, j)$. However, such a renegotiation only takes place if p' is large enough such that the worker can experience a wage increase to $w' > w$. Specifically, the poacher's productivity must exceed the threshold value $q(w, p, a, j)$ which is defined by the following indifference condition:

$$\bar{V}(w, p, a, j) = (1 - \eta)\bar{V}(\omega q, q, a, j) + \eta \bar{V}(\omega p, p, a, j) \ . \tag{3}$$

If $p' \leq q(w, p, a, j)$, the worker simply discards the outside offer and no wage renegotiation takes place.

Consider next the wage negotiated by a non-employed worker who receives an offer from a firm with match productivity p. Denote by $\bar{V}(w, 0, a, j)$ the value function of a household

[17] All wage negotiation outcomes build on the property that the worker value function $\bar{V}$ is increasing in its first two arguments while the firm's profit is decreasing in the wage, which we verify in numeric solutions of our model.

[18] As in Bagger et al. (2014) and Ozkan et al. (2023), utility is non-transferable between the worker and the firm, so that this bargaining rule does not correspond to the Nash bargaining solution. However, it can be rationalized as the equilibrium of a finite-horizon bargaining game with alternating offers between the two competing firms and the worker, as described in Cahuc et al. (2003). The same applies to the bargaining outcome of a non-employed worker described below.

of age j, assets a whose worker is non-employed with last wage prior to non-employment equal to w.[19] Then the negotiated wage w' solves

$$\bar{V}(w', p, a, j) = (1 - \eta)\bar{V}(w, 0, a, j) + \eta\bar{V}(\omega p, p, a, j) \ , \tag{4}$$

if $\bar{V}(\omega p, p, a, j) \geq \bar{V}(w, 0, a, j)$ in which case the worker obtains fraction η of the surplus $\bar{V}(\omega p, p, a, j) - \bar{V}(w, 0, a, j)$. Define $q^n(w, a, j)$ as the threshold level of productivity where $\bar{V}(\omega q, q, a, j) = \bar{V}(w, 0, a, j)$, so that only jobs with $p \geq q^n(w, a, j)$ are able to attract the worker, while job offers with $p < q^n(w, a, j)$ are turned down. A worker who is separated due to a reallocation shock has the same outside option as a previously non-employed worker. For such a worker the bargaining outcome is also given by equation (4).

Finally, consider a situation where $\bar{V}(w, p, a, j) < \bar{V}(w, 0, a, j)$ so that the employed worker in state (w, p, a, j) has a credible threat to quit into non-employment. In this case, the firm prevents the worker from quitting by raising the wage to $w' \leq \omega p$ satisfying

$$\bar{V}(w', p, a, j) = \bar{V}(w, 0, a, j) \ , \tag{5}$$

if $\bar{V}(\omega p, p, a, j) \geq \bar{V}(w, 0, a, j)$. Otherwise, there is no profitable retention possibility and the worker quits the job.

3.3 Household Decisions

Consider a household with a worker who holds a job of match productivity p paying wage w. At the *beginning of the period*, the household's assets are a_0, and the value function is denoted $V(w, p, a_0, j)$, see Figure 3. For a household with a non-employed worker at the beginning of the period, we use the same notation for the value function, where $p = 0$ indicates non-employment and w is the last wage prior to non-employment (set to zero for workers that never had a job). Likewise, the value function of a retired household is $V(w^r, 0, a_0, J)$ with pension income w^r.

If the worker is employed, utility shocks ε_i for active or passive search ($i = 1, 0$) are realized and the household chooses between active search with continuation utility $V^1(w, p, a_0, j) - \xi_e + \frac{\varepsilon_1}{\gamma_e}$ and passive search with continuation utility $V^0(w, p, a_0, j) + \frac{\varepsilon_0}{\gamma_e}$.

[19] If a worker retires from non-employment, the pension is linked to the last wage, which is why this wage enters the value function. For those non-employed workers who never had a job, we set $w = 0$.

Due to the distributional assumption, we have[20]

$$
\begin{aligned}
V(w,p,a_0,j) = &\ \mathbb{E}\max\left[V^1(w,p,a_0,j) - \xi_e + \frac{\varepsilon_1}{\gamma_e}, V^0(w,p,a_0,j) + \frac{\varepsilon_0}{\gamma_e}\right] \\
= &\ \frac{1}{\gamma_e}\ln\left\{e^{\gamma_e[V^1(w,p,a_0,j)-\xi_e]} + e^{\gamma_e V^0(w,p,a_0,j)}\right\} \ ,
\end{aligned} \tag{6}
$$

and the fraction of employed workers in state (w, p, a_0, j) choosing active search is

$$
\pi^1(w,p,a_0,j) = \frac{e^{\gamma_e[V^1(w,p,a_0,j)-\xi_e]}}{e^{\gamma_e[V^1(w,p,a_0,j)-\xi_e]} + e^{\gamma_e V^0(w,p,a_0,j)}} \ ,
$$

while the fraction of passive searchers is $\pi^0(w, p, a_0, j) = 1 - \pi^1(w, p, a_0, j)$.

After deciding between active or passive search, the household receives wage income, decides about consumption and saving, the worker may separate from the job or receive a job offer in which case a quit or a wage renegotiation may happen. Using the wage protocols described before, the value of a household searching actively or passively $(i = 1, 0)$ satisfies the Bellman equation[21]

$$
\begin{aligned}
V^i(w,p,a_0,j) = \max_{c,a} \Bigg\{ & u(c) + \rho\bar{V}(w,0,a,j) \\
& + \kappa\lambda(\theta)\int \max\left\{(1-\eta)\bar{V}(w,0,a,j) + \eta\bar{V}(\omega x,x,a,j), \bar{V}(w,0,a,j)\right\} \, dH(x) \\
& + s_e^i\lambda(\theta)\int_p (1-\eta)\bar{V}(\omega p,p,a,j) + \eta\bar{V}(\omega x,x,a,j) \, dH(x) \\
& + s_e^i\lambda(\theta)\int_{q(w,p,a,j)}^{p} (1-\eta)\bar{V}(\omega x,x,a,j) + \eta\bar{V}(\omega p,p,a,j) \, dH(x) \\
& + \left[1-\rho-\kappa\lambda(\theta) - s_e^i\lambda(\theta)\bar{H}(q(w,p,a,j))\right]\max\left[\bar{V}(w,p,a,j), \bar{V}(w,0,a,j)\right] \Bigg\}
\end{aligned} \tag{7}
$$

where maximization is subject to the budget and no-borrowing constraints

$$
c + a = w - T(w) + (1+r)a_0 \quad , \quad a \geq 0 \ .
$$

The Bellman equation involves the following continuation outcomes for a household after the consumption-saving choice is made. The household's worker may lose the job exogenously and become non-employed with value $\bar{V}(w, 0, a, j)$ (first line). The worker may receive a

[20]See e.g. Caliendo et al. (2019).

[21]$\bar{H} = 1 - H$ denotes the tail distribution of match productivity.

reallocation shock in which case she may quit into non-employment or enter a new job with productivity x (second line) or receive an outside offer that results in a quit (third line) or a renegotiation with the incumbent (fourth line). In all other events (fifth line), the worker either stays in the same contract or has a credible threat to quit into non-employment in which case continuation utility is $\bar{V}(w, 0, a, j)$, both after a quit or after a wage renegotiation.[22]

In Appendix B.1.1, we present the Bellman equations of non-employed and retired households and the recursive equations describing worker aging at the end of the period. We denote by $\nu(w, p, a_0, j)$ the measure of age-j households with assets a_0 working in a job with wage w and productivity p, at the beginning of a period. Likewise, $\nu(w, 0, a_0, j)$ is the measure of households with non-employed workers where w is the last wage prior to non-employment, and $\nu(w^r, 0, a_0, J)$ is the measure of retired households with pension income w^r. We further denote by $\mathcal{W}(x, p, a, j)$ the wage that an age-j worker with assets a bargains in a job of productivity p when holding an outside offer with productivity $x \leq p$, where $x = 0$ indicates that there is no outside offer so that the fallback position of the worker is non-employment. Finally, we write $c = \mathcal{C}(w, p, a_0, j, i)$ and $a = \mathcal{A}(w, p, a_0, j, i)$ for the consumption and savings policy functions of a household in state (w, p, a_0, j) searching actively or passively $(i = 1, 0)$, where again $p = 0$ indicates non-employment or retirement.

3.4 Firm Decisions

Firms decide about vacancy postings in every period. Once a vacancy is matched with a worker, match productivity is observed and the worker is possibly hired at the negotiated wage, as described above. Firms rent capital in proportion to their labor efficiency input, which implies that the flow profit of a match is $\omega p - w$ with $\omega = F_E(K, E)$, where the capital-to-labor-efficiency ratio K/E is determined from $F_K(K, E) = r + \delta$.[23]

Since all firms are owned by a mutual fund offering a riskless rate of return r, the value of a firm is the sum of the expected discounted profit stream of all jobs in the firm, where future profits are discounted with interest factor $(1+r)$. Paralleling the notation of household value functions, write $\Pi(w, p, a_0, j)$ for the discounted profit value of a job with productivity p and wage w filled with an age-j worker with assets a_0 at the beginning of a period. Further, write $\bar{\Pi}(w, p, a, j)$ for the profit value after the match/separation stage but prior to worker aging. Appendix B.1.2 describes the Bellman equations for Π and $\bar{\Pi}$ which take into account the

[22]By assumption, layoff shocks, reallocation shocks, and the arrival of outside offers are mutually exclusive events whose probabilities sum to less than one.

[23]As in any model with constant-returns production technologies, the firm size distribution is not determined and the number of firms is irrelevant.

wage negotiations, job acceptance and job quitting decisions of households described above.

At the beginning of the period, firms create jobs up to the point where the cost of a vacant job k equals its expected discounted profit value:

$$
\begin{aligned}
k = \frac{\lambda(\theta)}{\theta}\frac{1}{\bar{s}}\Bigg\{ & \int\limits_{j<J} \Big[\sum_{i=0,1} \pi^i(w,0,a_0,j) s_n^i \int\limits_{q^n(w,a_n^i,j)} \bar{\Pi}(\mathcal{W}(0,x,a_n^i,j),x,a_n^i,j)\ dH(x)\Big]\ d\nu(w,0,a_0,j) \\
& + \int\limits_{j<J,p>0} \Big[\sum_{i=0,1} \pi^i(w,p,a_0,j) s_e^i \int\limits_{p} \bar{\Pi}(\mathcal{W}(p,x,a_e^i,j),x,a_e^i,j)\ dH(x)\Big]\ d\nu(w,p,a_0,j) \\
& + \int\limits_{j<J,p>0} \Big[\sum_{i=0,1} \pi^i(w,p,a_0,j) \kappa \int\limits_{q^n(w,a_e^i,j)} \bar{\Pi}(\mathcal{W}(0,x,a_e^i,j),x,a_e^i,j)\ dH(x)\Big]\ d\nu(w,p,a_0,j) \Bigg\}\ ,
\end{aligned} \tag{8}
$$

A vacant job meets a random worker with probability $\lambda(\theta)/\theta$. The probability that this worker is in state (w,p,a_0,j) is equal to the search efficiency of workers in this state divided by aggregate search efficiency, which is denoted $\bar{s}$ and defined in equation (B.1) in the Appendix. The firm hires the worker whenever match productivity x (drawn from distribution H) exceeds the reservation productivity of the worker. The reservation productivity is either $q^n(w,a_n^i,j)$ when the worker is non-employed with savings $a_n^i = \mathcal{A}(w,0,a_0,j,i)$ (first line), it is p when the worker is employed in a job with productivity p (second line), or $q^n(w,a_e^i,j)$ for an employed worker who receives a reallocation shock and whose savings are $a_e^i = \mathcal{A}(w,p,a_0,j,i)$ (third line). As explained in the previous section, the starting wages for workers coming from these three states are denoted $\mathcal{W}(0,x,a_n^i,j)$, $\mathcal{W}(p,x,a_e^i,j)$, and $\mathcal{W}(0,x,a_e^i,j)$, respectively.

3.5 Stationary Equilibrium

Definition: A *stationary equilibrium* is a distribution ν of households over states (w,p,a_0,j), a collection of household value functions V, V^0, V^1, $\bar{V}$, active/passive search policies π^1, π^0, consumption and savings policy $\mathcal{C}$, $\mathcal{A}$, job value functions Π, $\bar{\Pi}$, equilibrium wage function $\mathcal{W}$, aggregate capital K, aggregate labor input E, market tightness θ, interest rate r, marginal product of labor efficiency ω, and tax parameter τ_0, such that

1. Households make optimal search, job acceptance, job quitting, and savings decisions, where wages are set according to the bargaining protocols described in equations (1)–(5).

2. Firms rent capital such that $F_K(K,E) = r + \delta$, the marginal product of efficient labor

is $\omega = F_E(K, E)$, and firms choose vacant jobs such that the free-entry condition (8) holds.

3. Government transfers to non-employed and retired workers are equal to the revenues from taxes and from the collection of accidental bequests net of the initial assets received by newborn households:

$$b \int_{j<J} d\nu(w, 0, a_0, j) + \int w^r \, d\nu(w^r, 0, a_0, J) \tag{9}$$

$$= \int\limits_{j<J, p>0} T(w) \, d\nu(w, p, a_0, j) + \mu_J \int \mathcal{A}(w^r, 0, a_0, J, 0) \, d\nu(w^r, 0, a_0, J) - \mu_0 \int a_0 \, d\Phi(a_0) \; .$$

4. Asset supply equals asset demand, i.e. assets of households are equal to the value of the mutual fund at the end of a period:[24]

$$\int a_0 \, d\nu(w, p, a_0, j) = K + \frac{\int_{j<J, p>0} \Pi(w, p, a_0, j) \, d\nu(w, p, a_0, j)}{1+r} \; . \tag{10}$$

5. Aggregate labor input is

$$E = \int p \, d\nu(w, p, a_0, j) \; .$$

6. ν is an invariant distribution with aggregate measure one, given the policy functions, wage protocols, labor market and demographic transitions.

Solving our model involves the computation of value functions of households and firms, the stationary distribution of households, and aggregate equilibrium conditions for market tightness (job creation), the tax parameter (government budget balance), and the interest rate (asset market equilibrium). The following loop describes the solution procedure.

1. Guess tightness θ, tax parameter τ_0 and the interest rate r.

2. Solve household value and policy functions and the stationary distribution ν.

3. Solve value functions of jobs.

4. Iterate over θ, τ_0 and r until (8), (9) and (10) are fulfilled with reasonable precision.

[24]The assets a_0 that households hold at the beginning of a period are bought in the previous period after dividends are paid out. Therefore, the value of firms is discounted with factor $(1+r)^{-1}$, which corresponds to the ex-dividend value of all firms. See Appendix B.1.3 on Walras's law for details.

Note that this is a rather tractable model since equilibrium wage protocols are solved jointly with step 2 which is essentially a standard consumption-saving problem with two continuous income state variables (w, p).

3.6 Macroeconomic Variables

Via Walras's law, the capital market equilibrium condition (10) together with budget constraints of households, firms and the government implies that the goods market is in equilibrium:

$$Y = F(K, E) = C + \delta K + kV \ , \tag{11}$$

with vacancies $V = \theta \bar{s}$ and aggregate consumption

$$C = \int \sum_{i=0,1} \pi^i(w, p, a_0, j) \mathcal{C}(w, p, a_0, j, i) \ d\nu(w, p, a_0, j) \ .$$

We verify this identity in Appendix B.1.3, where we also derive that output equals the sum of wage, profit and rental income:

$$Y = \int_{j<J, p>0} w \ d\nu(w, p, a_0, j) + \int_{j<J, p>0} [\omega p - w] \ d\nu(w, p, a_0, j) + (r + \delta)K \ .$$

Further note that aggregate labor input can be written $E = AL$ with aggregate employment and average labor efficiency defined by

$$L = \int_{j<J, p>0} d\nu(w, p, a_0, j) \quad \text{and} \quad A = \frac{1}{L} \int_{j<J, p>0} p \ d\nu(w, p, a_0, j) \ .$$

All three inputs into aggregate production $Y = F(K, AL)$ are jointly determined from capital and labor market equilibrium conditions. Figure 4 illustrates how the macroeconomic equilibrium is determined in our model. Solid curves in these figures are the relationships for the benchmark calibrated model, while dashed curves are those after a 1% increase of aggregate TFP (further explained below). Panel (c) illustrates equilibrium in the labor market, where the downward-sloping curve is the demand for efficient labor at the equilibrium capital stock K^* defined by $\omega = F_E(K^*, E)$. The curve $E(\omega)$ is the supply of efficient labor, i.e. aggregate efficiency units of labor when the labor market is in equilibrium at a given marginal product of efficient labor ω. This curve increases for three reasons: If labor is more productive, households search more intensively, thus leaving non-employment and climbing the job ladder faster. Second, matching rates are higher because firms create more jobs when they are more profitable at higher ω. Third, together with a higher ω, the interest rate falls due to the downward-sloping factor price frontier in panel (a) which is derived from the aggregate production function. The lower interest rate further stimulates search intensity and job creation.

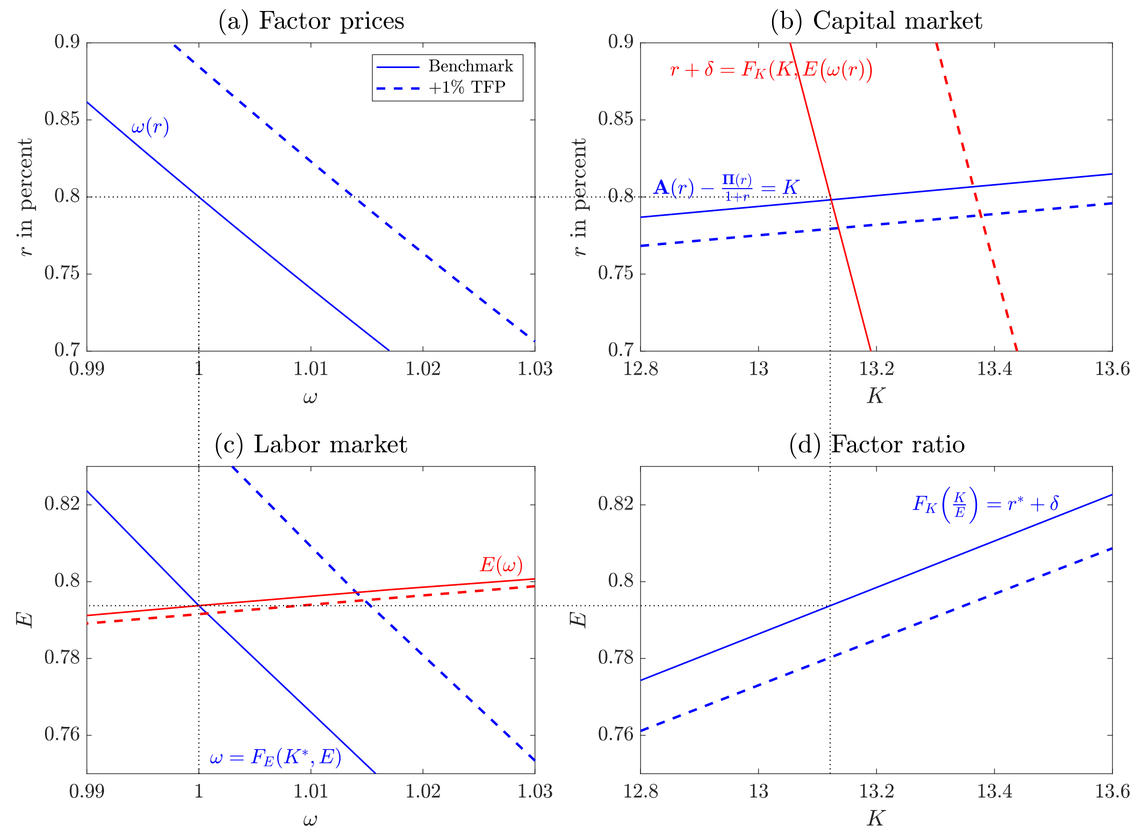


Figure 4: Macroeconomic equilibrium

NOTES: Equilibrium in the capital market (panel b), labor market (panel c), and the equilibrium relationships between factor prices (panel a) and production factors (panel d). Solid curves describe the benchmark calibrated model and dashed curves are the relationships after a 1% increase of TFP.

Panel (b) is equilibrium in the capital market, resembling a standard graph in incomplete-markets models (e.g. Figure IIb in Aiyagari, 1994). The downward-sloping curve is the demand for capital: At a higher interest rate r (and a lower marginal product of labor ω), efficient labor units E are lower, the marginal product of capital falls (because of $F_{KE} > 0$), so that firms demand less capital at the higher capital cost. The upward-sloping curve in panel (b) is the supply of rental capital which equals households' aggregate savings $\mathbf{A}(r)$ minus the aggregate profit value of firms $\mathbf{\Pi}(r)/(1+r)$ which are owned by households. This latter value is decreasing in r,[25] so the total supply of capital is upward-sloping whenever $\mathbf{A}$ is increasing, in which case the capital market equilibrium is unique.[26] Panel (d) simply pins down the factor ratio at the equilibrium interest rate.

When the economy experiences a permanent 1% increase of aggregate TFP, the intersections between the dashed curves in Figure 4 indicate the new stationary equilibrium. Capital and labor demand in panels (b) and (c) shift to the right. Together with rising employment and higher wages, household savings go up, shifting the supply of capital in panel (c) to the right, so that the equilibrium interest rate declines slightly. At a given marginal product of efficient labor ω, employment $E(\omega)$ decreases modestly in panel (c). The reason is as follows: With higher TFP the interest rate goes up at a given ω (panel a), and hence job creation and search activity go down with a higher financial discount factor. Ultimately, this general-equilibrium effect dampens the increase of employment. Nonetheless, while efficient labor E increases by 0.17%, employment L goes up by 0.3% which is a rather sizeable long-run response compared to other search-and-matching models with standard calibrations (cf. Shimer, 2005).[27]

4 Calibration and Model Fit

This section describes how we select parameter values for our benchmark model. We also assess the extent to which the model matches important data moments that we do not explicitly target in our calibration. We calibrate our model to the German economy after the year 2005. Next to the PASS data used in Section 2, we obtain further statistics from the German Socio-Economic Panel (SOEP), a representative household survey administered by the DIW Berlin; see Appendix A.2 for details about this dataset and the variables used for the model calibration.

[25]At a higher interest rate and lower marginal product of labor ω, the discounted profits of firms are lower.

[26]As is well known in incomplete-markets models (cf. Aiyagari, 1994), the savings curve $\mathbf{A}(.)$ is continuous but may be non-monotonic. In our model, ω and E fall with higher r, so that households' labor incomes decrease with a higher interest rate which dampens aggregate savings. Different from a standard incomplete-markets model with an exogenous earnings process, however, the higher risk of unemployment stimulates precautionary savings.

[27]Labor market amplification can be partly explained by counter-cyclical hiring standards (cf. Sedláček, 2014), as seen here by a long-term decline of labor efficiency by 0.13% in response to the permanent 1% TFP increase.

4.1 Calibration

Timing and aging. A period in the model is a quarter. We divide workers into the following age groups: 25-34, 35-44, 45-54, 55-66, and 67+. The aging probabilities μ_j during working age are set to match the average duration within each age group. This yields $(\mu_1, \mu_2, \mu_3, \mu_4) = (1/40, 1/40, 1/40, 1/48)$. In 2008, the conditional life expectancy at age 67 was 15 years for men and 19 years for women in Germany. Based on these numbers, we target an expected duration of 17 years for the retirement stage and set $\mu_5 = 1/68$.

Parameterization. The utility function is specified as $u(c) = \frac{c^{1-\sigma}-1}{1-\sigma}$, where σ is the inverse of the elasticitiy of intertemporal substitution which is set to the standard value $\sigma = 2$. The production function is $F(K, E) = \mathcal{T} K^{\alpha} E^{1-\alpha}$, where $\mathcal{T}$ is total factor productivity, and the matching function is $\lambda(\theta) = \lambda_0 \theta^{\varphi}$ where we set the elasticity to the standard value $\varphi = 0.5$. The distribution of match productivity H is a Gamma distribution with shape parameter $\chi_1 > 0$ and scale parameter $\chi_2 > 0$, and initial assets are Pareto distributed with shape and scale parameters ι_1 and ι_2.

Externally calibrated parameters. Table 2 reports the list of externally calibrated parameters. Capital depreciates at 1.5% per quarter. Given that average (quarterly) earnings are normalized to one (see below), we set the cost of a vacant job to $k = 0.17$ which corresponds to average recruiting costs of around 1,600 Euros as reported by Carbonero and Gartner (2022) on the basis of the German Job Vacancy Survey. We estimate the initial distribution of net wealth from the SOEP based on households aged 24–26 years.[28] Our estimates suggest that a Pareto distribution with shape parameter $\iota_1 = 1.3$ provides a good approximation. We set the scale parameter ι_2 of the Pareto distribution to match average net wealth in that sample. The tax function $T(w) = w - \tau_0 w^{1-\tau_1}$ in our model stands for income taxes and social security contributions, while it does not include government transfers. We utilize the estimates of Qiu and Russo (2022) who use a similar definition of post-tax income and set the progressivity parameter to their estimate for Germany which is $\tau_1 = 0.13$. We calibrate the level parameter τ_0 internally to balance the government budget; the resulting tax rate at median income turns out to be 27% which is very close to the empirical estimate of 28% of Qiu and Russo (2022). Finally, we set pensions at 42% of previous earnings with minimum and maximum caps at 14% and 74% of average earnings (see Kaas et al., 2021, for a similar calibration).

Internally calibrated parameters. The remaining parameters are calibrated jointly

[28] Self-reported wealth is collected in quinquennial survey modules since the year 2002. Net wealth is defined as the value of real estate, financial wealth, and other business and real wealth minus outstanding mortgages and other debt.

Table 2: Externally set parameters

Description	Parameter	Value	Explanation / Source
Aging probabilities	μ_j	–	See text
Elasticity of intertemp. subst.	σ	2	Standard value
Matching elasticity	φ	0.5	Standard value
Capital depreciation rate	δ	0.015	Standard value
Vacancy cost	k	0.17	Carbonero and Gartner (2022)
Initial wealth: Pareto shape	ι_1	1.30	Own estimate
Initial wealth: Pareto scale	ι_2	0.43	Own estimate
Tax progressivity	τ_1	0.13	Qiu and Russo (2022)
Retirement income	w^r	–	Replacement rate with caps (see text)

within the model in order to match selected data moments. Table 3 presents the list of parameter values, data targets, and the data moment that is most closely associated with each parameter.

The discount factor β is chosen to match the ratio between mean net wealth and (quarterly) mean labor earnings as estimated from SOEP data. The elasticity of production to capital input is set to match a quarterly interest rate of 0.8%; this yields $\alpha = 0.28$.

Active and passive search efficiencies are set to match quarterly NE and EE rates, separately for active and passive searchers.[29] The calibrated parameters reveal that passive searchers receive about the same number of offers whether employed or not, whereas employed active searchers are much more effective in generating offers than non-employed active searchers (cf. Faberman et al., 2022). This points at the importance of the offer-acceptance margin for the latter group. The disutility of active search for employed and non-employed workers is chosen to match the fraction of active searchers within these two subpopulations. Notice that active search is far more pervasive among the non-employed than among the employed. The model rationalizes this feature through a higher disutility of active search in employment compared with that in non-employment. The additive utility shock parameters γ_n and γ_e control the extent to which search decisions of (non-)employed workers depend on their current state vector. We estimate these parameters by matching the responsiveness of active search to household wealth as documented in Section 2. Specifically, we match the difference in active search between workers in the highest and lowest wealth quartiles,

[29] Since we relate transition rates to household wealth below, we estimate these rates from SOEP data. This survey, however, contains no information on active search of employed workers. Therefore we scale the PASS transition rates for active and passive searchers to match the average level of SOEP transition rates. While the difference in our estimated average EE rates in both surveys is negligible, NE rates in the SOEP are somewhat smaller than those in the PASS which is likely due to differences in survey design and in the respective worker samples.

Table 3: Internally calibrated parameters

Description	Parameter	Value	Moment	Data	Model
Discount factor	β	0.999	Wealth-to-income ratio	15.6	15.7
Capital elasticity	α	0.276	Interest rate	0.8%	0.8%
Passive search efficiency	s_n^0	1.15	NE rate passive (%)	7.4	7.4
Active search efficiency	s_n^1	2.54	NE rate active (%)	19.6	19.6
Passive search efficiency	s_e^0	1.17	EE rate passive (%)	4.0	4.0
Active search efficiency	s_e^1	5.69	EE rate active (%)	16.6	16.6
Disutility active search	ξ_n	0.96	$\pi^1_{n,\text{all}}$ (%)†	40.6	40.6
Disutility active search	ξ_e	12.0	$\pi^1_{e,\text{all}}$ (%)†	6.9	6.9
Search utility shock	γ_n	1.45	$\pi^1_{n,\text{Q1}} - \pi^1_{n,\text{Q4}}$ (%)†	28.4	28.5
Search utility shock	γ_e	0.25	$\pi^1_{e,\text{Q1}} - \pi^1_{e,\text{Q4}}$ (%)†	4.6	4.6
Gamma distrib. shape	χ_1	1.38	EN rate (%)	2.6	2.6
Gamma distrib. scale	χ_2	0.47	Normalize average earnings	1	1
Exogenous separation	ρ	0.010	Share layoffs in EN (%)	38.7	38.7
Reallocation shock	κ	0.180	EE w/ lower wage (%)	26.9	26.6
Bargaining weight	η	0.45	Std dev of log wages	0.49	0.49
Productivity penalty	ζ	0.177	Wages 55-66 vs 25-34	+17%	+17%
Unemployment income	b	0.32	Net replacement rate (%)	45.0	44.4
Tax level	τ_0	0.723	Balanced budget	–	–
Matching function	λ_0	0.165	Normalization $\theta = 1$	–	–
Total factor productivity	$\mathcal{T}$	0.637	Normalization $\omega = 1$	–	–

NOTES: † $\pi^1_{\ell,q}$ denotes the share of active searchers, $\ell = e, n$. Here, q = Q1 refers to the bottom wealth quartile, and q = Q4 refers to the top wealth quartile. See the text for further details about the calibration targets.

separately for employed and non-employed workers.[30] We show below that this calibration of γ_n and γ_e also generates plausible income elasticities.

The shape and scale parameters of the Gamma distribution for match productivity, χ_1 and χ_2, are set to match the transition rate from employment to non-employment (EN rate), and to normalize the average level of earnings in the model to one.[31] The exogenous separation shock ρ is set to match the share of EN transitions that are due to layoffs.[32] The reallocation shock parameter κ governs the share of job-to-job transitions where workers end up with a lower wage than in the previous job.[33] The bargaining parameter η influences

[30]While our model does not distinguish between financial and real wealth, we find that financial wealth is highly correlated with total household wealth in SOEP data.

[31]The shape parameter of the distribution controls the mass of match productivity at the bottom, thus influencing how many workers quit to non-employment when receiving a reallocation shock.

[32]We estimate this share using a survey question in the SOEP that asks workers why they were separated from their previous job during the last year. The share of layoffs is 38.7%, with the remaining reasons being own quits and job separations by mutual agreement, where workers whose fixed-term contract ended are removed from the sample.

[33]The implied quarterly probability to receive a reallocation shock is $\kappa\lambda_0\theta^\varphi \approx 3.0\%$. Among reallocated

the dispersion of wages. Intuitively, a lower value of η implies that workers are willing to accept initially lower-paying jobs in exchange for faster wage growth later, once they receive outside offers. This spreads out the distribution of wages. Accordingly, we set η to match the standard deviation of residualized wages.[34] We further introduce an age-specific productivity shifter ζ for employed workers in age group $j = 4$ (ages 55-66). We estimate ζ to match average wages in this age group relative to wages in the first age group, which implies a productivity drop of roughly 18%, relative to the younger age groups. Note that this is the only parameter that depends on the worker's age in our model.[35] Unemployment benefits are set at 45% of net average earnings which corresponds to the net replacement ratio of the long-term unemployed in the post-2005 period (cf. Krebs and Scheffel, 2013). Finally, the scale parameters of the matching function λ_0 and of the aggregate production function $\mathcal{T}$ are set to normalize tightness and the marginal product of efficient labor.[36]

4.2 Model Fit

We now assess the ability of the estimated model to match untargeted moments, with a particular focus on the empirical facts documented in Section 2.

Transition rates. Table 4 reports the transition rates between employment and non-employment (EN and NE) as well as the job-to-job transition rates (EE) by age and by wealth. The model generates a strong decline in the job-finding rate over the life cycle, which is consistent with our empirical evidence. Younger workers are also considerably more likely than older workers to make job-to-job transitions, a pattern that we document in the data as well. While the model matches most data values remarkably well, it does not fully capture the large drop of the NE rate for workers close to retirement, and it slightly underpredicts the high EE rate for early-career workers. As for separations into non-employment, the model generates an increasing age pattern and matches the peak in the last age group. One difference though is that there are more EN transitions for young workers as well in the data, whereas in the model the EN transition rates are almost the same for age groups 25-34 and 35-44.[37]

workers, 53% quit to non-employment and 47% experience an EE transition.

[34]We regress log hourly wages on dummies for education, marital status and calendar year (which all play no role in our model). Without this residualization, the dispersion of hourly wages is only slightly higher.

[35]In the absence of the productivity parameter, wages in the last age group are too high compared to the data. However, there are no major changes to the model fit in other dimensions or to the results.

[36]We show in Appendix B.1.4 that the normalization $\omega = 1$, together with normalizing average earnings to one, is innocuous.

[37]A potential mechanism that could help generating higher EN and EE separations of young workers is heterogeneity in unemployment risk as in Pinheiro and Visschers (2015) and Jarosch (2023).

Table 4: Transition rates

	NE rate		EE rate		EN rate	
	Data	Model	Data	Model	Data	Model
By age						
25-34	19.4	19.8	7.8	6.4	3.2	2.2
35-44	16.1	17.3	5.2	5.5	2.0	2.3
45-54	12.6	13.0	3.9	4.6	1.3	2.6
55-66	3.1	6.4	2.8	3.1	3.6	3.2
By wealth						
Quartile 1	15.1	17.0	5.3	7.3	3.8	2.3
Quartile 2	15.3	13.8	5.5	4.2	2.6	2.6
Quartile 3	9.6	10.0	4.5	4.1	1.8	2.6
Quartile 4	9.3	8.5	3.9	3.7	2.0	2.7

NOTES: All numbers in percent. For the calculation of quarterly transition rates in SOEP data, see Appendix A.2.

The lower panel of Table 4 documents how these transition rates vary between workers with different wealth positions.[38] As can be seen, the model comes reasonably close to matching the data numbers in this dimension as well. In the data, the NE rate decreases from 15% to just over 9% between the lower and the upper half of the wealth distribution. The model generates a similar difference, but features a larger gap between the bottom two wealth quartiles. In contrast, separation rates (EN rates) vary less with the wealth position in the model in comparison to the data; if anything, they mildly increase with wealth in the model, whereas in the data there is a slight U-shaped pattern. Similar to NE rates, job-to-job transition rates are lower in the upper half of the wealth distribution both in the data and in the model, where the model generates a larger difference between the bottom quartiles.

Note that transitions to a new job, either from non-employment or from a previous job, are jointly determined by workers' search behavior and their reservation productivities. Since our data allow us to identify workers' search choices, we now turn to assessing the model fit in that dimension. Section 5.1 sheds more light on the mechanisms behind the age profiles of labor market transition rates in the model.

Active search. Table 5 presents the model fit with respect to the share of active searchers among non-employed as well as employed workers. Recall that in the model calibration, we target the difference in active search between workers with low vs. high wealth.

[38] In Appendix B.2 we present the joint age-wealth relationships of the three transition rates in the model and in the data.

Table 5: Active search

Non-employed	Data	Model	Employed	Data	Model
By age			By age		
25-34	45.7	53.1	25-34	10.8	7.8
35-44	47.4	47.1	35-44	7.7	6.9
45-54	42.5	40.3	45-54	5.6	6.6
55-66	20.8	31.9	55-66	2.7	6.3
By wealth			By wealth		
Quartile 1	50.9	55.1	Quartile 1	9.5	9.8
Quartile 2	48.9	45.6	Quartile 2	7.8	6.5
Quartile 3	40.0	34.4	Quartile 3	5.5	5.9
Quartile 4	22.5	26.6	Quartile 4	5.1	5.2

NOTES: All numbers in percent. The data shares are obtained from the PASS.

The model does a good job at replicating the negative relation between search intensity and wealth observed in the data: conditional on employment status, workers in the bottom part of the wealth distribution are twice more likely to search actively compared with workers in the upper part of the distribution. This is similar in the model, where however the difference between the bottom quartiles is larger. In a similar vein, there is a steep negative relation between age and search intensity of non-employed workers in the data and in the model. For employed workers, the model captures only a part of the age decline.

Wages and wealth by age. The model generates a hump-shaped profile of wages by age, with wages rising by respectively 13% and 22% in age groups 35-44 and 45-54 relative to younger workers, and then decreasing to 17% in age group 55-66; see Table 6. We make the model match the latter number through the productivity penalty for older workers. Still, our model generates a plausible age-wage profile of prime-age workers without any other age-specific parameters and without human capital accumulation; the positive age gradient of wages is driven by workers climbing the job ladder and wage renegotiations on the job.

Table 6: Wages by age

	25-34	35-44	45-54	55-66
Data	–	+12%	+20%	+17%
Model	–	+13%	+22%	+17%

NOTES: The table shows average wages by age where hourly wages in SOEP data are residualized by education, gender, marital status and calendar year. All numbers are expressed relative to the first age group.

Turning to the variation of wealth by age, the model predicts a wealth accumulation pattern for working-age households that is similar to the one from the data; see Table 7. Mean wealth relative to average (quarterly) income increases with age, reaching values in the range 12-15 when workers are around 40 years old, to values around 21-23 for middle-aged and older workers. In line with standard life-cycle models without a bequest motive or other features, our model predicts too strong wealth decumulation in retirement compared to the data. Apart from this aspect, the model fit is good in describing life-cycle wealth accumulation given that the calibration only targets the unconditional wealth-income ratio.

Table 7: Wealth by age

	25-34	35-44	45-54	55-66	67+
Data (SOEP)	4.4	12.1	22.0	21.2	19.5
Model	6.6	14.6	22.1	23.2	12.6

NOTE: The table shows wealth by age expressed relative to average income.

Income elasticities. We calibrate the variance of idiosyncratic utility shocks to match the differences in active search between high- and low-wealth households. Generally, this variance controls the sensitivity of job search with respect to other household characteristics such as income. We assess the fit of the model in this dimension as follows. For employed workers, we use the active search regressions presented in Table 1 which deliver a coefficient estimate on current log gross earnings equal to -0.043 (significant at the 1% level). That is, a doubling of current earnings results in a 3.0 percentage point (pp) reduction in the active search probability (which averages at 6.3% in the data).[39] When we run a similar regression in our model, we obtain coefficient estimates of -0.040, which is very close to the data estimate. We further ask if the elasticity of unemployment duration with respect to UI benefits is in line with estimates from the literature. In the model, we consider the response of non-employed workers who receive 5% higher UI benefits (without solving for the new equilibrium) and calculate the resulting non-employment duration from a simulated panel of workers drawn from the stationary distribution. This allows us to calculate an elasticity of unemployment duration to higher benefits equal to 1.74. While we are not aware of comparable estimates for Germany, Card et al. (2015) use a regression kink design to estimate benefit elasticities of unemployment durations in Austria in the range 1.0-2.0. Schmieder and Von Wachter (2016) survey further studies, where most estimates for European countries fall in the range 0.8–1.6.

Wealth distribution. Without featuring entrepreneurs, superstar earners, or a bequest

[39]Faberman et al. (2022) estimate a similar regression in Survey of Consumer Expectations data with a coefficient estimate of -0.07, so that a doubling of the wage reduces active search by about 5 pp from an average 0.25.

motive, our model underpredicts the wealth concentration at the top. However, it generates a wealth Gini coefficient of 0.67 (compared to 0.74 in SOEP data), which is identical to the wealth Gini coefficient obtained by De Nardi and Fella (2017) when considering a benchmark overlapping-generations Bewley model with an age-dependent earnings process and accidental bequests.

Earnings dynamics. Recent empirical evidence indicates that the distribution of annual earnings growth rates is left-skewed and highly leptokurtic (Guvenen et al., 2021). Our job-ladder model with sequential bargaining, similar to the one of Ozkan et al. (2023), is able to generate such earnings dynamics: The distribution of annual earnings growth has a standard deviation of 0.46, skewness -0.18 and kurtosis 8.7, which are in the range of empirical estimates. While many workers do not experience wage changes from one year to the next, some workers receive outside offers triggering wage renegotiations or job-to-job transition. These can lead to small wage gains and occasionally even to large positive changes, while job loss presents an asymmetric downside risk.

5 Labor Market Dynamics: The Role of Age and Wealth

In this section, we investigate the role of the life cycle and household wealth for labor market dynamics. We first analyze the mechanisms behind the declining age profiles of labor market transition rates and then study the consequences of job loss for different workers.

5.1 Age Profiles of Labor Market Transitions

We demonstrate in Section 4 that job-finding rates of employed and non-employed workers are declining in age, an outcome that arises without any age variation in the exogenous parameters that govern search efficiency or utility costs of search. To examine how the characteristics of workers – namely age, wealth and match quality – matter for these life-cycle patterns, we conduct a decomposition analysis similar to the approach of Menzio et al. (2016).

Given the stationary distribution ν over characteristics (w, p, a_0, j), we calculate various conditional distributions. Denote by $\nu^e(w, p, a_0|j)$ the distribution of (w, p, a_0) among employed workers conditional on age j, $\nu^e_{job}(w, p|a_0, j)$ the distribution of job characteristics (w, p) conditional on age j and assets a_0, and $\nu^e_a(a_0|j)$ the distribution of assets conditional on age. All these are probability distributions conditional on employment, hence they integrate to one. Write $\text{EE}(w, p, a_0, j)$ for the EE rate of a worker with characteristics (w, p, a_0, j) and EE_j for the average EE rate of workers of age j. The difference in EE rates between age groups j and $j-1$ can be split into three terms as follows:

$$\mathrm{EE}_j - \mathrm{EE}_{j-1} = \underbrace{\int \boldsymbol{\mathrm{EE}(w,p,a_0,j)}\ d\nu^e(w,p,a_0|j) - \int \boldsymbol{\mathrm{EE}(w,p,a_0,j-1)}\ d\nu^e(w,p,a_0|j)}_{\text{horizon effect}}$$
$$+ \underbrace{\int \left[\int \mathrm{EE}(w,p,a_0,j-1)\ d\nu^e_{job}(w,p|a_0,j)\right] \boldsymbol{d\nu^e_a(a_0|j)} - \int \left[\int \mathrm{EE}(w,p,a_0,j-1)\ d\nu^e_{job}(w,p|a_0,j)\right] \boldsymbol{d\nu^e_a(a_0|j-1)}}_{\text{wealth effect}}$$
$$+ \underbrace{\int \left[\int \mathrm{EE}(w,p,a_0,j-1)\ \boldsymbol{d\nu^e_{job}(w,p|a_0,j)}\right] d\nu^e_a(a_0|j-1) - \int \left[\int \mathrm{EE}(w,p,a_0,j-1)\ \boldsymbol{d\nu^e_{job}(w,p|a_0,j-1)}\right] d\nu^e_a(a_0|j-1)}_{\text{selection effect}}\ .$$

The first line is the direct contribution of age to EE rates, labeled the *horizon effect*, which represents the role of the expected duration of working life on search behavior on-the-job (cf. Chéron et al., 2013; Menzio et al., 2016). The second line is the *wealth effect* which is the difference between the EE rate of age $j-1$ workers who counterfactually have the same wealth and job characteristics of age j workers and the EE rate of age $j-1$ workers who counterfactually have the same job characteristics as age j workers. This effect measures to what extent wealth accumulation over the life cycle contributes to declining job transitions. The third line is the *selection effect* which is the difference between the EE rate of age $j-1$ workers who counterfactually have the job characteristics of age j workers and the actual EE rate of age $j-1$ workers. It captures to what extent the higher positions on the job ladder of older workers contribute to fewer job-to-job transitions.

Regarding non-employed workers, denote by $\nu^n(w,a_0|j)$ the distribution of (w,a_0) conditional on age j, $\nu^n_{wage}(w|a_0,j)$ the distribution of previous wages w conditional on age j and assets a_0, and $\nu^n_a(a_0|j)$ the distribution of assets conditional on age. Again, these are all probability distributions conditional on non-employment. As above we can split the difference in job-finding rates between ages j and $j-1$ into a *horizon effect*, a *wealth effect*, and a *selection effect*:

$$\mathrm{NE}_j - \mathrm{NE}_{j-1} = \underbrace{\int \boldsymbol{\mathrm{NE}(w,a_0,j)}\ d\nu^n(w,a_0|j) - \int \boldsymbol{\mathrm{NE}(w,a_0,j-1)}\ d\nu^n(w,a_0|j)}_{\text{horizon effect}}$$
$$+ \underbrace{\int \left[\int \mathrm{NE}(w,a_0,j-1)\ d\nu^n_{wage}(w|a_0,j)\right] \boldsymbol{d\nu^n_a(a_0|j)} - \int \left[\int \mathrm{NE}(w,a_0,j-1)\ d\nu^n_{wage}(w|a_0,j)\right] \boldsymbol{d\nu^n_a(a_0|j-1)}}_{\text{wealth effect}}$$
$$+ \underbrace{\int \left[\int \mathrm{NE}(w,a_0,j-1)\ \boldsymbol{d\nu^n_{wage}(w|a_0,j)}\right] d\nu^n_a(a_0|j-1) - \int \left[\int \mathrm{NE}(w,a_0,j-1)\ \boldsymbol{d\nu^n_{wage}(w|a_0,j-1)}\right] d\nu^n_a(a_0|j-1)}_{\text{selection effect}}\ .$$

Here, $\mathrm{NE}(w,a_0,j)$ is the job-finding rate of a non-employed worker in state $(w,0,a_0,j)$, and NE_j is the average NE rate of workers of age j.

Table 8: Decomposition of age profiles of EE and NE rates

	$EE_2 - EE_1$	$EE_3 - EE_2$	$EE_4 - EE_3$	$NE_2 - NE_1$	$NE_3 - NE_2$	$NE_4 - NE_3$
Total	−0.91	−0.88	−1.55	−2.45	−4.35	−6.55
Horizon	−0.09	−0.21	−0.42	−1.04	−3.14	−5.24
Wealth	−0.53	−0.42	−0.16	−0.88	−0.75	−0.05
Selection	−0.29	−0.24	−0.97	−0.52	−0.45	−1.26

NOTE: EE_j and NE_j denote the average EE and NE rates of workers in age group j. All numbers are in percentage points.

Table 8 shows how the declines of EE and NE rates with age (first row in percentage points) is decomposed into the three effects. Regarding NE rates, the horizon effect plays the dominant role for the declining age patterns: as workers become older, their incentives to search actively for jobs decrease at an accelerating pace over the life cycle (cf. Table 5). The wealth effect plays a sizable role for falling job-finding rates early in working life, accounting for around 36% of the decline of the NE rate between the ages 25-34 and 35-44. According to our model, as younger workers accumulate wealth, the incentives to search actively go down and the reservation productivity increases.[40] The selection effect is least important early in life, but it accounts for a 1.26 pp lower job-finding rate (around 20% of the total drop) in the pre-retirement age group, where the wealth effect plays only a negligible role. Intuitively, as older non-employed workers have on average higher previous wages (and hence pension claims), their incentives to search for re-employment or to accept low-productivity jobs are lower.

Turning to the decline of job-to-job transition rates with age, we find that the wealth effect is the main driver for prime-age workers, explaining 58% of the decline going from age group 25-34 to age group 35-44, and 48% of the decrease to the subsequent age group 45-54. In contrast, fewer job switches of workers in the pre-retirement phase are mostly explained by the selection effect since older workers in productive and/or well-paid jobs have a lower chance to climb the job ladder further and hence decide to search less. Finally, search intensity on the job and the willingness to remain employed after a reallocation shock decrease with age due to a shorter working life horizon, especially for workers closer to retirement.

[40] Generally, there are two mechanisms for the variation of NE rates across workers: search intensity (active or passive search) and selectivity (job acceptance conditional on a job offer). In Appendix B.3 we provide a variance decomposition which reveals that search intensity is the dominant force for workers in the younger age groups, while selectivity matters more for variation of NE rates among workers in the older age groups.

5.2 The Consequences of Job Loss

Next, we use our model to analyze the consequences of job loss, with a view to understanding the role of age and wealth for household earnings and consumption dynamics. To do so, we simulate a panel and consider individuals who get hit by the exogenous layoff shock ρ in some time period denoted as quarter zero. We then track their outcomes over the subsequent twelve quarters in relation to individuals with identical characteristics that do not experience a layoff shock in quarter zero.

Figure 5 reports the trajectories of earnings, separately for workers in the four age groups and with wealth holdings in the lowest and highest quartiles of the respective age groups. For all workers, the model generates substantial and protracted earnings losses after a layoff shock. On average among prime age workers (25 to 54 years old), earnings after three years remain 30% below those of identical workers not losing their job in quarter zero. This number lines up well with the results of Jarosch (2023) based on German administrative data (see Figure 12 in his paper), although the recovery of earnings in our model follows a more gradual pattern compared to the data.[41]

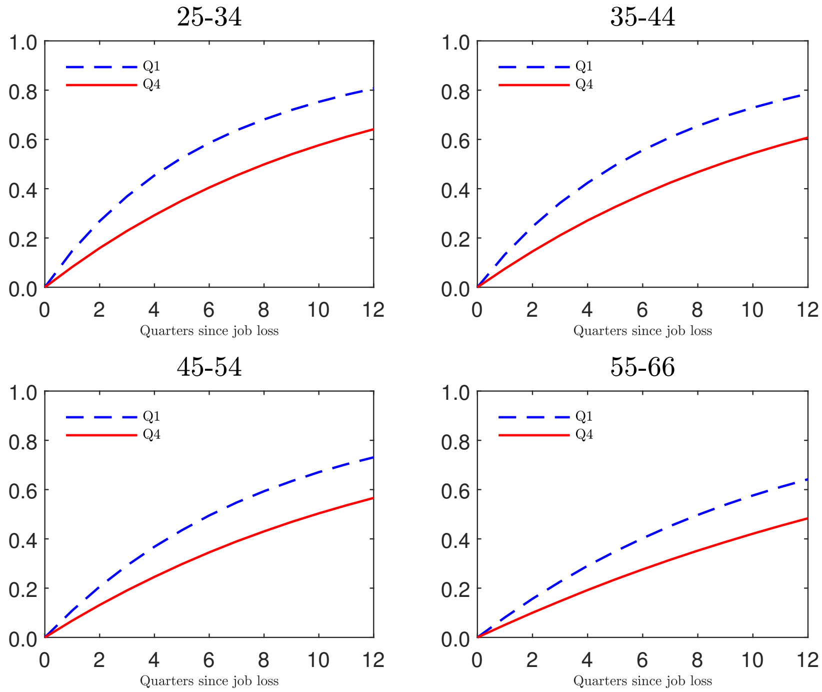
In the bottom panels of Figure 5 we observe that the negative consequences of job loss are more severe for older workers. In the age group 55–66, the earnings loss remains at a staggering 43% after three years, while the corresponding figure for workers of ages 25–34 is 28%. The correlation between age and the size of earnings losses is consistent with the evidence reviewed in Davis and von Wachter (2011).[42] In our model, there are two margins driving the recovery of earnings: active vs. passive search and reservation productivity. As discussed in the previous subsection, older workers have lower returns to engaging into active search and are more selective about match productivity mainly due to the shorter distance to retirement.

Another important observation of Figure 5 is that poorer individuals recover faster than their more wealthy peers. On average among prime-age workers, the Q1-Q4 earnings difference three years after layoff is about 17%. As discussed before, more wealthy individuals are less likely to search and more selective in their job acceptance which ultimately contributes to the slower earnings recovery.

Different from standard labor market models without savings, our model offers a distinct

[41] Our model abstracts from several features (specific human capital, job security, accumulation of employment rents) that are likely important to explain the empirical dynamics of earnings following job loss. Thus, we expect the model to generate a dynamics that is simpler than in the data.

[42] Using earnings records from the U.S. social security administration, Davis and von Wachter (2011) document that the present discounted value of earning losses is much larger for workers displaced in their 40s and 50s compared to younger workers (see Table 2 in their paper).

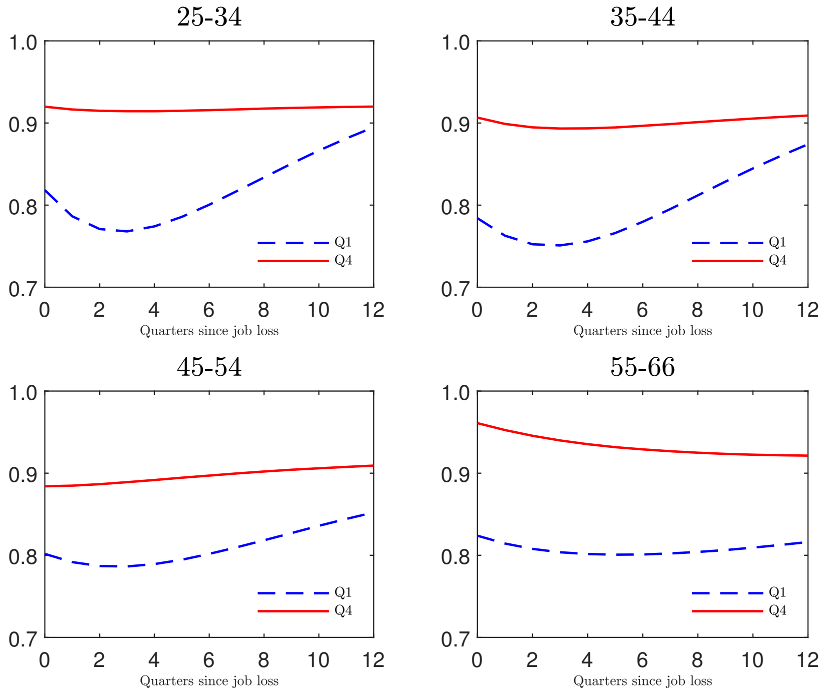


NOTES: Earnings in each quarter following job loss in relation to earnings of identical workers not losing their job at time zero. Solid curves describe the average of relative earnings among workers with pre-displacement wealth in the fourth quartile (Q4) while dashed curves correspond to workers in the first wealth quartile (Q1). Wealth quartiles are defined separately for each age group.

Figure 5: Consequences of job loss – Earnings

set of predictions about the consequences of job loss for consumption. These are depicted in Figure 6, again separately for wealth-poor and wealth-rich workers of different ages. To begin with, the model generates a consumption reduction by 14% on impact and by 11% after three years, on average across age and wealth groups. The initial drop in consumption is in the upper range of available estimates from studies that span countries with more and less generous unemployment insurance systems; see Ganong and Noel (2019) for the U.S. and Andersen et al. (2023) for Denmark. The high persistence also seems to line up with the data. For instance, Stephens (2001) finds (in U.S. data) that five years after job loss, consumption remains below its initial level by about 10%.

The consequences of job loss for consumption of workers with high and low wealth are rather distinct from the earnings consequences seen in Figure 5. For those in the top quartile of wealth, the impact drop in consumption is modest (8% on average across the four age groups), and there is little to no recovery after three years in relation to the "control group" of identical workers who do not experience job loss at time zero. In contrast, workers in the bottom wealth quartile suffer a drop by 19% on impact, followed by a gradual recovery, with



NOTES: Consumption in each quarter following job loss in relation to consumption of identical workers not losing their job at time zero. Solid curves describe the average of relative consumption among workers with pre-displacement wealth in the fourth quartile (Q4) while dashed curves correspond to workers in the first wealth quartile (Q1). Wealth quartiles are defined separately for each age group.

Figure 6: Consequences of job loss – Consumption

consumption remaining 14% below pre-displacement levels three years after job separation. The interpretation of these differences is straightforward: Workers in the top quartile have enough assets to dampen the fall in consumption upon job loss, while their less wealthy peers experience a larger pass-through from earnings losses onto consumption. As earnings in the latter group recover more quickly, however, the consumption gap between the two groups shrinks over time.

Figure 6 further indicates an important relationship between the magnitude of consumption losses and workers' age. In particular, workers in the pre-retirement group experience no consumption recovery, essentially because the earnings recovery for this group is much weaker. Hence, the consumption gap between wealth-rich and wealth-poor workers remains large even three years after job loss.

In sum, our model generates rich patterns of job loss consequences, and most importantly, produces consumption effects that are substantially different from the effects on labor earnings – something that standard job search models have little to say about. It also predicts heterogeneous effects across workers' age and wealth which is relevant for our understanding of tax and transfer policies aimed at mitigating the effects of labor market risks, as analyzed in the next section.

6 Policy Analysis

How are workers' job search, their decisions to accept and quit jobs, and the joint dynamics of earnings and wealth shaped by government policies? And what are the implications for aggregate outcomes? To answer these questions, we conduct a couple of counterfactual policy experiments, first considering a reduction of unemployment benefits and then studying the effects of a less progressive tax system.

6.1 Unemployment Benefits

In our first experiment, we lower unemployment benefits b by 10%. This brings the replacement rate of UI benefits closer to that for the U.S. labor market. We solve for a new stationary equilibrium and balance the government budget by adjusting the level parameter in the tax function τ_0. The second and third columns in Table 9 present our results, where the second column shows the response of the economy with a constant interest rate and fixed labor demand ("partial equilibrium") while the third column shows the full general-equilibrium response.[43]

In terms of macroeconomic aggregates, the reform leads to increases of employment by 3.8% and output by 3.4%. The employment increase is driven by several factors: First, job search effort among non-employed workers increases, and non-employed and reallocated workers become less selective about job productivity. The latter is reflected in a 1.4% reduction of aggregate labor efficiency, in spite of an increase of job search and greater job mobility among the employed. Second, the aggregate output and employment effects are substantially amplified in general equilibrium where firms' labor demand (job creation) responds to the increase in labor supply. With stronger labor demand, workers also search more intensively and accept more low-productivity matches, which further stimulates aggregate employment. Third, since households must rely more on precautionary savings to insure against non-employment risk, capital supply goes up and the interest rate falls slightly. In general equilibrium, the capital stock increases by 6.2% which further stimulates job creation and employment.

[43]To be precise, the partial equilibrium refers to an equilibrium of the Cahuc et al. (2006) block of our model (parts 1 and 6 of the equilibrium definition in Section 3.5) where households decide job search, job accepting, quitting and savings at fixed offer-arrival rates, while wages reflect worker-firm bargaining and the household distribution is stationary.

Table 9: Policy analysis – Aggregate results

	Benchmark	UI ↓		Tax Progressivity ↓	
		PE†	GE†	PE†	GE†
Output Y	1.096	+1.5	+3.4	−0.4	−0.6
Capital K	13.12	+1.5	+6.2	−0.4	−0.2
Employment L	80.05	+2.6	+3.8	−1.4	−1.9
Efficiency A	1.393	−1.1	−1.4	+1.0	+1.1
Interest rate r (%)	0.800	–	−6.0bp	–	−1.0bp
MP of labor ω	1.000	–	+1.0	–	+0.2
Tightness θ	1.000	–	+4.9	–	−2.8
Asset supply	15.67	+5.7	+5.4	+6.0	−0.3
EE rate (%)	4.87	+0.31pp	+0.57pp	−0.22pp	−0.32pp
NE rate (%)	12.37	+1.20pp	+2.00pp	−0.36pp	−0.70pp
EN rate (%)	2.57	−0.14pp	−0.17pp	+0.12pp	+0.11pp
Active search					
Employed (%)	6.91	+0.26pp	+0.32pp	+0.03pp	+0.05pp
Non-employed (%)	40.64	+2.93pp	+3.98pp	+0.28pp	+0.21pp
Average wage	1.001	−1.8	−1.4	+1.7	+2.0
Average productivity	1.393	−1.1	−0.4	+1.0	+1.3
Gini: Earnings	0.269	+4.8	+7.0	−3.2	−4.0
Gini: Wealth	0.671	−1.6	−0.5	+0.3	+1.5
Welfare (CEV)	–		−1.20		−0.76

NOTES: UI ↓ reduces b by 10%. Tax Progressivity ↓ reduces τ_1 from 0.13 to 0.05.
† Percentage change with respect to benchmark value, unless otherwise noted where bp = basis points and pp = percentage points.
PE is partial equilibrium (interest rate and labor demand fixed), GE is general equilibrium.

Our model also provides insights into the effects of the reform on labor market dynamics. It predicts a sharp increase in search activity and in the EE and NE rates which are also affected by lower reservation productivities. For instance, 44.6% of non-employed workers now search actively for a job which exceeds the benchmark value by almost four percentage points. Job search activity among employed workers also increases by almost 5% (0.57 pp) which contributes to a higher EE rate. The increase in job-to-job mobility can be traced back to three reasons. First, the fact that non-employed workers are willing to accept less productive jobs spreads out the distribution of wages (as seen in a larger earnings Gini coefficient) and implies that workers are moving up faster from the lower rungs of the job ladder. Second, more workers that are hit by a reallocation shock are willing to remain employed in a less productive job. Third, a larger precautionary savings motive induces them to incur the costs of job search in order to be able to earn more and save up.

To understand how the policy reform operates through different types of workers, we disaggregate the effects on NE, EE and EN rates across the age and wealth distribution, reporting the results in the respective second columns of Table 10. As can be seen, the increase in job-to-job mobility is strongest among low-wealth workers, and also the NE rate increases most for workers in the lowest wealth quartile. Regarding differences in age, the impact of lower UI benefits is rather similar for all prime-age workers but considerably weaker for older workers. In Appendix B.4 we show that these observations are also reflected in the active search choices of workers in different age and wealth groups.

It is worth noting that part of the overall employment increase in response to lower government transfers is due to a lower job separation rate (cf. Hartung et al., 2022), since fewer workers decide to quit and more workers find it beneficial to remain employed in a low-productivity job after a reallocation shock. Again, Table 10 shows that the decline in the separation rate is strongest for low-wealth workers.

Finally, the last row of Table 9 indicates that the policy reform brings about a welfare loss, as measured by the expected utility of a newborn worker in our model. This worker would be willing to give up 1.2% of consumption to keep the more generous public unemployment insurance level of the benchmark model.[44] Although employment prospects are better after the reform, workers incur greater utility costs of job search, they end up in less productive jobs, earn 1.4% lower wages on average and face greater earnings inequality. We further find that consumption of retired workers declines, while higher aggregate labor income translates into higher consumption of middle-aged and older workers. On the other hand, consumption of young workers remains unchanged since these workers face the strongest incentives for additional precautionary savings (see Table B.4 in Appendix B.4).

The negative welfare consequences of lower unemployment benefits contrast with related findings based on calibrated general equilibrium economies with search frictions, precautionary savings and capital (see e.g. Young, 2004; Krusell et al., 2010; Mukoyama, 2013; Popp, 2017). When calibrated to U.S. data, they find welfare gains from the elimination or reduction of UI benefits which result from the stimulative effect of lower public insurance on savings, capital accumulation and production. Different from these studies, Piguillem et al. (2021) find that a slight increase in UI benefits relative to the U.S. benchmark improves welfare, based on a model that includes finite life spans and human capital accumulation where the capital-labor ratio does not rise in general equilibrium. Our study indicates that

[44] See Appendix B.1.5 for the calculation of the consumption equivalent variation in our model.

Table 10: Policy analysis – Transition rates

	NE rate			EE rate			EN rate		
	Bench	UI ↓	TaxPr ↓	Bench	UI ↓	TaxPr ↓	Bench	UI ↓	TaxPr ↓
By age									
25-34	19.77	+2.83	−1.57	6.39	+0.66	−0.49	2.21	−0.23	+0.22
35-44	17.33	+3.33	−1.29	5.48	+0.65	−0.35	2.27	−0.23	+0.12
45-54	12.98	+2.78	−0.92	4.60	+0.62	−0.27	2.57	−0.17	+0.06
55-66	6.43	+1.16	−0.32	3.05	+0.38	−0.35	3.20	−0.06	+0.00
By wealth									
Quartile 1	17.00	+3.41	−1.20	7.31	+0.77	−0.56	2.35	−0.22	+0.20
Quartile 2	13.84	+1.39	−0.92	4.24	+0.43	−0.28	2.59	−0.15	+0.08
Quartile 3	9.97	+2.02	−0.41	4.07	+0.58	−0.27	2.63	−0.16	+0.06
Quartile 4	8.46	+0.95	−0.49	3.71	+0.43	−0.25	2.71	−0.12	+0.05

NOTES: The second and third columns of each panel report the percentage point changes with respect to the benchmark values shown in the first columns.

despite an increase of the capital-labor ratio in general equilibrium (Table 9), less generous UI benefits bring about larger utility costs of job search, lower productivity and greater earnings inequality, all of which contribute to an overall welfare loss.

6.2 Progressive Taxation

In our second experiment, we change the progressivity parameter of the income tax function τ_1. Specifically, we lower τ_1 from 0.13 to 0.05, the value that has been estimated by Qiu and Russo (2022) for the United States. We adjust the level parameter τ_0 to ensure revenue neutrality. Figure 7 indicates that the less progressive tax system implies higher net earnings for workers with earning 25% or more than average, at the expense of lower net earnings for all other workers.

The last two columns in Table 9 report our results, where the fourth column indicates the partial-equilibrium response and the fifth column shows the changes in general equilibrium. The model predicts that the less progressive tax system leads to a 0.6% reduction of output which is mainly due to a sizeable decline of aggregate employment by 1.9%. At the same time, the reform raises average labor efficiency by 1.1%.

A less progressive tax system affects the labor market in our model mainly through the selection of workers into more productive matches. In particular, since after-tax earnings decline for low-wage workers, some of the least productive matches do not anymore generate positive surplus and hence are not viable. Likewise, reallocated workers are unwilling to

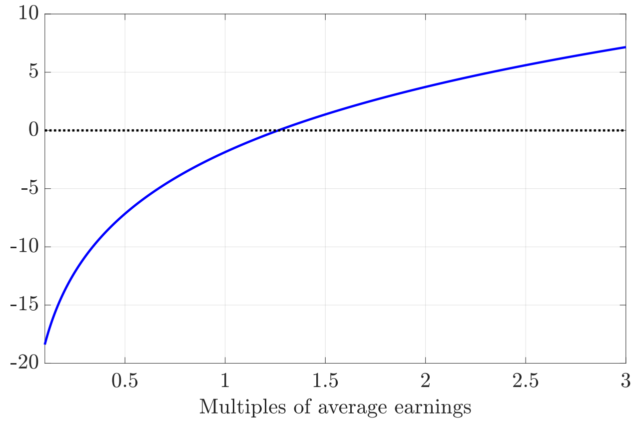


Figure 7: Percent change of net earnings after a reduction from $\tau_1 = 0.13$ to $\tau_1 = 0.05$.

accept those low-productivity jobs. As a result, the NE rate decreases and the EN rate increases. Higher reservation productivities further compress the earnings distribution as seen in a lower earnings Gini coefficient. Compared to the partial-equilibrium responses which point in the same direction, the employment decline is amplified due to weaker labor demand in general equilibrium: Since it becomes less likely to match with a worker, firms create fewer jobs.

Interestingly, we find sizable declines in the job-finding rates of employed and non-employed workers (EE and NE rates), despite the fact that search intensity increases slightly. This shows that the effects of a less progressive tax system mainly operate through the reservation productivity margin. While non-employed workers simply accept fewer job offers, job-to-job mobility declines even though the less progressive tax code increases the marginal net-of-tax gain from climbing the wage ladder. The intuition is, again, that average job productivity is higher in equilibrium, so that employed workers are less likely to quit to jobs of better match quality. In general equilibrium, their job-finding chances further deteriorate due to weaker labor demand.

Similar to the UI policy results, Table 10 shows that changes in tax progressivity have the strongest effects on labor market transition rates of wealth-poor workers. Additionally, young workers are impacted most by the policy reform. Intuitively, young and low-wealth workers are those that are willing to accept the least productive jobs in the benchmark economy. By making taxes less progressive and raising the tax level, these low-productivity matches disappear, worsening the job-finding and separation rates of these workers the most.

The weaker labor market together with a slight decline of the interest rate reduce aggregate savings in general equilibrium. This reduction is driven by lower savings among older and retired workers, whereas younger workers increase their precautionary savings, as these workers face a higher risk of job loss and also experience a stronger wage increase compared to older workers (see Table B.4).

A newborn household in our model dislikes the less progressive tax system as seen by a welfare loss equivalent to 0.76% lower consumption. Despite an increase of the average wage and higher net earnings for high-wage earners, the greater risk of unemployment is ultimately harmful for a worker entering the working-age population.

As in, e.g., Conesa and Krueger (2006), Krueger and Ludwig (2013) and Heathcote et al. (2017), the progressive tax in our model is a partial substitute for imperfect insurance against idiosyncratic labor market risk. A key difference is that these studies feature an intensive labor supply margin which is distorted by the labor tax: a less progressive tax system induces high-productivity workers to work more, thereby increasing hours at the top while decreasing them at the bottom, which leads to higher labor efficiency. Our model focuses on adjustments at the extensive margin in a frictional labor market where taxation distorts the job-selectivity and search-effort margins.[45] Less progressive taxes raise labor efficiency since workers select into more productive jobs at the expense of lower aggregate employment. Different from other studies investigating the effects of taxation in frictional labor markets (e.g. Gentry and Hubbard, 2004; Kreiner et al., 2015; Bagger et al., 2021), we find little impact on the search-effort margin.

7 Conclusions

We combine an incomplete-markets, overlapping-generations economy with a frictional job-ladder model with wage bargaining and endogenous search effort off- and on-the-job.

The resulting model is rich and connects to many microdata moments on the dynamics of search activity, job-finding rates, wages and wealth that we document in German data. We use the model to isolate factors that drive the decline of non-employment-to-employment as well as job-to-job transitions with respect to age. A shorter distance to retirement age and worker selection into higher rungs of the job ladder both play a role in explaining why older workers face lower transition rates. For the earlier portion of the working life, on the other hand, life-cycle wealth accumulation is the key driver, which underscores the importance of incorporating savings in a search model of the labor market. We also investigate the earnings and consumption effects of a layoff shock through the lens of our model. Foremost, we find patterns of consumption losses that are very different from those of earning losses, as well as a strong relation between these differences and workers' age and asset holdings.

[45] Another difference with those studies is that they analyze the tax distortions for skill formation.

Our model, which is cast in general equilibrium, allows us to revisit the effects of policies that have been extensively analyzed in the macroeconomic literature. Our most striking results concern the consequences of making the tax system less progressive. According to our model, the reform leads to a contraction of output through lower employment, while at the same time labor efficiency increases. These effects come about from the rich structure of the labor market in our model: low-productive jobs are associated with lower after-tax earnings, which makes workers search less and become more selective after the reform, to which firms respond by creating fewer jobs. Earnings inequality decreases, but wealth inequality increases as workers are induced to accumulate more precautionary savings.

Our analysis is a new step towards bridging the gap between macroeconomic incomplete-markets settings and frictional labor market models. Future research could extend the model in at least three directions. First, our model could be generalized to include human capital accumulation. This would provide further predictions for the interplay between search, wealth, and life-cycle earnings dynamics, and for the consequences of job losses. Second, introducing ex-ante worker heterogeneity could bring the model closer to empirical earnings processes that are usually used as inputs in standard incomplete-markets models. Third, incorporating dual-earner households, although potentially difficult, could provide novel insights into the relations between search and wealth dynamics in single and couple households as well as for the effects of progressive income taxation.

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Appendix

A Data Appendix

A.1 PASS

The Panel Study Labour Market and Social Security (PASS) is an annual representative household survey starting in the year 2007. The survey covers about 10,000 households including about 15,000 persons aged 15 or older. We use information elicited from the person and household questionnaire. The former includes a large set of demographic characteristics and information about the individual's employment and non-employment histories for which PASS also provides a biography spell module. All working-age household members (employed or non-employed) report whether they have been looking for jobs during the last four weeks, and if so, they report further information about job search behavior. See Trappmann et al. (2019) for a detailed description of these data.

Here we present descriptive statistics about households and workers surveyed in the PASS (waves 2007–2019). As described in the main text, we only consider persons aged 25–66 who are neither in education, parental leave, childcare leave or sick leave. Moreover, we exclude all individuals who spent less than 70% of their worklife (after age 25) in paid employment. Therefore, the non-employed workers in our sample are closely attached to the labor force. Cross-sectional sampling weights are applied throughout.

Table A.1 presents basic demographic characteristics of employed and non-employed workers in our pooled worker-year sample. While 92.3% are employed overall, employment rates are higher for prime-age, male, skilled workers, or workers in a couple with children.

Tables A.2 and A.3 show the means of various household and individual characteristics, where household statistics are based on the cross section and person statistics are based on the pooled worker-year observations. The reported statistics are in line with other statistics about the working-age population in Germany.

Table A.4 reports in the first row the share of active searchers among employed and non-employed workers in our sample.[46] Conditional on active searching, the other rows report the means of further statistics about job search behavior. Relative to employed job seekers, non-employed searchers make use of more search channels, they send more applications, they apply more broadly and spend more time on job search.

[46] The shares of active searchers shown in Table A.4 are somewhat higher in the sample used for model calibration which includes only observations with non-missing wealth information (6.9% for employed and 40.6% for non-employed workers).

Table A.1: Employment Status by Demographics

	All	25-34	35-44	45-54	55-66	Female	Male	Unskilled	Skilled
Employed	0.923	0.938	0.965	0.956	0.811	0.897	0.941	0.879	0.927
	(250.24)	(130.79)	(223.10)	(216.97)	(78.21)	(129.30)	(240.07)	(51.36)	(243.28)
Non-employed	0.0769	0.0619	0.0351	0.0440	0.189	0.103	0.0591	0.121	0.0729
	(20.84)	(8.64)	(8.11)	(9.99)	(18.24)	(14.79)	(15.08)	(7.07)	(19.12)
Observations	53917	11087	13423	17394	12013	25383	28533	5325	48583

	Single	Couple w/o child	Single Parent	Couple with child
Employed	0.923	0.871	0.926	0.939
	(126.94)	(102.28)	(67.28)	(190.17)
Non-employed	0.0774	0.129	0.0738	0.0608
	(10.65)	(15.21)	(5.36)	(12.32)
Observations	9950	14339	5203	22112

NOTE: t statistics in parentheses

Table A.2: Household characteristics (means)

Wealth	
Low	0.323
Middle	0.351
High	0.263
Missing	0.0628
Income	2922.3
Household size	2.358
Number of children	0.638
Debt	
Low	0.582
Middle	0.198
High	0.206
Missing	0.0134
Observations	9637

NOTE: For financial wealth and non-mortgage debt, “Low” is up to €2,500, “Middle” is €2,500 – 20,000, “High” is over €20,000.

Table A.3: Individual characteristics (means)

Age	45.11
Female	0.470
German	0.940
Education	
Years	12.80
Unskilled	0.098
Vocational training	0.692
University	0.210
Employment Status	
Dependent employed	0.893
Self-employed	0.00123
Registered unemployed	0.0527
Non-participation	0.0535
Number of employer changes	0.786
Net income	1852.9
Weekly working hours	38.37
Observations	53454

Table A.4: Job search (means)

	Employed	Non-employed
Job Search	0.0626	0.326
Job Search Channels		
Number	2.323	3.667
Newspaper	0.580	0.724
Public agency job posting	0.376	0.694
Other internet sources	0.669	0.726
Private networks	0.518	0.719
Public agency	0.0978	0.579
Private agent	0.0822	0.225
Number of applications	3.747	11.34
More than one occupation	0.548	0.664
Any possible occupation	0.192	0.285
Hours of job search per week	2.523	8.528
Observations	48626	4864

A.2 SOEP

To obtain further statistics for calibration and evaluation of model fit, we use data from the German Socio-Economic Panel (SOEP). SOEP is a well-known and widely used longitudinal panel dataset of the population in Germany. Every year, surveyed individuals provide information on their income, employment history, and education, among other topics. The survey also includes modules that are administered at a lower frequency, such as the quinquennial survey of wealth introduced in 2002.

We compute total household net wealth from SOEP in the following way. We take the sum of real estate wealth net of mortgage debt, financial wealth (including building society deposits and life or private pension insurance values), business wealth, and further real wealth minus other debt. When computing labor market statistics from the SOEP, we use data for 2005 through 2015. We impose sample restrictions similar to those with the PASS data, namely we exclude unattached workers by requiring that individuals spent at least 70% of their worklife in employment, and we further exclude workers whose part-time experience accounts for more than 50% of their total work experience. We use information from the monthly calendar module to construct quarterly transiton rates across labor force statuses.

To compute EE rates, we consider individuals whose reported job tenure at the current employer is less than one quarter at the time of the survey, and who have been continuously employed for one quarter based on the survey date and the monthly calendar module. The EE rates that we obtain from SOEP are fairly similar to those from PASS. As mentioned in the text, for the NE rates on the other hand, we find those from PASS to be somewhat higher. We rescale the PASS rates for respectively active and passive searchers to match the unconditional rates from SOEP.

We also report transition rates by wealth groups. To define a respondent's wealth, we use his/her most recent reported information from the quinquennial survey of wealth. As shown in the main text, there is a significant gradient with wealth for both the NE and EE rates.

A.3 Job Search and Wealth in U.S. Data

We conduct an empirical analysis similar to the one presented in Section 2 for the United States, using the Survey of Consumer Expectations (SCE). As explained below, the sample is much smaller than that of the German PASS data. As a result, the U.S. estimates are less precisely estimated. Nonetheless, our results confirm, at least qualitatively, the empirical patterns of the relationships between active search on the one hand, and age and wealth on the other hand, found in German data.

The SCE is a nationally representative, online survey of a rotating panel of approximately 1,300 household heads, administered by the Federal Reserve Bank of New York. The survey is carried out monthly, with respondents participating in the panel for up to twelve months. The SCE focuses primarily on expectations about economic outcomes. In addition, all participants fill out a labor market survey (which includes information on wages, occupation, etc. and job search behavior) and a household finance survey. Since our analysis requires linking respondents who participate in both modules to the core survey, we lose a fraction of the SCE panel. We then restrict the analysis to individuals between the ages of 25 and 66 who participate in the labor market and who are not permanently disabled (as a labor force status), retired or studying. The resulting sample contains about 2,000 individuals.

Beginning with the labor market questions, we classify as "employed" those individuals who are either working full time or part time or are currently on leave. We classified as "non-employed" the individuals who are not working but would like to work and those who are on temporary lay-off. For employed workers, we consider that the individual is actively searching if s/he has been looking for a new job or for an additional job in the last four weeks. For non-employed workers, we classify them as actively searching if they report searching for work in the last four weeks. Next, from the household finance module, we extract information about household wealth and debt. The financial wealth variable corresponds to the total value of checking and savings accounts, certificates of deposit, money market funds, savings bonds, mutual funds or investment trusts, and treasury bonds. Note that it does not include the value of retirement accounts. For debt, the variable includes balances on credit cards (including retail cards), student loans, vehicle loans, and other personal loans, as well as medical or legal bills; it excludes housing-related debt.

A.3.1 Main Findings

We first verify that the univariate correlations between search and financial wealth that we document in the German PASS data are also present in the U.S. SCE data. When we group individuals by wealth in three bins of roughly the same size, we find that the fraction of active searchers is at 28% for those with less than $8,000 of financial wealth vs. about 20% among those with between $8,000 and $50,000, and slightly under 20% above $50,000 of financial wealth. This negative relation continues to hold when we restrict the analysis to individuals who are currently employed. At the same time, we find a positive relation between active search and debt. Among workers with debt under $2,500, the fraction searching is at roughly 20%, while it increases to 22-23% for those with debt between $2,500 and $21,000, and to

Table A.5: Active search

	(1) All workers	(2) Employed	(3) All workers	(4) Employed
Middle wealth	-0.0474*	-0.0428*	−0.0354	−0.0306
	(0.0209)	(0.0211)	(0.0211)	(0.0212)
High wealth	-0.0113	-0.0102	0.0088	0.0100
	(0.0253)	(0.0255)	(0.0258)	(0.0260)
Age	−0.0042***	−0.0046***	−0.0039***	−0.0044***
	(0.0008)	(0.0008)	(0.0008)	(0.0008)
Middle debt			0.0273	0.0269
			(0.0226)	(0.0229)
High debt			0.0853***	0.0881***
			(0.0217)	(0.0219)
Observations	2,088	1,995	2,088	1,995
R^2	0.117	0.070	0.124	0.078

NOTES: OLS regressions on the active search dummy. Further controls include gender, marital status and presence of children, annual income, education and race dummies. "Low wealth", defined as wealth up to $8,000, is the reference category; "Middle wealth" is $8,000-$50,000, "High wealth" is over $50,000. In columns (3) and (4), "Low debt", defined as debt up to $2,500, is the reference category, "Middle debt" is $2,500-$21,000, "High debt" is over $21,000. * $p < 0.05$, ** $p < 0.01$, * $p < 0.001$.

about 28% above the latter debt threshold.

Next, as with the German PASS data, we observe a negative relation between active search and age. When looking across all individuals, employed and non-employed, we find that the fraction actively searching decreases from slightly more than 30% at the beginning of the working life to about 15% when workers are in their 60s. One difference with the German data, though, is that a substantial share of the decline in active search in the U.S. data occurs between the ages of 25 and 40; the fraction plateaus between the ages of 40 and 60, and then falls again as individuals get closer to retirement.

The next step of our analysis is a multivariate regression analysis similar to Table 1 of the main text. We run OLS regressions of the active search indicator on age, wealth and debt, and a number of individual and household controls. Table A.5 reports the results.

First, the regressions confirm the negative relationships between age and active search and between financial wealth and active search. The wealth coefficients reported in Table A.5 are barely statistically significant at conventional levels, but note that the regression includes many individual controls that correlate with wealth. Second, there is a positive relationship between debt and active search; this is shown in columns (3) and (4) of Table A.5. In sum, the U.S. SCE data confirm, albeit with less precision in the estimates, the empirical patterns that we document using the German PASS data.

B Model Appendix

B.1 Further Model Details

B.1.1 Households' Bellman Equations

Similar to a household with an employed worker, a household with a non-employed worker decides between active and passive search at the beginning of the period. The expected value prior to the realization of utility shocks is

$$V(w,0,a_0,j) = \frac{1}{\gamma_n} \ln \left\{ e^{\gamma_n [V^1(w,0,a_0,j) - \xi_n]} + e^{\gamma_n V^0(w,0,a_0,j)} \right\} \ ,$$

where the continuation values under active and passive search ($i = 1, 0$) are

$$\begin{aligned} V^i(w,0,a_0,j) = \max_{c,a} \Big\{ & u(c) + [1 - s_n^i \lambda(\theta) \bar{H}(q^n(w,a,j))] \bar{V}(w,0,a,j) \\ & + s_n^i \lambda(\theta) \int_{q^n(w,a,j)} (1-\eta) \bar{V}(w,0,a,j) + \eta \bar{V}(\omega x, x, a, j) \ dH(x) \Big\} \end{aligned}$$

subject to

$$c + a = b + (1+r) a_0 \quad , \quad a \geq 0 \ .$$

With probability $s_n^i \lambda(\theta) \bar{H}(q^n(w,a,j))$, the worker receives an offer from a firm with match productivity $x \geq q^n(w,a,j)$ that the worker accepts. Otherwise the worker remains non-employed with continuation utility $\bar{V}(w,0,a,j)$.

Similar to employed workers, the fraction of non-employed workers in state $(w,0,a_0,j)$ choosing active search is

$$\pi^1(w,0,a_0,j) = \frac{e^{\gamma_n [V^1(w,0,a_0,j) - \xi_n]}}{e^{\gamma_n [V^1(w,0,a_0,j) - \xi_n]} + e^{\gamma_n V^0(w,0,a_0,j)}} \ ,$$

while the fraction of passive searchers is $\pi^0(w,0,a_0,j) = 1 - \pi^1(w,0,a_0,j)$.

At the end of the period, households age with probability μ_j. For $j < J-1$, this implies

$$\bar{V}(w,p,a,j) = \beta \left[\mu_j V(w,p,a,j+1) + (1-\mu_j) V(w,p,a,j) \right] \ .$$

For $j = J-1$, an aging event is a transition into retirement:

$$\bar{V}(w,p,a,J-1) = \beta \left[\mu_{J-1} V(w^r(w),0,a,J) + (1-\mu_{J-1}) V(w,p,a,J-1) \right] \ ,$$

where the value function in retirement solves a standard consumption-saving problem

$$V(w^r, 0, a_0, J) = \max_{c,a} u(c) + \beta(1-\mu_J)V(w^r, 0, a, J) \quad \text{s.t.} \quad c + a = w^r + (1+r)a_0 \ , \ a \geq 0.$$

B.1.2 Firms' Bellman Equations

To describe the Bellman equation of a firm with a job filled with a worker in state (w, p, a_0, j) at the beginning of the period, note first that wage renegotiations may occur in two situations. First, the worker (with savings a at the match/separation stage) receives an outside offer from a firm with productivity $x \in [q(w, p, a, j), p]$ in which case the wage is renegotiated to $w' = \mathcal{W}(x, p, a, j)$. Second, the worker has a credible threat to quit to non-employment, in which case either the quit occurs or the wage is raised. Write $w' = \mathcal{W}^c(w, p, a, j)$ for the continuation wage which satisfies

$$\mathcal{W}^c(w, p, a, j) = \begin{cases} w & \text{if } \bar{V}(w, p, a, j) \geq \bar{V}(w, 0, a, j) \ , \\ \min[w', \omega p] & \text{else, where } w' \text{ satisfies } \bar{V}(w', p, a, j) = \bar{V}(w, 0, a, j) \ . \end{cases}$$

In the first line, the worker has no credible threat to quit so that the wage remains at w. In the second case, the firm either retains the worker if $w' \leq \omega p$. But if $w' > \omega p$, the worker quits and the continuation profit is zero which is (for the firm) equivalent to employing the worker at continuation wage ωp.

The Bellman equation for the profit value of a job is

$$\Pi(w, p, a_0, j) = \omega p - w + \sum_{i=0,1} \pi^i(w, p, a_0, j) \Bigg\{ s_e^i \lambda(\theta) \int_{q(w,p,a^i,j)}^{p} \bar{\Pi}(\mathcal{W}(x, p, a^i, j), p, a^i, j) \ dH(x)$$
$$+ \left[1 - \rho - \kappa\lambda(\theta) - s_e^i \lambda(\theta) \bar{H}(q(w, p, a^i, j))\right] \bar{\Pi}(\mathcal{W}^c(w, p, a^i, j), p, a^i, j) \Bigg\} \ ,$$

with assets $a^i = \mathcal{A}(w, p, a_0, j, i)$. The continuation profits on the right-hand side entail the following possibilities: Either the worker (searching actively or passively in proportions π^1 and π^0) obtains an outside offer. If match productivity at the poaching firm is above $q(.)$ and below p (which happens with probability $s_e^i \lambda(\theta)[H(p) - H(q(.)])$, a renegotiation takes place (first line). If the job at the poaching firm is more productive (probability $s_e^i \lambda(\theta) \bar{H}(p)$), and also if an exogenous separation shock occurs (probability $\rho + \kappa\lambda(\theta)$), the worker quits and continuation profit is zero (not shown in the Bellman equation). In all other events (shown in the second line), the job either survives with continuation wage $\mathcal{W}^c(.) < \omega p$. Or, alternatively, if the worker cannot be profitably retained ($\mathcal{W}^c = \omega p$), the worker quits and the continuation profit $\bar{\Pi}(\omega p, p, a^i, j)$ is zero.

After the matching and renegotiation stage and before aging, profit values satisfy the recursions

$$\bar{\Pi}(w,p,a,j) = \frac{1}{1+r}\left[\mu_j \Pi(w,p,a,j+1) + (1-\mu_j)\Pi(w,p,a,j)\right] \ , \ j < J-1 \ ,$$
$$\bar{\Pi}(w,p,a,J-1) = \frac{1}{1+r}(1-\mu_{J-1})\Pi(w,p,a,J-1) \ .$$

In the last equation, the worker retires with probability μ_{J-1} in which case continuation profit is zero. Next-period profit values Π are discounted with financial discount factor $(1+r)^{-1}$.

Finally, the free-entry condition (8) reflects that the probability to meet a worker in a given state (w, p, a_0, j) is given by the search efficiency of workers in that state, which is $\sum_{i=0,1} s^i_\ell \pi^i(w,p,a_0,j) d\nu(w,p,a_0,j)$ for $\ell = e, n$, relative to aggregate search efficiency which is the sum of search efficiency of all employed and non-employed workers, including those employed workers receiving reallocation shocks:

$$\bar{s} \equiv \int_{j<J,p>0} \sum_{i=0,1} \pi^i(w,p,a_0,j)(s^i_e + \kappa)\, d\nu(w,p,a_0,j) + \int_{j<J} \sum_{i=0,1} \pi^i(w,0,a_0,j) s^i_n \, d\nu(w,0,a_0,j) \ . \tag{B.1}$$

B.1.3 Walras's Law

To derive the goods-market equilibrium condition, write

$$M = (1+r)K + \int_{j<J,p>0} \Pi(w,p,a_0,j)\ d\nu(w,p,a_0,j)$$

for the (cum-dividend) value of the mutual fund at the beginning of a period. This value satisfies the recursion

$$M = rK + \int_{j<J,p>0} [\omega p - w]\ d\nu(w,p,a_0,j) - kV + \frac{M}{1+r} \ , \tag{B.2}$$

because the distribution of filled jobs ν (over $p > 0$ and $j < J$) is stationary. Furthermore, stationarity of the household distribution implies that the assets bought in any period, net of those accidental bequests which are not paid to newborn households (hence collected by the government), are identical to households' asset holdings at the beginning of a period, i.e.

$$\int \sum_{i=0,1} \pi^i(w,p,a_0,j) \mathcal{A}(w,p,a_0,j,i)\ d\nu(w,p,a_0,j)$$

$$-\mu_J \int \mathcal{A}(w^r, 0, a_0, J, 0)\ d\nu(w^r, 0, a_0, J) + \mu_0 \int a_0\ d\Phi(a_0) = \int a_0\ d\nu(w, p, a_0, j)\ . \tag{B.3}$$

From (10) and (B.2) follows that

$$\begin{aligned} (1+r) \int a_0\ d\nu(w, p, a_0, j) &= M \\ &= rK + \int_{j<J, p>0} [\omega p - w]\ d\nu(w, p, a_0, j) - kV + \frac{M}{1+r} \\ &= \ -\delta K + F_K(K, E)K + F_E(K, E)E - W - kV + \frac{M}{1+r}\ , \end{aligned} \tag{B.4}$$

with aggregate wage income $W = \int_{j<J,p>0} w\ d\nu(w, p, a_0, j)$. The third line follows from $F_K = r + \delta$ and $\int \omega p d\nu(w, p, a_0, j) = \omega E = F_E E$. Adding up budget constraints of all (employed, non-employed, retired) households gives

$$\begin{aligned} &(1+r) \int a_0\ d\nu(w, p, a_0, j) = \\ &\int_{j<J,p>0} \sum_{i=0,1} \pi^i(w, p, a_0, j)[\mathcal{C}(w, p, a_0, j, i) + \mathcal{A}(w, p, a_0, j, i) - w + T(w)]\ d\nu(w, p, a_0, j) \\ &\quad + \int_{j<J} \sum_{i=0,1} \pi^i(w, 0, a_0, j)\, [\mathcal{C}(w, 0, a_0, j, i) + \mathcal{A}(w, 0, a_0, j, i) - b]\ d\nu(w, 0, a_0, j) \\ &\quad + \int [\mathcal{C}(w^r, 0, a_0, J, 0) + \mathcal{A}(w^r, 0, a_0, J, 0) - w^r]\ d\nu(w^r, 0, a_0, J) \\ &= \int \sum_{i=0,1} \pi^i(w, p, a_0, j)\, [C(w, p, a_0, j, i) + \mathcal{A}(w, p, a_0, j, i)]\ d\nu(w, p, a_0, j) \\ &- \int_{j<J,p>0} w\ d\nu(w, p, a_0, j) - \mu_J \int \mathcal{A}(w^r, 0, a_0, J, 0)\ d\nu(w^r, 0, a_0, J) + \mu_0 \int a_0\ d\Phi(a_0) \\ &= C - W + \int a_0\ d\nu(w, p, a_0, j)\ . \end{aligned} \tag{B.5}$$

Here the second equation uses the government budget constraint, and the third equation uses (B.3).

Equating (B.4) and (B.5), using $F_K(K, E)K + F_E(K, E)E = F(K, E)$ and capital market equilibrium (10) yields the goods market equilibrium identity (11). The partition of $F(K, E)$ into wage, profit and rental income follows since $F_E(K, E) = W + \int_{j<J,p>0} [\omega p - w]\ d\nu(w, p, a_0, j)$.

B.1.4 Normalization

Here we explain why the normalization of the marginal product of labor efficiency $\omega = 1$ together with the normalization of average earnings to one is innocuous. For arbitrary ω, write $\tilde{p} = \omega p$ for the marginal product of a job with labor efficiency p. We calibrate the gamma distribution of $\tilde{p}$ to normalize average earnings to one and to target the average NE rate, as explained in Section 4. For the calibrated value of the real interest rate r and the normalized tightness (vacancy-to-search-efficiency ratio) $\theta = 1$, together with further externally calibrated parameters (governing pensions, initial assets), we can solve the household problem, equilibrium wages and the stationary distribution ν. Hence we obtain aggregate labor efficiency $E = \int_{p>0} p \, d\nu$, and define $\Omega = \omega E$. Note that Ω is independent of the choice of ω, since the distribution of $\tilde{p}$ (and not the distribution of p) is calibrated to match average earnings $\int_{p>0} w \, d\nu / (\int_{p>0} d\nu) = 1$. Instead, aggregate labor efficiency $E = \Omega/\omega$ scales inversely proportional with ω.

We can also solve aggregate household assets, firm profits (from firms' value functions) and obtain aggregate capital K from capital market equilibrium and hence independent of ω.

From the marginal products of capital and efficient labor:

$$(r + \delta) = F_K = \alpha \mathcal{T} K^{\alpha-1} E^{1-\alpha} \quad , \quad \omega = F_E = (1-\alpha)\mathcal{T} K^{\alpha} E^{-\alpha} \; .$$

Substituting $E = \Omega/\omega$ into the second equation implies

$$\omega^{1-\alpha} = (1-\alpha)\mathcal{T} K^{\alpha} \Omega^{-\alpha} \; .$$

This shows that any arbitrary choice of ω pins down aggregate TFP $\mathcal{T}$ proportionate to $\omega^{1-\alpha}$. The choice of ω (and $\mathcal{T}$) has no consequence for any economic outcomes, however. The capital cost satisfies

$$r + \delta = \frac{\alpha}{1-\alpha} \frac{\Omega}{K} \; ,$$

which shows how the calibrated values of r and δ determine parameter α uniquely.

Aggregate output is

$$Y = \mathcal{T} K^{\alpha} E^{1-\alpha} = \mathcal{T} \omega^{\alpha-1} K^{\alpha} \Omega^{1-\alpha} = \frac{\Omega}{1-\alpha} \; ,$$

which is unaffected by the choice of ω.

B.1.5 Consumption-Equivalent Variation

We describe how we calculate the percentage increase in consumption $\hat{c}$ (the consumption-equivalent variation CEV) that would make a newborn household in the benchmark economy (index B) indifferent to the newborn household in the post-reform environment (index P). Due to the presence of idiosyncratic search utility shocks, we cannot calculate $\hat{c}$ directly from the obtained value functions, so that we need to resort to simulations.

For both economies B and P, we simulate a large number i of newborn households until they either die or until time exceeds an implausibly large number (800 quarters). We calculate the average discounted utility of consumption for both economies and denote them

$$U^B = \text{ Average}^B \left(\sum_{t \geq 0} \beta^t \tilde{u}(c_t^i) \right) \ ,$$
$$U^P = \text{ Average}^P \left(\sum_{t \geq 0} \beta^t \tilde{u}(c_t^i) \right) \ ,$$

with $\tilde{u}(c) = c^{1-\sigma}/(1-\sigma)$. It is important to use $\tilde{u}(c)$ at this stage and not the original CRRA utility function $u(c) = (c^{1-\sigma} - 1)/(1-\sigma)$. The difference is a constant which is the same for both scenarios.

From the solution of the model, we can calculate the values of newborn households:

$$V^B = \mathbb{E}V^B(0,0,a_0,1) \quad , \quad V^P = \mathbb{E}V^P(0,0,a_0,1) \ ,$$

where the expectation is over the initial asset endowment a_0. Then we calculate the component of utility which is due to the fixed utility costs of search, the idiosyncratic search utility shocks, and the constant term in the utility function, which is defined as the residuals

$$X^B = V^B - U^B \quad , \quad X^P = V^P - U^P \ .$$

The consumption-equivalent variation $\hat{c}$ increases (decreases) U^B to $U^B(1+\hat{c})^{1-\sigma}$ when $\hat{c} > 0$ ($\hat{c} < 0$). From the above terms, we obtain

$$\hat{c} = \left(\frac{V^P - X^B}{U^B} \right)^{\frac{1}{1-\sigma}} - 1 \ .$$

B.2 Model Fit: Further Results

Table B.1 reports the transition probabilities for each age and wealth groups, in both data and the model. As in the main text, the thresholds that define the four quartiles are defined based on individuals' employment statuses, but they are not conditional on age.

We observe in the data panel of Table B.1 that wealth has negative relation with NE transition rates for all age groups, reducing the NE rate by about 25% going from the first to the fourth quartile. The model matches these conditional declines very well. For workers between the ages of 35 and 54, the levels of NE transition rates in the model are higher than in the data, but the decreases in percentage points going from the bottom to the top quartile are similar to the data. For older workers, while the transition rates are again higher compared to the data, the model matches the fact that the decrease with wealth occurs mostly between the first and second quartiles.

Table B.1: Transition rates by demographics and wealth: data vs. model

Data					Model				
NE rate	Q1	Q2	Q3	Q4	NE rate	Q1	Q2	Q3	Q4
25-34	20.8	19.7	12.7	15.5	25-34	20.0	20.3	17.7	16.3
35-44	16.5	16.0	16.6	11.8	35-44	19.9	17.3	16.0	15.0
45-54	12.0	11.5	16.0	8.9	45-54	16.8	13.6	12.5	11.3
55-66	3.0	2.4	2.5	2.5	55-66	8.7	6.7	6.2	5.6
EE rate	Q1	Q2	Q3	Q4	EE rate	Q1	Q2	Q3	Q4
25-34	9.8	5.3	8.9	6.3	25-34	7.9	5.0	4.9	4.8
35-44	6.5	3.8	3.3	3.7	35-44	7.4	4.7	4.7	4.7
45-54	5.2	3.5	4.3	2.1	45-54	6.9	4.3	4.3	4.0
55-66	4.8	2.7	2.4	1.7	55-66	5.2	2.9	2.9	2.6
EN rate	Q1	Q2	Q3	Q4	EN rate	Q1	Q2	Q3	Q4
25-34	2.6	2.0	1.6	2.0	25-34	2.2	2.2	2.1	2.1
35-44	2.1	1.3	1.2	0.9	35-44	2.3	2.3	2.3	2.2
45-54	2.5	1.0	1.2	0.6	45-54	2.4	2.6	2.6	2.6
55-66	4.8	2.9	3.2	2.8	55-66	3.0	3.2	3.2	3.2

NOTES: All numbers in percent.

The middle panel of Table B.1 shows the model fit with respect to the EE transition rates by age and wealth. Similar to NE transitions, the rate of job-to-job transitions decreases with wealth within each of the age groups, and it decreases with age conditional on wealth. Overall, the model does a good job at capturing these patterns. EE transition rates in the model are slightly below those in the data for younger workers, while the pattern is reserved for middle-aged workers, but aside from these differences it lines up well with the levels of EE transition rates on average.

Last, we consider transitions from employment to non-employment. As shown in the bottom left panel of Table B.1, these transitions show some variation by age and wealth in the data. In the model, EN rates are more similar among prime-age workers, and higher for older workers, with little variation in wealth for all age groups. The data also exhibit higher EN rates for older workers, although the wealth gradient is steeper.

B.3 The Role of Search Effort and Selectivity for NE Rates

To uncover the mechanisms behind the variation of job-finding rates in our model, we analyze how endogenous search intensity and differences in reservation productivity (selectivity) account for the differences in NE rates.

The job-finding rate (NE rate) of a worker in state $(w, 0, a_0, j)$ is

$$\mathrm{NE}(w, a_0, j) = \pi^1(w, 0, a_0, j) s_n^1 \lambda(\theta) \bar{H}(q^n(w, A^1, j)) + \pi^0(w, 0, a_0, j) s_n^0 \lambda(\theta) \bar{H}(q^n(w, A^0, j)) \ ,$$

where we use the abbreviation $A^i = A(w, 0, a_0, j, i)$, $i = 0, 1$ for assets of active and passive searchers at the matching stage. To understand to what extent job-finding rates are driven either by the search intensity margin or by the reservation productivity margin, we calculate counterfactual transition rates that arise when the search intensity margin is turned off. To do so, let $\bar{\pi}_n^1$ denote the share of active searchers among all non-employed workers, so that $\bar{\pi}_n^0 = 1 - \bar{\pi}_n^1$ denotes the share of passive non-employed searchers.

To deactivate the search intensity margin, we assign any worker to active or passive search according to the respective population shares. The resulting counterfactual job-finding rates vary only due to the reservation-productivity margin. These transition rates are given by

$$\mathrm{NE}^{rp}(w, a_0, j) \equiv \bar{\pi}_n^1 s_n^1 \lambda(\theta) \bar{H}(q^n(w, A^1, j)) + \bar{\pi}_n^0 s_n^0 \lambda(\theta) \bar{H}(q^n(w, A^0, j)) \ .$$

The variation of job-finding rates accounted for by the search intensity margin is then obtained by the residuals

$$\mathrm{NE}^{si}(w, a_0, j) \equiv \mathrm{NE}(w, a_0, j) - \mathrm{NE}^{rp}(w, a_0, j) \ .$$

To analyze how much of the variation in job-finding rates is accounted for by the two margins, we calculate the variance decomposition (using population weights from the stationary distribution ν):

$$\text{var}(\text{NE}) = \text{var}(\text{NE}^{rp}) + \text{var}(\text{NE}^{si}) + 2\text{cov}(\text{NE}^{rp}, \text{NE}^{si}) \ .$$

Results are shown in Table B.2, where the first row shows the overall variance and the other rows are separate decompositions for each age group. While overall the reservation-productivity margin accounts for the majority of the variation in NE rates, the search intensity margin is the dominant force for the variation among early-career workers. This is intuitive since young workers are much less selective about the jobs they accept compared to workers in the other age groups. Note, however that the NE rate has relatively little variation in the youngest age group (see the last column). For workers in the second age group, where variation of NE rates is considerably larger, the search intensity margin still plays a more important role than the selectivity margin.

Table B.2: Variance decomposition of NE rates

	Decomposition†			
	Reservation Productivity	Search Intensity	Covariance Term	Total Variance*
Overall	69.3	5.3	25.4	381.6
By age				
25-34	32.8	66.5	0.7	15.5
35-44	30.0	41.3	28.7	59.6
45-54	47.0	20.4	32.6	100.0
55-66	66.4	7.5	26.2	78.8

NOTES: † All numbers in percent. * All numbers multiplied by 10^5.

B.4 Policy Experiments: Further Results

To complement the policy findings in the main text, we show how the two policy experiments affect the decisions of different households about active search, savings and consumption. Table B.3 reports the percentage-point changes of active search for employed and non-employed workers, differentiated by age and wealth. Regarding the reduction of unemployment benefits, the findings are consistent with those of Table 10: Active search goes up more strongly for low-wealth employed and non-employed workers which then raises their respective job-finding rates (EE and NE rates). Regarding variation by age, the increase in active search is weakest for non-employed workers in the oldest age group which is then reflected in a rather moderate increase of the NE rate compared to prime-age workers. The increase in active search is also weaker for older employed workers, in line with our findings for EE rates.

Table B.3: Policy analysis – Active Search

	Non-employed			Employed		
	Bench	UI ↓	TaxPr ↓	Bench	UI ↓	TaxPr ↓
By age						
25-34	53.12	+6.49	−0.19	7.79	+0.53	+0.08
35-44	47.06	+5.39	−0.01	6.92	+0.30	+0.07
45-54	40.32	+4.31	−0.11	6.61	+0.26	+0.04
55-66	31.86	+2.50	+0.03	6.33	+0.24	+0.01
By wealth						
Quartile 1	55.10	+7.06	−0.35	9.80	+0.72	+0.06
Quartile 2	45.63	+3.74	+0.11	6.47	+0.16	+0.01
Quartile 3	34.44	+3.39	+0.36	5.91	+0.24	−0.01
Quartile 4	26.64	+1.04	−0.09	5.23	+0.11	−0.01

Notes: The second and third columns of each panel report the percentage point changes with respect to the benchmark values shown in the first columns.

Changes in tax progressivity have much smaller effects on the active search choices compared with the UI experiment, which is also seen in Table 9. Hence, the policy effects are mainly driven by the selectivity margin. Still, there are noteworthy differences on the search choices of households in different age and wealth groups. Low wealth and young non-employed workers reduce their search activity since these workers are now less likely to find employment in low-productivity jobs. Higher wealth non-employed workers (except those in Q4) however decide to search harder, as do most employed workers, especially when they are younger or when they have low wealth, because the gains from climbing the job ladder are higher with a less progressive tax schedule.

Table B.4 reports the percent changes of savings (asset holdings), consumption and wage earnings across age groups after both policies are implemented. Regarding lower UI payments, the increase of savings in response to weaker public insurance is rather homogeneous across age groups, but we observe a steep age gradient in the consumption response: Although aggregate employment goes up for all workers, young workers' consumption hardly changes while consumption in the pre-retirement group increases by over 2%, although wage earnings of workers in the pre-retirement group decline more than those of younger workers. This is intuitive since the youngest (oldest) workers have the highest (lowest) need for additional precautionary savings.

Regarding the tax progressivity reform, we find that consumption and savings increase

Table B.4: Policy analysis – Assets, Consumption and Wages

	Bench	UI ↓	TaxPr ↓
Assets			
25-34	6.58	+5.45	+0.47
35-44	14.56	+5.38	+0.51
45-54	22.14	+5.37	+0.32
55-66	23.18	+6.37	−0.83
67+	12.56	+4.12	−0.95
Consumption			
25-34	0.502	+0.03	+0.68
35-44	0.577	+0.91	+0.44
45-54	0.681	+1.14	+0.23
55-66	0.780	+2.29	−0.33
67+	0.827	−0.69	−0.05
Wage			
25-34	0.886	−1.25	+2.89
35-44	0.998	−1.13	+2.16
45-54	1.079	−1.94	+1.89
55-66	1.035	−1.40	+1.07

NOTES: The second and third columns report the percent changes with respect to the benchmark values shown in the first column.

for younger workers, while both go down for older and retired workers. The explanation is that despite lower overall employment, wages increase most for younger workers who also have a stronger motive for additional precautionary savings due to the higher risk of job loss. In contrast, reduced chances of re-employment and lower average incomes reduce consumption and savings for older and retired workers.