# On-the-Job Search and Inflation under the Microscope*

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March 31, 2025

**Abstract**

We show that workers' on-the-job search (OJS) decisions respond to economic conditions, significantly influencing macroeconomic fluctuations and the relationship between nominal and real variables. Specifically, we exploit the 2012 Danish tax reform, which heterogeneously altered OJS incentives of workers, to examine its effects on employment-to-employment transitions and wage growth across income groups. A heterogeneous-agent model with endogenous OJS replicates these effects and predicts that plausibly calibrated shocks to OJS costs generate sizable responses of output and inflation. Moreover, declining OJS costs—driven, for instance, by the spread of ICT and AI-based search tools—contribute to flattening the Phillips curve.

JEL Codes: E31, J64.

Keywords: Job ladder models; inflation; business cycles; Danish microdata, wages; bargaining, tax incentives.

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# 1 Introduction

Workers may decide to search for better job opportunities while still employed—a behavior known as on-the-job search (OJS). These decisions can be driven by a variety of factors, including wage prospects, job security, working conditions, career advancement opportunities, and broader economic conditions such as inflation expectations or fiscal incentives. OJS is widely regarded as a key driver of workers' career progression, wage growth, productivity, and welfare, yet its broader macroeconomic implications are not fully understood.

In this paper, we investigate the macroeconomic effects of changes in OJS on both theoretical and empirical grounds. We conduct this analysis using a heterogeneous agent general equilibrium model that can account for the response of individual OJS behavior to changes in fiscal incentives in the microdata across the income distribution. In the model, agents optimally engage in OJS to transition into more productive jobs. In each period, employed workers face a stochastic OJS cost and decide whether to search based on whether the expected benefits outweigh the cost. We view these costs as encompassing both pecuniary expenses and non-pecuniary factors, such as psychological costs and time commitments. Employers compete à la Bertrand to hire or retain workers, allowing employees to negotiate higher wages when presented with outside offers. As a result, income processes evolve endogenously, driven by individual reallocation decisions that lead to better matches, wage renegotiations, and a higher rate of inflation.

An appealing feature of this model is that it captures the influence of search activity among the entire workforce on inflation, not just the small share that is unemployed. In a stylized version, we derive a closed-form relationship linking inflation, the unemployment rate, and the *share* of employed workers searching on the job. This implies that increased on-the-job search (OJS) can weaken the traditional inflation-unemployment relationship, especially when employed workers respond strongly to incentives.

We establish two key results. First, exogenous changes in OJS costs can significantly influence business cycle dynamics. We interpret these costs as partly driven by collective fads, which may lower subjective search costs by reshaping social norms—making it feel less burdensome or risky for workers to explore new job opportunities. For example, during the DotCom bubble of the late 1990s, excitement around tech made it easier for workers to justify switching into rapidly-developing sectors. Similarly, during the Great Resignation in 2021, shifting expectations around work made it more psychologically acceptable—even expected—for workers to reconsider their jobs, seek better work-life balance, or demand greater flexibility.

An increase in OJS costs leads to a simultaneous decline in both unemployment and inflation. Inflation falls as wage competition among firms to hire or retain workers eases, reducing expected wage costs for new hires and, in turn, lowering marginal costs. At the same time, the smaller share of employed job seekers depresses expected wage pressures, encouraging vacancy posting, increasing labor market tightness, and thereby reducing unemployment. The resulting rise in employment more than offsets the decline in labor productivity, ultimately leading to an expansion in output.

Overall, this shock to OJS has sizable effects on both nominal and real variables, making it a quantitatively relevant source of business-cycle fluctuations. Specifically, following a shock calibrated to produce a one-standard-deviation decline in the EE transition rate, inflation falls by about 40 basis points, while unemployment decreases by roughly 1 percentage point.[1]

Our second result is that as OJS costs decline over time—due to the diffusion of ICT technologies and AI-driven tools—the model predicts that inflation rises less and unemployment falls more in response to demand shocks, meaning the Phillips curve becomes flatter. Although lower OJS costs lead more workers to search for new jobs after a positive demand shock, the percentage increase is smaller, since more were already searching prior to the shock. This smaller share of additional job seekers results in fewer wage renegotiations and lower inflation. At the same time, unemployment falls more under low OJS costs because the modest rise in job search encourages greater vacancy creation.

These results emerge from a model in which OJS endogenously responds to incentives. However, can our heterogeneous agent model with endogenous OJS behavior replicate these microdata responses to fiscal incentives and offer insights into macroeconomic dynamics? Validating this is essential to ensure that the model provides a credible framework for analyzing the macroeconomic implications of changes in OJS behavior.

To address this question, we implement the 2012 Danish income tax reform within our model and assess whether the model can replicate the observed changes in employment transitions and wage growth across the income distribution in the microdata. For workers earning well below the original threshold, job-to-job transitions remain taxed at the lower marginal rate, so their search behavior is largely unchanged. Likewise, those earning above the new threshold continue to face the same high marginal tax rate, leaving their incentives unaffected. The reform's main impact falls on workers between these extremes, particularly near the old threshold, whose post-reform wage gains from job transitions are now taxed at a lower rate. This variation in incentives across income levels, hence, generates an inverse-V-shaped response in the share of employed job seekers.

As a result, job-to-job transitions also follow an inverse V-shaped pattern across the

[1] The time series of EE transition rates is constructed following Fujita et al. (2024). The standard deviation estimated using almost 30 years of data (January 1996-February 2025) is about 2.5%.

income distribution. A similar pattern emerges in wage changes before and after the reform—but only for workers who stay in their jobs. For job switchers, wage increases are similar before and after the reform, so their wage growth remains unchanged. The reason wage growth among job movers is unaffected by the tax reform is that the change in the tax threshold primarily incentivizes workers to search on the job, thereby increasing the rate at which workers change jobs but not affecting wage growth conditional on a transition. In contrast, stayers benefit indirectly: as more workers receive outside offers, employers are pressured to raise wages to retain staff. Since this effect depends on the number of employed job seekers, wage growth for stayers also follows an inverse V-shaped pattern.

In the microdata, the observed effects of the Danish fiscal reform on individual OJS behavior, employment transitions, and wage growth across the income distribution are shown to closely align with the model's predictions described above. Specifically, the comparison reveals a remarkably similar inverse-V-shaped response in EE transition rates and wage growth for stayers, with no corresponding response in wage growth for job switchers consistently with model's predictions.

Our model features complete markets. When we relax this assumption to study a HANK framework with endogenous OJS decisions, we find that the responses of OJS are fully preserved. This indicates that including wealth heterogeneity is not essential to illustrate the mechanism of the paper.

**Literature Review.** Our work belongs to the recent literature that examines inflation dynamics through job ladder models of the labor market. Seminal work by Moscarini and Postel-Vinay (2023), for instance, shows how cyclical labor misallocation affects the transmission of shocks to inflation. However, their model assumes a constant on-the-job search (OJS) rate, omitting the channel central to this paper. Faccini and Melosi (2023) extend the model of Moscarini and Postel-Vinay (2023) by allowing for exogenous variations in the propensity to search on the job. They show that their model can quantitatively account for the "missing inflation" before the pandemic and some of the wage acceleration observed during the Great Resignation. Using reduced-form empirical analysis, Ahn and Rudd (2024) find that quits reallocation shocks played an important role in driving wage and price inflation from the 1970s through the 1990s and in the aftermath of the Great Recession.

Our modeling framework builds on the HANK model with a job ladder developed by Alves (2020) and Birinci et al. (2023), but deviates from it in a critical way. In our framework, the key source of agent heterogeneity arises from endogenous OJS decisions, a feature absent in those earlier contributions. We show that our main results are driven by heterogeneity in OJS behavior, rather than by wealth heterogeneity.

Pilossoph and Ryngaert (2024) provide evidence that workers expecting higher inflation are more likely to engage in OJS and experience EE transitions in the short term. Their model connects inflation expectations with search behavior, generating potential wage-price spirals. Using large-scale survey data, Hajdini et al. (2022) show that increased inflation expectations cause households to report a higher probability of seeking better-paying jobs. This connection between expected inflation and OJS is also present in our model. However, unlike their work, our general equilibrium framework allows OJS to feed back into price setting, capturing broader economic interactions.

Compared to this literature, we contribute both theoretically and empirically. On the theoretical side, we show that endogenous responses in OJS can operate as an important propagation mechanism for macroeconomic dynamics and demonstrate how, when wage and price inflation are influenced by the search behavior of the employed, the long-run fall in the cost of OJS can explain the flattening of the Phillips curve. Empirically, we examine the effects of taxes on EE transitions and wages using Danish microdata. By specifically analyzing the wages of stayers, we provide causal evidence that supports the foundational assumptions of this class of models.

Our paper also relates to a broad literature on the impact of income taxes on labor market outcomes. Traditionally, this research has focused on how taxes affect the intensive and extensive margins of labor supply (Keane, 2011; Chetty et al., 2013). Our model departs from these channels to highlight a different mechanism, which depends on the response of on-the-job search—a relatively underexplored aspect of labor supply decisions. Closely related to our work is Bagger et al. (2021), who examine the effects of income taxes within a job ladder model featuring endogenous OJS, using Danish microdata for estimation. Like ours, their study finds that income taxation reduces the returns to OJS. However, their focus is on the impact of taxes on labor allocation and the elasticity of taxable income, while we investigate how taxes influence inflation.

The paper is organized as follows. Section 2 presents a simple model to illustrate the core mechanism at work. Section 3 then extends this framework to a richer New Keynesian job-ladder model with endogenous on-the-job search and taxation. Section 4 describes the datasets used in the empirical analysis, while Section 5 covers the calibration of the model. Section 6 examines the effects of a shift in the high-income tax threshold on EE rates and wages across the income distribution, both theoretically and empirically. Section 7 examines the general equilibrium effects of this policy, along with other policies that influence the cost of on-the-job search, on macroeconomic aggregates. In Section 8, we relax the assumption of complete markets and construct a HANK model with endogenous OJS decisions, showing that the responses in OJS are not materially affected by wealth heterogeneity. Finally, Section 9 concludes the paper.

## 2 A stylized Model with On-the-Job Search

We present a simplified version of the job-ladder model from Faccini and Melosi (2023), which abstracts from match-specific productivity and other unnecessary complications. To build intuition, we focus solely on the key equations that highlight the link between on-the-job search (OJS) and inflation.

**The Economic Environment.** The economy consists of a representative household with a unit measure of infinitely-lived members, each of whom is either employed or unemployed. Unemployed members derive utility from leisure, represented by $b$, while employed members earn a wage $w$. At the end of each period, household members pool their income and consume an equal amount, determined by a standard intertemporal optimization problem. All workers are identical, and employed workers produce the same output $y$. Although employed workers have the same productivity across jobs, on-the-job search allows them to secure a larger share of the surplus.

The labor market features frictions, with workers searching for jobs whether employed or unemployed. Unemployed individuals are always job seekers, while employed workers search for new jobs with a probability $s_t$, which follows an exogenous first-order autoregressive process with Gaussian shocks.

The labor market is characterized by frictions and is represented by a standard matching function. Labor market tightness, defined as the ratio of vacancies to unemployment ($\theta = \frac{v}{u}$), determines the rates at which workers meet vacancies and vacancies meet workers. The vacancy-filling rate is denoted by $q(\theta)$, where the homotheticity of the matching function ensures that $q'(\theta) < 0$.

Wages are determined through sequential auction bargaining, following Postel-Vinay and Robin (2002), which assumes Bertrand competition between employers. Specifically, unemployed workers have no bargaining power, so the value of taking a first job from unemployment equals the value of unemployment. Since all workers are equally productive and match-specific productivity is abstracted away, workers are indifferent to working at different jobs. Bertrand competition ensures that whenever firms attempt to poach workers, the workers end up extracting the entire surplus of the match. In equilibrium, poaching is assumed to be unsuccessful, so workers remain with their current employer.

**The Firms.** We consider two types of firms: price setters and labor-service firms. Labor-service firms supply a homogeneous good, which is purchased by price setters and transformed into differentiated goods under price rigidities. Let $p_t^l$ denote the price of labor services. The standard profit maximization problem faced by price setters yields the New Keynesian Phillips curve:

$$\hat{\pi}_t = \varsigma \hat{p}_t^l + \beta E_t \hat{\pi}_{t+1}, \tag{1}$$

where $\pi$ represents inflation, $\varsigma > 0$ is a slope parameter, $\beta \in (0, 1)$ is the discount factor, and the hat symbol denotes variables expressed as log deviations from their steady state values.

In the labor-service market, we define a firm as a filled job, following the framework of Diamond (1982), Mortensen (1982), and Pissarides (1985). Assuming linear utility in consumption and denoting the job separation rate by $\delta$, match surplus can be expressed as:

$$S_t = E_t \left[ \sum_{\tau=0}^{\infty} (1-\delta)^{\tau} \left( p_{t+\tau}^l y - b \right) \right], \tag{2}$$

where $p_t^l$ represents the price of labor services, $y$ is the output per worker, and $b$ is the flow value of unemployment.

Service firms incur two types of costs: a recurring advertising cost $\kappa$ per period and a sunk fixed cost of hiring $\kappa^f$ to form a match and produce. The expected cost of creating a job is given by $\kappa^f + \frac{\kappa}{q_t}$, where $q_t$ represents the vacancy-filling rate. The term $q_t^{-1}$ indicates the expected number of periods required to fill a vacancy. The expected returns from hiring a worker depend on whether the worker is employed or unemployed. Based on the assumptions above, firms derive a positive value from hiring only if the matched worker is unemployed. Under random matching, the probability of meeting an unemployed worker is determined by the share of unemployed individuals among all job seekers. The free-entry condition, which equates the expected costs and returns from hiring, can therefore be expressed as:

$$\kappa^f + \frac{\kappa}{q(\theta_t)} = \frac{u_t}{u_t + s_t(1-u_t)} S_t, \tag{3}$$

where $u_t$ denotes the unemployment rate, and $s_t(1-u_t)$ is the share of employed workers searching on-the-job.

**OJS and Inflation.** A key property of the match surplus, $S_t$, in this model is that it can be rewritten as a linear function of a single variable—the *surplus kernel*, $\mathcal{W}_t$—with no dependence on any other variables.. Substituting this linear definition of the match surplus into the free-entry condition (eq. 3) yields an equation that links the surplus kernel to unemployment, $u_t$, the share of employed workers searching on the job, $s_t$, and labor market tightness $\theta_t$. Under plausible calibration of the model parameters, however, it can be shown that labor market tightness plays a neglible role in this equation.[2] Furthermore, we show that in the log-linearized version of the model, the surplus kernel $\mathcal{W}_t$ closely corresponds to the inflation rate. Thus, equilibrium inflation is approximately governed by an equation that echoes the traditional Phillips curve:

$$\hat{\pi}_t \simeq -a\hat{u}_t + b\hat{s}_t, \tag{4}$$

where $a$ and $b$ are positive coefficients. Details on how to derive this equation are discussed in Appendix A.

This equation is reminiscent of an "old-style" Phillips curve because it connects current-period inflation to current-period unemployment, and "augmented" because it extends this relationship by incorporating the job search behavior of employed workers, breaking the exclusive link between inflation and unemployment. It is a broader formulation of the traditional Phillips Curve because it accounts for the search behavior of all workers, not just the unemployed, who make up only a small fraction of the labor force. Importantly, this old-style Phillips Curve coexists with the New Keynesian, purely forward-looking Phillips Curve described in equation (1).

What are the implications of an increase in OJS, represented by the variable $s_t$? Since hiring employed job seekers is costly and generates zero surplus when poached, a higher share of employed job seekers reduces the returns from posting vacancies. Under flexible prices, markups $(1/p^l)$ remain constant, leaving labor market tightness as the only variable adjusting in equation (4). Specifically, an increase in $s_t$ reduces labor market tightness $(\theta_t)$, which raises the vacancy-filling rate $(q(\theta_t))$ and lowers the expected cost of hiring. In equilibrium, this decrease in tightness leads to reduced job creation and higher unemployment. Under nominal rigidities, however, prices also adjust to restore equilibrium. Specifically, the current and expected future prices of labor services $(p^l_{t+\tau})$ increase, raising the real value of the match surplus. Intuitively, the higher hiring costs induced by a rise in $s_t$ are passed on to price setters as higher real marginal costs. As a result, an increase in $s_t$ generates a positive comovement between unemployment and inflation.

Examining equation (4) suggests that changes in OJS could potentially explain the empirically weak relationship between unemployment and inflation. But for OJS to have a significant impact on inflation, workers' decisions to search while employed must be highly responsive to incentives and exert strong upward pressure on the wages of those who remain with their current employers, aligning with the model's bargaining framework. This is crucial because, for workers who do not switch jobs, wage increases occur independently of

[2] The reason is that the variable vacancy advertisement costs are small relative to the fixed costs of training new hires; consistently with micro evidence documented in Silva and Toledo (2009).

productivity changes. As a result, a rise in OJS directly translates into higher labor costs without a corresponding productivity gain, effectively functioning as a pure cost-push shock.

In the next section, we introduce a full fledged model where the decision to search on the job is endogenized. To ensure that the model's predictions regarding the relationship between OJS and inflation are quantitatively meaningful, we will verify that it generates responses in job-to-job transitions and wages consistent with outcomes estimated from microdata, following exogenous changes in OJS incentives.

We will then demonstrate that in the calibrated and empirically validated model, OJS serves as a potentially powerful mechanism for propagating both nominal and real variables and that changes in the nature of OJS over time may have caused a decline in the slope of the Phillips curve.

# 3 The Full-Fledged Model

We present a New Keynesian model with heterogeneous agents extended to include a job ladder, endogenous on-the-job search and income taxes. This setup allows us to investigate how tax shocks affect macroeconomic dynamics when on-the-job search responds to incentives. In Section 6, we show that in this model, a change in the income threshold for the marginal tax rate produces differential responses in the rate of on-the-job search, employment-to-employment transitions, and wage growth across the income distribution. These theoretical predictions highlight a key mechanism, whereby exogenous tax shocks to OJS affect wage inflation. We then test these predictions using administrative Danish microdata.

We note that the baseline model presented in this section assumes full consumption insurance, in order to avoid unnecessary complications in the exposition of the mechanism. In Section 8 we will introduce an incomplete market structure to illustrate the robustness of our results in a more traditional HANK setup.

## 3.1 The environment

The economy comprises a unit measure of ex-ante identical individuals facing a discrete and infinite time horizon. All of them participate to the labor market until they retire. While active in the labor market, workers can be either employed or unemployed. The pool of job seekers comprises the entire measure of the unemployed, and an endogenous share of the employed. Every period, an employed worker draws a psychological cost of search from a stochastic distribution and optimally decides to search provided that the expected return is larger than the cost. By searching on the job, the workers can move up the ladder to more productive matches. Employers compete *à la* Bertrand to hire or retain workers, which implies that workers have the opportunity to renegotiate their wages upwards with the arrival of outside offers. As a result, income processes evolve endogenously in this model, in the sense that they originate from individual search and reallocation decisions, which lead to better matches and wage renegotiations. At the end of the period, all workers pool their income together and the consumption-savings decision is taken at the level of the representative household. The household saves by investing in a mutual fund that holds all government bonds and firms in the economy. This mutual fund distributes all profits as dividends.

We assume the economy consists of two types of firms: service-sector firms and price setters. Service-sector firms decide whether to post a vacancy to form a match with a job seeker. Once a match is formed, the firm produces a homogeneous good, which is sold to monopolistically competitive price setters. Price setters differentiate the homogeneous good purchased from service-sector firms and sell it to households. Price setters choose the price of the differentiated good given a downward-sloping demand function and nominal price rigidities *à la* Rotemberg. Finally, a monetary authority is in charge of setting the nominal interest-rate policy, while the fiscal authority levies taxes with tax rates varying across labor-income brackets and administers lump-sum transfers.

## 3.2 Labor market and wage negotiations

The labor market is governed by a standard meeting function that brings together vacancies and job seekers. This implies that the rates at which job seekers meet a vacant job, $\phi(\theta)$, and the rate at which vacant jobs meet a job seekers, $q(\theta)$, only depends on labor market tightness $\theta$, defined as the ratio of the aggregate measure of vacancies and job seekers, i.e. $\theta = \frac{v}{S}$. Homotheticity of the meeting function implies that $d\phi(\theta)/d\theta > 0$ and $dq(\theta)/d\theta < 0$.

Consider a worker employed in a job with productivity $x$. When encountering a vacancy, the worker draws a new match productivity at the poaching firm, given by $x' = x(1+\epsilon)$, where $\epsilon$ follows a Normal distribution $G^{\epsilon} \sim N(\omega_x, \sigma_x)$. The worker then receives a wage offer (details below) and decides whether to accept or reject it. Similarly, unemployed workers who meet a vacancy draw a productivity $x' = \underline{x}(1+\epsilon)$, where $\underline{x} > 0$ is a fixed parameter. Each period, matches may dissolve either due to an exogenous shock occurring with probability $\delta$ or because workers voluntarily reallocate to other firms.

The bargaining protocol follows Bagger et al. (2014) and assumes that firms Bertrand compete on the share of output they are willing to pay as wages. Workers hired from unemployment cannot spark wage competition between employers, and are assumed to receive a wage equal to the full production of the least productive firm in the economy, $\underline{x}$.

To understand wage determination for the employed workers who receive an outside wage offer, it is useful to distinguish between two different cases. Let the wage schedule be denoted by $w(x, \alpha) = \alpha x$, where $\alpha$ represents the share of output that a worker captures as wage. Consider first the case of a worker employed with productivity $x$, who meets with a firm with productivity $x' > x$. This is the case where the poaching firm is more productive than the incumbent. The maximum wage that the incumbent can offer is $w(x, 1)$. This offer can be outbid by the poacher, by offering $w(x, 1) + \epsilon$, where $\epsilon \approx 0$ is an arbitrarily small value. Bertrand competition implies that the worker will switch employer, and receive the wage schedule $w(x', x/x')$, where $\alpha' = x/x'$ is the updated piece-rate.

Now consider the case where a worker employed in a match with productivity $x$ and piece-rate $\alpha$ meets with a firm with productivity $x' < x$. In this case the poacher is less productive than the incumbent. In this case, the worker stays with the incumbent, but the wage is still renegotiated upwards if the maximum wage that the poacher is willing to pay is higher than the pay the worker is currently receiving. That is, the outcome of the auction is a wage that satisfies $\max\{w(x, \alpha), w(x, x'/x)\}$.

Finally, the measure of workers looking for jobs at the beginning of a period is given by:

$$S = u_0 + \int \xi\left(x_0, \alpha\right) d\mu_0^E\left(x_0, \alpha\right), \tag{5}$$

where $u_0$ denotes the measure of unemployed workers, $\mu_0^E(x, \alpha)$ stands for the distribution of the employed workers, where the 0 subscript indicates beginning-of-period values, and $\xi\left(x, \alpha\right)$ denotes the share of employed workers in the state space defined by the vector $(x, \alpha)$ who optimally decides to search.

## 3.3 Timing of events

The timing of events is as follows: first, the aggregate tax shock hits the economy. Then both the unemployed and the employed workers search for jobs. Subsequently, reallocation takes place: some unemployed find jobs and some employed move to a different employer. Next, production takes place, wages, interest rates, dividends from mutual funds, and government transfers are paid, taxes are levied and consumption decisions are taken. At the end of the period, idiosyncratic separation, retirement, and death shocks occur.

Henceforth, we use the time subscript 0 to indicate the value of a variable at the beginning of the period, specifically at the stage when the search decision is made. The subscript 1 denotes the value of the variable at the end of the period, i.e., at the production stage.

## 3.4 The Consumption-Savings Decision

At the end of each period, after reallocation has occurred, the representative household pools the incomes of all its members—employed, unemployed, and retired. Specifically, employed workers earn a wage $w(x, \alpha)$, unemployed individuals receive benefits $b$, and retirees collect pensions $T^R$. The household derives utility from consuming a homogeneous good $c$, as described by the utility function $u(c)$. The price of the consumption good, which serves as the *numeraire* in this economy, is denoted by $P$. Households also receive nominal dividend payments $D$ per share of the mutual fund they own. The number of shares held is denoted by $e$, with each share priced at $P^e$. For each worker, labor market income is taxed at a rate $\tau$, which depends on income and will be specified later. Additionally, all workers receive the same government transfer $T$. Let $\beta \in (0, 1)$ be the discount factor, and let a prime ($'$) indicate next-period values. The household's optimization problem is expressed through the following value function:

$$\mathcal{W}(e) = \max_{c} \; \{u\,(c) + \beta \mathcal{W}(e')\} \tag{6}$$

subject to

$$\begin{aligned} Pc + P^e e' = P\,(1-\tau(b))\,bu_1 + P \int (1-\tau(w))\,w(x,\alpha) d\mu_1^E\,(x,\alpha) \\ + \left[1-\tau\left(T^R\right)\right] T_1^R \varpi_1 + (P^e + D)e + T, \end{aligned} \tag{7}$$

where $u_1$ and $\varpi_1$ denote the measure of workers unemployed and retired at the end of the period, respectively.

The solution of this optimization problem is the Euler equation:

$$u'\,(c) \quad = \quad \beta u'\,(c')\,\frac{P^{e\prime} + D'}{P'}\frac{P}{P^e}, \tag{8}$$

which equalizes the marginal utility of consumption to the discounted utility of savings in a share of the mutual fund. By combining the optimality condition above with the no-arbitrage condition from mutual funds (eq.10 derived below), we define $\lambda$ as the real discount factor applied by all workers and firms:

$$\lambda \equiv \frac{\beta u'\,(c')}{u'\,(c)} = \frac{1}{\frac{P^{e\prime}+D'}{P^e}\frac{1}{1+\pi'}} = \frac{1}{\frac{1+i}{1+\pi'}} \equiv \frac{1}{1+r}, \tag{9}$$

where $i$ and $r$ denote the nominal and real interest rates, respectively and $\pi$ denotes the rate of inflation. The real interest rate is governed by the Fisher equation:

$$1 + i \equiv E\,(1+\pi')\,(1+r)\,. \tag{10}$$

## 3.5 Workers

We let $U$, $V$ and $\Gamma$ denote the value function associated with the states of unemployment, employment and retirement, respectively. Consider an unemployed worker who did not manage to find a job within a given time period. At the end of the period, the value of unemployment is

$$U{=}b+\left(1-\psi^{R}\right)\lambda\left[f\left(\theta'\right)E_{x}V_{1}\left(x,\frac{\underline{x}}{x}\right)+\left(1-f\left(\theta'\right)\right)U'\right]+\lambda\psi^{R}\Gamma' \tag{11}$$

where $E$ represents the expectation operator, and $\psi^R$ is the probability that a worker retires at the end of the period. This expression illustrates that the value of unemployment is a weighted average of three possible future contingencies. If the worker does not retire (with probability $1-\psi^R$), they will either be employed or remain unemployed in the next period, with probabilities $f(\theta)$ and $1-f(\theta)$, respectively. If employed, the worker enters a match with productivity $x$ but starts at the lowest rung of the wage ladder, earning an initial salary of $\underline{x}$. This corresponds to a piece-rate $\alpha = \underline{x}/x$.

The end-of-period value of employment is:

$$V_1\left(x_1,\alpha\right)=w_1\left(x_1,\alpha\right)+\lambda\left\{\left(1-\psi^{R}\right)\left[\left(1-\delta\right)V_0(x_1,\alpha)+\delta U'\right]+\psi^{R}\Gamma'\right\}, \tag{12}$$

where $w_1\left(x_1,\alpha\right)=\alpha x_1$ and $V_0(x,\alpha)$ is the value function of employment at the beginning of the period, i.e., before the search cost is drawn from the i.i.d. stochastic distribution $G^\phi$.

The search decision maximizes the expected value:

$$V_0(x_0,\alpha)=\int_{\phi}\widetilde{V}_0\left(x_0,\alpha,\phi\right)G^{\phi}\left(d\phi\right), \tag{13}$$

where

$$\widetilde{V}_0\left(x_0,\alpha,\phi\right)=\max\left\{-\phi+V_0^{S}\left(x_0,\alpha\right),V_0^{NS}\left(x_0,\alpha\right)\right\}, \tag{14}$$

and where $V^S$ and $V^{NS}$ denote the value of an employed worker searching and not searching, respectively. In turn, these are given by:

$$V^{NS}\left(x_0,\alpha\right)=V_1\left(x_0,\alpha\right)$$

$$\begin{aligned}V^{S}\left(x_0,\alpha\right)=&f\left(\theta\right)E_{\widetilde{x}}\max\left\{V_1\left(\widetilde{x},\frac{x_0}{\widetilde{x}}\right),V_1\left(x_0,\max\left\{\alpha,\frac{\widetilde{x}}{x_0}\right\}\right)\right\}\\&+\left(1-f\left(\theta\right)\right)V_1\left(x_0,\alpha\right).\end{aligned} \tag{15}$$

The first term inside the curly brackets represents the value of a worker who, with probability $f(\theta)$, meets another firm and transitions to a new job with higher productivity $\widetilde{x}>x$. The second term captures the case where the worker, also with probability $f(\theta)$, meets another firm but renegotiates their wage with their current employer instead of switching jobs. The new wage is given by $\max\left\{\alpha,\frac{\widetilde{x}}{x}\right\}x_0$. This situation arises when the incumbent firm's productivity is greater than that of the poaching firm, i.e., $x > \widetilde{x}$. With probability $1-f(\theta)$, the worker does not encounter a vacancy and remains in the current job without any change in value. Expanding the expectation operator, the above equation can be rewritten as follows:

$$V^S(x_0,\alpha) = f(\theta)\left\{\int_{\widetilde{x}=x_0}^{\overline{x}} V_1\left(\widetilde{x},\frac{x_0}{\widetilde{x}}\right)G^x(d\widetilde{x})\right.$$
$$\left. + \int_{\widetilde{x}=\underline{x}}^{x_0} V_1\left(x_0,\max\left\{\alpha,\frac{\widetilde{x}}{x_0}\right\}\right)G^x(d\widetilde{x})\right\} + (1-f(\theta))V_1(x_0,\alpha).$$

We can define a threshold search cost $\phi^T(x_0,\alpha)$ such that the employed worker is indifferent between searching and not searching:

$$-\phi^T + V^S(x_0,\alpha) = V^{NS}(x_0,\alpha). \tag{16}$$

The solution to this problem is a rule, which can be expressed by the indicator function $I_{\phi<\phi^T}(x_0,\alpha) = 1$, which means that the worker searches if and only if $\phi < \phi^T$. For future convenience, it is helpful to denote by $\xi(x,\alpha)$ the ex-ante probability (i.e. before the fixed cost of search is drawn) that a worker defined by the state vector $\{x_0,\alpha\}$ ends up searching. By the law of large numbers, this will be given by the share of workers searching in every bin over $\{x,\alpha\}$.

The value of retirement is

$$\Gamma' = \left[1-\tau\left(T^R\right)\right]T^R + \beta\left(1-\psi^D\right)\Gamma', \tag{17}$$

where $\psi^D$ is the probability that a retired worker dies, and $T^R$ denotes pension income.

## 3.6 Labor service firms

The end-of-period value of a filled job is given by:

$$\begin{aligned} J(x,\alpha) = {} & p^l x - w(x,\alpha) + \frac{1}{1+r}\left(1-\psi^R\right)(1-\delta) \\ & \times\{[(1-\xi(x,a)) + \xi(x,a)(1-f(\theta'))]\,J(x,\alpha) \\ & +\xi(x,a)f(\theta')\int_{\underline{x}}^{x} J\left(x,\max\left\{\alpha,\frac{\widetilde{x}}{x}\right\}dG^x(\widetilde{x})\right)\Bigg\}, \end{aligned} \tag{18}$$

The above expression relates the present value of a match to current period profits and expected future values. The profits are given by the value of production $x$, measured in terms of the consumption good, $p^l$, minus the real wage. If the match is not dissolved at the end of the period at rate $\delta$, and if the worker does not retire at rate $\psi^R$, the firm gets the continuation value of the relationship. This value depends on whether the worker will search or not, in the following period. In turn, the probability of searching depends on current productivity and the piece-rate wage the worker is able to command. If the worker does not search, with probability $1-\xi(x,a)$, or if the worker searches but does not meet a vacancy, with probability $\xi(x,a)\,(1-f(\theta'))$, the match will continue with the same productivity $x$ and piece-rate $\alpha$. If the worker instead searches and finds a job, with probability $\xi(x,a)\,f(\theta')$, the match will continue only if the worker meets with a firm with lower productivity than the incumbent, i.e. for any $\tilde{x} < x$, where $\tilde{x}$ is the poacher's productivity. In this case, the wage will be renegotiated upwards with the incumbent whenever $\tilde{x}/x > \alpha$.

Vacancies are opened at the beginning of the period at a flow cost $\kappa$. An additional fixed cost $\kappa^f$ is paid if a match is formed. We assume that vacancies are matched at random with the workers in the pool of job seekers, who are either employed or unemployed. The free entry condition, which equates the expected costs and returns from a match, is:

$$\begin{aligned}\kappa^f + \frac{\kappa}{q(\theta)} \quad = \quad & \frac{1}{S_t}\left[u\int\limits_{\widetilde{x}} J\left(\widetilde{x},\frac{\underline{x}}{\widetilde{x}}\right)dG^x(\widetilde{x})\right.\\ & \left.+\int\limits_{x,\alpha}\int\limits_{x}^{\overline{x}} J\left(\widetilde{x},\frac{x}{\widetilde{x}}\right)dG^x(\widetilde{x})\,\xi(x,\alpha)\,d\mu_0^E(x,\alpha)\right] \qquad (19)\end{aligned}$$

On the LHS, the expected cost is given by the flow cost $\kappa$ times the number of periods that a vacancy is expected to remain open before a match is found, $1/q(\theta)$, plus the fixed cost, $\kappa^f$. On the RHS, the expected return is broken down into two terms: the first (second) integral expression inside the squared brackets characterizes the expected return of meeting with an unemployed (employed) worker. The value of a match with an unemployed depends on the stochastic productivity draw, and reflects the assumption that all unemployed workers start at the bottom of the wage ladder. The value of meeting with a worker employed depends not only on the productivity draw, but also on the productivity of their employer, the piece rate of their current wage contract, as well as the distribution of on-the-job search across productivity and wage-piece rates.

The free entry equation (19) is key to understand the mechanism, which follows the same intuition conveyed by the simple model of Section 2. The value to the firm of meeting with a worker unemployed is higher, everything else equal, than the value of meeting with a worker employed, because unemployed workers are cheaper to hire, given that they are not able to elicit wage competition between employers. A fall in the share of job seekers that are employed will increase the chances of meeting an unemployed worker, reducing in expectation the wage payments of a new hire, and increasing the surplus of a match on the

RHS.

It is worth highlighting the interaction between the free-entry equation and the assumption of price rigidities. With flexible prices, labor market tightness is the only variable that adjusts to restore equilibrium in the labor market. Specifically, tightness would increase, lowering the vacancy-filling rate and raising the expected vacancy costs required to match with a worker on the left-hand side of the free-entry equation.

However, with nominal price rigidities, there is a second variable that can be adjusted to restore equilibrium in the free-entry condition: it is the relative price of the labor service $p^l$, which appears in the expression for the value function $J$ in equation (18). Specifically, when the share of employed job seekers falls, the price of the labor service also falls, reducing the value of the expression on the right-hand side of the free-entry equation, which compensates for the expected increase in match surplus.

Lower expected wage payments in the service sector are passed through as a lower cost of the homogeneous service that is provided to the intermediate fringe of producers. Hence, in this model, the current and future path of real marginal costs $p^l$ is directly affected by the composition of the pool of job seekers; specifically, it is related positively to how many employed workers decide to search on the job and negatively to the measure of unemployed.

## 3.7 Price setting firms

Intermediate goods producers purchase one unit of the homogeneous labor service and transform it into one unit of a differentiated good, subject to the demand function from the workers. Under the standard assumption that workers minimize the expenditure required to consume a CES bundle of differentiated products, the demand for an individual variety is given by

$$y_i = \frac{p_i}{P}^{-\eta}, \tag{20}$$

where $\eta$ is the elasticity of substitution across varieties.

The problem of the price setters is to maximize current and expected profits subject to the demand constraint in equation (20) and quadratic price adjustment costs *à la* Rotemberg. The value function of the price setters solves:

$$\Omega(p_{i,-1}) = \max_{p_i}(p_i - p^l)y_i - \frac{\eta}{2\vartheta} log\left(\frac{p_i}{p_{i,-1}}(1+\pi)\right)^2 Y + \frac{1}{1+r}\Omega(p_i), \tag{21}$$

where $\vartheta$ is a price adjustment cost parameter.

The solution of the maximization problem is the standard Phillips curve:

$$\frac{\log(1+\pi)(1+\pi)}{1+\pi} = \vartheta\left(p^l - \frac{\eta-1}{\eta}\right) + \frac{1}{1+r}\frac{\log(1+\pi')(1+\pi')}{1+\pi'}\frac{Y'}{Y}.$$

## 3.8 Fiscal and monetary authorities

The fiscal authority levies income taxes with varying tax rates across brackets and administers lump sum transfers to ensure that the budget balances period-by-period. Define two income brackets $w_L$ and $w_H$, with $w_L < w_H$. The tax schedule is such that the marginal tax rate is equal to: (i) $\tau_0$ for any income below $w_L$; (ii) $\tau_L > \tau_0$ for any share of income above $w_L$ and below $w_H$; $\tau_H > \tau_L$ for any share of income above $w_H$. The government budget constraint is given by:

$$\begin{aligned} B_{-1} + T + P \cdot b \cdot \cdot u + P \cdot T^R \cdot \varpi \quad = \quad & \frac{B}{1+i} \\ & + P \cdot u \cdot b \cdot \tau(b) \\ & + P \int w(x,\alpha)\,\tau(w(x,\alpha))\,d\mu_1^E(x,\alpha) \\ & + PT^R \tau\left(T^R\right)\varpi, \end{aligned} \tag{22}$$

where LHS and RHS denote the allocation and funding of the government, respectively. Namely, the government revenues on the RHS are given by the new emissions of public debt, $B/(1+i)$, and by the taxes levied on the unemployed, the employed and the retirees. These funds can be used to repay outstanding government debt, transfers, unemployment benefits and pensions. In equilibrium, it is assumed that government bonds are in zero net supply, i.e. $B = 0$.

The monetary authority is assumed to set the nominal interest rate $i$ of the one-period government bond following the Taylor rule:

$$i = i^* + \Phi_\pi(\pi - \pi^*) + \Phi_U(u - u^*), \tag{23}$$

where starred variables mean variables at their steady-state value.

## 3.9 Mutual fund

The mutual fund owns all government bonds and firms in the economy. The no arbitrage condition across these two assets implies that the returns on investing in bonds and ownership of firms are equalized:

$$\frac{P^{e\prime} + D'}{P^e} = 1 + i. \tag{24}$$

It is assumed that all balances are redistributed as dividends to the shareholder, including profits and changes in the value of bond holdings i.e.,

$$D = B_{-1} - \frac{B}{1+i} + P\Pi^I + P\Pi^S,$$

where $\Pi^I$ and $\Pi^S$ denote the profits of the price setters and the firms operating in the service sector, respectively. Specifically, the profits of the intermediate producers are given by:

$$\Pi^I = \left(1 - p^l - \frac{\eta}{2\vartheta} \log\left(1 + \pi - \pi^*\right)^2\right) Y,$$

where $1 - p^l$ is the real marginal profit obtained from selling one unit of the differentiated product purchased at the relative price $p^l$, net of the Rotemberg costs of price adjustment. The profits of service sector are given by the period profits integrated across the employment distribution:

$$\Pi^S = \int \left[p^l x - w\left(x, \alpha\right)\right] d\mu_1^E\left(x, \alpha\right).$$

### 3.10 Market clearing and equilibrium

The goods market clearing condition requires that the aggregate demand of labor services from the intermediate producers equals supply

$$\int_0^1 y_i di \equiv Y = \int x d\mu_1\left(x, \alpha\right). \tag{25}$$

Moreover, the total demand for shares of the mutual fund must equal supply, which is normalized to unity, implying , $Y - C = P^e e$. Finally, labor market clearing requires that the sum of the employed, unemployed and retirees equals unity, both at the beginning and at the end of a period:

$$\int d\mu_j^E\left(x, \alpha\right) + u_j + \varpi_j = 1, \quad \text{for} j \in \{0, 1\}. \tag{26}$$

### 3.11 Computational strategy

We solve both the stationary equilibrium and the transitional dynamics non-linearly using global methods. A detailed description of both algorithms can be found in Appendix D.1.1 and D.1.2, respectively.

## 4 Data

We combine various administrative records provided by Statistics Denmark. At the heart of our analysis are three data sets, which are described below.

**Wage Payment Data.** The *Beskæftigelse for Lønmodtagere* (BFL) registry contains the universe of wage payments. We use these to create employment spells. Each record contains the hours registered for a period and the gross paid earnings, together with a firm and worker identifier.

**Social Security Data.** *Ikke Lønmodtagerdata fra E-Indkomst* (ILME) contains the universe of social security payments. We use these to create unemployment spells, and to compute unemployment and pension benefits. Each record contains a person identifier, a period, a benefit-type code and the corresponding payments. Individuals might receive multiple payments simultaneously.

**Education Data.** *Uddanelser* (UDDA) contains for each individual and year the highest obtained degree. We exclude workers from our analysis that have not yet reached their highest obtained degree.

**Job Spells and Job-to-job Transitions.** Consecutive wage payments within a worker-firm pair define a job spell, while unemployment spells are identified using unemployment benefit payments.[3] Both employment and unemployment spells are constructed following the detailed methodology outlined in Bunzel and Hejlesen (2016) for Danish administrative data. This approach has been widely applied in the study of Danish labor market dynamics—see, for instance, Bagger et al. (2014), Bertheau et al. (2020), and Bagger et al. (2021).

We measure job-to-job transitions as follows. Let $t$ denote the month in which a worker-firm spell ends. If the worker starts another job spell within the interval $[t-1, t+1]$, we classify it as a job-to-job transition, provided that (i) the worker physically changes workplaces, and (ii) the worker does not receive unemployment benefits during $[t-1, t+1]$. This definition includes both overlapping transitions, where the next job begins before the previous one ends, and transitions with up to a one-month gap between spells. In the context of our model, overlapping transitions indicate that the subsequent job was secured while the worker was still employed, meaning the previous job's earnings influenced the acceptance decision. Separated transitions, on the other hand, may represent two distinct scenarios: (1) spells where the worker experienced unemployment or nonemployment, during which the worker's outside option was considerably lower; or (2) cases where the worker secured the new job while still employed (and with a higher outside option) but deliberately timed the start of

[3] A job spell is considered to end if there is a gap of one year or more between payments. Single wage payments occurring more than three months after the previous payment are treated as "clearing payments", which may include residual benefits or holiday payments. These are removed from the data to avoid artificially extending the duration of the job spell.

| Calibration | | | |
|---|---|---|---|
| Parameters | Description | Value | Target/source |
| $\beta$ | Discount factor | 0.9875 | Faccini et al. (2024) |
| $\chi$ | Elasticity of substitution | 6.0000 | 25% markup |
| $\xi$ | Elasticity of CES matching function | 1.6000 | Schaal (2017) |
| $\psi^D$ | Death probability | 0.0125 | 40 years of work life |
| $\psi^R$ | Retirement probability | 0.00625 | 20 years of retirement |
| $\tau^H$ | High marginal tax rate | 0.5606 | Danish data |
| $\tau^L$ | Low marginal tax rate | 0.4226 | Danish data |
| $\tau^0$ | Low marginal tax rate | 0.0800 | Danish data |
| $w^L$ | Low income tax threshold | 0.0667 | Danish data |
| $w^H$ | High income tax threshold | 0.7200 | Danish data |
| $\delta$ | Job separation rate | 0.0400 | Calibrated |
| $b$ | Unemployment benefits | 0.2 | Calibrated |
| $T^R$ | Pension income | 0.4923 | Calibrated |
| $\kappa$ | Flow cost of vacancy | 0.0468 | Calibrated |
| $\kappa^f$ | Fixed cost of hiring | 0.7729 | Calibrated |
| $\omega_x$ | Mean productivity growth dist. | 0 | Normalization |
| $\sigma_x$ | Std. productivity growth dist. | 0.0548 | Calibrated |
| $\vartheta^l$ | Lower bound cost-search distribution | 0.0000 | Normalization |
| $\vartheta^u$ | Upper bound cost-search distribution | 0.7890 | Calibrated |
| $\varsigma$ | Slope of Phillips Curve | 0.0525 | Hansen and Hansen (2007) |
| $\phi_\pi$ | Taylor rule response to inflation | 1.5 | Conventional |
| Variable | Description | Model | Target |
| | *Steady-state calibration targets* | | |
| $\frac{\kappa}{q(\theta)}/\kappa^f$ | Ratio of variable to fixed cost | 0.0777 | 0.0780 |
| $\frac{\kappa^f+\kappa/q(\theta)}{p^l}$ | Total hiring costs over wages | 0.9995 | 1.0000 |
| $E[\xi(x,\alpha)]$ | EE transition rate | 0.0356 | 0.0365 |
| $u$ | Unemployment rate | 0.0586 | 0.0550 |
| $\sqrt{E\{[\log w(x,\alpha) - E(\log w(x,\alpha))]^2\}}$ | Std. log wages | 0.0552 | 0.0660 |
| $(1-\tau)b/E[w(x,\alpha)]$ | Average unempl.- over empl.-income | 0.2167 | 0.2966 |
| $(1-\tau)T^R/E[w(x,\alpha)]$ | Average pension- over empl.-income | 0.4811 | 0.4900 |
| $b/w^L$ | Benefits over low tax threshold | 3.0000 | 2.5200 |

Table 1: Calibrated values for model parameters. Notes: EE stands for employment-to-employment.

the new job to allow for additional leisure between the two spells.[4] We count these transitions as job-to-job transitions, as long as the worker receives no unemployment benefits between the two spells (restriction (ii)). Restriction (i) ensures that firm restructuring, mergers, and similar events are not falsely measured as job-to-job transitions.

# 5 Calibration

We calibrate the stationary equilibrium of the model to the Danish economy at quarterly frequencies. Some parameters are assigned using conventional values in the literature, others are fitted directly from the data while the remaining ones are calibrated to match a number of moments from the Danish micro data.

With regards to functional forms, we assume a CES matching function, which ensures that the contact rates of both workers and vacancies do not exceed unity, i.e. $f(\theta) = \theta(1+\theta^{\xi})^{(-1/\xi)}$ and $q(\theta) = (1+\theta^{\xi})^{(-1/\xi)}$, where $\xi$ is an elasticity parameter. The utility function is assumed to be logarithmic in consumption. The distribution of idiosyncratic productivity shocks is assumed to be normal, and defined by the mean and standard deviation parameters $\omega_x$ and $\sigma_x$, respectively. The distribution of search costs is assumed to be uniform over the support $\left[\vartheta^l, \vartheta^u\right]$, where the lower bound $\vartheta^l$ is normalized to zero. The parameters governing the probability of dying and moving to the retirement state, $\psi^D$ and $\psi^R$ respectively, are chosen in order to match an expected duration of retirement of twenty years and an expected duration of work life of forty, as in Birinci et al. (2023).

The elasticity of substitution between goods, $\eta$, is set to 6, which implies a markup of 25%, as estimated by Adam et al. (2024) for the Danish economy. The discount factor is set to .9875, as in Faccini et al. (2024). The marginal tax rates $\tau_0$, $\tau_L$ and $\tau_H$ are set to 0.08, 0.4226 and 0.5606, which are the income tax rates in force in Denmark in 2012. The threshold earnings at which the high income tax rates apply, $w^H$, is set to be 10.8 times higher than the low threshold $w^L$, as in the data. The elasticity of the matching function, $\xi$, is set to 1.6, in line with estimates by Schaal (2017) for the US economy.

This leaves us with eight parameters to calibrate: $\delta$, $b$, $T^R$, $\kappa$, $\kappa^f$, $\vartheta^u$, $\sigma_x$, and $w^L$. The calibration process involves simultaneously solving a system of equations to ensure that the model matches specific empirical moments. While all parameters contribute to achieving the targets, certain moments are particularly sensitive to specific parameters. In this context, each parameter is explicitly linked to the moment it is intended to match.

The job separation rate, $\delta$, is adjusted to match an unemployment rate of 5.5%. The unemployment benefits parameter, $b$, is calibrated to reproduce a ratio of net unemployment income to average gross employment income of around 30 percent.[5] The transfer to retired

[4]For a fuller discussion, we refer to Caplin et al. (2023), who show that Danish workers expect time off after a voluntary separation, consistent with the notion that households plan additional leisure between job-to-job transitions.

[5]We compute the ratio of unemployment-to-employment income as follows: we compute for each worker the ratio of their average monthly net unemployment benefit payments over their average monthly gross earnings. The reported statistic is the average across the Danish labor force for the year 2012. Denmark has a high unemployment benefit replacement rate of approximately 90%. However, benefits are capped at

workers, $T^R$, is calibrated to match a ratio of average net pension payments to average gross employment income of 49%. The variable cost of posting vacancies, $\kappa$, is adjusted to match the ratio of total variable costs of hiring to fixed costs, $\frac{c/q(\theta)}{c^f}$, at 0.078, consistent with estimates from Silva and Toledo (2009).[6] The fixed cost of posting vacancies, $\kappa^f$, is calibrated to ensure that total hiring costs, including both pre-match and post-match costs, equal one quarter of wage payments, in line with the accounting estimates in Faccini and Yashiv (2022). The upper bound of the uniform search-cost distribution, $\vartheta^u$, is calibrated to match the EE transition rate of 3.65 percent. Finally, the dispersion parameter of the idiosyncratic productivity shock process, $\sigma_x$, is set to reproduce a standard deviation of residualized log wages of about 6.6%.[7] The low tax threshold is set so to be about 2.5 times larger than the unemployment benefit, as implied by the microdata.

As for the parameters that do not affect the stationary equilibrium of the model, we set the parameter governing the response to inflation in the Taylor rule to 1.5. The slope of the Phillips curve is set to 0.0525, in line with micro estimates by Hansen and Hansen (2007) on Danish data.

# 6 The Effects of a Danish Tax Reform: Model vs. Data

In this section, we validate the model by examining how the empirical effects of Denmark's 2012/2013 labor income tax reform on job-to-job transitions and wage growth align with the model's predictions. Our analysis focuses on a sizable shift in an income tax bracket implying a fall in the tax rate for workers whose income lies within 423,804 DKK to 457,609 DKK.[8] This threshold remained unchanged in the three years leading up to and including 2012. For the tax year 2013, the higher tax threshold experienced a substantial shift, namely from 423,804 DKK to 457,609 DKK, representing an 8% increase.[9] Figure 1 illustrates this shift, with earnings denominated in monthly Euros.

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a relatively low ceiling, meaning the replacement rate declines for higher earnings, and is in fact quite low for high-income earners (see https://www.hk.dk/akasse/dagpenge/dagpengesatser).

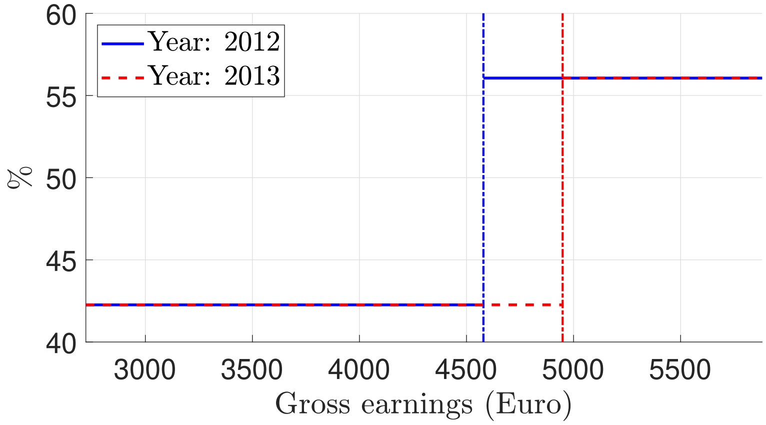
[6]This value is the ratio of pre-match recruiting, screening, and interviewing costs to post-match training costs in the U.S.

[7]We estimate the average EE rate and the dispersion of log wages using Danish workers aged 25-65 in the year 2012. Unlike the model, the data suffers from measurement error and uncaptured firm- and worker-level heterogeneity. To compute the model-equivalent of the data, we measure worker-firm level hourly wages as the annual earnings of a worker-firm pair, divided by the corresponding annual hours worked, exclude outliers and focus on workers that work full-time hours. Finally, we residualize log wages using worker-fixed and firm-fixed effects, since our model abstracts from any worker or firm-level heterogeneity.

[8]The nominal increase in the gross marginal tax rate for high-income earners is 15 percentage points, which effectively becomes 13.8 percentage points after accounting for labor market contributions.

[9]Data on tax rates and thresholds are available at: https://skm.dk/tal-og-metode/satser/tidsserier/centrale-beloebsgraenser-i-skattelovgivningen-2018-2024

Figure 1: Marginal Tax Rates in Denmark, 2012 vs. 2013




**Notes**: Earnings are monthly. The vertical blue and orange lines represent the thresholds for the top marginal tax rate in 2012 and 2013, respectively.

**Analysis of Tax Brackets.** Through the lenses of our model, reducing the marginal tax rate strengthens on-the-job search incentives by increasing the expected after-tax return to search, i.e., net wage growth. Changes in tax thresholds can substantially modify marginal tax rates for specific workers while maintaining them constant for others, ensuring that threshold adjustments primarily affect a distinct subset of the population without raising concerns about general equilibrium effects.[10]

Job search behavior exhibits substantial variation across income levels in the data. To isolate the effects of tax bracket changes, it is not sufficient to compare workers near the threshold to those further away, as differences in search behavior may stem from income variation rather than differences in effective marginal tax rates. Since the tax threshold affects all workers uniformly within a given year, we identify causal effects by comparing workers before and after the reform.

The 2012/2013 adjustment of Danish tax brackets provides an ideal setting for studying job search behavior for several reasons. First, the threshold had remained stable in the years leading up to this fiscal change, creating a clean baseline for comparison. Second, the substantial magnitude of the shift ensured high salience among workers, making them more likely to respond behaviorally, while also generating meaningful increases in job-search returns—defined as the potential wage improvements associated with successful job search. Third, the Danish economy experienced moderate but constant growth in the years surrounding that adjustment. The combination of salience and magnitude is crucial; low awareness of tax changes would diminish behavioral responses, while small changes in returns might be

[10]We will use the model to study the general equilibrium effects in the subsequent section. These GE effects are qualitatively in line with what we would expect, but quantitatively irrelevant for our empirical findings.

indistinguishable from normal variation in the data. Furthermore, the threshold stability in previous years allowed workers to fully adjust to the existing tax structure, enabling us to compare "after" workers (post-2012/2013) with "before" workers (2011, 2012) whose search behavior and income patterns had already normalized to the previous tax regime. This addresses potential confounds that might arise if workers were still adapting to recent policy changes during our pre-treatment period. Finally, because both the broader economy and tax brackets remained relatively stable for several years before and after the reform, we can pool multiple years of pre- and post-reform data to enhance statistical power. Our empirical strategy leverages these advantages to present results across various time horizons.

**Data and Empirical Framework.** We examine year-on-year changes in job-to-job transitions and annual wage growth around the top tax threshold using job spells and transitions as described in Section 4. Our analysis compares workers in pre- and post-reform periods, and we present both the results from the year immediately following the reform (2013 vs 2012) and a three-year average on both sides (2013-2025 vs 2010-2012). The sample includes workers aged 25 to 65. We restrict attention to full-time employed workers in each period.[11] For each worker, we compute annual labor earnings as total labor income across all job spells, including both wages and bonuses. We derive annual hourly wages by dividing annual labor earnings by annual hours worked.

According to our model, a change in the tax threshold influences not only workers whose earnings are at the threshold but also those in a broader range above and below it, an effect we will examine in the next section. To capture this, we analyze the empirical outcomes of workers whose earnings fall within 20% of the threshold, grouping them into equally sized income bins, each containing approximately 50,000 workers.

We employ a simple difference-in-difference framework where we compare changes in outcome variables at the income-bin level, after relative to before the tax reform. We estimate

$$y_{i,t} = \text{after}_t + \sum_g \beta_g \mathbf{1}_{(\text{income}\,=\,g),i,t} + \gamma_g \mathbf{1}_{(\text{income}\,=\,g),i,t} \times \text{after}_t + X_{i,t} + \epsilon_{i,t}, \tag{27}$$

where $y_{i,t}$ represents an outcome variable for individual $i$, in year $t$. For example, the subsequent analysis will first consider job-to-job transitions rates, in which $y_{i,t}$ will contain whether worker $i$ had a job-to-job transition in year $t$. *after* is a dummy variable equaling one in the period following the threshold change of January 1, 2013, $\mathbf{1}_{income=g}$ indicates the income bin $g$ and $X$ represents potential control variables. $\gamma_g$ can be understood as the effect of the reform on outcome variable $y$ for income bin $g$, relative to a benchmark bin.

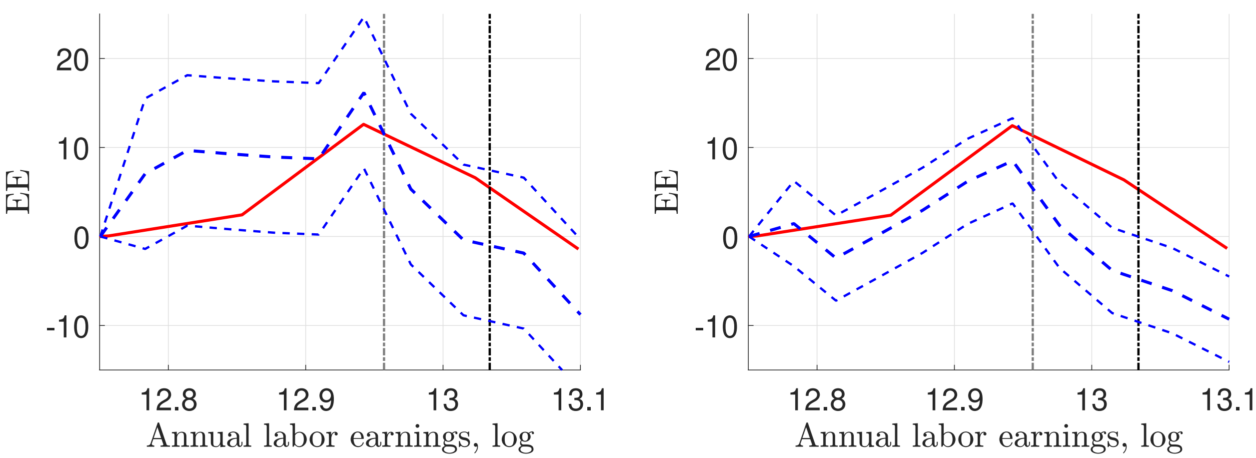
[11] We require annual hours worked within 5% of 1,927, consistent with Statistics Denmark's definition of full-time employment (160.6 monthly hours). This restriction effectively addresses extreme fluctuations in annual wage growth that arise even from single-month non-employment spells.

We report our estimates for $\gamma_g$ together with the 95% confidence bands in Figures (2)-(5) for different outcome variables $y_{i,t}$. In these figures, the coefficients are scaled by the sample average of the outcome variable $y$ and can thus be understood as percent changes of $y$ relative to its mean.

**Quantitative Framework.** We study the 2013 threshold adjustment also in our model, to compare our model predictions to that of the data. Here, we first solve for the steady state based on our model calibration for the year 2012. We then introduce an unanticipated change in the top-tax threshold according to the tax reform, and simulate the transition of the model to the new steady state. We use distributions and policy functions 4 quarters and 12 quarters after the change, relative to the distributions and policy functions of the steady state, to compute the model-analogue of the empirical regressions, studying the after-vs-before changes.

## 6.1 Job Search Response to Tax Threshold Shift

Figure 2: Effects of Shifting the High-Income Tax Threshold on EE Rates




(a) 1 year window

(b) 3 years window

**Untargeted moments**: The figure displays the percentage change in employment-to-employment (EE) rates across income bins before and after the tax reform. The solid red lines depict the evolution of EE rates in the model, relative to the 2012 steady-state distribution, after 1 and 3 years of transition to the new steady-state equilibrium characterized by the 2013 tax thresholds. The light gray and dark gray vertical bars indicate the high-income tax thresholds for 2012 and 2013, respectively. The dashed blue lines indicate the empirical estimates of equation (27), together with the 95% confidence intervals, when comparing 2013 vs 2012 (left panel) and 2013-2015 vs 2010-2012 (right panel). Income bins are constructed to include approximately 50,000 workers per year during 2010–2015.

We begin our analysis by studying the response of EE rates to the change in the tax threshold. The red solid line in Figure 2 displays the model-implied effect of the tax change on EE rates across two panels: the percentage change in EE rates in 2013 relative to 2012 (panel a, one-year window), and the percentage change in EE rates over the 2013–2015 period relative to 2010–2012 (panel b, three-year window), computed for each income bin.[12] As shown in Figure 2, the change in EE rates increases in earnings while approaching the 2012 tax threshold, and then falls rapidly.

These findings follow economic intuition. Any change in the high-income threshold would be irrelevant for workers with earnings far below it, since the higher earnings associated with a job-to-job transition would still be taxed at the lower marginal rate; hence workers in lower income bins should not exhibit differential on-the-job search behavior before and after the reform. Similarly, workers who already in 2012 had incomes above the 2013 threshold would face the same high-income-tax rate both before and after: so for workers in these high income bins, there should be no differential effect of the reform on job search behavior. The income group most strongly affected by the tax reform lies between these two polar cases and, specifically, around the old income-tax threshold. For these workers, the entire additional wage growth from a transition is taxed at a lower marginal rate after the reform, compared to the period that precedes it. These differential effects of the tax reform on the returns to on-the-job search across the income distribution lead to an inverse-V shape response in the share of employed job seekers.

In the empirical analysis, we let our outcome variable $y_{i,t}$ indicate whether worker $i$ experienced a job-to-job transition in year $t$ and estimate (27). The blue lines in Figure 2 present our main empirical results. The empirical patterns align closely with our model predictions, even though not directly targeted in the calibration. EE transition rates exhibit an inverse-V shape that peaks near the 2012 threshold, with the pattern becoming more pronounced as we expand the estimation window and exploit larger samples. The increases in transition rates are statistically significant across both specifications. Consistent with the model, we observe point estimates trending negative beyond the 2013 threshold.

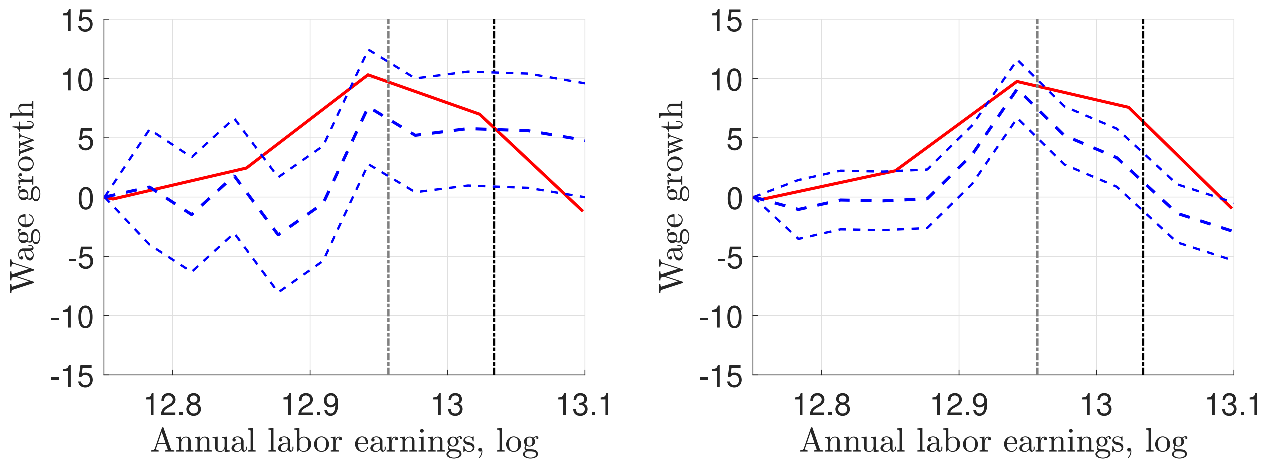
The results provide strong evidence that reduced marginal tax rates stimulate on-the-job search and job-to-job transitions. The magnitude is economically significant: in the most affected income bin, EE transition rates increase by 11%, i.e., from 4.7% to 5.2% annually.

## 6.2 Wage Growth of Stayers

The tax threshold shift generates wage growth effects through two distinct mechanisms. First, a mechanical composition effect arises as increased EE transitions (see Figure 2) generate a larger share of workers transitioning to higher-wage employment. Second, the reform

[12] In the model, we average quarterly outcomes in the transition to the post-reform stationary equilibrium to compute the 2013 EE rates.

Figure 3: Effects of Shifting the High-Income Tax Threshold on the Wage Growth of Job Stayers




(a) 1 year window (b) 3 years window

**Notes**: The figure displays the percentage change in wage growth for workers remaining with the same employer across income bins before and after the tax reform. In the model, the solid red line shows the evolution of wage growth, relative to the 2012 steady-state distribution, after 1 and 3 years of transition to the new steady-state equilibrium characterized by the 2013 tax thresholds. The light gray and dark gray vertical bars indicate the high-income tax thresholds for 2012 and 2013, respectively. Empirical estimates, depicted by the broken blue lines in the middle, compare outcomes for 2013 versus 2012 in the left panel and for 2013–2015 versus 2010–2012 in the right panel. The areas between the top and bottom broken blue lines represent 95% confidence intervals, with standard errors clustered by earnings bin. Income bins are constructed to include approximately 50,000 workers per year during 2010–2015.

affects incumbent workers through a bargaining channel: intensified on-the-job search increases the number of outside offers that incumbent employers must match to retain workers. The red solid lines in Figure 3 demonstrate that the threshold adjustment generates in the model an inverse-V shaped wage growth response among job stayers, mirroring the pattern observed for EE transitions in Figure 2. This response peaks near the 2012 threshold before turning negative beyond the 2013 threshold.

Our empirical analysis of hourly wage growth among job stayers (the broken blue lines in Figure 3) align closely with the model's predictions. The estimated response exhibits significant increases near the 2012 threshold, with the inverse-V pattern becoming more pronounced as we extend the estimation window. The magnitude is economically significant: peak wage growth effects reach 10%, representing an increase from 2.68% to 3.11% in annual terms. This wage effect is particularly notable as it applies to job stayers, who constitute the vast majority of the workforce. In the model, these workers do not experience changes in match productivity as they stay in the same job. So an increase in wages for the stayers is akin to a pure cost-push shock. Thus, our estimation reveals that the threshold adjustment generated substantial wage pressure through the bargaining channel alone.

Note that the observed inverse-V pattern in stayer wages provides evidence supporting the sequential auction bargaining protocol used in the model. Under Nash bargaining, instead, the tax reduction would increase match surplus, requiring gross wages to decline to maintain constant surplus shares—yielding the opposite wage response.[13]

To address potential confounders, we conduct additional specifications controlling for observable characteristics. We re-estimate our baseline specifications after residualizing both EE rates and wages with respect to age groups, gender, education, industry, and occupation fixed effects. The results demonstrate remarkable stability relative to the baseline estimates. Both EE rates and stayer wages maintain their inverse-V pattern with peaks near the 2012 threshold. The robustness of these patterns to extensive controls suggests effective balance in treatment and control characteristics within income bins.

## 6.3 Wage Growth of Leavers

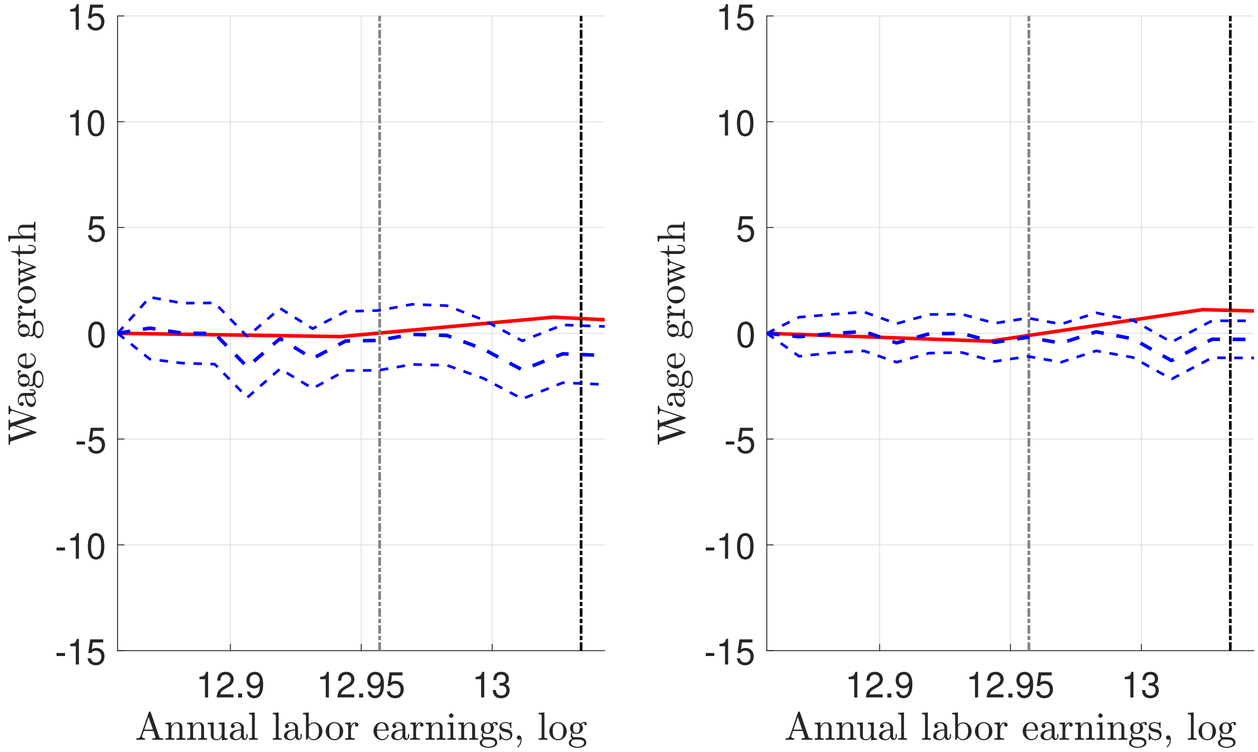
Does the tax change affect the wage growth of workers who experience a job-to-job transition? The answer to this question is no. As shown by the red solid lines in Figure 4, the change in wage growth before and after the reform is nearly zero for any bin of the income distribution. We note that wage growth conditional on changing jobs is still positive, as implied by the calibration. It is the differential effect before and after the reform, that is close to zero.

This is because in this model, the wage change conditional on a job change only depends on the productivity difference between the two firms, and the extent to which the worker was already extracting wages at the previous firm. A higher job-search intensity increases the likelihood of changing jobs, but not the wage change conditional on a job change.

The blue broken lines in Figure 4 show the empirical counterpart to the model-generated patterns. In line with our model, there is no difference between the wage growth of job changers in the years before and after the change of the tax schedule.

Note that a model with Nash Bargaining would have predicted lower growth of gross wages for job leavers in response to the change in the tax schedule. Intuitively, this is because the same transition from a less productive to a more productive firm now yields a larger surplus increase. This higher surplus increase would be split among the worker and the new firm, leading to a larger growth in net wages, but a smaller growth of gross wages.[14]

Figure 4: Effects of Shifting the High-Income Tax Threshold on Wage Growth of Job Changers




(a) 1 year window (b) 3 years window

**Notes**: The figure displays the percentage change in wage growth for workers changing employer across income bins before and after the tax reform. In the model, the solid red line shows the evolution of wage growth, relative to the 2012 steady-state distribution, after 1 and 3 years of transition to the new steady-state equilibrium characterized by the 2013 tax thresholds. The light gray and dark gray vertical bars indicate the high-income tax thresholds for 2012 and 2013, respectively. Empirical estimates, depicted by the broken blue lines in the middle, compare outcomes for 2013 versus 2012 in the left panel and for 2013–2015 versus 2010–2012 in the right panel. The areas between the top and bottom broken blue lines represent 95% confidence intervals, with standard errors clustered by earnings bin. Income bins are constructed to include approximately 50,000 workers per year during 2010–2015.

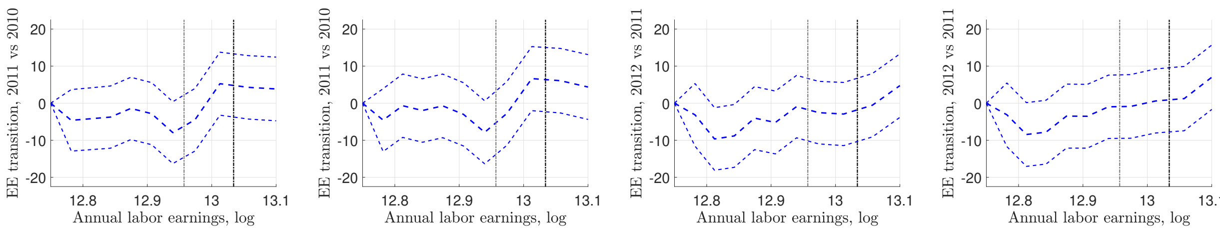
## 6.4 Placebo exercise

To ensure that our results are indeed due to the 2013 change in the tax threshold and not to other factors that may correlate with the income distribution, we create placebo experiments on neighboring years. Here we expect no significant findings around the tax threshold since it remained constant throughout these placebo periods.

Figure 5 presents the results of these placebo experiments. Panels (a) and (b) compare EE transition rates in 2011 relative to 2010, while panels (c) and (d) compare 2012 relative

[13] We provide the proof in Appendix E.
[14] We provide the proof in Appendix E.

Figure 5: Placebo experiment: Empirical Responses of EE rates in Years of No Tax Reforms




(a) No controls (b) Worker controls (c) No controls (d) Worker controls

**Notes**: Placebo experiment: difference-in-difference effect of a shift in the tax threshold on EE transition rates. The vertical bars represent the high-income tax thresholds for the years 2012 and 2013. Panels (a) and (b) compare EE transition rates in 2011 relative to 2010, while panels (c) and (d) compare 2012 relative to 2011. Within each comparison, panels (a) and (c) display results using raw EE data, whereas panels (b) and (d) show results using residualized data.

to 2011. Within each comparison, panels (a) and (c) display results using raw EE data, whereas panels (b) and (d) show results using residualized data. Because the threshold tax rate for high income earners remained unchanged over the 2010-2012 period, the difference-in-difference results should show no differential outcomes across the treatment and control periods, which is precisely what the figure illustrates.

## 6.5 Anticipation Effects

The computation of the effects of a change in the tax threshold on EE rates and wages that we have examined so far in the model, implicitly assumes that changes in the tax threshold affects workers' incentives to search for jobs only in 2013 and not already in 2012, i.e., that responses to the change in threshold were not anticipated. However, the tax reform was already announced at the end of May 2012, so it is indeed possible that workers responded to the announcement well before the beginning of 2013. Yet, it takes time to process new tax information and take decisions to change jobs. Moreover, even after one decides to look for jobs, it takes time before finding a suitable offer. Hence, it is reasonable to believe that most of the workers seeking to increase their earnings to take advantage of lower marginal tax rates, would have been able to do so only in 2013. That said, it is still possible that some workers managed to respond to the announcement of the tax reform, shift jobs and get higher earning already before the end of 2012. To the extent that that is the case, our estimated increase of earnings for the stayers is biased downwards, and hence should be regarded as conservative.

# 7 Macroeconomic effects

The results in the previous section show that the model's mechanism, where the threshold-tax shock affects wage inflation through OJS, generates quantitatively reasonable responses across the income distribution. In this section, we examine the macroeconomic effects of a change in the high-income tax threshold and a shock to the cost of OJS. The reason for considering the shock to the cost of OJS is that the change in the high-income tax threshold primarily affects a small portion of the population, meaning its aggregate effects are necessarily limited. In contrast, a shock to the cost of OJS affects all workers, regardless of their income, allowing for a broader influence on the economy. Like the threshold shock, the shock to the cost of OJS exogenously shifts the incentives for on-the-job search, potentially leading to a change in workers' behavior across the entire labor market. As a result, the shock to the cost of OJS has the potential to generate quantitatively meaningful macroeconomic effects.

## 7.1 The macroeconomic effects of the 2012 Danish tax reform

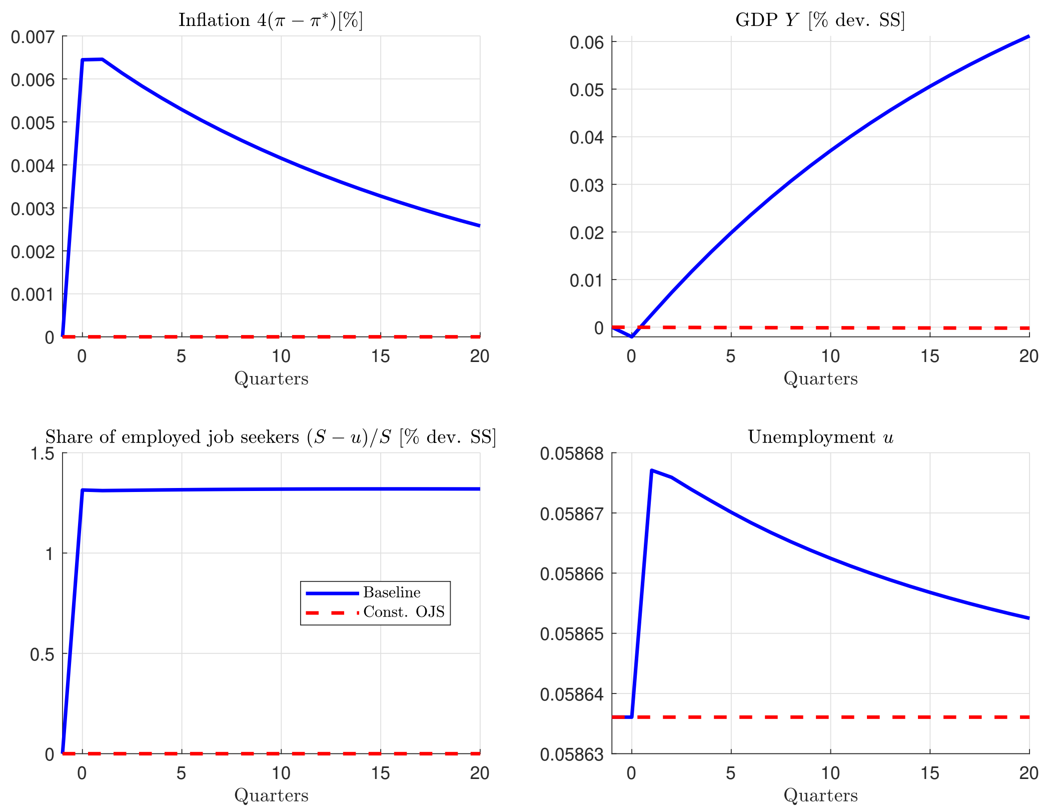
We now turn to investigate the effects of the tax reform on macroeconomic aggregates such as unemployment, output and price inflation implications. We do so by computing the transition path to the new stationary equilibrium featuring an eight percent permanent increase in the high-income tax threshold $w^H$, as dictated by the 2012 tax reform. Figure 6 compares the responses to this policy that are generated by the baseline model (blue solid line), against the case where OJS is constant (red dashed line).[15] Comparing the two lines clearly reveals that the effects observed in the baseline scenario are entirely driven by endogenous OJS decisions.

In the baseline model, the tax reform lowered the marginal tax rate faced by the workers with incomes close to the 2012 high-income tax threshold, leading to a permanent increase in the average rate of OJS. Consequently, it led to a persistent increase in both unemployment and inflation, as illustrated by the blue lines in the first row of Figure 6.

The mechanism leading to a simultaneous rise in both inflation and unemployment works as follows. The increase in OJS raises the share of employed job seekers. The expected return to posting a vacancy falls, given that firms are able to extract a lower share of surplus when meeting an employed worker, relative to an unemployed one. Intuitively, the employed are more expensive to hire, given that their bargaining position is higher; unlike the unemployed, employed workers can spark wage competition between poachers and incumbent employers.

[15] These transitions are triggered by changes in the relevant parameters, which agents did not anticipate ex-ante (MIT shocks).

Figure 6: Macroeconomic Effects of a Permanent Shift in the Tax Threshold




**Notes**: Impulse responses to a 8% increase in the tax threshold for high-income earners.

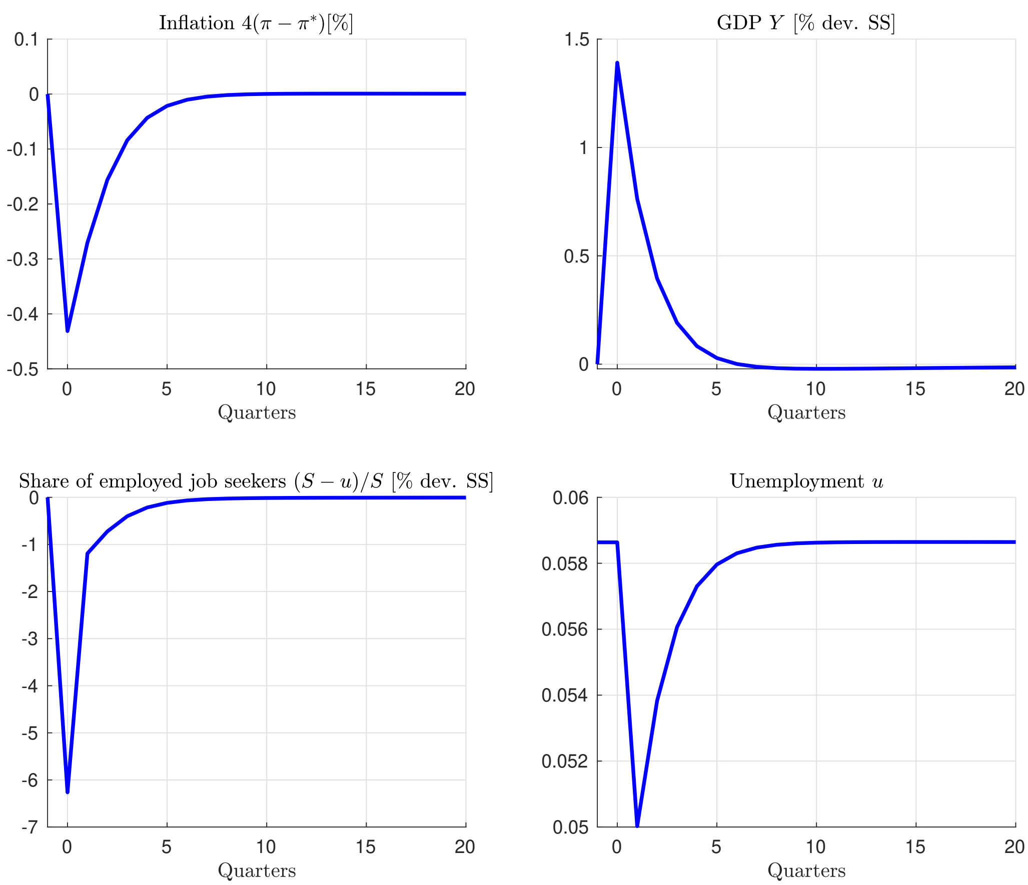
Wage pressures rise, and higher expected wage payments in the labor market are reflected into higher real marginal costs for the price-sector firms, which in turn are passed through to higher prices, increasing the rate of inflation persistently over the impulse response horizon.

Output falls on the impact of the shock, driven by the fall in employment. Over time though, the increased OJS rate leads to a more efficient allocation of workers up the ladder, raising the average product of labor in a way that more than compensates for the persistent fall in employment.

Quantitatively, the effects of this particular policy are negligible. This is not surprising, given that this policy only affects a small share of high-income workers located close to the threshold, so the average rate of OJS increases only marginally. The general equilibrium effect of this policy are naturally small, and too small to be retrieved in the microdata. In the next section, we show that an alternative shock or policy, which affects OJS costs for all the workers, has the potential to generate quantitatively strong results.

## 7.2 Business-cycle implications of aggregate OJS costs

Figure 7: Macroeconomic effects of a Shock to the Cost of Searching on the Job




**Notes**: Impulse responses to an increase in the upper-bound parameter of the search-cost distribution.

We now study the effects of a temporary shock to the cost of searching on the job, affecting all workers at any rung of the job ladder. We interpret these costs as partly driven by collective fads, which may lower subjective search costs by reshaping social norms—making it feel less burdensome or risky for workers to explore new job opportunities. For example, during the DotCom bubble of the late 1990s, excitement around tech made it easier for workers to justify switching into unproven sectors. Similarly, during the Great Resignation in 2021, shifting expectations around work made it more psychologically acceptable—even expected—for workers to reconsider their jobs, seek better work-life balance, or demand greater flexibility. We keep the lowerbound of the cost-shock distribution $\vartheta^l = 0$ and assume that the upperbound follows the process $\vartheta^u_t = \rho_\vartheta \vartheta^u_{t-1} + \epsilon_t$, where we set the autocorrelation coefficient $\rho_\vartheta = 0.5$ and the shock on impact produces a one-standard-deviation decline in the EE transition rate—based on estimates from January 1996 to February 2025.[16]

The impulse responses to a positive cost shock are reported in Figure 7. As shown by the panel in the top-left corner, the shock is short-lived, and almost entirely gone by the end of the fourth quarter. The higher search cost produces a simultaneous fall in unemployment and inflation. Inflation decreases, reflecting the fall in the expected wage costs of new hires, and hence a cheaper labor service. At the same time, the fall in the share of job seekers, by lowering the expected wage-cost of new hires, increases labor market tightness, and reduces unemployment. The resulting increase in employment, more than compensates for the decline in productivity, leading to an increase in output.

Although the decline in the share of employed job seekers is short-lived, its impact on inflation and unemployment is substantial. As a result, inflation drops by more than 40 basis points, and unemployment decreases by roughly 1 percentage points. Despite its relative richness, the model——like any other——remains inherently misspecified. Therefore, the quantitative results should be interpreted as indicative of the channel's power within this framework.

## 7.3 The Role of OJS in the Propagation of Demand Shocks

Search costs, or the time and effort required to find information and applying for jobs, have evolved significantly due to technological advancements. Over the past thirty years, as information and communication technologies (ICT) have become more widespread, the process of applying for jobs has shifted from traditional mail to email. At the same time, the time and effort required to gather information about available job opportunities has decreased dramatically. This is largely due to the increasing efficiency of internet search engines and platforms like LinkedIn, which allow job seekers to discover relevant vacancies with minimal effort and cost. Search engines, in particular, have become much more sophisticated, enabling individuals to quickly access and filter job listings based on specific criteria.

For individuals who are already employed, reducing time spent on job searching is especially valuable, as their time outside of work is limited. Looking ahead, the continued diffusion of artificial intelligence (AI) is expected to further lower the time-costs associated with preparing job application materials, making the process even more streamlined. In this section, we examine how reducing search costs affects the transmission of demand shocks.

Figure 8 illustrates the effects of an expansionary demand shock triggered by a one-standard-deviation decline in the discount factor. The figure compares two scenarios: the baseline economy with low search costs (solid blue line) and a case where search costs are

[16] Computing the standard deviation using only data from before the COVID period would not materially change our results.

doubled, increasing the upper bound from 0.5 to 1 (dashed red line). The shock raises aggregate demand. With nominal rigidities, firms supply all demanded consumption goods, increasing labor services. Higher labor demand raises the relative price of labor, $p^l$, fueling price inflation. As labor's marginal revenue product rises, firms post more vacancies, boosting employment and reducing unemployment.

The model with low search costs generates a weaker inflation response and a stronger unemployment response compared to the high search cost case. In other words, lower search costs lead to a flatter Phillips curve in response to demand shocks. Although the absolute increase in on-the-job search is larger under low search costs, its percentage increase is smaller because the share of employed job seekers is larger in steady state than in the high search cost case.

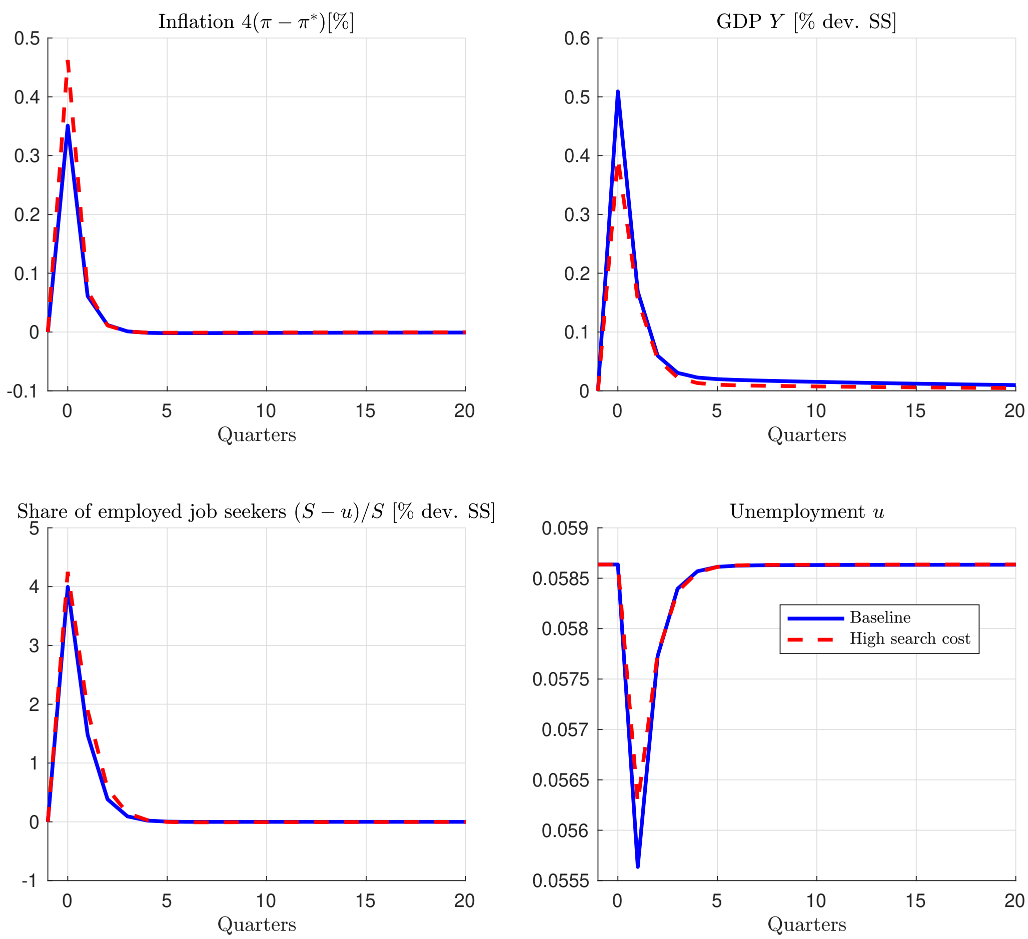
Differences in the percentage response of employed job seekers explain the varying responses of unemployment and inflation, following the intuition conveyed by the simple model of Section 2. Namely, a smaller percentage rise in employed job seekers in the low-cost case leads to lower inflationary pressure, as the percent increase in re-negotiations is smaller. At the same time, expansionary demand shocks consistently reduce unemployment, regardless of search costs. However, the reduction in unemployment is smaller when the percentage increase in employed job seekers is higher, as the higher incidence of costly re-negotiations discourages vacancy creation.

# 8 Incomplete Market Structure

In this Section, we introduce an incomplete market structure into the baseline model presented in Section 3 to show that the propagation mechanism highlighted in this paper is robust to allowing for heterogeneity in marginal propensities to consume. The only difference in assumptions between the HANK job ladder model presented here and the baseline of Section **??**is that the consumption-savings decision is now made at the individual worker level, rather than at the household level. This change introduces wealth heterogeneity as an additional state variable, leading to differences in the marginal propensity to consume across workers. As a result, the optimal decision rules for OJS, $\xi(e, x, \alpha)$, now also depend on asset holding $e$. The full description of this extended model is provided in Appendix F. We extend the baseline algorithms to solve both the stationary equilibrium and the transitional dynamics to include the wealth distribution as third dimension of heterogeneity. The extended algorithms are described in detail in Appendix D.2.1 and D.2.2, respectively.

Figure 9 illustrates that the differential response of both EE rates and wages to a shift in the high-income threshold are very similar in the baseline model and in the HANK model.

Figure 8: Demand Shock

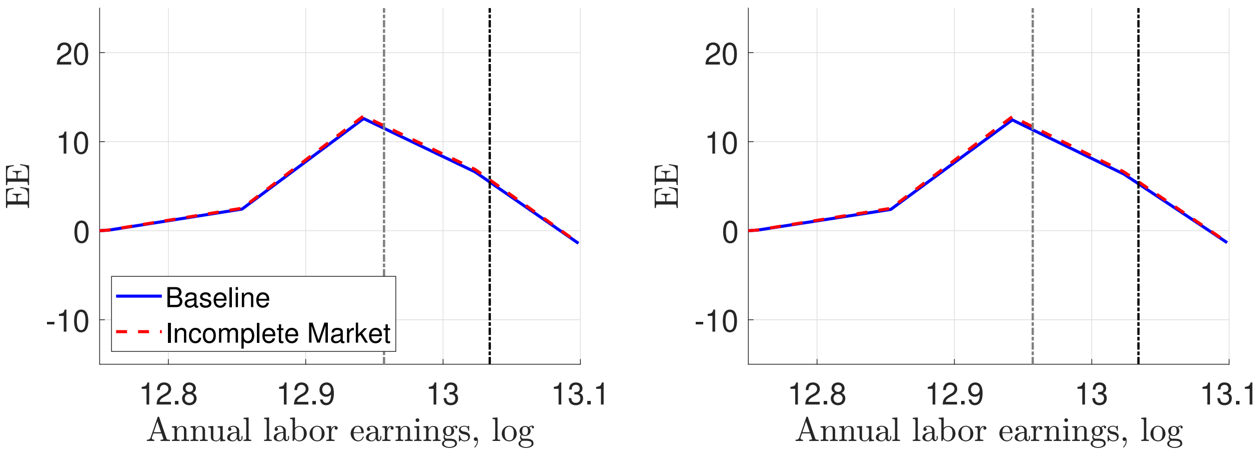



**Notes**: Impulse responses to a decrease in $\beta$.

Similar results are obtained when looking at the wage growth of job stayers and leavers, as reported in Figures (C3) and (C4), respectively. So we conclude that the propagation mechanism highlighted in this paper, which works through the endogeneity of OJS, is best illustrated in the simpler, baseline model. The discussion of the policy functions for the OJS decisions in the HANK model is therefore relegated to Appendix G.

That said, it would be incorrect to conclude that introducing an incomplete market structure has no impact on how aggregate shocks propagate through the macroeconomy, leaving the results in Figures 6 and 7 unchanged. Aggregate shocks influence GDP, which in turn affects government revenues and transfers. In HANK models, redistributive policies play a crucial role, creating significant differences between economies with varying levels of consumption insurance. Ultimately, differences in macroeconomic propagation between our baseline model and the HANK extension would depend on specific, arbitrary fiscal policy assumptions. Since this redistribution mechanism is well understood, we abstract from it to maintain clarity.

Figure 9: Effects of Shifting the High-Income Tax Threshold on EE Rates: Complete- vs. Incomplete-Market model




(a) 1 year window

(b) 3 years window

**Notes**: The figure compares the percentage change in employment-to-employment (EE) rates across income bins before and after the tax reform, as produced by the baseline model with complete markets (solid blue line) and the HANK model with incomplete-markets (dashed red line). The two panels depict the percent changes in EE rates in the model, relative to the 2012 steady-state distribution, after 1 and 3 years of transition to the new steady-state equilibrium characterized by the 2013 tax thresholds. The light gray and dark gray vertical bars indicate the high-income tax thresholds for 2012 and 2013, respectively.

# 9 Conclusions

We developed a New Keynesian job-ladder model incorporating endogenous OJS to examine how workers' OJS decisions influence wage and price inflation. To validate the model's quantitative implications for the effect of OJS on wage inflation, we generated impulse responses to a change in the high-income tax threshold. These responses for EE rates and wages across the income distribution were then compared with estimates derived from Danish microdata, finding similar results. Our findings that higher OJS increases negotiated wages not just for the leavers but also for the stayers provides evidence in favor of the sequential auction bargaining protocol. Moreover, the strong response of EE rates and wage growth for the stayers, both in the model and in the microdata, suggests that the search behavior of the employed matters for inflation dynamics. The general equilibrium dynamics generated by the model suggest that changes inincentives to search on the job can be a material driver of business cycle fluctuations. Moreover, the long-term decline in search costs, can offer an explanation for the flattening of the Phillips curve.

While this paper focuses on the positive role of OJS as a propagation mechanism, our model also reveals a novel externality: OJS reduces the returns to posting vacancies, thereby discouraging job creation. As a result, income taxes may improve welfare in this framework by letting workers internalize this externality. We leave the analysis of optimal policy in this context to future research.

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APPENDIX TO

# On-the-Job Search and Inflation under the Microscope

by Saman Darougheh, Renato Faccini, Leonardo Melosi, and Alessandro T. Villa

## A Inflation dynamics in the Simple Model

Rewrite eq. (2) in the main text:

$$S_t = E_t \left[ \sum_{\tau=0}^{\infty} \beta^{\tau} (1-\delta)^{\tau} \left( p^l_{t+\tau} y - b \right) \right]$$

as

$$S_t\left(y\right) = y\mathcal{W}_t - \frac{b}{1-\beta\left(1-\delta\right)}, \tag{28}$$

where

$$\mathcal{W}_t = p^l_t + \beta\left(1-\delta\right) E_t \mathcal{W}_{t+1}. \tag{29}$$

In steady state

$$\mathcal{W} = \frac{p^l \lambda}{1-\beta\left(1-\delta\right)}$$

Log linearizing (29) yields:

$$\widehat{\mathcal{W}}_t = \frac{p^l}{W}\widehat{p}^l_t + \beta\left(1-\delta\right) E_t \widehat{\mathcal{W}}_{t+1} \tag{30}$$

Multiply by the slope of the Phillips curve $\varsigma$ and divide by $\frac{p^l}{W}$ to get:

$$\frac{\varsigma W}{p^l}\widehat{\mathcal{W}}_t = \varsigma\widehat{p}^l_t + \beta\left(1-\delta\right)\frac{\varsigma W}{p^l} E_t \widehat{\mathcal{W}}_{t+1}$$

Rename

$$\widehat{\widehat{\mathcal{W}}}_t \equiv \frac{\varsigma W}{p^l}\widehat{\mathcal{W}}_t \tag{31}$$

and rewrite the above equation as:

$$\widehat{\widehat{\mathcal{W}}}_t = \varsigma\widehat{p}^l_t + \beta\left(1-\delta\right) E_t \widehat{\widehat{\mathcal{W}}}_{t+1}.$$

Comparing this equation with the forward looking Phillips curve

$$\hat{\pi}_t = \varsigma\hat{p}^l_t + \beta E \hat{\pi}_{t+1},$$

we can establish that for values of the separation rate $\delta$ that are small enough:

$$\widehat{\widehat{\mathcal{W}}}_t \simeq \hat{\pi}_t. \tag{32}$$

Now consider the free entry condition (eq.3 in the main text):

$$\kappa^f + \frac{\kappa}{q(\theta_t)} = \frac{u_t}{u_t + s_t(1-u_t)} S_t(y).$$

Plugging eq.(28) into (32) and get

$$\kappa^f + \frac{\kappa}{q(\theta_t)} = \frac{u_t}{u_t + s_t(1-u_t)} \left[ y\mathcal{W}_t - \frac{b}{1-\beta(1-\delta)} \right] \tag{33}$$

Log linearize eq.(33), replacing $\widehat{\mathcal{W}}_t$ with $\frac{p^l}{\varsigma W}\widehat{\widehat{\mathcal{W}}}_t$ using 31 and get:

$$\begin{aligned}
&-\left(\frac{-q'(\theta_t)\kappa}{q(\theta_t)^2}\right)\theta\widehat{\theta}_t \\
&+\frac{us}{[u+s(1-u)]^2}\left(y\mathcal{W}-\frac{b}{1-\beta(1-\delta)}\right)\widehat{u}_t \\
&-\frac{(1-u)us}{[u+s(1-u)]^2}\left(y\mathcal{W}-\frac{b}{1-\beta(1-\delta)}\right)\widehat{s}_t \\
&+\frac{u}{u+s(1-u)}y\frac{p^l}{\varsigma}\widehat{\widehat{\mathcal{W}}}_t = 0
\end{aligned}$$

Now replace $\widehat{\widehat{\mathcal{W}}}_t$ with $\hat{\pi}_t$ using 32, which yields:

$$\hat{\pi}_t \simeq -a\widehat{u}_t + b\widehat{s}_t + c\widehat{\theta}_t \tag{34}$$

where

$$\begin{aligned}
a &= \frac{s}{[u+s(1-u)]}\frac{\varsigma}{p^l y}\left(y\mathcal{W}-\frac{b}{1-\beta(1-\delta)}\right) > 0 \\
b &= \frac{\varsigma}{p^l y}\frac{(1-u)s}{[u+s(1-u)]}\left(y\mathcal{W}-\frac{b}{1-\beta(1-\delta)}\right) > 0
\end{aligned}$$

and

$$c = \frac{\varsigma}{p^l y}\frac{u+s(1-u)}{u}\left(\frac{-q'(\theta_t)\kappa}{q(\theta_t)^2}\right)\theta \simeq 0 \text{ for } \kappa \simeq 0.$$

In our calibration, following empirical evidence, the variable costs of posting vacancies are very small relative to the fixed costs, which implies a tiny value of $\kappa$. Under this condition, eq.(34) can be rewritten as:

$$\hat{\pi}_t \simeq -a\widehat{u}_t + b\widehat{s}_t.$$

# B Laws of motion

Labor force constraint

$$\int d\mu_1^E(x,\alpha) + u + \varpi = 1.$$

Intertemporal law of motion for the employed

$$\mu_{0,t+1}^{E}\left(x',\alpha'\right)=\left(1-\psi^{R}\right)\left(1-\delta\right)\mu_{1,t}^{E}\left(x',\alpha'\right) \tag{35}$$

Intratemporal law of motion for the employed

$$\begin{aligned}\mu_{1,t}^{E}\left(x',\alpha'\right) &= \mu_{0,t}^{E}\left(x',\alpha'\right)\left[\left[1-\xi\left(x',\alpha'\right)f\left(\theta\right)\right]+\xi\left(x',\alpha'\right)f\left(\theta\right)\sum_{\widetilde{x}<x'\alpha'}G^{x}\left(\widetilde{x}\right)\right] \\ &+\sum_{\alpha}\mu_{0,t}^{E}\left(x',\alpha\right)\xi\left(x',\alpha\right)f\left(\theta\right)G^{x}\left(x'\alpha'\right)\mathbf{1}_{x'\alpha'>x'\alpha} \\ &+\sum_{\alpha}\mu_{0,t}^{E}\left(\underbrace{\alpha'x'}_{x},\alpha\right)\xi\left(\alpha'x',\alpha\right)f\left(\theta\right)G^{x}\left(x'\right) \\ &+uf\left(\theta\right)G^{x}\left(x'\right)\mathbf{1}_{\alpha'=\frac{\underline{x}}{x'}}\end{aligned} \tag{36}$$

The first row in the above expression refers to employed workers who either do not search for jobs at all or, if they do search and receive a job offer, the offer is too low to justify renegotiating their wage with their current employer.

The second row refers to employed workers who find a new job offer that leads them to renegotiate their wage with their current employer, allowing them to extract a share $\alpha'$ of the incumbent's productivity $x'$.

The third row refers to workers who are employed in a job with productivity $x$, search for a new job, and find an offer that leads them to switch to a different employer with productivity $x'$. In this case, they manage to extract exactly a share $\alpha'$ of the poacher's productivity.

The fourth row refers to unemployed workers who find a job with productivity $x'$, and in this case, the share of output paid as wages is exactly $\alpha'=\underline{x}/x'$.

Intertemporal law of motion for the unemployed:

$$u_{0,t+1}=\left(1-\psi^{R}\right)u_{1,t}+\left(1-\psi^{R}\right)\delta\sum_{\alpha}\sum_{x}\mu_{1,t}^{E}\left(x,\alpha\right)+\psi^{D}\varpi_{1,t} \tag{37}$$

Intratemporal law of motion for the unemployed:

$$u_{1,t}=u_{0,t}\left[1-f\left(\theta\right)\right] \tag{38}$$

Intertemporal law of motion for the retirees:

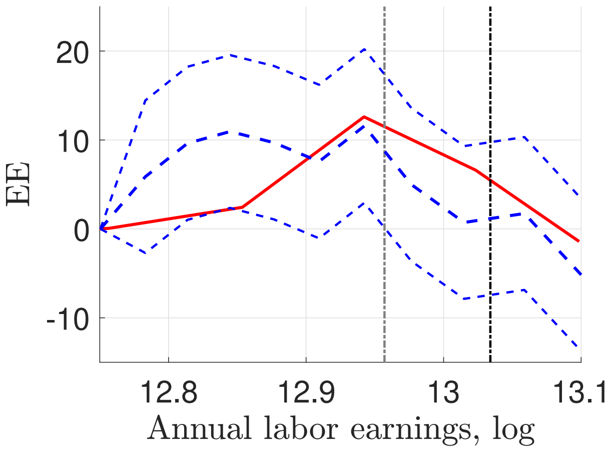
$$\varpi_{0,t+1}=\left(1-\psi^{D}\right)\varpi_{1,t}+\psi^{R}u_{1,t}+\psi^{R}\sum_{x,\alpha}\mu_{1,t}^{E}\left(x,\alpha\right) \tag{39}$$

Intratemporal law of motion for the retirees:

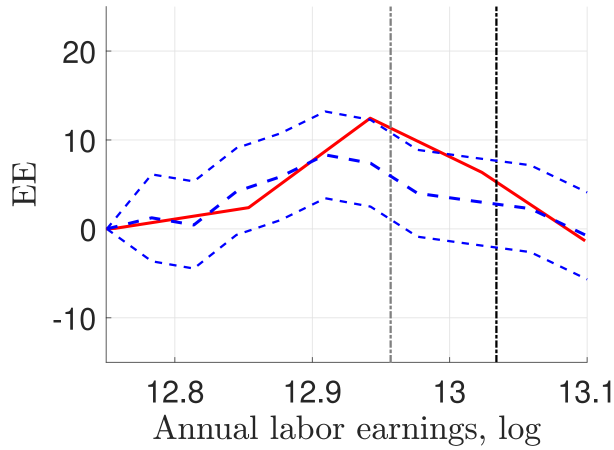
$$\varpi_{1,t}=\varpi_{0,t} \tag{40}$$

# C Additional figures

Figure C1: Effects of Shifting the High-Income Tax Threshold on EE Rates (with controls)



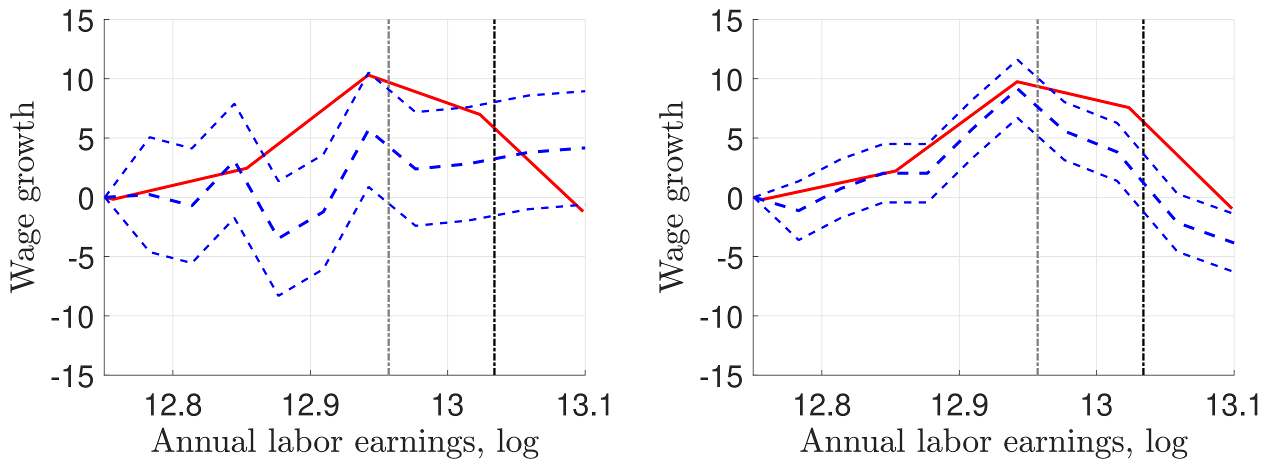

(a) 1 year window




(b) 3 years window

**Notes**: The figure displays the percentage change in employment-to-employment (EE) rates across income bins before and after the tax reform. The solid red lines depict the evolution of EE rates in the model, relative to the 2012 steady-state distribution, after 1 and 3 years of transition to the new steady-state equilibrium characterized by the 2013 tax thresholds. The light gray and dark gray vertical bars indicate the high-income tax thresholds for 2012 and 2013, respectively. The dashed blue lines indicate the empirical estimates of equation (27), together with the 95% confidence intervals, when comparing 2013 vs 2012 (left panel) and 2013-2015 vs 2010-2012 (right panel). Income bins are constructed to include approximately 50,000 workers per year during 2010–2015.

Figure C2: Effects of Shifting the High-Income Tax Threshold on the Wage Growth of Job Stayers (with controls)

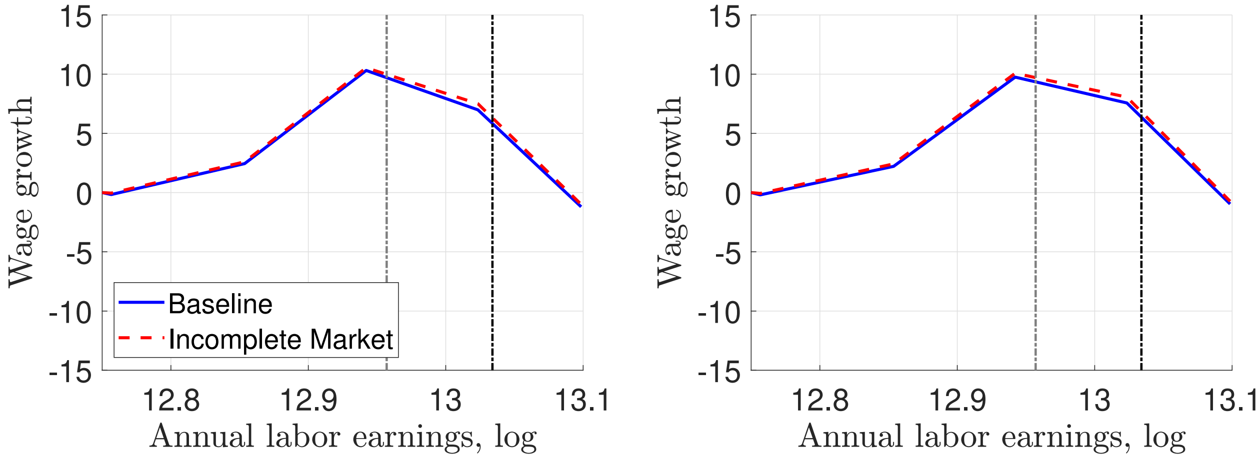



(a) 1 year window

(b) 3 years window

**Notes**: The figure displays the percentage change in wage growth for workers remaining with the same employer across income bins before and after the tax reform. In the model, the solid red line shows the evolution of wage growth, relative to the 2012 steady-state distribution, after 1 and 3 years of transition to the new steady-state equilibrium characterized by the 2013 tax thresholds. The light gray and dark gray vertical bars indicate the high-income tax thresholds for 2012 and 2013, respectively. Empirical estimates, depicted by the broken blue lines in the middle, compare outcomes for 2013 versus 2012 in the left panel and for 2013–2015 versus 2010–2012 in the right panel. The areas between the top and bottom broken blue lines represent 95% confidence intervals, with standard errors clustered by earnings bin. Income bins are constructed to include approximately 50,000 workers per year during 2010–2015.

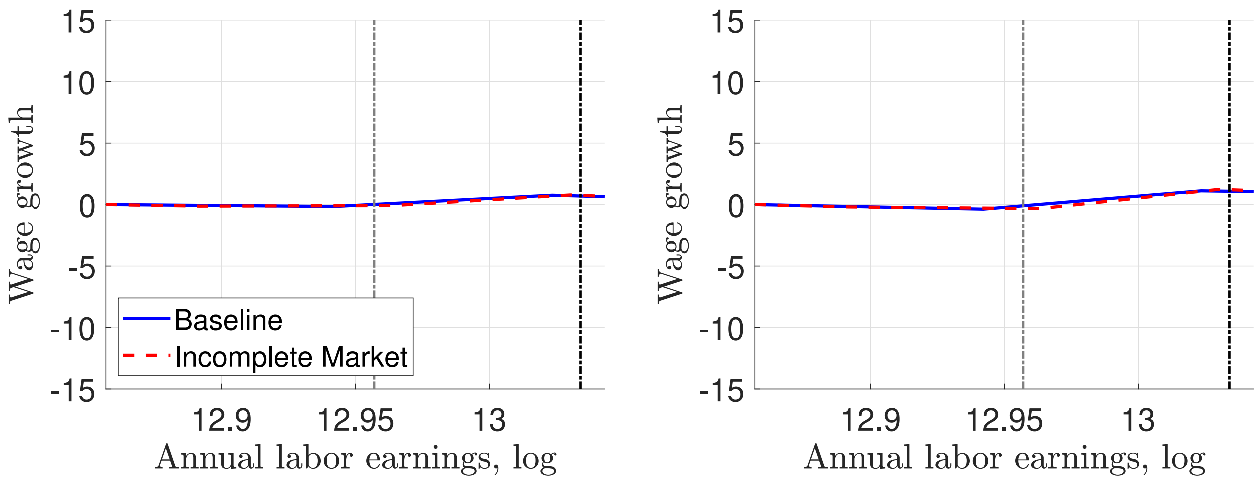
Figure C3: Effects of Shifting the High-Income Tax Threshold on the Wage Growth of Job Stayers: Complete- vs. Incomplete-Market model




(a) 1 year window (b) 3 years window

**Notes**: The figure compares the percentage change in the wage growth of job stayers across income bins before and after the tax reform, as produced by the baseline model with complete markets (solid blue line) and the HANK model with incomplete-markets (dashed red line). The two panels depict the percent difference in wage growth, relative to the 2012 steady-state distribution, after 1 and 3 years of transition to the new steady-state equilibrium characterized by the 2013 tax thresholds. The light gray and dark gray vertical bars indicate the high-income tax thresholds for 2012 and 2013, respectively.

Figure C4: Effects of Shifting the High-Income Tax Threshold on Wage Growth of Job Changers: Complete- vs. Incomplete-Market model




(a) 1 year window (b) 3 years window

**Notes**: The figure compares the percentage change in the wage growth of job changers across income bins before and after the tax reform, as produced by the baseline model with complete markets (solid blue line) and the HANK model with incomplete-markets (dashed red line). The two panels depict the percent difference in wage growth, relative to the 2012 steady-state distribution, after 1 and 3 years of transition to the new steady-state equilibrium characterized by the 2013 tax thresholds. The light gray and dark gray vertical bars indicate the high-income tax thresholds for 2012 and 2013, respectively.

# D Computational Appendix

In this section, we describe the algorithms we use to solve for the stationary equilibrium and the transitional dynamics both for the baseline and the model with incomplete market.

## D.1 Computational Appendix for the baseline model

In this section, we describe the algorithms we use to solve for the stationary equilibrium and the transitional dynamics for representative agents.

### D.1.1 Solution algorithm for the stationary equilibrium

We create the following two grids. Namely, the log-normally distributed productivity grid $\mathcal{X} = [\underline{x}, x_1, ..., \bar{x}]$ and the linearly scaled piece rate grid $P = [\underline{\alpha}, \alpha_1, ..., 1]$, where $\underline{\alpha}$ is the minimum possible piece rate $\underline{x}/\bar{x}$. The population density distributions are $\mu^U_{p,t}, \mu^R_{p,t}$, and $\mu^E_{p,t}(x, \alpha)$ for period $p \in \{0, 1\}$. We use 21 nodes on productivity and 17 nodes for the piece rate, for a total of 357 nodes. We use piece-wise linear interpolation to evaluate both policy and value functions outside of the nodes of the grids. The distribution of search costs is assumed to be uniform over the support $\left[\vartheta^l, \vartheta^u\right]$, where the lower bound $\vartheta^l$ is normalized to zero.

We also employ normally distributed shocks to worker productivity, $\Delta = [\underline{\epsilon}, \epsilon_1, ..., \bar{\epsilon}]$. Shocks are applied intertemporally in the form $x' = \min(\max(\underline{x}, x \cdot (1 + \epsilon)), \bar{x})$.

We compute a wage grid $w = \zeta \cdot P \times \mathcal{X}$, where $\zeta$ is the maximum share of output as wages and $\times$ indicates the Cartesian product. We use the three taxation brackets $\tau_0, \tau_L$, and $\tau_H$ to create a measure of average taxation in function of income $w$:

$$\tau = \begin{cases} \tau_0, & \text{if } w \leq w_L \\ \dfrac{w_L \cdot \tau_0 + (w - w_L) \cdot \tau_L}{w}, & \text{if } w_L \leq w \leq w_H \\ \dfrac{w_L \cdot \tau_0 + (w_H - w_L) \cdot \tau_L + (w - w_H) \cdot \tau_H}{w}, & \text{otherwise.} \end{cases} \tag{41}$$

The algorithm works as follows.

1. Create an iterator $j$ and set $j = 0$. Guess the initial transfer $T^j$.

   - Create a second iterator $w$ and set $w = 0$.

     (a) We initialize constant values for retired, $\Gamma$, and the unemployed, $U$. For the employed, their start-of-period value of employment is $V_0^w(x, \alpha)$ and end-of-period is $V_1^w(x, \alpha)$. Thus, we look to solve the associated optimization problems (12) and (13) and find $V_0^{w+1}(x, \alpha)$, and $V_1^{w+1}(x, \alpha)$.

(b) Update the job search policy function for the employed population, $I^{w+1}_{\phi<\phi^T}(x,\alpha)$ using equations (15) and (16) and evaluate the job search probability $\xi^{w+1}(x,\alpha)$ based on the job search decisions for the employed.

(c) Using $r = \pi^*/\beta$ and $\xi^{w+1}(e,x,\alpha)$, calculate the value of a filled job $J^{w+1}(x,\alpha)$ using equation (18).

(d) If all value functions converged (i.e. $\max(\sup|V^{w+1}(x,\alpha)-V^{w}(x,\alpha)|, \sup|J^{w+1}(x,\alpha)-J^{w}(x,\alpha)|) < \epsilon$), exit the loop. Otherwise, set $w = w+1$ and restart from step (a).

- Create an iterator $t$ and set $t = 0$. This step uses the policy functions to solve for the asymptotic distributions. We simulate using the Young (2010) lottery method when the policy functions contains value outside of the nodes of the grids.

  (a) Use the intratemporal laws of motion, calculate the population distribution density for the employed $\mu^E_{1,t}(x^{'},\alpha^{'}), \mu^U_{1,t}$, and $\mu^R_{1,t}$ in period $p=1$, from the guess for period $p=0$, $\mu^E_{0,t}(x^{'},\alpha^{'}), \mu^U_{0,t}$, and $\mu^R_{0,t}$ using equations (37), (38), and (40).

  (b) Using the results from step (a), $\mu^E_{1,t}(x,\alpha), \mu^U_{1,t}$, and $\mu^R_{1,t}$ and the intertemporal laws of motion, calculate the population distribution function for period 0 for $t+1$, $\mu^E_{0,t+1}(x^{'},\alpha^{'}), \mu^U_{0,t+1}$, and $\mu^R_{0,t+1}$ using equations (35), (37), and (39).

  (c) If the population distributions converge (i.e. $\max(\sup|\mu^E_{0,t+1}-\mu^E_{0,t}|, \sup|\mu^E_{1,t+1}-\mu^E_{1,t}|, \sup|\mu^U_{0,t+1}-\mu^U_{0,t}|, \sup|\mu^U_{1,t+1}-\mu^U_{1,t}|, \sup|\mu^R_{0,t+1}-\mu^R_{0,t}|, \sup|\mu^R_{1,t+1}-\mu^R_{1,t}|) < \epsilon^T$), exit the loop. Otherwise, set $t = t+1$ and restart from step (a).

- Calculate the implied transfer $T^{j+1}$ using the values for wages $w$ and the population density distribution $\mu^E_1(x',\alpha'), \mu^U_1$, and $\mu^R_1$ using the government budget constraint (22). If transfers converged (i.e. $|T^{j+1} - T^j| < \epsilon$), then exit the loop. Otherwise, set $j = j+1$, update the value of $T^j$ towards $T^{j+1}$ using a dampening parameter and restart. We use a dampening parameter of 0.9, i.e. $T^{j+1} \leftarrow 0.9 \cdot T^{j+1} + (1-0.9)\cdot T^j$. If the transfer clearing condition is satisfied, we can exit the loop. Otherwise, restart with the new $j$.

### D.1.2 Solution algorithm for the dynamic equilibrium

The economy is initially in a stationary equilibrium when all agents experience a sudden tax shock in the form of change of tax brackets. For the baseline case, the highest tax slab starts at the stationary equilibrium associated with the calibrated wage $w^H$. Here, we introduce a shock in the form of a change of this tax slab such that, $w^H_{high} = w^H \cdot 1.08$. We solve for both stationary equilibria first. Then, we solve for the transition numerically, allowing a sufficiently high number of periods $\bar{t}$ for the masses to adjust and the economy to converge to the stationary equilibrium associated with $w^H_{high}$. In particular, we use $\bar{t} = 100$. We run an identical procedure for the search cost shock except that instead of changing the tax bracket we introduce a shock to $\vartheta^u$ allowing it to dynamically change. In particular, on impact it increases by 50% and then reverts back to its calibrated value following an AR(1) with persistence 0.5. In order to calculate the equilibrium dynamics, we need to find sequences of: (i) government transfer, $\{T_t\}_{t=0}^{\bar{t}}$ , (ii) market tightness parameter, $\{\theta_t\}_{t=0}^{\bar{t}}$, (iii) price of one share of the mutual fund, $\{P^e_t\}_{t=0}^{\bar{t}}$, and (iv) real interest rates, $\{r_t\}_{t=0}^{\bar{t}}$.

1. Create an iterator $j$ and set $j = 0$. Guess an interest rate path $\{r^j_t\}_{t=0}^{\bar{t}}$. Using the Taylor Rule (23), calculate the associated inflation path $\{\pi^j_t\}_{t=0}^{\bar{t}}$.

2. Create an iterator $t$ and set $t = \bar{t} - 1$. Hence, use projection with backward time iteration from $t = \bar{t} - 1$ to $t = 0$. The policy functions at $t = \bar{t}$ are the ones associated with the ending stationary equilibrium as previously calculated. At each time $t = 0$, we proceed similarly as before in the case of stationary equilibrium. Start from guessed paths $\{T^j_t\}_{t=0}^{\bar{t}}$ and $\{\theta^j_t\}_{t=0}^{\bar{t}}$ using the stationary equilibrium values do the following two steps.

   - Calculate consumption for unemployed, employed, and retired population, $C^U_t$, $C^R_t$, and $C^E_t(x, \alpha)$ after having update the average taxation level generated by equation (41).
   - Start from the stationary equilibrium value functions and iterate backward on the optimization problems (11), (12), (13), and (17) to find $\{V^t_0(x, \alpha)\}_{t=0}^{\bar{t}}$ for start-of-period and $\{V^t_1(x, \alpha)\}_{t=0}^{\bar{t}}$ for end-of-period value of employment.

3. Now, start from $t = 0$ and iterate forward up to $t = \bar{t}$. Start at $t = 0$ from the $p = 0$ distributions of the initial stationary equilibrium $\mu^E_{0,0}(x, \alpha), \mu^U_{0,0}$, and $\mu^R_{0,0}$.

   (a) Use the intratemporal laws of motion to calculate the population distribution density for period $p = 1$, $\mu^E_{1,t}(x, \alpha), \mu^U_{1,t}$, and $\mu^R_{1,t}$ from the $p = 0$, $\mu^E_{0,t}(x, \alpha), \mu^U_{0,t}$, and $\mu^R_{0,t}$ using equations (37), (38), and (40).

   (b) Use the results from step (a), $\mu^E_{1,t}(x, \alpha), \mu^E_{1,t}$, and $\mu^R_{1,t}$ and the intertemporal laws of motion to calculate the population distribution functions for $p = 0$ for $t + 1$, $\mu^E_{0,t+1}(x, \alpha), \mu^U_{0,t+1}$, and $\mu^R_{0,t+1}$ using equations (35), (37), and (39).

4. Iterate backward again from $t = \bar{t} - 1$ to $t = 0$.

- Retrieve stored policy decisions and population distributions generated in the previous steps to calculate the value of filled job $\{J^t(x, \alpha)\}_{t=0}^{\bar{t}}$ at each time $t$ using equation (18).

5. Iterate forward again from $t = 0$ to $t = \bar{t}$.

   - Calculate transfers $\{T_t^{j+1}\}_{t=0}^{\bar{t}}$ from wages and the population density distributions using equation (22).
   - Evaluate the market clearing condition (63) at each time $t$. Update $\{r_t^j\}_{t=0}^{\bar{t}}$ to get $\{r_t^{j+1}\}_{t=0}^{\bar{t}}$ using the residuals on all asset market clearing conditions.
   - Calculate the market tightness path $\{\theta_t^{j+1}\}_{t=0}^{\bar{t}}$ using equation (19).
   - Calculate the price for one share of the mutual fund $\{P_t^{e,j+1}\}_{t=0}^{\bar{t}}$ using equation (24).

6. If all market clearing conditions are satisfied and the government transfer and market tightness paths converged, and real interest rates (i.e. $\max(\sup|\{r_t^{j+1}\}_{t=0}^{\bar{t}} - \{r_t^j\}_{t=0}^{\bar{t}}|, \sup|\{T_t^{j+1}\}_{t=0}^{\bar{t}} - \{T_t^j\}_{t=0}^{\bar{t}}|, \sup|\{\theta_t^{j+1}\}_{t=0}^{\bar{t}} - \{\theta_t^j\}_{t=0}^{\bar{t}}|, \sup|\{P_t^{e,j+1}\}_{t=0}^{\bar{t}} - \{P_t^{e,j}\}_{t=0}^{\bar{t}}| < \epsilon^T$), stop. Otherwise, set $j = j+1$, shift the values for $\{r_t^{j+1}\}_{t=0}^{\bar{t}}$, $\{T_t^{j+1}\}_{t=0}^{\bar{t}}$, $\{\theta_t^{j+1}\}_{t=0}^{\bar{t}}$, and $\{P_t^{e,j+1}\}_{t=0}^{\bar{t}}$ using a dampening parameter and restart from step (2).

## D.2 Computational Appendix for the model with incomplete markets

### D.2.1 Solution algorithm for the stationary equilibrium

We create the following three grids. Namely, the exponentially scaled assets grid $A = [\underline{e}, e_1, ..., \bar{e}]$, the log-normally distributed productivity grid $\mathcal{X} = [\underline{x}, x_1, ..., \bar{x}]$, and the linearly scaled piece rate grid $P = [\underline{\alpha}, \alpha_1, ..., 1]$, where $\underline{\alpha}$ is the minimum possible piece rate $\underline{x}/\bar{x}$. The population density distributions are $\mu_{p,t}^U(e), \mu_{p,t}^R(e)$, and $\mu_{p,t}^E(e, x, \alpha)$ for period $p \in \{0, 1\}$. We use 21 nodes on both assets and productivity grids, and 17 nodes for the piece rates, for a total of $21 \cdot 21 \cdot 17$ nodes. We use piece-wise linear interpolation to evaluate both policy and value functions outside of the nodes of the grids.. The distribution of search costs is assumed to be uniform over the support $\left[\vartheta^l, \vartheta^u\right]$, where the lower bound $\vartheta^l$ is normalized to zero.

We also employ normally distributed shocks to worker productivity, $\Delta = [\underline{\epsilon}, \epsilon_1, ..., \bar{\epsilon}]$. Shocks are applied intertemporally in the form $x' = \min(\max(\underline{x}, x \cdot (1 + \epsilon)), \bar{x})$.

We compute a wage grid $w = \zeta \cdot P \times \mathcal{X}$, where $\zeta$ is the maximum share of output as wages and $\times$ indicates the Cartesian product. We use the three taxation brackets $\tau_0, \tau_L$, and $\tau_H$ to create a measure of average taxation in function of income $w$ using equation (41).

The algorithm works as follows.

1. Create an iterator $z$ and set $z = 0$. Guess initial values for the real rate of interest $r^z$.

2. Create a second iterator $j$ and set $j = 0$. Guess the initial transfer $T^j$.

   - Create a third iterator $w$ and set $w = 0$.

     (a) Use guesses for all value functions: $\Gamma^w(e)$ for retired, $U^w(e)$ for the unemployed, $V_0^w(e, x, \alpha)$ for start-of-period, and $V_1^w(e, x, \alpha)$ for end-of-period value of employment to solve the associated optimization problems (50), (51), (52), and (56) and find $\Gamma^{w+1}(e), U^{w+1}(e), V_0^{w+1}(e, x, \alpha)$, and $V_1^{w+1}(e, x, \alpha)$.

     (b) Update the job search policy function for the employed population, $I_{\phi<\phi^T}^{w+1}(e, x, \alpha)$ using equations (54) and (55) and evaluate the job search probability $\xi^{w+1}(e, x, \alpha)$ based on the job search decisions for the employed.

     (c) Using $e_E^{'}(e, x, \alpha), r^z$, and $\xi^{w+1}(e, x, \alpha)$, calculate the value of a filled job $J^{w+1}(e, x, \alpha)$ using equation (57).

     (d) If all value functions converged (i.e. $\max(\sup|\Gamma^{w+1}(e) - \Gamma^w(e)|, \sup|U^{w+1}(e) - U^w(e)|, \sup|V^{w+1}(e, x, \alpha) - V^w(e, x, \alpha)|, \sup|J^{w+1}(e, x, \alpha) - J^w(e, x, \alpha)|) < \epsilon$), exit the loop. Otherwise, set $w = w + 1$ and restart from step (a).

   - Create an iterator $t$ and set $t = 0$. This step uses the policy functions to solve for the asymptotic distributions. We simulate using the Young (2010) lottery method when the policy functions contains value outside of the nodes of the grids.

     (a) Use the intratemporal laws of motion, calculate the population distribution density for period $p = 1$, $\mu_{1,t}^E(e^{'}, x^{'}, \alpha^{'}), \mu_{1,t}^U(e^{'})$, and $\mu_{1,t}^R(e^{'})$ from the guess for period $p = 0$, $\mu_{0,t}^E(e, x^{'}, \alpha^{'}), \mu_{0,t}^U(e)$, and $\mu_{0,t}^R(e)$ using equations (66), (68), and (70).

     (b) Using the results from step (a), $\mu_{1,t}^E(e, x, \alpha), \mu_{1,t}^U(e)$, and $\mu_{1,t}^R(e)$ and the intertemporal laws of motion, calculate the population distribution function for period 0 for $t + 1$, $\mu_{0,t+1}^E(e^{'}, x^{'}, \alpha^{'}), \mu_{0,t+1}^U(e^{'})$, and $\mu_{0,t+1}^R(e^{'})$ using equations (65), (67), and (69).

     (c) If the population distributions converge (i.e. $\max(\sup|\mu_{0,t+1}^U - \mu_{0,t}^U|, \sup|\mu_{0,t+1}^R - \mu_{0,t}^R|, \sup|\mu_{0,t+1}^E - \mu_{0,t}^E|, \sup|\mu_{1,t+1}^U - \mu_{1,t}^U|, \sup|\mu_{1,t+1}^R - \mu_{1,t}^R|, \sup|\mu_{1,t+1}^E - \mu_{1,t}^E|) < \epsilon^T$), exit the loop. Otherwise, set $t = t + 1$ and restart from step (a).

   - Calculate transfer $T^{j+1}$ using the values for wages $w$ and the population density distributions $\mu_1^U(e'), \mu_1^R(e')$, and $\mu_1^E(e', x', \alpha')$ using the government budget constraint (59). If transfers converged (i.e. $|T^{j+1} - T^j| < \epsilon^T$), then exit the loop. Otherwise, set $j = j + 1$, update the value of $T^j$ towards $T^{j+1}$ using a dampening parameter and restart. We use a dampening parameter of 0.9, i.e. $T^{j+1} \leftarrow 0.9 \cdot T^{j+1} + (1 - 0.9) \cdot T^j$.

3. Calculate the savings aggregated across all workers and evaluate the asset market clearing condition (63). If the asset market clearing condition is satisfied then exit the loop. Otherwise, set $z = z + 1$ and restart from step (2). Use a bisection algorithm to find the value of real interest rate $r$ that clears the asset market.

### D.2.2 Solution algorithm for the dynamic equilibrium

The economy is initially in a stationary equilibrium when all agents experience a sudden tax shock in the form of change of tax brackets. For the baseline case, the highest tax slab starts at the stationary equilibrium associated with the calibrated wage $w^H$. Here, we introduce a shock in the form of a change of this tax slab such that, $w^H_{high} = w^H \cdot 1.08$. We solve for both stationary equilibria first. Then, we solve for the transition numerically, allowing a sufficiently high number of periods $\bar{t}$ for the masses to adjust and the economy to converge to the stationary equilibrium associated with $w^H_{high}$. In particular, we use $\bar{t} = 100$. In order to calculate the equilibrium dynamics, we need to find sequences of: (i) government transfer, $\{T_t\}_{t=0}^{\bar{t}}$ , (ii) market tightness parameter, $\{\theta_t\}_{t=0}^{\bar{t}}$, and (iii) real interest rates, $\{r_t\}_{t=0}^{\bar{t}}$.

1. Create an iterator $j$ and set $j = 0$. Guess an interest rate path $\{r_t^j\}_{t=0}^{\bar{t}}$. Using the Taylor Rule (23), calculate the associated inflation path $\{\pi_t^j\}_{t=0}^{\bar{t}}$.

2. Create an iterator $t$ and set $t = \bar{t} - 1$. Hence, use projection with backward time iteration from $t = \bar{t} - 1$ to $t = 0$. The policy functions at $t = \bar{t}$ are the ones associated with the ending stationary equilibrium as previously calculated. At each time $t = 0$, we proceed similarly as before in the case of stationary equilibrium. Start from guessed paths $\{T_t^j\}_{t=0}^{\bar{t}}$ and $\{\theta_t^j\}_{t=0}^{\bar{t}}$ using the stationary equilibrium values.

   - Calculate consumption for unemployed, employed, and retired population, $C_t^U(e), C_t^E(e, x, \alpha)$, and $C_t^R(e)$ after having update the average taxation level generated by the tax shock $\Delta\tau_t$ calculated, at each time $t$, from equation (41).

   - Start from the stationary equilibrium value functions and iterate backward on the optimization problems (50), (51), (52), and (56) to find $\{\gamma^t(e)\}_{t=0}^{\bar{t}}$ for retired, $\{U^t(e)\}_{t=0}^{\bar{t}}$ for the unemployed, $\{V_0^t(e, x, \alpha)\}_{t=0}^{\bar{t}}$ for start-of-period, and $\{V_1^t(e, x, \alpha)\}_{t=0}^{\bar{t}}$ for end-of-period value of employment.

3. Now, start from $t = 0$ and iterate forward up to $t = \bar{t}$. Start at $t = 0$ from the $p = 0$ distributions of the initial stationary equilibrium $\mu^E_{0,0}(e, x, \alpha)$, $\mu^U_{0,0}(e)$, and $\mu^R_{0,0}(e)$.

   (a) Use the intratemporal laws of motion to calculate the population distribution density for period $p = 1$, $\mu^E_{1,t}(e, x, \alpha)$, $\mu^U_{1,t}(e)$, and $\mu^R_{1,t}(e)$ from the $p = 0$, $\mu^E_{0,t}(e, x, \alpha)$, $\mu^U_{0,t}(e)$, and $\mu^R_{0,t}(e)$ using equations (66), (68), and (70).

   (b) Use the results from step (a), $\mu^E_{1,t}(e, x, \alpha)$, $\mu^U_{1,t}(e)$, and $\mu^R_{1,t}(e)$ and the intertemporal laws of motion to calculate the population distribution functions for $p = 0$ for $t + 1$, $\mu^E_{0,t+1}(e, x, \alpha)$, $\mu^U_{0,t+1}(e)$, and $\mu^R_{0,t+1}(e)$ using equations (65), (67), and (69).

4. Iterate backward again from $t = \bar{t} - 1$ to $t = 0$.

   - Retrieve stored policy decisions and population distributions generated in the previous steps to calculate the value of filled job $\{J^t(a, x, \alpha)\}^{\bar{t}}_{t=0}$ at each time $t$ using equation (18).

5. Iterate forward again from $t = 0$ to $t = \bar{t}$.

   - Calculate transfers $\{T^{j+1}_t\}^{\bar{t}}_{t=0}$ from wages and the population density distributions using equation (59).
   - Evaluate the market clearing condition (63) at each time $t$. Update $\{r^j_t\}^{\bar{t}}_{t=0}$ to get $\{r^{j+1}_t\}^{\bar{t}}_{t=0}$ using the residuals on all asset market clearing conditions.
   - Calculate the market tightness path $\{\theta^{j+1}_t\}^{\bar{t}}_{t=0}$ using equation (58).

6. If all market clearing conditions are satisfied and the government transfer and market tightness paths converged, and real interest rates (i.e. $\max(\sup|\{r^{j+1}_t\}^{\bar{t}}_{t=0} - \{r^j_t\}^{\bar{t}}_{t=0}|, \sup|\{T^{j+1}_t\}^{\bar{t}}_{t=0} - \{T^j_t\}^{\bar{t}}_{t=0}|, \sup|\{\theta^{j+1}_t\}^{\bar{t}}_{t=0} - \{\theta^j_t\}^{\bar{t}}_{t=0}) < \epsilon$), stop. Otherwise, set $j = j + 1$, shift the values for $\{r^{j+1}_t\}^{\bar{t}}_{t=0}$, $\{T^{j+1}_t\}^{\bar{t}}_{t=0}$, and $\{\theta^{j+1}_t\}^{\bar{t}}_{t=0}$ using a dampening parameter and restart from step (2).

# E Wages and taxes under Nash bargaining

In this section, we briefly study the effects of a change in the labor tax rate on wages set according to generalized Nash bargaining. Let $w$ be the wage rate, $y$ be worker productivity, $b$ be unemployment benefits or value of leisure, $\theta$ be labor market tightness, $r$ be the discount rate, $\lambda$ be the job separation rate, $q(\theta)$ be the probability of a firm filling a vacancy, $f(\theta)$ be the probability of a worker finding a job, $\beta$ be the worker's bargaining power, $c$ be the cost of posting a vacancy, and $\tau$ be the tax wedge representing the difference between the gross wage that firms pay $w(1+\tau)$ and the net wage that workers receive $w$.

The value functions for workers and firms are given by

For workers:

$$rE = w - \lambda(E - U) \tag{42}$$

$$rU = b + f(\theta)(E - U) \tag{43}$$

$$rJ = y - w(1+\tau) - \lambda(J - V) \tag{44}$$

$$rV = -c + q(\theta)(J - V) \tag{45}$$

Wages are given by

$$\beta(J - V) = (1-\beta)(E - U) \tag{46}$$

In equilibrium, market tightness $\theta$ is such that $V = 0$.

**Proposition 1** *In this environment, and for $\beta \in (0, 1)$, a decrease in taxes $\tau$ lowers gross wages*

$$\frac{\partial w(1+\tau)}{\partial \tau} < 0.$$

*Furthermore, a transition from a firm with productivity $\underline{y}$ to a firm with $\overline{y}$ with $\overline{y} > \underline{y}$ leads to a smaller wage increase when taxes are lower.*

$$\frac{\partial^2 w(y)(1+\tau)}{\partial y \partial \tau} < 0.$$

**Proof.** With free entry, $V = 0$, therefore:

$$J = \frac{c}{q(\theta)}$$

it is possible to rewrite (42) and (44) respectively as

$$E - U = \frac{w - rU}{r + \lambda} \tag{47}$$

$$J - V = \frac{y - w(1+\tau)}{r + \lambda} \tag{48}$$

Substituting surplus expressions:

$$\beta \left[\frac{y - w(1+\tau)}{r+\lambda}\right] = (1-\beta)\left[\frac{w - rU}{r+\lambda}\right]$$

$$\leftrightarrow w = \frac{\beta y + (1-\beta) rU}{1 + \beta\tau}$$

The value of unemployment can be written as:

$$rU = b + f(\theta)\frac{\beta}{1-\beta}\frac{c}{q(\theta)}$$

Which allows us to write wages as

$$w = \frac{\beta(y + c\theta) + (1 - \beta)b}{1 + \beta\tau}$$

Where $\theta = \frac{v}{u}$ is market tightness.

For $\tau = 0$, we recover the standard wage equation for Nash-bargained wages. For $\beta \to 0$, the worker receives exactly their outside option. For $\beta \to 1$, the worker's net wage is given by $(y + c\theta)/(1 + \tau)$. In this case, the workers gross wage is given by $y + c\theta$—the worker receives the entire surplus of the match as gross payment, but has to pay taxes on it.

Note that gross wages are given by

$$w(1 + \tau) = [\beta(y + c\theta) + (1 - \beta)b] \cdot \frac{1 + \tau}{1 + \beta\tau}$$

And the derivative w.r.t. $\tau$ is given by

$$\frac{d}{d\tau}[w(1 + \tau)] = [\beta(y + c\theta) + (1 - \beta)b] \cdot \frac{1 - \beta}{(1 + \beta\tau)^2},$$

which is strictly positive for $\beta < 1$.

To address the second part of the proposition, we note that

$$\frac{\partial^2[w(1 + \tau)]}{\partial y \partial \tau} = \beta \cdot \frac{1 - \beta}{(1 + \beta\tau)^2},$$

which is also strictly positive for $\beta \in (0, 1)$.

# F The HANK Job-Ladder Model

Below, we focus only on the aspects of the model that differ from the baseline presented in the main text.

## F.1 The labor market

Let $\mu_0^U(e)$ and $\mu_0^E(e, x, \alpha)$ denote the beginning-of-period distribution of the unemployed and the employed workers, respectively. Let $\xi\,(e, x, \alpha)$ denote the share of workers in the state space defined by the vector $(e, x, \alpha)$ who optimally decides to search. Then the measure of workers looking for jobs at the beginning of a period is given by:

$$S = \int d\mu_0^U\,(e) + \int \xi\,(e, x_0, \alpha)\, d\mu_0^E\,(e, x_0, \alpha)\,. \tag{49}$$

Tightness $\theta$ is the ratio of vacancies to job seekers:

$$\theta \;=\; \frac{v}{S}.$$

## F.2 Workers

We assume that all workers receive the same amount of transfers $T$ from the government independently of their employment state. Consider an unemployed worker who did not manage to find a job within a given time period. At the end of the period, the value of unemployment is

$$U(e)=u(c) + \left(1-\psi^R\right)\beta\left[f(\theta')\, E_x V_1\left(e', x, \frac{x}{x}\right) + (1-f(\theta'))\, U(e')\right] + \beta\psi^R\Gamma(e'), \tag{50}$$

subject to the budget constraint

$$Pc + P^e e' = P(1-\tau(b))\, b + (P^e + D)e + T,$$

The above maximization problem shows that an unemployed workers chooses current consumption and savings $e'$ taking into account the probabilities associated with being in the three different labor market states next period.

The problem of an employed worker is separated in two parts. First, she choose whether to search. Next, after reallocation has taken place and wages have been rebargained, she choose consumption and savings. So the problem of search is solved at the beginning of the period (intra-time 0), while the consumption-savings problem is solved at the end (intra-time 1). Let's proceed by backward induction and start from the end-of-period problem. The end-of-period value of employment is:

$$V_1(e, x_1, \alpha) = \max_{e'\geq 0, c}\left\{u(c) + \beta\left(1-\psi^R\right)\left[(1-\delta)\, V_0(e', x_1, \alpha) + \delta U(e')\right] + \psi^R\Gamma(e')\right\} \tag{51}$$

subject to

$$Pc + P^e e' = P\left[1-\tau(w)\right] w_1(x_1, \alpha) + (P^e + D)e + T$$

where $V_0(e, x_0, \alpha)$ is the value function of employment at the beginning of the period, i.e., before the search cost is drawn from the i.i.d. stochastic distribution $G^\phi$. The solution to this problem is a policy function that characterizes the optimal savings decision: $e' = g^E(e, x, \alpha)$.

The search decision maximizes the expected value:

$$V_0(e, x_0, \alpha) = \int_\phi \widetilde{V}_0(e, x_0, \alpha, \phi)\, G^\phi(d\phi), \tag{52}$$

where

$$\widetilde{V}_0(e, x_0, \alpha, \phi) = \max\left\{-\phi + V_0^S(e, x_0, \alpha), V_0^{NS}(e, x_0, \alpha)\right\}, \tag{53}$$

and where $V^S$ and $V^{NS}$ denote the value of an employed worker searching and not searching, respectively. In turn, these are given by:

$$V^{NS}(e, x_0, \alpha) = V_1(e, x_0, \alpha)$$

$$V^S(e,x_0,\alpha) = f(\theta)\, E_{\widetilde{x}} \max\left\{V_1\left(e,\widetilde{x},\frac{x_0}{\widetilde{x}}\right), V_1\left(e,x_0,\max\left\{\alpha,\frac{\widetilde{x}}{x_0}\right\}\right)\right\}$$
$$+\left(1-f(\theta)\right)V_1(e,x_0,\alpha)\,. \tag{54}$$

Opening the expectation operator, the above equation can be rewritten

$$V^S(e,x_0,\alpha) = f(\theta)\left\{\int_{\widetilde{x}=x_0}^{\overline{x}} V_1\left(e,\widetilde{x},\frac{x_0}{\widetilde{x}}\right)G^x(d\widetilde{x})\right.$$
$$\left.+\int_{\widetilde{x}=\underline{x}}^{x_0} V_1\left(e,x_0,\max\left\{\alpha,\frac{\widetilde{x}}{x_0}\right\}\right)G^x(d\widetilde{x})\right\} + \left(1-f(\theta)\right)V_1(e,x_0,\alpha)\,.$$

We can define a threshold search cost $\phi^T(e,x_0,\alpha)$ such that the employed worker is indifferent between searching and not searching:

$$-\phi^T + V^S(e,x_0,\alpha) = V^{NS}(e,x_0,\alpha)\,. \tag{55}$$

The solution to this problem is a rule, which can be expressed by the indicator function $I_{\phi<\phi^T}(e,x_0,\alpha)=1$, which means that the worker searches if and only if $\phi<\phi^T$. For future convenience, it is helpful to denote by $\xi(e,x,\alpha)$ the ex-ante probability (i.e. before the fixed cost of search is drawn) that a worker defined by the state vector $\{e,x_0,\alpha\}$ ends up searching. By the law of large numbers, this will be given by the share of workers searching in every bin over $\{e,x,\alpha\}$.

The value of retirement is

$$\Gamma(e) = \max u(c) + \beta\left(1-\psi^D\right)\Gamma(e') \tag{56}$$

s.t

$$Pc + P^e e' = \left[1-\tau\left(T^R\right)\right]T^R + (P^e+D)e + T,$$

where $\psi^D$ is the probability that a retired worker dies, and $T^R$ denotes pension income.

## F.3 Labor service firms

The end-of-period value of a filled job is given by:

$$J(e,x,\alpha) = p^l x - w(x,\alpha) + \frac{1}{1+r}\left(1-\psi^R\right)(1-\delta)$$
$$\times\left\{\left[(1-\xi(e',x,a)) + \xi(e',x,a)\left(1-f(\theta')\right)\right]J(e',x,\alpha)\right.$$
$$\left.+\xi(e',x,a)\,f(\theta')\int_{\underline{x}}^{x} J\left(e',x,\max\left\{\alpha,\frac{\widetilde{x}}{x}\right\}dG^x(\widetilde{x})\right)\right\}, \tag{57}$$

where $e'$ satisfies the savings policy function of the workers, i.e., $e' = g^E(e,x,\alpha)$.

The free entry condition, which equates the expected costs and returns from a match, is:

$$\kappa^f + \frac{\kappa}{q(\theta)} = \frac{1}{S_t}\left[\int\limits_e \int\limits_{\widetilde{x}} J\left(e, \widetilde{x}, \frac{\underline{x}}{\widetilde{x}}\right) dG^x(\widetilde{x})\, d\mu_0^U(e) \right.$$
$$\left. + \int\limits_{e,x,\alpha} \int\limits_{x}^{\overline{x}} J\left(e, \widetilde{x}, \frac{x}{\widetilde{x}}\right) dG^x(\widetilde{x})\, \xi(e,x,\alpha)\, d\mu_0^E(e,x,\alpha)\right] \tag{58}$$

## F.4 Fiscal and monetary authorities

The government budget constraint is given by:

$$\begin{aligned} B_{-1} + T + P\int b d\mu_1^U(e) + P\int T^R d\mu_1^R(e) = {} & \frac{B}{1+i} \\ & + P\int b\tau(b)\, d\mu_1^U(e) \\ & + P\int w(e,x,\alpha)\,\tau(w(e,x,\alpha))\, d\mu_1^E(e,x,\alpha) \\ & + P\int T^R\tau\left(T^R\right) d\mu_1^R(e), \end{aligned} \tag{59}$$

where the LHS and RHS denote the allocation and funding of the public administration, respectively.

The monetary authority is assumed to set the nominal interest rate $i$ following the Taylor rule:

$$i = i^* + \Phi_\pi(\pi - \pi^*) + \Phi_U(u - u^*), \tag{60}$$

where an asterisk superscript over a variable denotes its the steady-state value. The link between nominal and real interest rates is governed by the Fisher equation:

$$1 + i \equiv E(1 + \pi')(1 + r). \tag{61}$$

## F.5 Market clearing and equilibrium

The goods market clearing condition requires that the aggregate demand of labor services from the intermediate producers equals supply

$$\int_0^1 y_i di \equiv Y = \int x d\mu_1(e,x,\alpha). \tag{62}$$

Moreover, the total demand for shares of the mutual fund, which is obtained by aggregating the optimal savings decisions across the workers distribution, must equal supply, which is normalized to unity:

$$\int g^{U}(e)\,d\mu_{1}^{U}(e)+\int g^{E}(e,x,\alpha)\,d\mu_{1}^{E}(e,x,\alpha)+\int g^{R}d\mu_{1}^{R}(e)=1, \tag{63}$$

where $g$ denotes the saving policy functions, i.e., the optimal choice of $e'$ for every combination of $\{e,x,\alpha\}$ defined for each of the three labor market states, unemployment, employment and participation, respectively.

Finally, labor market clearing requires that the sum of the employed, unemployed and retirees equals unity, both at the beginning and at the end of a period:

$$\int d\mu_{j}^{E}(e,x,\alpha)+\int d\mu_{j}^{U}(e)+\int d\mu_{j}^{R}(e)=1,\quad \text{for} j\in\{0,1\}. \tag{64}$$

## F.6 Laws of motion

Define $\mathcal{E}_{t}^{E}(e';e,x,\alpha)=\left\{e\in\mathcal{E}:g^{E}(e,x,\alpha)=e'\right\}$, $\mathcal{E}_{t}^{U}(e';e)=\left\{e\in\mathcal{E}:g^{U}(e)=e'\right\}$ and $\mathcal{E}_{t}^{R}(e';e)=\left\{e\in\mathcal{E}:g^{R}(e)=e'\right\}$ denote the set of period-t share holdings $e$ that map into a given level of next-period share holdings $e'$ by employment status, through the policy functions $g$.

Intertemporal law of motion for the employed

$$\mu_{0,t+1}^{E}(e',x',\alpha')=\left(1-\psi^{R}\right)(1-\delta)\,\mu_{1,t}^{E}(e',x',\alpha'), \tag{65}$$

Intratemporal law of motion for the employed

$$\begin{aligned}\mu_{1,t}^{E}(e',x',\alpha')=&\sum_{e\in\mathcal{E}_{t}^{E}}\mu_{0,t}^{E}(e,x',\alpha')\left[\left[1-\xi(e,x',\alpha')f(\theta)\right]+\xi(e,x',\alpha')f(\theta)\sum_{\widetilde{x}<x'\alpha'}G^{x}(\widetilde{x})\right]\\&+\sum_{\alpha}\sum_{e\in\mathcal{E}_{t}^{E}}\mu_{0,t}^{E}(e,x',\alpha)\,\xi(e,x',a)\,f(\theta)\,G^{x}(x'\alpha')\,\mathbf{1}_{x'\alpha'>x'\alpha}\\&+\sum_{\alpha}\sum_{e\in\mathcal{E}_{t}^{E}}\mu_{0,t}^{E}\left(e,\underbrace{\alpha'x'}_{x},\alpha\right)\xi(e,\alpha'x',a)\,f(\theta)\,G^{x}(x')\\&+\sum_{e\in\mathcal{E}_{t}^{U}}\mu_{0,t}^{U}(e)\,f(\theta)\,G^{x}(x')\,\mathbf{1}_{\alpha'=\frac{x}{x'}}\end{aligned} \tag{66}$$

The first raw in the above expression refers to the employed workers who do not search for jobs, or, if they search and find a job, they get an outside offer that is too low to renegotiate the wage with the current employer.

The second row refers to the employed workers who find a job leading to renegotiate their wage at the current employer such that they extract a share $\alpha'$ of the incumbent's productivity $x$.

The third row refers to workers who are employed in some job with productivity $x$, search for a job and find one that leads them to shift to a different employer of productivity $x'$, and such that they extract exactly a share $\alpha'$ of the poacher's productivity.

The fourth row refers to the unemployed workers who match with a job with productivity $x'$, and such that the share of output paid as wages is exactly $\alpha' = \underline{x}/x'$.

Intertemporal law of motion for the unemployed

$$\mu^U_{0,t+1}(e') = \left(1-\psi^R\right)\mu^U_{1,t}(e') + \left(1-\psi^R\right)\delta\sum_{\alpha}\sum_{x}\sum_{e\in\mathcal{E}^U_t}\mu^E_{1,t}(e,x,\alpha) + \psi^D\sum_{e\in\mathcal{E}^R_t}\mu^R_{1,t}(e) \quad (67)$$

Intratemporal law of motion for the unemployed

$$\mu^U_{1,t}(e') = \sum_{e\in\mathcal{E}^U_t}\mu^U_{0,t}(e)\left[1-f(\theta)\right] \quad (68)$$

Intertemporal law of motion for the retirees

$$\mu^R_{0,t+1}(e') = \left(1-\psi^D\right)\sum_{e\in\mathcal{E}^R_t}\mu^R_{1,t}(e) + \psi^R\sum_{e\in\mathcal{E}^U_t}\mu^U_{1,t}(e) + \psi^R\sum_{x,\alpha,e\in\mathcal{E}^E_t}\mu^E_{1,t}(e,x,\alpha) \quad (69)$$

Intratemporal law of motion for the retirees

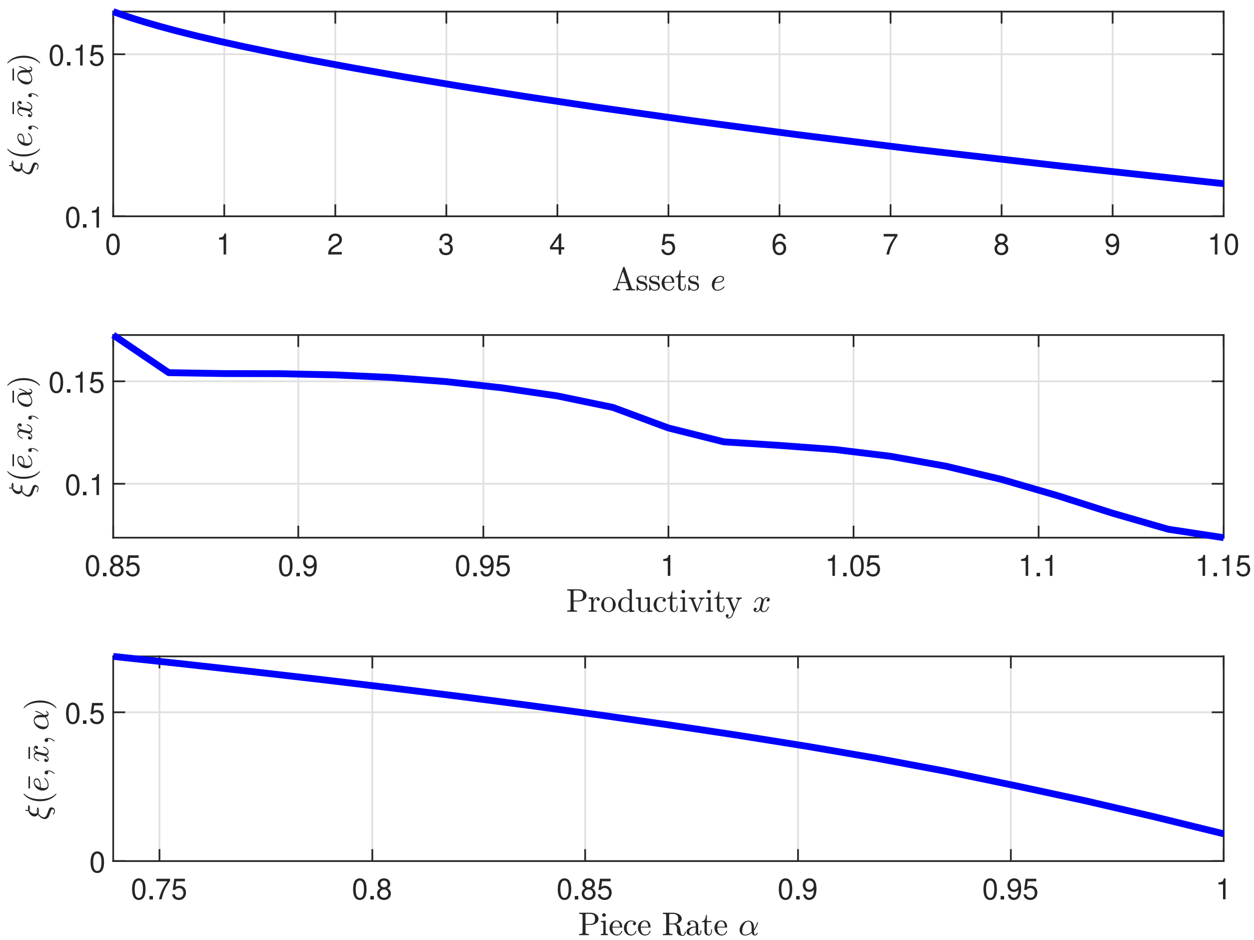
$$\mu^R_{1,t}(e') = \mu^R_{0,t}(e') \quad (70)$$

# G Model determinants of OJS decisions in HANK

In the HANK model, workers decide to search on the job in any given period provided that, given the draw of a stochastic search cost, the value of searching exceeds the value of not searching. The share of workers searching on the job, $\xi(e,x,\alpha)$ depends on wealth, $e$, productivity, $x$, and the share of output paid as wages, $\alpha$. Figure G5 shows how $\xi(e,x,\alpha)$ depends on each of its arguments, by changing one variable at the time, and keeping the other two fixed at their median value.

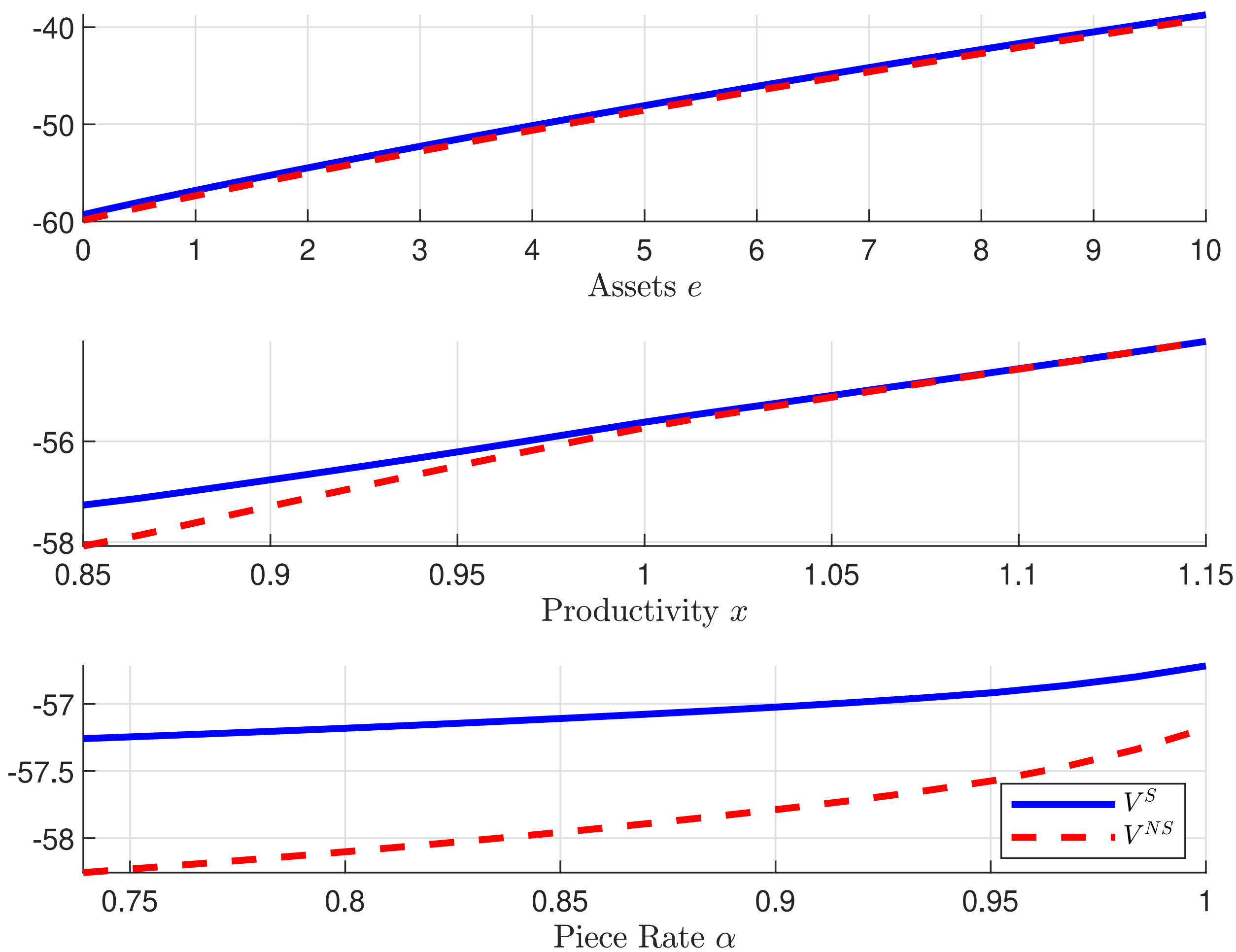
As shown in the top panel, OJS decreases with increasing wealth, all else being equal. This is intuitive, as the marginal propensity to consume declines with wealth, reducing the utility gains from higher earnings. Quantitatively, the impact of wealth on the optimal decision to search on the job is small, as can be noticed by comparing the range of changes in OJS induced by wealth relative to the other two determinants, especially wage piece rates. The middle panel shows that the incidence of OJS decreases with higher match productivity. This result arises from the difference between the value of searching and the value of not searching. While both values increase with productivity, the value of not searching grows faster due to the concavity of the utility function. This relationship is illustrated in Figure G6 below. Finally, the share of workers engaging in OJS decreases as the share of output received as wages increases. Intuitively, workers who already receive the maximum possible share of output have no incentive to search for alternative employment.

Figure G5: The determinants of on-the-Job Search




**Notes**: This figure shows how the share of workers searching on the job, $\xi(e, x, \alpha)$, depends on its three arguments. In the panels above we change one variable at the time, holding the other two arguments fixed at their median values.

Figure G6: Value Functions of searching and not searching




**Notes**: The blue solid line and red broken line show the value of searching and not searching, respectively.