Labor Market Liquidity*

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Abstract

Labor market liquidity (flows to and from employment) have decreased sharply in the US in the last decades while the unemployment rate has remained constant; and across developed economies, there are also huge differences in flows. This poses very different risk profiles for workers: low labor market liquidity makes employment more attractive (higher job security) and unemployment less so (lower reemployment security). In this paper we ask which regime offers better insurance and higher welfare: job security or reemployment security? Except for very high levels of labor market liquidity, we find that welfare for a given asset level is increasing in liquidity for both the unemployed and employed. To avoid being borrowing constrained in an illiquid labor market, unemployed workers dissave more slowly, and the employed increase their savings, whose value is affected by equilibrium prices (wages and the interest rate). However, allowing capital markets to readjust generates higher aggregate welfare as flows decrease, completely through improved job security and asset accumulation for the low-skilled employed. The aggregate welfare gains from lower liquidity are sizable, 1.4% of consumption when comparing across countries. Optimal Unemployment Insurance (UI) is around 40% in the benchmark US economy and is increasing with lower labor market liquidity. A skill-specific optimal policy heavily favors the less wealthy low skilled but less so in a more illiquid labor market. Finally, we find lower flows decrease wealth inequality.

Keywords: Labor market liquidity. Labor Mobility. Consumption Smoothing. Precautionary Savings. Unemployment Insurance.

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1 Introduction

Over the past two decades, there has been a decline in US labor mobility. It takes longer for unemployed workers to find jobs, but employment tends to last longer. The difference between 1999 and 2016 is substantial: in the United States, the monthly unemployment-to-employment (UE) flow rate has dropped from 51.2% to 34.6% and employment-to-unemployment (EU) rate from 3% to 2.3%. At the same time, the average unemployment rate has remained unchanged at around 6%. And comparing across developed countries, the differences are even bigger. Flow rates in Portugal for example are about 8 times smaller than they are in the US: the UE rate is 6.3% and the EU rate is 0.4%. This has far-reaching implications. In a labor market with low mobility, *job security* is high – jobs last on average much longer –, yet there is low *reemployment security* – it takes a long time for an unemployed worker to find a job. For example in Portugal, the average job duration is 21 years whereas in the US it used to be 3 years. At the same time, the average duration of unemployment in Portual is 16 months versus 2 months in the US. Key is that these flows move in lockstep. If UE flows are high then EU flows are high. If that were not the case unemployment rates would vary substantially, which they do not.

In this paper paper we ask what the welfare implications are of those differences in job mobility, which we denominate labor market liquidity. Our objective is not to explain why those differences exist or what the origin is of the secular decline,[1] but rather to ask how labor market liquidity affects welfare. Less labor market liquidity leads to more job security and longer job duration, yet it decreases reemployment security as unemployment spells are longer. With risk averse workers who can smooth consumption with precautionary savings, different degrees of labor market liquidity now introduce a tradeoff. At face value, the overall effect is not clear. High labor market liquidity appears better for the unemployed but worse for the employed. In a sense, one would expect the value being employed and of being unemployed to be closer to each other since the likelihood of extreme outcomes is small. But there are also substantial equilibrium effects: the continuation values affect the outside option and hence wage determination, and the savings decision affects the endogenous interest rate. Wages and interest rates affect welfare.

We analyze this question in a Diamond-Mortensen-Pissarides (DMP) model with incomplete markets, moral hazard, and heterogeneous skills.[2] We induce a realistic wealth distribution across workers and skill using a variation of the stochastic discount process in Krusell and Smith (1998). Compared to the high skilled, low-skilled workers are characterized by empirically consistent levels of lower job duration, employment, wages, and propensities to save.[3] We solve the steady state of economies where we exogenously impute different flow rates and the same unemployment rate.

[1]Several hypotheses have been proposed to explain these substantial differences. For the cross-country differences, the most cited explanation is differences in regulation and labor market protection in particular. For the secular decline in the US, proposed explanations include a changing age and education composition (Cairo (2013)), disappearance of short-duration jobs (Hyatt and Spletzer (2013)), asymmetric declines within age and skill flow rates (Davis and Haltiwanger (2014)), or higher risk of skill loss (Fujita (2015)). Hyatt and Spletzer (2013) show that any one of a number of theories cannot explain more than a third of the fall in separations and hires.

[2]See Diamond (1981) and Mortensen and Pissarides (1994).

[3]The latter feature is generated by lower exposure to extreme stochastic discount rates.

Using the values derived from these economies, consumption-equivalent welfare is derived for several subgroups of interest.

Our main finding is that decreasing flows will eventually lead to a decline in both unemployed and employed welfare for a given level of assets.[4] Because unemployed workers face a lower probability of becoming employed, they consume less of their assets to prevent being borrowing constrained for a longer period of time. While the employed face longer spells of employment and hence higher utility, the fall in the value of the unemployed spills over to the employed through prices (wages and interest rate) and expectations. As employed workers want to avoid being borrowing constrained in the event of unemployment, they increase precautionary savings. This increased supply of assets decreases the return on savings and consumption at low levels of assets. Lower interest rates imply a negative wealth effect, particularly for agents with high savings. In addition, wages also decrease from lower values for the unemployed which enters into the wage bargaining. The general pattern of results holds true for both the low and the high skilled. However, if we account for the change in capital holdings, aggregate welfare improves. This happens completely through the low-skilled employed who face a disproportionately high EU rate. The decline in EU rates allows them to accumulate wealth, and their risk of being borrowing constrained decreases. Conversely, the high skilled and unemployed are worse off.

The rise in precautionary savings generates the secondary effect of decreasing wealth inequality. This results in an asset distribution in the low liquidity labor market that second-order stochastically dominates: households save more to insure against unemployment outcomes that are lengthy (low reemployment security) but lower interest rates dissuade wealth accumulation. Ceteris paribus, any assumption in our model that increases precautionary savings (e.g., lowering unemployment insurance) will reduce wealth inequality under general equilibrium.

The welfare effects can be big. Halving the flow rates – as has happened over the last two decades in the US – leads to an increase in consumption-equivalent welfare of 0.3%. Comparing the US flow rates with those of economies like Portugal (a separation rate of 3% versus 0.5%), aggregate welfare is 1.4% higher with low flow rates. If we subdivide by employment and skill, the high-skilled unemployed (employed) experience a 5.8% (1.4%) decline in welfare moving to a Portugal economy. Longer duration of unemployment and lower dissaving reduces the value of the unemployed. For the savings-inclined high skilled, the increased demand for precautionary savings decreases the interest rate and produces a large negative wealth effect.

The interest rate in our model is endogenous. If we change the setup to a fixed, exogenous interest rate as in a small open economy, then lower labor market liquidity leads to a sharp increase in welfare for all subgroups. To understand why, it is sufficient to notice that the fixed interest rate removes the negative wealth effect through equilibrium prices.

As a final exercise, we evaluate optimal unemployment insurance (UI) policies in a high versus low flow economy.[5] We are interested in both equal and skill-dependent (discriminatory) optimal

[4] For very high flows, welfare is non-monotonic for the low skilled. For further details, see Section 5.1.

[5] The low flow economy sets flow rates similar to Portugal. Elsby, Hobijn, and Şahin (2013) estimated a 0.4% EU rate and 6.3% UE rate for Portugal.

policies. Equal optimal UI prescribes 40% of employed wages for the high flow (US) economy and rises to 53% in the low flow economy. This is in stark contrast to the 12% optimal benefits of Krusell, Mukoyama, and Şahin (2010) and emphasizes the importance of a realistic wealth distribution. Allowing for a discriminatory policy rewards the liquidity constrained low skilled with generous benefits. In the high flow economy, the low skilled receive 70% of their employed wage while the high skilled receive only 12%. The gap is slightly lower in the low flow economy, with 17.5% for the high skilled and 70% for the low skilled.

To our knowledge, our paper is the first to measure welfare effects from a decline in EU and UE flow rates. However, other papers have explored the relationship between optimal unemployment insurance and flow rates. Using a model of political economy, Hassler and Mora (1999) determine optimal UI policies across different turnover rates. They find the median voter prefers low unemployment insurance in a high turnover economy. Hassler, Rodriguez Mora, Storesletten, and Zilibotti (2005) document lower geographical mobility in European countries compared to the United States. They develop a dynamic general equilibrium model without savings, and find agents voting on UI can settle in one of two steady states: a "European" low mobility, high UI regime or an "American" high mobility, low UI regime. Our model also suggests high unemployment insurance for lower flow rate economies but also includes the additional insight that high-skilled workers drive the demand for higher unemployment benefits.

We add to a growing literature that combines uninsurable risk and search. Shao and Silos (2007) and Shao and Silos (2016) investigate the contribution of wealth inequality in generating realistic business cycle dynamics in a DMP model, incorporating stochastic discount factors in one specification. They conclude realistic wealth heterogeneity can make wages less volatile, improving performance of the model. Using a DMP model with uninsurable risk, Krusell, Mukoyama, and Şahin (2010) evaluate optimal UI policy and alternative model calibrations. They show these models are unable to generate realistic unemployment volatility unless a Hagedorn and Manovskii (2008)-type calibration is assumed. Optimal UI is about 12% in their environment, and they argue lower vacancy creation from higher UI is responsible for this low value. Bils, Chang, and Kim (2011) allow workers to separate endogenously subject to idiosyncratic productivity shocks but find the model cannot simultaneously produce realistic volatility and wage dispersion. Workers in Nakajima (2012) can endogenously adjust their labor supply, leading to business cycle fluctuations consistent with data. Lise (2012) estimates a rich partial-equilibrium search model that includes on-the-job search, moral hazard, and skill. By accounting for the asymmetric variation in risk and savings behavior across the wage ladder, the model is able to reasonably match the empirical distribution in earnings, wealth, and consumption. We contribute to this literature by introducing skill heterogeneity in a DMP setting with general equilibrium. We find differences across skills interact in meaningful ways through prices.

As in Hansen and İmrohoroğlu (1992), Chetty (2008), and Lentz (2009), our findings stress the interaction between of moral hazard versus liquidity in determining optimal UI. Schaal and Taschereau-Dumouchel (2012) also explore means-tested benefits. They create a frictional labor

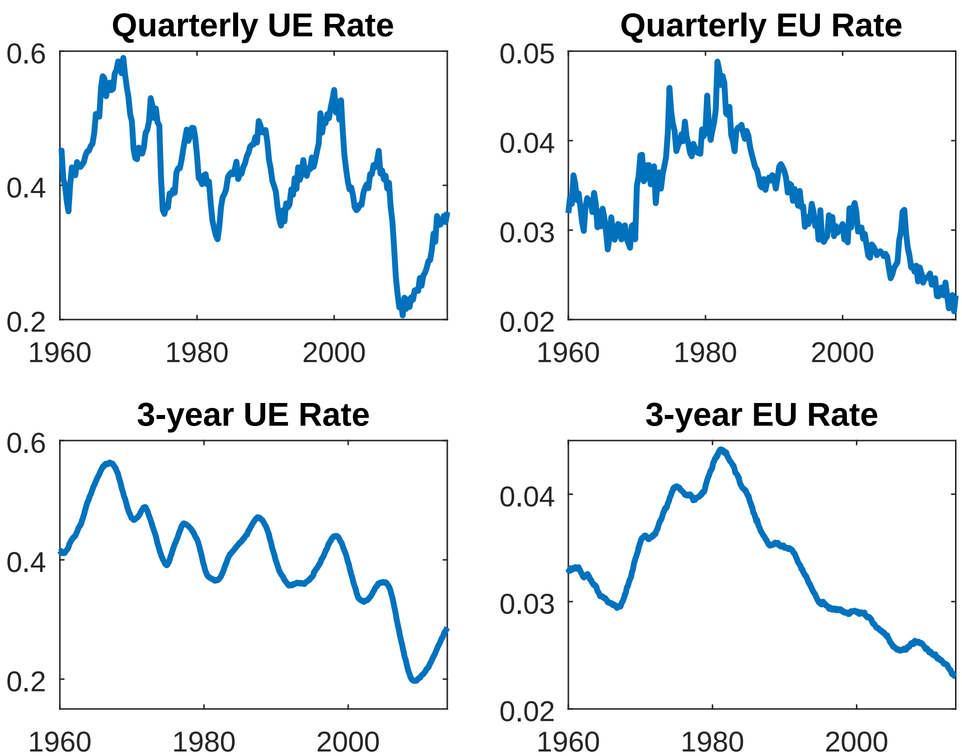

Figure 1: Monthly data from BLS CPS (1960M1-2016M9). Flow rates derived using the method described in Shimer (2005).

market model wherein agents have private, heterogenous productivities. Optimal policy in their model suggests higher UI and marginal tax rates for low productivity workers. In contrast to these papers, our model allows for precautionary savings to serve a role in determining optimal benefits. A rise in low-skilled unemployment benefits decreases high skilled income through a rise in taxes, but they are partially compensated through a positive wealth effect. Our setting will suggest a larger spread in optimal benefits compared to one without endogenous prices.

We organize the rest of the article as follows. Section 2 discusses data on flow rates and skills. Section 3 describes the model, and Section 4 covers our calibration strategy and algorithm. Section 5 provides results on our welfare and optimal UI exercises. Section 6 concludes.

2 Data: Flow and Skill Differences

This section presents data on changing UE and EU flows in the US and average differences across countries. We also discuss some labor market characteristics of education groups within the US that will be used in our model's calibration.

Flows in the US and Abroad. Figure 1 shows the quarterly and 3-year rolling average of the EU and UE rate in the United States from 1960Q1 to 2016Q3. Since the mid-1980s there has

Table 1: Changes in the US Labor Market

Variable	Average High Flow US	Average Low Flow US	$t_{HighFlow=LowFlow}$
UE Rate	43.2 (0.33)	35.2 (0.62)	0.0
EU Rate	3.46 (0.03)	2.67 (0.02)	0.0
U Rate	6.02 (0.08)	6.23 (0.12)	0.15
Theoretical U Rate	7.5 (0.08)	7.4 (0.12)	0.54

Note: U rate is from the monthly CPS. High flow US is 1984Q1-1999Q4, low flow US is 2000Q1-2016Q3. The theoretical U rate is derived from the implied unemployment rate of the EU and UE rate: $\frac{U}{1-U} = \frac{EU}{UE}$. The last column tests statistical equivalence of the variable between the two periods.

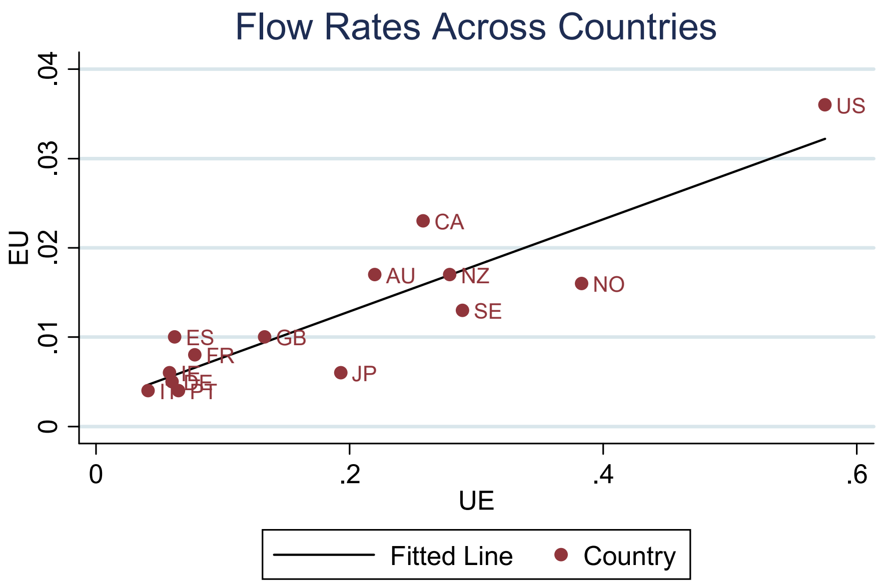

Figure 2: Data from Elsby, Hobijn, and Şahin (2013).

been a secular decline in the EU rate, reaching historically low levels past 2000. The UE rate also exhibited a slight downward trend starting in the mid-1980s but substantially declined after 2000.

Because 2000 seemed to be a key turning point in the levels of flows, we label the period from 2000Q1 to 2016Q3 as the low flow US economy. For a fair comparison, we define 1984Q1-1999Q4 as the high flow US economy.[6] Table 1 provides a comparison of flows and unemployment rates between these two periods. Although there is a clear statistical difference in flow rates, unemployment rates (actual or derived from flows) have remained unaffected. This makes the welfare effect of a decline in flows more ambiguous. While individuals do stay in unemployment longer, they also have increased job security.

If we look across countries, we can see that there exists a large variation of flows for a given

[6] The Great Moderation and jobless recovery began after 1984. The high flow economy choice is to emphasize that the decline in flows is not just a product of these two changes.

unemployment level. Figure 2 plots country-level flow rate data from Elsby, Hobijn, and Şahin (2013) with a fitted line regression. While there are large differences between flow rate levels, countries tend to be close to the fitted line implying similar unemployment rates. This leads to the main question of our paper: keeping unemployment rates fixed, does a decline in flow rates matter for welfare?

Skill Characteristics in the US. A fall in flows may imply very different welfare consequences depending on the type of worker. Education (i.e., skill) is one characteristic that generates substantial variation in labor market outcomes. We incorporate this skill dimension in our model and assume that workers are either low skilled or high skilled. We define low-skilled workers as those in the labor force aged 25+ with a high school degree or below. High-skilled workers are the remaining set of the labor force aged 25+. Changes across these two skills over the low flow period is shown in Figure 3.

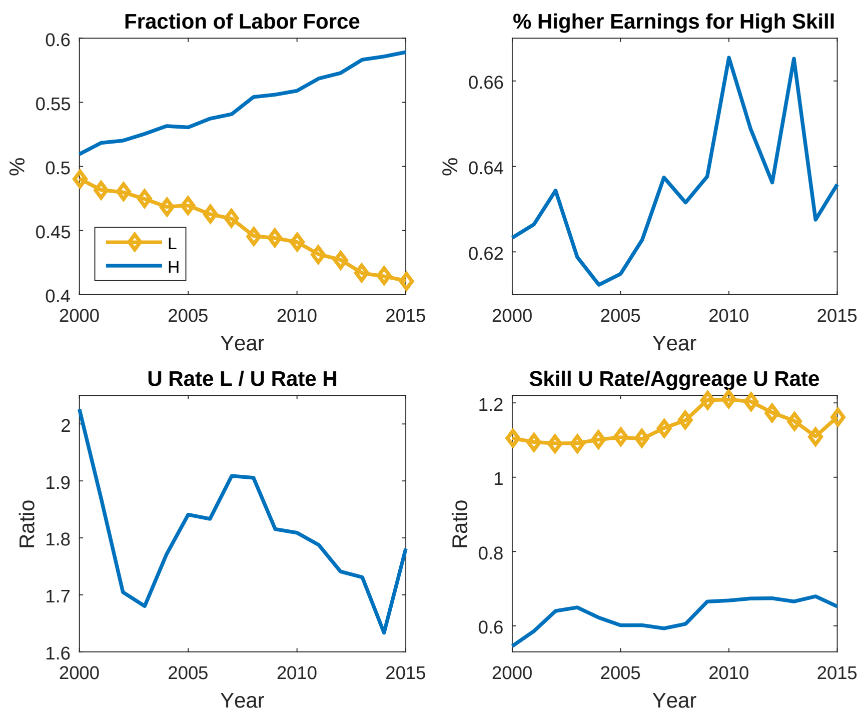

Figure 3: Data compiled from BLS CPS and March supplement. L stands or low skilled, H is high skilled.

There has been a non-trivial shift from low-skilled workers to high-skilled workers in the low flow period. However, there does not seem to be a strong trend in the earnings premium but we are also not controlling for other worker characteristics. There may be a declining trend in relative unemployment rates between the two skills, but we will assume this ratio is fixed at an intermediate value in our model exercises. This assumption implies that a higher fraction of skilled for a given aggregate unemployment rate must generate higher unemployment rates for both high skilled and low skilled. The bottom right graph of Figure 3 tests this result by tracking the change of a skill's unemployment rate relative to the aggregate unemployment rate. Consistent with our finding, there is a modestly increasing trend.

3 Model

We now develop the steady state of a DMP model with uninsurable risk, heterogeneous skills, stochastic discounting and search intensity to explore the welfare effect of changes in EU and UE flow rates.

Environment and Technology. The model is in discrete time and matches between worker and firm are one-to-one. There is a measure of firms and a unit measure of workers. Workers can vary in their worker status $w \in \{0, 1\}$, being either unemployed ($w = 0$) or employed ($w = 1$), and skill $s \in \{L, H\}$. Skill is a permanent feature and there are no transitions. Workers are also subject to variation in patience $\beta_i \in \{1, \dots, N_\beta\}$ in the style of Krusell and Smith (1998). In constrast to their environment, workers' patience evolves according to a skill-specific Markov process π_s^β, that we specify below.

A matched firm invests in capital k subject to the return on capital r and depreciation rate $\delta > 0$. Given a firm's capital choice, a pair produces $\epsilon_s F(k)$, where ϵ_s is the labor productivity of skill s and $F(k)$ is an increasing, strictly concave production function in k.

Workers can hold assets $a \in [\underline{a}, \infty]$ and receive return r. We assume individual asset holdings are not observable by firms, only s and β_i. We make this assumption not only because we view it as being more realistic, but it also reduces the computational burden and avoids the wage bargain's unstable asset bound regions.

Distribution and Matching Technology. Define $\mu(a, w, s, \beta_i)$ as the distribution of workers over the individual state space. Let μ_x denote aggregation over dimension x.[7] Firms create vacancies over independent (s, β_i) submarkets and unmatched workers direct search to their specific submarket. Unmatched workers can vary their search intensity λ which depends on a workers assets, skill, and patience.[8] This translates to an increased probability of a match given by function $p(\lambda)$ where $p(\cdot)$ is increasing and strictly concave. Average return to search intensity in a submarket is given by

$$\Lambda_a(s, \beta_i) = \frac{1}{\mu_a(0, s, \beta_i)} \int_{\underline{a}}^{\infty} p(\lambda(a, s, \beta_i))\mu(da, 0, s, \beta_i). \tag{1}$$

Therefore, $\Lambda_a(s, \beta_i)\mu_a(0, s, \beta_i) \equiv u_{s,\beta_i}$ is the effective number of searchers in submarket (s, β_i). The matching probability is given by a Cobb-Douglas technology

$$m_s(v_{s,\beta_i}, u_{s,\beta_i}) = A_s v_{s,\beta_i}^{1-\omega} u_{s,\beta_i}^{\omega}, \tag{2}$$

where A_s is skill-specific matching efficiency, v_{s,β_i} number of vacancies in submarket (s, β_i), and ω is the matching elasticity parameter.

[7] For example, $\mu_a(w, s, \beta_i) = \int_{\underline{a}}^{\infty} \mu(da, w, s, \beta_i)$ or $\mu_w(a, s, \beta_i) = \mu(a, 0, s, \beta_i) + \mu(a, 1, s, \beta_i)$.

[8] To ease notation, these arguments will not be included unless necessary.

Define $\tilde{\theta}_{s,\beta_i} = \frac{v_{s,\beta_i}}{u_{s,\beta_i}}$ as effective market tightness.[9] It can be shown that the firm job-filing rate is given by $q^f(\tilde{\theta}) = A_s\tilde{\theta}^{-\omega}$. The UE rate of the worker is $q^w(\lambda, \tilde{\theta}) = p(\lambda)A_s\tilde{\theta}^{1-\omega}$.

Matched and Unmatched Firm Value. Free entry into submarkets drives the value of entry to 0, pinning down a submarket's effective market tightness

$$0 = -\kappa + \frac{q^f(\tilde{\theta})}{1+r}\sum_{j=1}^{N_\beta}\pi^\beta_{s,ij}P(s,\beta_j). \tag{3}$$

In the above, κ is the flow cost of creating a vacancy. Firms discount by one plus the return to capital and, conditional on matching, form expectations over a possible change in their worker's patience.

Given wage $w(s,\beta_i)$, matched firms choose capital k to maximize value

$$P(s,\beta_i) = \max_k \left\{\epsilon_s F(k) - (r+\delta)k - w(s,\beta_i) + \frac{(1-\chi_s)}{(1+r)}\sum_{j=1}^{N_\beta}\pi^\beta_{s,ij}P(s,\beta_j)\right\}. \tag{4}$$

Matched pairs separate at exogenous rate χ_s which varies by skill.

Matched and Unmatched Worker Value. A worker chooses consumption c and future asset holdings a'. For a matched worker their value is given by:

$$\begin{aligned} W(a,1,s,\beta_i) = \max_{c,a'} &\left\{u(c) + \beta_i\sum_{j=1}^{N_\beta}\pi^\beta_{s,ij}\left[(1-\chi_s)W(a',1,s,\beta_j) + \chi_s W(a',0,s,\beta_j)\right]\right\} \\ \text{s.t. } & c + a' \leq (1+r)a + (1-\tau_s)w(s,\beta_i) \\ & a' \geq \underline{a} \end{aligned} \tag{5}$$

Wage income is taxed at rate τ_s. The government uses tax revenue to finance workers' unmatched benefits. Benefits are a fraction b_s of a worker's after-tax employed wage.

Unmatched workers have an additional choice of search intensity. Choice of λ generates disutility according to an increasing, strictly convex function $d(\cdot)$. Unmatched value is

$$\begin{aligned} W(a,0,s,\beta_i) = \max_{c,a',\lambda} &\left\{u(c) - d(\lambda) + \beta_i\sum_{j=1}^{N_\beta}\pi^\beta_{s,ij}\left[q^w(\lambda,\tilde{\theta})W(a',1,s,\beta_j) + (1-q^w(\lambda,\tilde{\theta}))W(a',0,s,\beta_j)\right]\right\} \\ \text{s.t. } & c + a' \leq (1+r)a + b_s(1-\tau_s)w(s,\beta_i) \\ & a' \geq \underline{\text{a}} \end{aligned} \tag{6}$$

Benefits and taxes can differ across skill, allowing us to explore optimal benefits and taxation. We

[9] As with search intensity, the subscript is removed with the understanding that $\tilde{\theta}$ is submarket specific.

assume the government runs a balanced budget. To guarantee uniqueness, the relative income tax across skills is fixed, and the government chooses a common tax rate τ where $\tau_s = x_s\tau$.

Wage Determination. Wages are determined via Nash bargaining. Because a given worker's assets are unobservable, the bargain generates the same wage for all assets in a (s, β_i) submarket. Explicitly, the wage solves

$$\underset{w(s,\beta_i)}{\arg\max} \int_{\underline{a}}^{\infty} \Big(W(a,1,s,\beta_i) - W(a,0,s,\beta_i)\Big)^{\eta} \mu_w(da,s,\beta_i) \Big(P(s,\beta_i)\Big)^{1-\eta} \tag{7}$$

where η is the bargaining power of the worker. The bargain maximizes joint surplus of the worker and firm where worker surplus is averaged across all asset levels in the submarket. To be well-defined, the bargain assumes that the worker or firm can walk away from a given w, implying $W(a,1,s,\beta_i;w) \geq W(a,0,s,\beta_i;w)$ and $P(s,\beta_i;w) \geq 0$, $\forall w$.

4 Calibration and Solution Method

This section discusses our calibration strategy and algorithm. We begin by specifying common parameters and then skill-specific parameters.

Common Parameters. Our benchmark model is the high flow US economy (1984Q1-1999Q4). A period is 1.5 months. The average β is set to 0.9949, generating an annual interest rate of 4%. Capital depreciation is set to equal 10% annually ($\delta = 0.0131$). The production function is given by $F(k) = k^{\alpha}$ and α is set to 0.33. Utility over consumption is specified by a CRRA utility function $u(c) = \frac{u^{1-\sigma}}{1-\sigma}$, with σ set to 2. Disutility to search intensity is given by a simple convex function $d(\lambda) = \frac{\lambda^2}{2}$ while the return to search intensity is bounded above by one $p(\lambda) = (1 - e^{-h\lambda})$. We set the return to effort h to 6 which generates an EU rate elasticity of -0.12 with respect to assets.[10] The borrowing constraint targets the fraction of population with negative net worth in the 2001 Survey of Consumer Finances (SCF), leading to $\underline{a} = -7.2$.

Parameters common in a DMP setting are set to standard values. Matching elasticity (ω) and bargaining power (η) are both 0.6. For now, we assume unemployment insurance is equal to 40% of employed wages for all skills, $b_L = b_H = b = 0.4$. The vacancy posting cost (κ) is set to 0.4, equaling one week of the average low-skilled wage. Table 2 summarizes all shared parameter choices.

Skill-Specific Parameters. We will calibrate the wealth distribution to the 2001 SCF (the start of the low flow economy) and choose skill-specific parameters to be consistent with 2001 values. The fraction of high-skilled workers is set to 0.518, low skilled to 0.482. Low-skilled labor productivity is set to 1. To generate an average earnings premium of 63%, $\epsilon_H = 1.336$. Both skills face the same tax rate: $x_L = x_H = 1$.

[10] Lentz and Tranaes (2005) document a declining relationship with search intensity and assets using Danish micro data.

Table 2: Common Parameter Values

Variable	Value	Target
β	0.9949	4% annual interest rate
σ	2.0	CRRA Coefficient
$\underline{a}$	-7.2	Negative net worth of 6.9%
α	0.33	33% Capital Share
δ	0.0131	10% annual depreciation rate
h	6	JFR elasticity wrt assets of -.12
η	0.6	Bargaining power
ω	0.6	Matching elasticity
b	0.4	40% Replacement Rate
κ	0.4	1 Week Low-Skilled Wage

Note: Benchmark is high flow US economy at 1.5 month frequency.

Matching efficiency and exogenous EU rates are pinned down by several restrictions. First, we assume the aggregate unemployment rate is 6%, in line with the US average. Second, the relative unemployment rate of low skilled to high skilled is 1.8. Lastly, Cairo and Cajner (2017) find all variation in unemployment rates across education is largely attributable to variation in separation rates. To be consistent with this finding, the UE rate will be the same across skills and equal the aggregate UE rate.

The statistics for flows in the high flow US economy suggest an unemployment rate higher than 6%. We target an aggregate UE and EU rate of 47.5% and 3.04%, respectively.[11] The UE rate assigns matching efficiency values: $A_L = 0.4824$ and $A_H = 0.4515$. Likewise, the EU rate and relative skill unemployment rate determines the separation rates: $\chi_L = 0.0602$ and $\chi_H = 0.0323$.

The stochastic discount factor process is calibrated to match the US wealth distribution and the relative average assets of high skilled versus low skilled. We share several assumptions with Krusell and Smith (1998) on our stochastic discount factor process: (1) $N_\beta = 3$, (2) the extreme β values are symmetric around the intermediate β ($\beta_1 = \beta - 0.0015$, $\beta_2 = \beta$, $\beta_3 = \beta + 0.0015$), (3) the probability of transitioning between extreme values is 0, (4) the ergodic distribution of workers at each extreme value is equal, and (5) the average duration at extreme β values is 50 years, incorporating a sort of generational component. As a departure from their approach, we allow the fraction of workers at extreme values to differ across skill. This incorporates a stronger savings motive for the skilled with a higher fraction of its population at extreme values. A comparison of our β specification to Krusell and Smith (1998) is given in Table 3. Agents in Krusell and Smith (1998) were all subject to the same Markov chain, resulting in 10% of households at each extreme β. High-skilled workers face the same Markov chain while a larger fraction of low-skilled workers lie in the intermediate β.

[11] These values were chosen to minimize the square percent difference from the empirical values with the restriction of generating a 6% unemployment rate.

Table 3: β Process Comparison

Model	β_1	β_2	β_3	Frac L	Frac H
Krusell and Smith (1998)	.944	.958	.972	20%	N/A
Benchmark Model	.948	.96	.972	12%	20%

Note: β is annualized. Frac L (H) is the fraction of low skilled (high skilled) at extreme β values.

Algorithm. To solve the model, we bisect for an interest rate r that clears the capital market. Given an interest rate guess and last iteration's wage, iterate over firm value until convergence and derive effective market tightness. Solve for workers' policy function via the endogenous grid method and iterate over worker value, bisecting for an unmatched worker's search intensity choice at each iteration. Using workers' policy function and effective market tightness, the steady state distribution μ is derived. Once μ is acquired, the wages from the Nash bargain are pinned down using golden section search and income tax τ equates total benefits to total tax income. If the absolute difference between this and last iteration's wage is not below some threshold, return to firm value. Otherwise, check the distance between the interest rate bounds of the bisection. If it is below some precision, the model solved. If it is above, bisect and return to firm value.

5 Results

Using our benchmark model, we now investigate how lower UE and EU rates affect welfare and optimal benefits. We start by examining the welfare changes resulting from a fall in flows relative to our benchmark economy. Next, we will remove ingredients from the model to show the importance of a realistic wealth distribution and endogenous prices in generating our welfare measurements. Lastly, we ask how optimal unemployment insurance may change as flow rates change.

Table 4: Wealth Distribution Comparison

Data	1%	5%	10%	50%	≤ 0	Gini	HS/LS
US Data	28.2%	54.7%	66.7%	95.8%	6.9%	0.78	2.62
Benchmark Model	13.3%	42.5%	62.6%	97.5%	7.2%	0.78	2.73
No β Model	5.1%	19.2%	32.3%	86.1%	6.9%	0.5	0.92

Note: Fraction of net worth by top x%. HS/LS is the average asset holdings of high skilled versus low skilled. US Data on wealth distribution from Kennickell (2003) using 2001 SCF. HS/LS data derived from the PSID.

Table 4 presents the performance of the benchmark model in matching the wealth distribution. Included in the table is a recalibrated model without the stochastic β process. Call this the no β model. It is clear that some other ingredient beyond unemployment risk is necessary to generate a realistic wealth distribution. Additionally, the no β model produces counterfactually higher savings behavior for the low skilled. In the no β model, low skilled save more because their income is lower and risk of unemployment is higher. When the stochastic β process is included, the high skilled will save more on average because they put their higher income towards saving. However, this alone is insufficient to generate the relative average savings of high skilled and low skilled seen in the data.[12] By facing a Markov process that assigns higher probability of extreme β values, the high skilled save more at intermediate levels of β and simply have more patient, high-saving types.

Welfare Across Flows. The difference of flows over time in the US and across countries could be due to a multitude of factors.[13] For a neutral exercise, we will assume the decline in flows is strictly through an exogenous decrease in the separation rate and matching efficiency. Therefore, wages and savings are only affected by flows and not some other source of variation in the economy. As we change the flow rate across economies, only χ_s and A_s are recalibrated. These flows are subject to the same restrictions as our benchmark calibration (e.g., an aggregate unemployment rate of 6%).[14]

We use the same method as described in Krusell, Mukoyama, and Şahin (2010) to derive welfare in terms of consumption. In more detail, we solve two different steady-state economies and acquire average value for a given subgroup of interest, $\tilde{V}$ and $\hat{V}$. We then derive consumption of an infinitely-lived representative agent that equals these values. For example,

$$\sum_{t=0}^{\infty} \beta^t \frac{\tilde{c}^{1-\sigma}}{1-\sigma} = \tilde{V}.$$

Once we acquire $\tilde{c}$ and $\hat{c}$, we find ψ such that $(1+\psi)\tilde{c} = \hat{c}$. In all of our welfare analysis, $\tilde{c}$ will be the benchmark high flow US economy.

We will first look at a change from a high to low flow US economy. The EU rate falls from 3.04% to 2.47%, implying the UE rate decreases from 47.5% to 38.7%. Figure 4 plots the change in welfare for a given level of assets across four subgroups: high-skilled employed (HE), high-skilled unemployed (HU), low-skilled employed (LE), and low-skilled unemployed (LU).

When unemployed workers are close to the borrowing constraint, they experience a large drop in welfare from two effects. First, they will be constrained for longer due to the decreased UE rate. Second, once they get sufficiently close to the borrowing constraint, they respond with a larger drop in consumption to avoid being liquidity constrained. There is a decrease in dissaving for any level of assets, hence the persistently low welfare of the unemployed as assets increase.

The employed have a non-monotonic response. Welfare falls at low levels of assets because matched workers increase their savings rate (consuming less) to avoid being liquidity constrained and unemployed. Additionally, the large drop in unmatched value affects matched worker value

[12] If each skill group had the same fraction across extreme values of β, the relative savings rate would be around 1.5.

[13] See footnote 2.

[14] For example, a 1% aggregate EU rate requires a 15.7% aggregate UE rate. The high and low skilled UE rate both equal 15.7% and EU rates are set to generate 80% more unemployed for the low skilled.

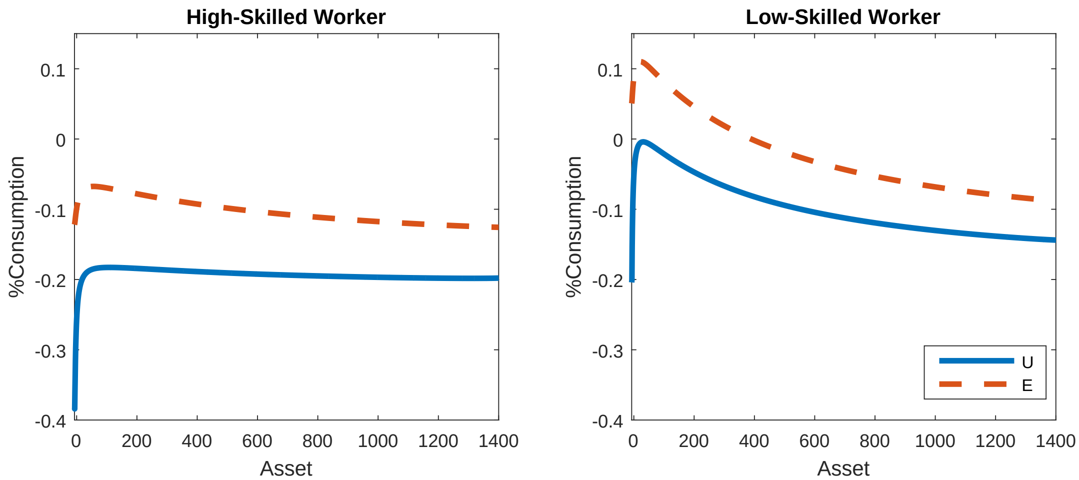

Figure 4: Consumption gain ψ across assets from high flow US to low flow US.

through $\chi_s W(a', 0, s, \beta_j)$ in equation (5). As the worker accumulates assets and moves away from the risk of being liquidity constrained, her welfare improves. However, for sufficiently high assets, welfare begins to decline again. With the increased demand for precautionary savings, the interest rate falls, decreasing the return to savings and generating a negative wealth effect. In sum, the initial drop in welfare is due to liquidity concerns and the latter drop from a negative wealth effect.

Looking at the welfare change's sign, the drop in flows creates a strictly negative effect for the high skilled. The high skilled have a higher propensity to save, putting more weight on the negative wealth effect. The HE could also sufficiently insure themselves previously, so the lower separation rate offers no substantive benefit in their employed value. Because of their lower outside option, high-skilled workers also see decreased average wages, further affecting employed value negatively. Unmatched value is negative from a combination of liquidity concerns and the negative welfare impact on employed value.

The LE experience a rise in welfare for lower asset levels. Their separation rate in the benchmark was high; they expected to enter unemployment at low levels of assets. The fall in separation rates allows them to better smooth their consumption, producing a positive effect on welfare. The low-skilled unemployed value inherits some of this rise in welfare through equation (6) but is ultimately negative from lower consumption at a given asset level.

Average welfare is shown in Table 5. To aggregate, we account for redistribution and use the asset distribution of the low flow US economy.[15] The second row presents welfare changes if we assume the distribution of workers across skill is fixed while the third accounts for the change in composition. Keeping skill composition fixed, we see that the high skilled are hurt but the low skilled experience a positive benefit. The positive benefit of the low skilled dominates and there is a 0.27% increase in aggregate consumption equivalent welfare. In the high flow economy, the

[15]We assume this for all of our average welfare measures in this section. Alternatively, one could assume the asset distribution is the same across regimes. One can predict average welfare from Figure 4 and similar future figures in such a case.

illiquidity risk is high for low skilled from an inability to accumulate wealth. The decreased EU rate increases the LE's ability to self-insure.

Table 5: Welfare for US

New Economy	HE	LE	HU	LU	Aggregate
Low Flow US	-0.001%	0.47%	-0.22%	0.21%	0.27%
Low Flow US+Skill Comp	-0.55%	-0.05%	-0.84%	-0.34%	-0.35%

Note: Skill comp is shift of high-skilled types from 0.518 (2001) to 0.589 (2015).

The aggregate effect is negative if we account for changing skill composition. A higher fraction of high-skilled types lead to a larger fall in the interest rate. The lower return to savings clearly hurts the saving-inclined high skilled, but it also impedes the increased ability of the low skilled to accumulate wealth.

While the decline in US flow rates was non-trivial, the differences in flows across countries are much larger. For example, Portugal has an EU (UE) rate of 0.4% (6.3%), nearly ten times below the high flow US economy. How does welfare change if EU and UE rates drop to this level?

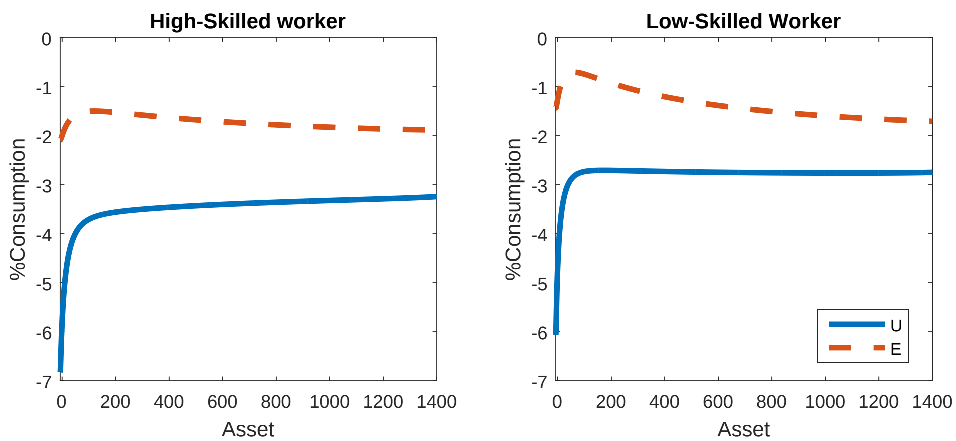

Figure 5: Consumption gain ψ across assets from high flow US to 0.5% EU rate.

As shown in Figure 5, moving from the high flow US economy to an EU (UE) rate of 0.5% (7.83%) significantly impacts welfare across assets. We call this low level of flows the Portugal economy.

Table 6: Welfare for Portugal

New Regime	HE	LE	HU	LU	Aggregate
Portugal	-1.06%	3.45%	-5.81%	-1.05%	1.37%
Portugal+Skill Comp	-1.41%	3.1%	-6.19%	-1.33%	0.32%

Aggregating welfare in Table 6 confirms that groups experience large changes in welfare. The wealthy high skilled are particularly hurt, as are the unemployed. However, the LE favor low flow rates as it allows for a greater accumulation of assets. The low-skilled employed dominate in aggregate, and there is a positive gain of about 1.4%. Lastly, although a change in skill composition reduces welfare relative to a fixed composition, the qualitative results still hold.

The same intuition for Figure 5 holds as previously: the employed face a decline in value from liquidity concerns and the wealth effect, the unemployed from decreased consumption. We can decompose these effects more clearly in the Portugal economy.

The decrease in consumption for both employed and unemployed can be seen in Figures 6 and 7. Figure 6 is the amount of savings a high-skilled employed makes relative to their current asset holdings. We can see a much larger precautionary motive in the Portugal economy. The rise in precautionary savings drives down the interest rate and dissuades asset accumulation for higher levels of assets. A similar story can be seen for the high-skilled unemployed in Figure 7. Dissaving rates are much lower in the Portugal economy from liquidity concerns. The low skilled experience a qualitatively similar change in savings behavior moving to the Portugal economy.

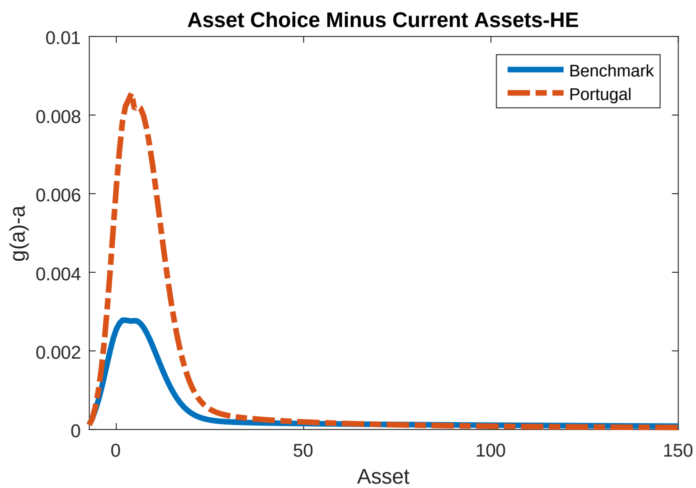

Figure 6: Future asset choice minus current assets, high-skilled employed.

Suppose we are examining a small open economy and interest rates do not adjust to changes in local conditions, essentially removing the negative wealth effect. Applying this assumption to the Portugal economy transition, Figure 8 shows that the non-monotonicity of employed value is removed. The decline in welfare is strictly due to liquidity concerns.

Figure 9 varies the separation rate and tracks the evolution of aggregated welfare. As flow rates rise, the welfare returns to the high skilled and unemployed is concave. Conversely, the low-skilled employed have a convex loss in welfare. Total welfare decreases monotonically, but its shape suggests there may be a peak level of welfare at flow rates below 0.5%.

Lastly, Figure 10 tracks prices and features of the wealth distribution for different flow rates. As flows fall, wages strictly decrease for the high skilled from a falling outside option while the low skilled see an initial improvement from better self-insurance when unemployed. Responding to a stronger precautionary savings motive, the decrease in interest rates reduces incentive to save

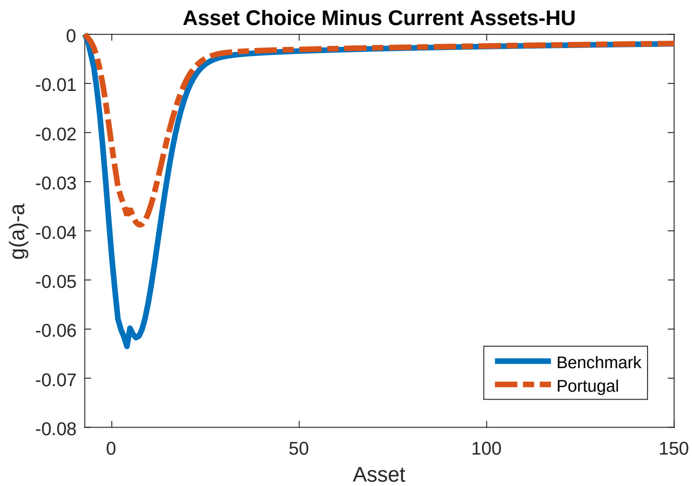

Figure 7: Future asset choice minus current assets, high-skilled unemployed.

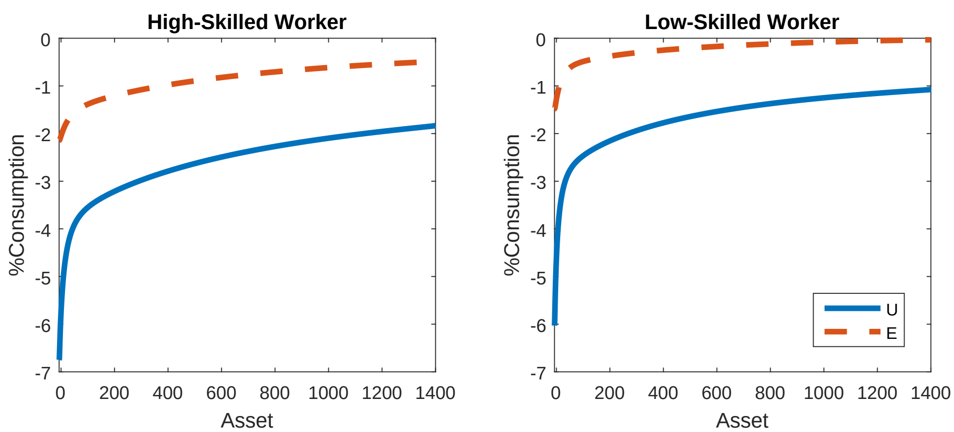

Figure 8: ψ across assets from high flow US to .5% EU rate, small open economy.

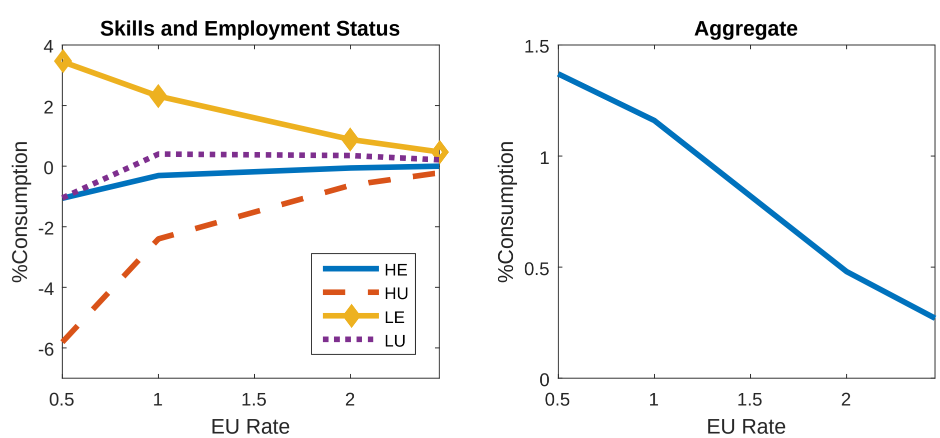

Figure 9: ψ across subgroups and flow rates.

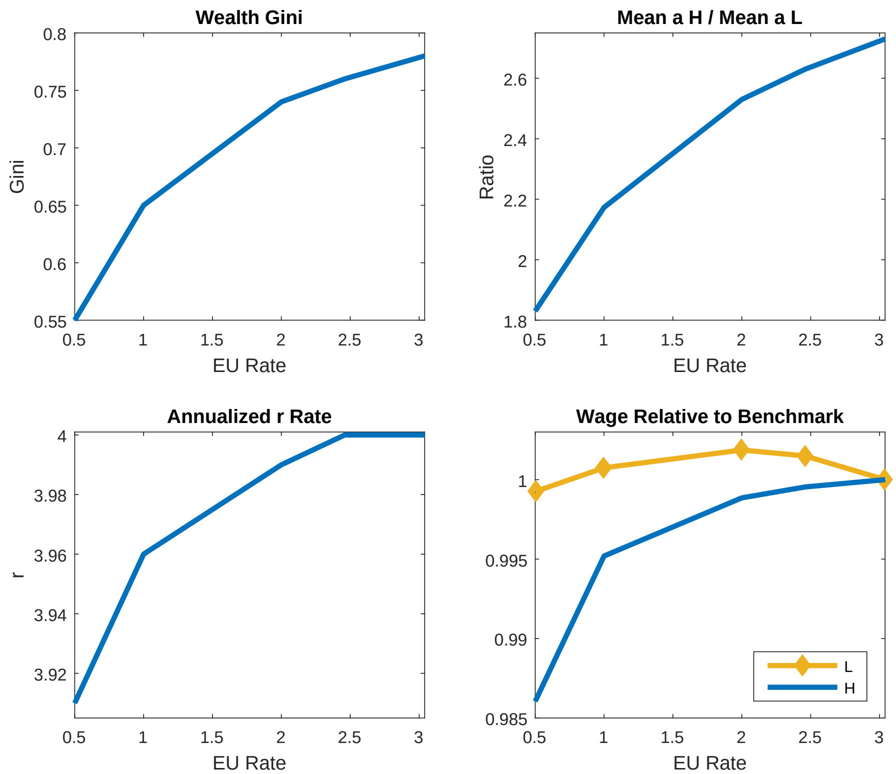

Figure 10: Prices across flows. Mean a H (L) is average asset holdings of high (low) skilled

at high levels of wealth and the distribution of wealth condenses. Extrapolating this result, any economic phenomenon that increase precautionary savings will decrease wealth inequality unless accompanied by another change (e.g., increased dispersion in earnings).[16] Therefore, the rise in wealth equality of the United States does not seem to be caused by the fall in EU and UE flow rates.[17]

Model Decomposition. The welfare results of the previous section depend critically on general equilibrium and realistic savings behavior. Table 7 compares aggregate welfare results for a variety of different modeling assumptions. By removing general equilibrium effects (Small Open Economy and Fixed Wage), qualitatively different welfare values are generated for some subgroups. A fall in flows is a large boon for welfare in the small open economy. As Figure 8 showed, values will generally be lower for a given level of assets but employed workers can accumulate a lot of wealth. A fixed wage prevents the fall in wages, propping up value and increasing welfare above the flexible wage case.

In a model without a stochastic β process, the relatively wealthier low skilled receive the largest fall in welfare. This points to wealth being a key feature to determine the welfare effect of flows.

[16]This also explains why our benchmark model with no β matches the wealth Gini better than the Krusell and Smith (1998) no β benchmark (a Gini of .25). In our framework, the precautionary motive is dampened from positive unemployment insurance while workers in the Krusell and Smith (1998) economy entirely depend on savings.

[17]See Saez and Zucman (2016). They find the rise in wealth inequality is almost completely from the extreme rise in the top 0.1% while wealth inequality has been decreasing for the bottom 90%.

Table 7: Testing the Mechanisms: 3.04% to 0.5% EU Rate

Model	HE	LE	HU	LU	Aggregate
Full Model	-1.06%	3.45%	-5.81%	-1.05%	1.37%
Small Open Economy	5.46%	9.08%	1.49%	5.11%	7.4%
Fixed Wage	0.21%	3.86%	-4.48%	-0.59%	2.13%
No Stochastic β	-0.09%	-1.96%	-4.38%	-6.02%	-1.48%
No Search Intensity	-0.98%	3.7%	-4.68%	-0.33%	1.69%
Only Risk Aversion	N/A	-0.12%	N/A	-4.4%	-0.39%

Note: Small open economy keeps the interest rate fixed. Only risk aversion has no savings, search intensity, or skill. β, search intensity, and only risk aversion are recalibrated to match high flow US economy moments.

It is the wealthy that are most hurt by a fall in flows.

Removing search intensity does not seem to be overly important in the context of this exercise. We set flow rates exogenously. Although there is an endogenous increase in search intensity from a fall in flow rates, average search intensity changes marginally as increased matched worker surplus is offset by the exogenous fall in matching efficiency. However, search intensity plays a much larger role when determining optimal benefits.

As a final exercise, we solve a model with risk aversion but do not allow workers to save or vary search intensity. Unmatched value falls substantially as the duration of unemployment is longer. Lower unemployed value feeds back to decrease employed value through expectations and wage, but the lack of a negative wealth or distributional effect prevents a large decline.

Optimal Unemployment Benefits. Previous literature has emphasized the importance of liquidity constraints and moral hazard in determining optimal unemployment insurance (UI).[18] To our knowledge, our environment is the first search model with an equilibrium interest rate that contains these two ingredients.[19] Additionally, we can explore discriminatory UI policies across skill and how declining UE and EU flow rates affect optimal policies.

For this exercise, we will track the change in consumption-equivalent welfare moving from the benchmark UI policy of an equal 40% replacement rate. The marginal tax is the same for all skills, and any benefit scheme must be financed by taxes on employment income. As in Krusell, Mukoyama, and Şahin (2010), we will aggregate our welfare measurements using the 40% UI distribution. That is, we keep the orkers' working status and asset level fixed at the benchmark when comparing two different benefit schemes. Using the 40% UI benchmark distribution assigns the same fraction of employed and unemployed across economies. Therefore, we also create an alternative welfare measure that accounts for changes in employment but keeps the asset distribution

[18] See Hansen and İmrohoroğlu (1992), Chetty (2008), or Lentz (2009).

[19] A search environment makes employment responsive to both moral hazard and the vacancy decision of the firm, and the previous section showed changes in the interest rate have large effects on welfare.

conditional on working status fixed. We find that both methods recommend similar levels of UI.

Figures 11 and 12 map the welfare benefits of varying UI for the high flow US and Portugal economy, respectively. If we allowed for no discrimination across groups, optimal UI in the US is about 40% and rises to 53% for Portugal. Our optimal benefits are much higher than the 12% of Krusell, Mukoyama, and Şahin (2010), stressing the importance of a realistic wealth distribution when evaluating unemployment insurance policies.

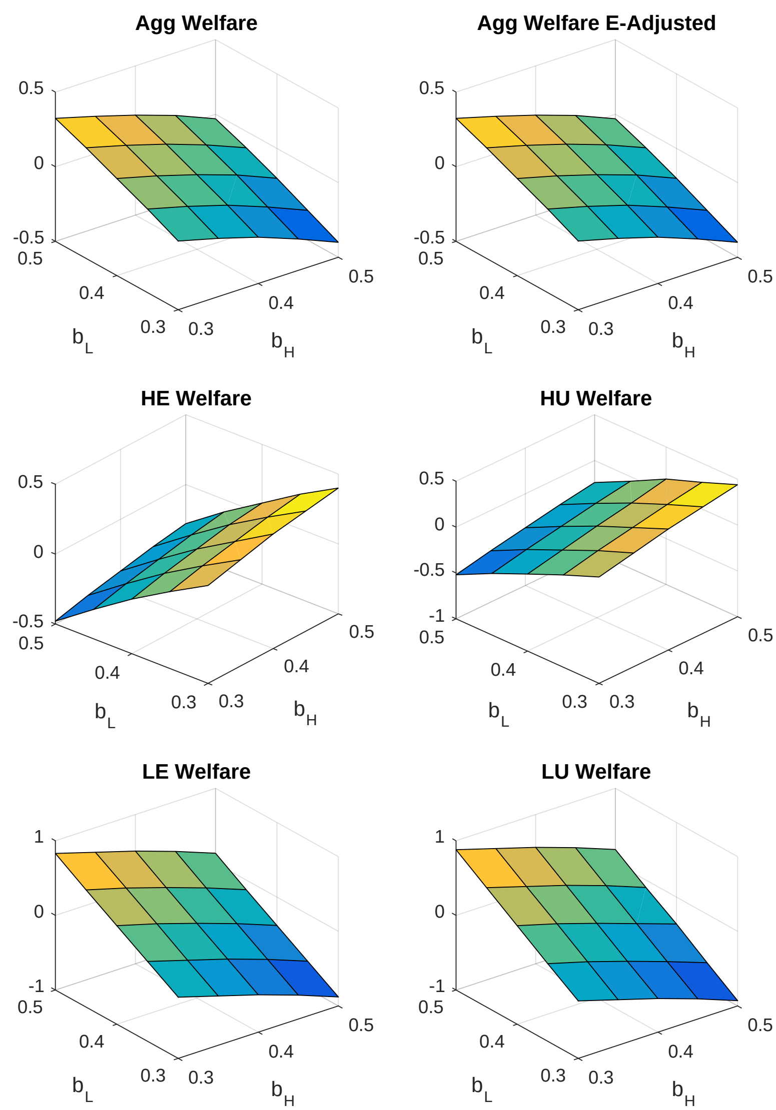

Figure 11: Welfare (ψ) related to benefits, high flow US.

Consistent with past work, discriminatory benefits heavily favor the liquidity constrained. For the US, optimal benefits for high-skilled workers are 12% versus 70% for low-skilled workers. The high-skilled optimal UI rises in Portugal to 17.5% while low-skilled optimal benefits are unchanged at 70%.

Multiple components in the environment prescribe higher (lower) benefits to the low (high)

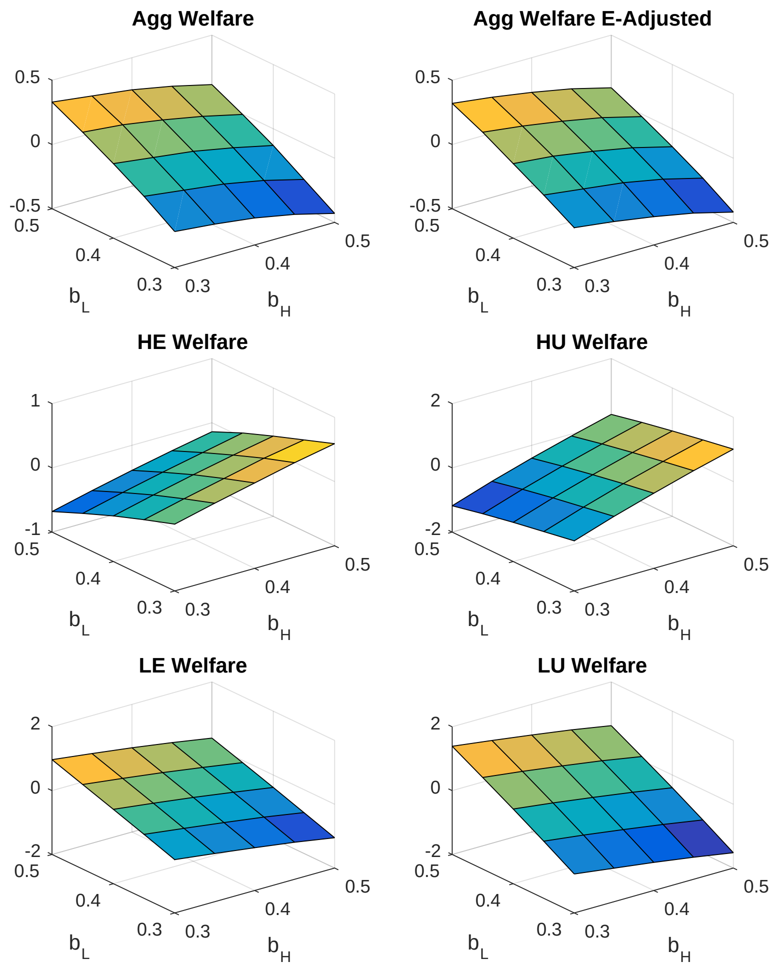

Figure 12: Welfare (ψ) related to benefits, Portugal.

skilled. First, the low skilled are more liquidity constrained from a higher risk of unemployment and lower propensity to save. At low levels of wealth, changes in benefits generate a larger welfare gain. Second, low-skilled workers receive less income, producing a wider difference between matched and unmatched value for the same level of benefits. In turn, they tend to exert more search effort for a given level of assets and this search effort becomes more extreme near the liquidity constraint. The unconstrained high skilled face a larger moral hazard problem. Decreasing high-skilled UI increases their search effort but also raises firm vacancies through a fall in unmatched value. Combined, more high-skilled become employed and the tax burden is reduced. Third, benefits applied to the wage of the low skilled produces a small change in the tax rate. If UI rises for the high skilled, there will be less high-earning employed to tax. A higher amount of financing would also be required for the same rise of high-skilled unemployed compared to the low skilled. Lastly, endogenous interest rates compensate the wealthy high skilled. Low-skilled workers engage in less precautionary saving as their benefits increase and the interest rate rises. A positive wealth effect partially offsets the negative income effect of higher taxation.

6 Conclusion

The degree of labor market liquidity affects the welfare of workers, whether unemployed or employed. We find that job security dominates reemployment security once we account for the equilibrium response of savings to wages and interest rates. Savings increase when labor market liquidity goes down. We find that the aggregate welfare effect is as large as 1.4% of consumption when comparing across developed economies.

Overall, agents are affected by declining flow rates very differently depending on their skill characteristics, asset liquidity, and working status. Although welfare declines across a given level of assets, accounting for the savings response leads to increased aggregate welfare. That increase is fueled strictly by the low-skilled employed. Ultimately, lower flow rates provide a substantial benefit to workers who face a high risk of unemployment but hurts individuals with high propensities to save or exposure to asset liquidity risk. General equilibrium and a realistic wealth distribution are two critical ingredients for these results. Finally, an analysis of optimal equal UI assigned higher benefits in the low flow economy. A means-tested optimal policy suggests stark differentiation of benefits across skill levels.

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