Why does liquidity raise unemployment duration but not job quality? A simple resolution based on on-the-job search

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Abstract

We propose a simple resolution of a long-standing empirical puzzle in public finance and unemployment insurance (UI) research: unemployed job seekers prolong their unemployment duration in response to more liquidity (cash on hand), but do not appear to select better jobs. This pattern is surprising in light of the micro models of job search commonly used in this literature. These search models predict that liquidity constraints should prompt workers to rush to reemployment not only by increasing search effort but also by lowering their reservation wages. Our resolution builds on incorporating on-the-job search (OJS): the ability to continue to search once reemployed. This feature is standard in modern search models featuring job ladders, but is omitted in the public finance literature that focuses on UI policy design and the job search behavior of the unemployed. OJS can eliminate the dynamic trade-off between accepting a given job over potential alternative job offers in the future—and hence can neutralize the intertemporal distortion from liquidity constraints. We formalize this resolution in a parsimonious McCall sequential search model with two features: endogenous search effort (so that higher liquidity increases unemployment duration) and OJS (so that higher liquidity need not increase new job quality). The calibrated model reconciles the large positive duration effects of liquidity and its zero wage effects.

We thank Jalen Nichols for excellent research assistance. The views expressed in this paper are those of the authors and do not necessarily reflect the position of the Federal Reserve Bank of Kansas City or the Federal Reserve System. Clymo: a.clymo@essex.ac.uk. Denderski: piotr.denderski@leicester.ac.uk. Mercan: aymmercan9@gmail.com. Schoefer: schoefer@berkeley.edu.

Important note

Feb. 10, 2024

Dear Raj and PF meeting organizers,

Please find our submission entitled "Why does liquidity raise unemployment duration but not job quality? A simple resolution based on on-the-job search." This is work in progress but progressing fast. It was meant to be a compact contribution as a short paper (a spin-off from a larger project).

We want to disclose a missing literature reference regarding a specific paragraph in an existing publication (Card, Chetty, and Weber, 2007). We had of course carefully read the paper but until today (the deadline for your conference), we had missed the following paragraph at the top of page 1547:

> There are several possible explanations for the absence of significant match quality effects from severance pay or extended benefits. [...] **A third possibility is that reservation wages do not rise much in response to severance pay or extended benefits because employed workers can continue to search. Indeed, if search is equally productive on and off the job, the reservation wage only depends on current UI benefits (Lise 2006), and severance pay and extended benefits should have no effect on the quality of the jobs** obtained in the first 20 weeks of unemployment. [...] Unfortunately, given the available evidence, we cannot distinguish between these alternative explanations.

Our paper is in fact devoted to exactly making, dissecting and quanitatively assessing this point.

However, our draft below is written *without knowledge of this paragraph*, in which you and your coauthors pointed out this potential explanation. We had already cited and discussed what is now published as Lise (2013). We still think that it could be worth devoting a dedicated and compact treatment of this effect in a short paper. We would need to qualify our contribution and point out that the conjecture was pointed out already in Card, Chetty, and Weber (2007) and tone down various statements.

Since we were unable to update the paper today, the day of the deadline, this cover letter is to disclose that the paper was written without us having been aware of this paragraph.

Thank you!
Best,
Alex, Benjamin, Piotr, and Yusuf

1 Introduction

Becoming unemployed is among the largest negative income shocks. Since workers appear to only imperfectly insure against this shock (see, e.g. Gruber, 1997), job loss generates a consumption-smoothing rationale for unemployment insurance (UI). Optimal UI policy trades off this consumption smoothing benefit with a moral hazard cost (Baily, 1978): first, workers search less intensely; second, they become more selective by increasing their reservation wage. However, exactly in the presence of liquidity constraints—which justify UI in the first place—, the behavioral responses to UI reflect a mix of moral hazard and relaxation of liquidity constraints (Chetty, 2008). The perceived wisdom in public finance is that the direction of UI generosity and liquidity effects are identical:[1] the unemployed should reduce job search effort and increase reservation wages. However, while there is ample evidence for duration effects of UI and liquidity (for a recent review, see Cohen and Ganong, 2024),[2] effects on reservation and reemployment wages appear to be zero (if anything go into the "wrong", negative direction):

> LESSON 3: In the majority of recent studies, more generous UI policy *decreases wages* [emphasis added] imposing further (second-order) behavioral cost to provide UI. (Handbook of Labor Economics, Barbanchon, Schmieder, and Weber, 2024, p. 108))

This view echoes the state of the literature at the time of the original contribution by Chetty (2008):

> Recent evidence indicates that UI benefit levels have little effect on wages and other measures of the accepted job's quality (Card et al. 2007; van Ours and Vodopivec 2008). (Chetty, 2008, p. 191))

The strongest evidence for this finding stems from Card et al. (2007), who obtain duration effects from severance payments but no wage effects.

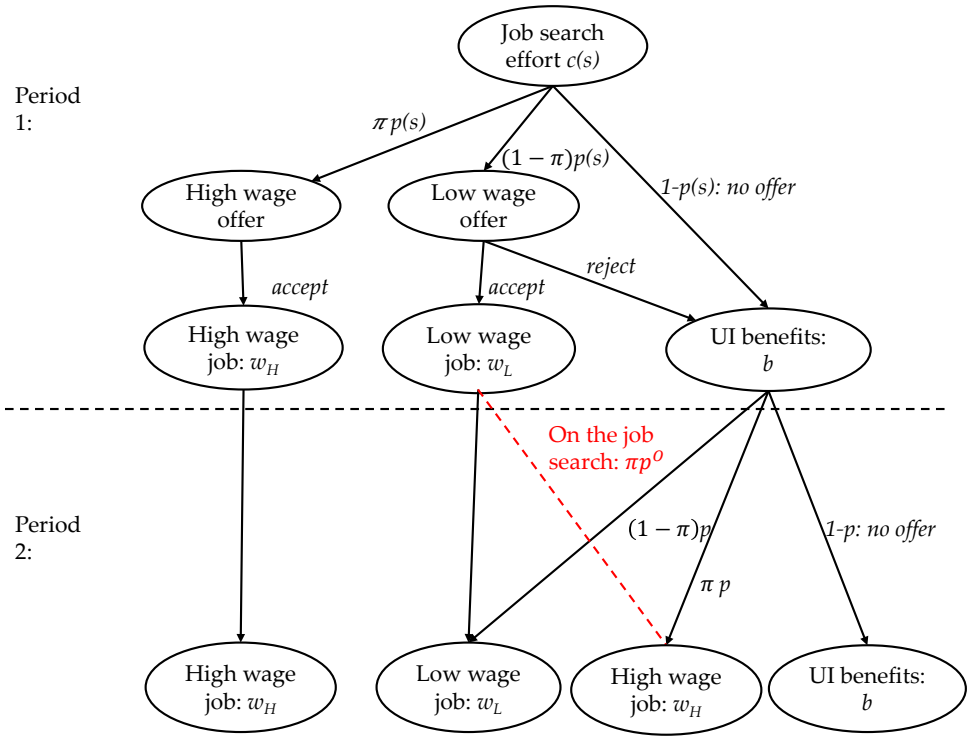
Taken together, these two empirical facts—positive duration but zero reemployment wage effects of liquidity—are puzzling. In the standard sequential search models of unemployment (McCall, 1970) that the public finance literature draws on, liquidity constraints should lead workers to rush to reemployment not only via higher search effort, but also via lower reservation wages (Marimon and Zilibotti, 1999; Shimer and Werning, 2008). Both margins are facets of a dynamic distortion emanating from liquidity constraints.

As a result of this puzzle, both pedagogical and workhorse models used in the public finance treatment of unemployed search assume a single wage per unemployed job seeker, switching off the selection margin (see, e.g. Baily, 1978; Chetty, 2008). This assumption stands in contradiction with the large degree of wage dispersion for observationally similar workers (Abowd et al., 1999; Card et al., 2013), often linked to search-frictional wage dispersion (Hornstein et al., 2011) and the

[1] Hence, they cannot be empirically disentangled by relying on UI benefit generosity variation only. Liquidity effects are either indirectly indicated by stronger responses to UI generosity among plausibly constrained workers, or require independent variation in the form of pure liquidity shocks.

[2] This evidence comes in the form of pure liquidity effects (as in, e.g., severance pay variation Card et al., 2007; Chetty, 2008) or it comes in the form of longer duration in response to UI that provides a mix of liquidity and price distortions.

Figure 1: The logic of on-the-job search: two-period model with two job types.



job ladder (Ozkan et al., 2023)—all of which emphasize an active selection margin in job search. While the majority of the public finance literature has largely sidestepped this empirical puzzle, the existing resolutions predominantly rely on declining labor demand side valuations of the worker's skills—such as skill depreciation in unemployment or duration dependence that points to statistical discrimination (Kroft et al., 2013; Nekoei and Weber, 2017).

We propose a simple, powerful and realistic resolution to this puzzle: on-the-job search (OJS), i.e., the ability of workers to continue to receive and entertain job offers once reemployed out of unemployment. This feature is ubiquitous in modern labor search models featuring job ladders (Postel-Vinay and Robin, 2002; Cahuc et al., 2006; Krolikowski, 2017; Jarosch, 2023). Moreover, search on the job is growingly recognized to be advantageous compared to unemployed search (Faberman et al., 2022). But OJS is largely ignored in the public finance literature that focuses on UI policy design and the search behavior of the unemployed.

We show that OJS can eliminate the dynamic trade-off between accepting a job offer and waiting for potential alternative offers in the future—and thereby neutralizes the intertemporal distortion from liquidity constraints. Hence, in the model, the wage effect can be small (and reflect moral hazard only). At the same time, this feature preserving the standard effect on search effort and hence unemployment duration.

Figure **??** illustrates the simplicity of the idea in the form of an event tree that highlights two decisions: job search effort and selection. The black solid elements denote the standard model,

whereas the red dashed elements add the incremental features of OJS. Initially unemployed, the worker may meet a job offer with probability $p(s)$, and can invest search effort s to boost that probability. The offer can be high or low wage (probability π and $1-\pi$). In this environment, a liquidity-constrained household will accelerate job search. Then, the decision whether or not to accept the low-wage job involves the dynamic trade-off: the opportunity cost of accepting the low-wage job is the inability to receive the high-wage offer in period 2—which liquidity constraints distort. But this dynamic trade-off rests on the assumption that search is precluded if in the low-wage job. OJS (red dashed features) obviously eliminates this opportunity cost—and hence the dynamic distortion from liquidity constraints on this selection margin.

The rest of the paper formalizes and quantitatively explores this intuition in a more formal way. We first formalize this resolution in a parsimonious McCall sequential search model with a consumption and saving decision margin and endogenous search effort (so that higher liquidity increases unemployment duration). The key incremental feature is OJS (so that higher liquidity need not increase the quality of jobs accepted out of unemployment). We frontload the intuitions for our resolution in a simple two-period model, and then present a full dynamic model that features the mechanisms in a potentially quantitatively realistic environment.

Our model points to a sufficient statistic that mediates the relative effect of liquidity on unemployment duration and reemployment wages: the efficiency of OJS relative to unemployed search. More precisely, the relevant statistic is the job offer arrival rate while unemployed compared to the offer arrival rate while employed in the reservation job. Intuitively, this feature pins down the essence of the selectivity margin: the opportunity cost of accepting a job in the form of forgoing additional offers in the future.

To discipline our quantitative model, we provide two meta-analyses: duration and reservation wage effects of UI through liquidity, and OJS efficiency vis-à-vis unemployed job search. Existing estimates of the latter suggest considerable OJS efficiency (see, e.g. Faberman et al., 2022). Hence, our calibrated model reconciles the large positive duration effects of liquidity on unemployment duration and its zero reemployment wage effects. *[A full development of this material remains in progress.]*

Our paper's contribution is decidedly compact: to point out a simple and basic resolution to a puzzle in the public finance literature, and to quantify its potential power to reconcile duration and wage effects of liquidity among the unemployed. As such, any modern search model with a job ladder may be suitable to derive the conditions we point to. The relevant model features are incomplete markets, an endogeneous search effort margin for unemployed workers and the presence of OJS. For instance, the model in Lise (2013) features these ingredients, albeit for a natural borrowing limit rather than a liquidity constraints, and specifying a search technology amounting to one specific knife-edge case (of equal search efficiency) that we nest in our treatment. That paper's main focus is to link wealth dynamics (with a natural borrowing limit) and OJS, rather than to rationalize the empirical effects of UI/liquidity on unemployed job search behavior. We pick up this reference again in our theoretical discussion.

2 The empirical puzzle and the our resolution: meta-analysis of wage effects and on-the-job search efficiency *[in progress]*

In this section—*which is in progress*—we provide two meta-analyses: first, we detail the puzzling insensitivity of reemployment wages to liquidity and UI generosity, and second, we show that on-the-job search appears to be similarly efficient to unemployed search, the basis of our resolution.

Meta-analysis: liquidity and UI effects on reemployment wages. The empirical public-finance and labor literature robustly document that providing unemployed workers with more liquidity—most notably in the form of UI benefits but in rare examples also in pure liquidity transfers—leads to higher unemployment duration, but *not* due to higher quality of jobs (e.g., as proxied by reemployment wages) accepted out of unemployment. This latter finding suggests that higher liquidity does not seem to have an impact on workers' job selectivity margin.

In Table 1, we summarize the semi-elasticity of reemployment wages with respect to liquidity provision as estimated across different countries and in using different identification strategies. A prominent theme is that the point estimates are very small, and even *negative*—going in the "wrong" direction as pointed by Barbanchon et al. (2024).

Meta-analysis: on-the-job search efficiency. Our resolution for this empirical puzzle relies on the presence of OJS—the ability of workers to continue searching for new jobs even after they have accepted a job out of unemployment. This common feature of the labor market is often overlooked in the public-finance literature, but is omnipresent in the macro-labor literature.

Table 2 shows that not only OJS is a very common feature of search models, but importantly that on-the-job search is often viewed as as effective as unemployed search. We make the notion of search efficiency and the required statistics concrete in our full model below. Intuitively, the relative efficiency column denotes the arrival rate of job offers when employed compared to unemployed (depending on the study, it may also denote the return to job search effort). In our theoretical treatment, we highlight the knife-edge case of employed and unemployed search efficiencies being identical, and how this condition implies that while search effort decreases with liquidity, the reservation wage out of unemployment becomes independent of it. The bottom line of the table is that this range is not far from a common assumptions in studies of on-the-job search.

3 Two-period model

We start by presenting the main insights for our resolution in a maximally parsimonious two-period search model, before moving to the full model in Section 4.

The simple model studies the decision of an initially unemployed job seeker, featuring a consumption-savings margin, potentially distorted by a liquidity constraint. The worker can exert effort to find a job in period 1, and faces the trade-off between accepting the job and rejecting

Table 1: Meta-analysis of reemployment wage effects of liquidity

Paper	Elasticity of w w.r.t. liquidity	Source	Notes
Card, Chetty and Weber (2007)	−0.005 −0.009	Table 3	UI benefit extension Severance pay (Austria)
Lalive (2007)	Men: −0.000, −0.001 (170 wks, 13 wks) Women: 0.010, −0.020 (170 wks, 13 wks)	Table 1	UI benefit extension (Austria)
van Ours and Vodopivec (2008)	Men: −0.016 Women: 0.030	Table 3	UI benefit cut (Slovenia)
Centeno and Novo (2009)	−0.009 (below median pre-UI wage; age 30 cutoff) −0.010 (above median pre-UI wage; age 30 cutoff) −0.015 (below median pre-UI wage; age 40 cutoff) −0.012 (above median pre-UI wage; age 40 cutoff)	Table 2	Age discontinuity (Portugal)
Barbanchon (2016)	0.0009	Table 5	UI benefit extension (France)
Schmieder, von Wachter and Bender (2016)	−0.0078 (age 42 cutoff) −0.0051 (age 44 cutoff)	Table 1	UI benefit extension (Germany)
Nekoei and Weber (2017)	0.00506	Table 2	Regression discontinuity (Austria)
Johnston and Mas (2018)	0.035	Table 4	UI benefit cut (Missouri, USA)
Gerards and Welters (2019)	0.049	Table 4	Liquidity constraint (Australia)
Chetty (2008)	[in progress]		

Notes: This table provides a meta-analysis of the reemployment wage effects of liquidity. In progress: the units of each study's estimate will be clarified in the next version, currently drawing on Barbanchon et al. (2024).

Table 2: Meta-analysis of on- and off-the-job search

Paper	Relative OJS efficiency, λ_E/λ_U	Search cost	Notes
Postel-Vinay and Turon (2010)	0.361	Exogenous search effort	Table 2
Hubmer (2018)	1	Higher OJS cost	Section 3.2, Table 1
Menzio and Shi (2011)	0.904	Exogenous search effort	Table 2
Krolikowski (2017)	1.72	Exogenous search effort	Table 1
Christensen et al. (2005)	1	Identical search cost	Table 2
Lise (2013)	1	Identical search cost	Table 2
Elsby and Gottfries (2022)	0.148	Exogenous search effort	Table 1
Nagypal (2007)	1	Identical search cost	Section 3.1
Moscarini and Postel-Vinay (2016, job ladder)	0.203	Exogenous search effort	Table 1
Moscarini and Postel-Vinay (2016, wage posting)	0.13	Exogenous search effort	Table 2
Faberman et al. (2022)	Different arrival processes	Different search cost functions	Table 9
Hornstein, Krusell and Violante (2011)	[in progress]		

Notes: This table provides a meta-analysis of the relative efficiency of on-the-job search in the literature.

it to potentially obtain another job offer in period 2. Without OJS, liquidity constraints distort this choice, raising the worker's search effort and lowering the reservation wage in period 1 in an effort to rush to reemployment. We incrementally include the ability to search on the job in period 2 in case the worker accepts a job in period 1, and show how this feature can eliminate the effect of liquidity on the reservation wage but not on job search effort.

Model setup. The following are the minimal features required for a two-period model to replicate the empirical puzzle (without OJS) and our resolution (allowing for OJS). The setup echoes the intuitions in Figure **??**, except for a richer job distribution. In this model, the worker starts her life unemployed. Consumption-saving decisions are made at the end of each period, after income y_t is realized. Income is either UI benefit b during unemployment, or a wage. Wages differ across jobs (described below), and are fixed on the job.

Job search in period 1 is endogenous: the worker puts in effort s, subject to an increasing and convex utility cost function $c(s)$. The probability that a job arrives is increasing in search effort, $p(s)$ (with $p' \geq 0 and p'' \leq 0$). There is no endogenous effort margin in period 2, when a job offer

arrives with exogenous probability p.

If the worker receives a job offer, its wage w is drawn from the wage offer distribution $w \sim F(w)$. The worker can decide whether to accept or reject it. If he rejects, he receives UI benefit b and enters the next period unemployed.

In the extended version of the model, jobs continue to arrive in period 2 even for workers that accepted a job in period 1. Our baseline assumption is that they do so with probability $p_O = 0$, so that we nest the standard model without OJS. We then consider a model with OJS, specifically $p_O = p$. The precise level of p_O relative to p determines the power of our mechanism, with $p_O = p$ achieving full neutrality of liquidity on selectivity. In that sense, p^O and p determine relative job search efficiency.

The worker faces an intertemporal budget constraint $a = a_0 - c_1 + y_1$, where a_0 denotes net assets with which he enters period 1, y_1 is end-of-period-1 income, and c_1 is the consumption choice. Asset choice a, which the worker carries into period 2, is subject to a liquidity constraint $a \geq \underline{a}$. For expositional simplicity, the discount factor β and the interest rate r are such that $\beta = 1 + r = 1$.[3]

The worker's utility in period 1 is separable in consumption and search effort, $u(c_1) - c(s)$, and it is $u(c_2)$ in period 2 as we assume search effort is exogenous in period 2. $u(c)$ is increasing and concave, generating a consumption smoothing motive.

Period 2. As the model in this section is finite horizon, we proceed by backward induction, describing the problems starting from the final period 2. Since the worker exits the model at the end of period 2, he consumes all financial wealth a and labor income y_2, receiving utility $u(a + y_2)$, so that:

$$U_2(a) = u(b + a) \tag{1}$$

$$W_2(a, w) = u(w + a). \tag{2}$$

where $U_2(a), W_2(a, w)$ are the end-of-period-1 values of unemployment and employment in a job paying w, respectively. With these last-period values in hand, we now move to period 1.

Period 1. At the beginning of period 1, the unemployed worker chooses search effort. The consumption-saving decision occurs after the income is realized. The value of unemployment is:

$$U_0(a_0) = \max_{s \geq 0} -c(s) + \big(1 - p(s)\big)U_1(a_0) + p(s) \int \max\left\{W_1(a_0, w), U_1(a_0)\right\}, \tag{3}$$

where $U_1(a_0)$ and $W_1(a_0, w)$ are the values of unemployment and employment in a job paying w in period 1, respectively.

[3] As a result, employed workers are never liquidity constrained as long as $\underline{a} < a_0/2$ and when there is no OJS, see also Footnote 4.

If the worker accepts the job, the value is:

$$W_1(a_0, w) = \max_{a \geq \underline{a}} u(w + a_0 - a) + u(w + a) = 2 \cdot u(w_H + a_0/2), \tag{4}$$

where the second equality uses the fact that the worker smooths consumption over two periods.[4]

The acceptance decision induces a reservation wage, which we define below after characterizing the unemployment value $U_1(a_0)$ next. If the worker stays unemployed at the end of period 1, the remaining decision is consumption (i.e., savings). Period-2 job finding probability is fixed at p, and any type of job above b is accepted given that it is the final period. This value is then given by:

$$U_1(a_0) = \max_{a \geq \underline{a}} u(b + a_0 - a) + (1 - p)u(b + a) + pF(b)u(b + a) + p \int_b^\infty u(w + a) dF(w) \tag{5}$$

$$= \max_{a \geq \underline{a}} u(b + a_0 - a) + u(b + a) + p \int_b^\infty (u(w + a) - u(b + a))\, dF(w). \tag{6}$$

Savings and liquidity constraints. The standard Euler equation emerges (recall that $\beta(1+r) = 1$):[5]

$$u'(b + a_0 - a_U^*) = \underbrace{(1 - p(1 - F(b)))u'(b + a_U^*) + p \int_b^\infty u'(w + a_U^*) dF(w)}_{\mathrm{E}_y\left[u'(y + a_U^*)\right]} + \mu_U, \tag{7}$$

where μ_U denotes the multiplier on the borrowing constraint for the unemployed job seeker at the end of period 1. If $\mu_U > 0$, $a_U^* = \underline{a}$, and the marginal propensity to consume in unemployment is one—in response to both liquidity provision raising the borrowing limit $\underline{a}$ or to higher initial wealth a_0.

We define as liquidity the level of the borrowing constraint, $\underline{a}$, and conduct comparative statistics with respect to it below. In our analysis, we use the definition of the Lagrange multiplier as the shadow price of relaxing the liquidity constraint:

$$\frac{dU_1(a_0)}{d\underline{a}} = \mu_U. \tag{8}$$

The *source* of the liquidity effect can be characterized by rewriting Equation (7) as:

$$\mu_U = u'(b + a_0 - a_U^*) - \mathrm{E}_y\left[u'(y + a_U^*)\right], \tag{9}$$

where $\mathrm{E}_y\left[u'(y + a_U^*)\right] = (1 - p(1 - F(b)))u(b + a_U^*) + p \int_b^\infty u(w + a_U^*)$ and and $\mu_U = u'(b + a_0 - \underline{a}) - \mathrm{E}_y\left[u'(y + \underline{a})\right]$ whenever the constraint binds. That is, liquidity constraints reflect the expectation

[4] To see this formally, consider the Lagrangian $\mathcal{L}^j = \max_{a \geq \underline{a}} u(w + a_0 - a) + u(w + a_w) + \mu_w(w - \underline{a})$, where μ_w is the multiplier on the liquidity constraint $a \geq \underline{a}$. The first-order condition with respect to a yields the savings choice a_w^* as the solution to $u'(w + a_0 - a_w^* = u'(w + a_w^*) + \mu_w$. An interior solution, $\mu_w = 0$, is ensured by a sufficiently low $\underline{a}$ and/or a sufficiently high a_0, namely $a_0/2 \geq \underline{a}$. With this, $a_w^* = a_0/2$ and hence $c_{w1} = c_{w2} = w + a_0/2$.

[5] Formally, the Lagrangian is $\mathcal{L}_U = \max_{a \geq \underline{a}} u(b + a_0 - a) + (1 - pF(b))u(b + a) + p \int_b^\infty u(w + a) dF(w) + \mu_U(a - \underline{a})$.

of consumption growth due to income growth (reemployment).

We now characterize the remaining two choices, namely period-1 search effort and the period-1 reservation wage, and how they relate to liquidity. We do so first in the baseline environment without OJS, and then show how these margins qualitatively change when we allow for OJS.

Search effort. The job search effort decision solves Equation (3), taking as given the income realizations and consumption choices in period 2, yielding the following optimality condition:

$$c'(s^*) = p'(s^*) \int_{\tilde{w}}^{\infty} (W_1(a_0, w) - U_1(a_0))\, dF(w), \tag{10}$$

where $\tilde{w}$ is the reservation wage.

Reservation wage. The second choice that may be affected by liquidity is the selectivity margin: whether to accept or reject the first-period job offer. The choice follows a reservation wage $\widetilde{w}$, the wage that ensures $U_1(a_0) = W_1(a_0, w)$:

$$\underbrace{2 \cdot u(\widetilde{w} + a_0/2)}_{=W_1(a_0,w)} = U_1(a_0). \tag{11}$$

Liquidity effect: job search. We now derive liquidity effects—here defined as shifting borrowing constraint $\underline{a}$. (A similar logic holds for wealth effects shifting a_0 Lise, 2013, as in).

Starting with job search effort, the effect of relaxing liquidity constraints by increasing $\underline{a}$ is given by—where for exposition we for this expression assume that the marginal offer arrival rate is constant $p'(s^*) = \lambda$:[6]

$$\frac{ds^*}{d\underline{a}} = -c''(s^*)^{-1} \lambda (1 - F(\tilde{w})) \cdot \boxed{\mu_U} \leq 0, \tag{12}$$

Hence, liquidity (relaxing the borrowing limit $\underline{a}$) affects job search as expected, lowering job search effort, if and only if the liquidity constraint binds, i.e., $\mu > 0$.

Intuitively, higher liquidity increases the value of unemployment. This reduces the benefit of job search effort, by closing the gap between the values of employment and unemployment. The value gain of unemployment is given by μ, which is the shadow value of liquidity, and this is multiplied with the share of job offers that are preferred to unemployment. To translate this reduction in gains from search, which is in utility terms, to job search effort, it is divided by the second derivative of the search cost (positive due to convexity).

[6]This expression uses three facts: (i) $\mu_U = dU_1(a_0)/d\underline{a}$ is the shadow price of relaxing the liquidity constraint, (ii) the reservation jobs' value equals the unemployment value when applying the Leibnitz rule, and (iii) the liquidity constraint in this environment binds only for the unemployed due to stable wages.

Liquidity effect: reservation wage. The effect of liquidity $\underline{a}$ on the reservation wage is given by:

$$\frac{d\widetilde{w}}{d\underline{a}} = \frac{\boxed{\mu_U}}{2u'(\widetilde{w} + a_0/2)} \geq 0, \tag{13}$$

where we again used the definition of the Lagrange multiplier, $\mu_U = dU_1(a_0)/d\underline{a}$. This derivative is strictly positive for a liquidity constrained worker, $\mu_U > 0$.

The intuition is simple: any shifter in the value of unemployment must increase the value of the reservation job, raising the reservation wage. Liquidity is one such shifter.

To see the dynamic distortion from liquidity constraints that is the source of the liquidity effect, note that due to consumption smoothing on the job, the reservation wage functions as the *certainty equivalent* of the risky income stream from unemployment and another job offer in period 2:

$$\begin{aligned} 2u(\widetilde{w} + a_0/2) &= u(b + a_0 - a_U^*) + \mathrm{E}_y\left[u(y + a_U^*)\right] &(14)\\ &= \left[u(b + a_0 - a_U^*) + u(b + a_U^*)\right] + p(1 - F(b))\mathrm{E}_w\left[u(w + a_U^*) - u(b + a_U^*)|w \geq b\right]. &(15)\end{aligned}$$

The first line makes clear that with complete markets or risk neutrality, the reservation wage equals the present value of the income stream. Self-insurance through a state-independent asset a partially insure the worker compared to that benchmark, lowering the reservation wage relative to the complete-markets benchmark. Liquidity constraints hamper this self-insurance, further lowering the reservation wage.

The second line makes clear that *selectivity*—$\widetilde{w} > b$—stems from the prospect of obtaining draws above the unemployment payoff in period 2. Since accepted wages exceed b in period 2, the reservation wage exceeds b by more, the more likely (p) or the higher-paying (w) period-2 job offers are.

The puzzle defined: liquidity effects operate on both margins. Our simple model formalizes the idea that liquidity effects show up in both margins: moral hazard in job search effort ($ds^*/d\underline{a} < 0$) and the selection margin through reservation wage adjustment ($d\widetilde{w}/d\underline{a} > 0$). Both effects originate from liquidity constraints: they are operational if $\mu_U > 0$ and they disappear when $\mu_U = 0$.

Existing resolution: assuming away frictional wage dispersion. The simplest resolution in the literature is to simply assume away search-frictional wage dispersion: in our model, this arises by with a degenerate wage offer distribution $F(w)$. In that case, the worker accepts the (any) job offer. This choice is reflected in canonical and pedagogical versions of the model as in Chetty (2008), where the worker can only draw one type of wage.

While an effective theoretical solution, the assumption required, that a worker gets paid the same across all potential job offers, would stand in contrast to the large theoretical and empirical literature on sequential search with a wage-offer distribution and the robust finding that observationally similar workers are paid different wages across different jobs (for example, see McCall,

1970; Shimer and Werning, 2008; Hornstein et al., 2011; Card et al., 2013, and many more).[7]

Existing resolution: skill depreciation. While the majority of the public finance literature has largely sidestepped this empirical puzzle, the existing resolutions predominantly rely on declining labor demand side valuations of the worker's skills—such as skill depreciation in unemployment or duration dependence that points to statistical discrimination (Kroft et al., 2013; Nekoei and Weber, 2017). In the simple model above, this resolution would show up as a reduction in the wage offer distribution in period 2, so that reemployment wages fall due to the longer duration from the search effort reduction (and would do so even with stable reservation wages).

Our resolution: on-the-job search. Our resolution instead points to the crucial absence of OJS in the baseline class of search models used to study the above questions. Next, we show that the presence of OJS *qualitatively* changes the logic of sequential search and breaks the role of liquidity constraints—reducing the job acceptance decision to a static one with appropriate assumptions on the relative efficiency of on OJS. For that reason, the reservation wage will be insensitive to liquidity.

To understand the role of on-the-job search, we now add a feature in period 2: the employed worker runs into an opportunity to search with exogenous probability p, and draws a job from $w \sim F(w')$. If that wage w' exceeds the current job's wage w from period 1, he switches and "moves up the job ladder." This feature extends the value of accepting a job with wage w in period 1 as follows:

$$W_1^O(a_0, w) = \max_{a \geq \underline{a}} u(w + a_0 - a) + (1 - p_O F(w))u(w + a) + p^O \int_w^\infty u(w' + a)dF(w'). \tag{16}$$

This option can reduce the reservation wage choice to a mechanical static comparison and hence removes the dynamic distortion from the liquidity constraint. To see this, we now expand the period-1 reservation-wage definition $W_1^O(a_0, \tilde{w}_O) = U_1^O(a_0)$ and show that it is insensitive to liquidity $\underline{a}$ (and wealth a_0):

$$u(\widetilde{w}_O + a_0 - \widetilde{a}_O) + u(\widetilde{w}_O + \widetilde{a}) + p^O \int_{\widetilde{w}_O}^\infty u(w + \widetilde{a}) - u(\widetilde{w}_O + \widetilde{a})dF(w) \tag{17}$$

$$= u(b + a_0 - a_U) + u(b + a_U) + p \int_b^\infty u(w + a_U) - u(b + a_U)dF(w). \tag{18}$$

For $p_O = 0$, the model nests the baseline case without OJS. For $p^E > 0$, i.e, with OJS, the additional considerations attenuate the dynamic distortion from liquidity constraints.

In the extreme case, for $p^O = p$ when OJS is as effective as search while unemployed in period

[7] Related, but still somewhat "mechanical" resolutions would rely on a very elastic job search effort margin while reservation wages may not respond much due to a low density of job offers around the reservation wage—such that the observed reemployment wage may not vary much despite an active selectivity margin in the latent reservation wage. *We aim to have explored this channel quantitatively in the next version.*

2, the reservation wage is a simple cutoff in the UI benefit b, irrespective of the shape of the utility function or liquidity constraints:[8]

$$\Rightarrow \widetilde{w}^O = b \tag{19}$$

$$\Rightarrow \frac{d\widetilde{w}^O}{d\underline{a}} = 0, \tag{20}$$

where, more precisely, $a_U = a_O$ and $\widetilde{w}_O = b$ are an equilibrium.

That is, with on the job search, liquidity—or any other dynamic considerations—can be entirely absent. For $0 < p_O < p$, the reservation wage closer to b than without OJS, and liquidity effects are attenuated.[9] This result formalizes the intuition from the introduction and Figure **??**.

4 Full model and quantitative analysis *[work-in-progress]*

In this section we formalize our resolution to the empirical puzzle that higher liquidity leads to longer unemployment duration but not higher reemployment wages. The key to our explanation is the presence of on-the-job search that eliminates the dynamic trade-off between accepting a given job offer over potential alternative future job offers—and hence neutralizes the intertemporal distortion from liquidity constraints. As our focus is on individual worker behavior, we abstract from endogenizing the worker contact rates and the risk-free interest rate.

4.1 Setup

We start by presenting the most general model, which nests all the specific cases which we then incrementally study.

Environment. Time is continuous and indexed by $t \in [0, \infty)$. Workers live forever and discount the future at rate $\rho > 0$.

Job search. Both unemployed and employed workers look for jobs in a frictional labor market, where search is random. Job offers arrive at exogenous rates $\lambda_U(s)$ and $\lambda_E(s)$ for the unemployed and employed workers, respectively. They may depend on endogenous search intensity s. Endogenous search effort is is subject to disutility functions $k_U(s)$ and $k_E(s)$, which are convex and

[8] To see this most clearly, set $a_0 = 0$ and $\widetilde{a}_O = a_U = 0$. This property echoes that in Lise (2013).

[9] These considerations regarding the role of p vs. p^O in the reservation wage become clearer in the following rearrangement of the indifference condition:

$$u(\widetilde{w}_O + a_0 - \widetilde{a}_O) + u(\widetilde{w}_O + \widetilde{a}) = u(b + a_0 - a_U) + u(b + a_U) \tag{21}$$

$$+ p(1 - F(b))(u(\widetilde{w}^O + a) - u(b + a_U)) + p \int_b^{\widetilde{w}_O} u(w + a) - u(\widetilde{w}_O + \widetilde{a}) dF(w) \tag{22}$$

$$+ (p - p^O) \int_{\widetilde{w}_O}^{\infty} u(w + a) - u(\widetilde{w}_O + \widetilde{a}) dF(w). \tag{23}$$

increasing in search effort. Upon a worker-firm contact, a wage w is drawn from an exogenous distribution with cumulative density function $F(w)$. After observing the wage, the worker decides whether to consummate the match. At each instant in time, active matches separate at rate δ, upon which the worker becomes unemployed.

Consumption and saving. Workers obtain utility from consumption $u(c)$. The utility function is of the constant relative risk aversion (CRRA) form given by $u(c) = c^{1-\sigma}/(1-\sigma)$ with $\sigma \geq 0$. $\sigma = 0$ nests the risk-neutral case and $u(c) = \log(c)$ when $\sigma = 1$. Workers choose consumption to maximize life-time utility. Workers receive income $y = w$ when employed in a job with wage w and unemployment insurance (UI) benefits $y = b$ when unemployed. Workers can save in a risk-free asset a paying interest at rate r. The law of motion for a worker's assets is then given by:

$$\dot{a}_t = \frac{da_t}{dt} = \begin{cases} b + ra_t - c_t & \text{if unemployed,} \\ w + ra_t - c_t & \text{if employed.} \end{cases} \tag{24}$$

Workers face a borrowing constraint $a_t \geq \underline{a}$, yielding the boundary condition $\dot{a}_t = y_t + r\underline{a} - c_t \geq 0$.

Unemployment value. Value of unemployment for a worker with wealth a satisfies the following Hamilton-Jacobi-Bellman (HJB) equation:

$$\rho U(a) = \max_{c,s} \; u(c) - k_U(s) + \lambda_U(s) \int \max\left\{0, W(a, \widetilde{w}) - U(a)\right\} dF(\widetilde{w}) + U_a(a)\dot{a}, \tag{25}$$

where U_a is the derivative of $U(a)$ with respect to assets. An unemployed worker chooses search effort s, and consumption c subject to the borrowing constraint. At rate $\lambda_U(s)$, she draws a wage offer $\widetilde{w}$ from $F(\widetilde{w})$, which she accepts if it provides a value higher than unemployment.

Employment value. Value of employment for a worker with wealth a, in a job paying wage w is given by the following HJB equation:

$$\begin{aligned} \rho W(a,w) = \max_{c,s} u(c) - k_E(s) + \lambda_E(s) \int \max\left\{0, W(a,\widetilde{w}) - W(a,w)\right\} dF(\widetilde{w}) \\ + \delta\big[U(a) - W(a,w)\big] + W_a(a,w)\dot{a}, \end{aligned} \tag{26}$$

where W_a is the partial derivative of $W(a,w)$ with respect to assets. Similar to the unemployed, the employed worker chooses consumption c and search effort s. She receives an outside offer at rate $\lambda_E(s)$, which she accepts if it offers a higher value than her current job. The worker separates into unemployment at rate δ.

Optimal choices. The first-order conditions for consumption give the following policy functions:

$$c_U^*(a) = u'^{-1}\left(U_a(a)\right), \tag{27}$$

$$c_E^*(a,w) = u'^{-1}\left(W_a(a,w)\right) \tag{28}$$

The first-order conditions for search effort yield the following policy functions for job search:

$$s_U^*(a) = k_U'^{-1}\left(\lambda_U'(s_U^*(a)) \int \max\left\{0, W(a,\widetilde{w}) - U(a)\right\} dF(\widetilde{w})\right), \tag{29}$$

$$s_E^*(a,w) = k_E'^{-1}\left(\lambda_E'(s_E^*(a)) \int \max\left\{0, W(a,\widetilde{w}) - W(a,w)\right\} dF(\widetilde{w})\right). \tag{30}$$

The reservation wage on the job is simply the current job's wage. The reservation wage for the unemployed job seeker holding assets a is $w_r(a)$, si given by the indifference condition between taking the job and staying unemployed:

$$W\left(a, w_r(a)\right) = U(a). \tag{31}$$

The reservation wage can be written as:[10]

$$w_r(a) = b - \left(k_U(s_U^*(a)) - k_E(s_E^*(a, w_r(a)))\right) + \left(\lambda_U(s_U^*(a)) - \lambda_E(s_E^*(a, w_r(a)))\right) \int_{w_r(a)} \frac{\left(W(a,\widetilde{w}) - U(a)\right)}{U_a(a)} dF(\widetilde{w}) \tag{35}$$

4.2 Parameterization *[work-in-progress]*

For now, we fix all the model parameters exogenously to qualitatively study how the presence of OJS changes the impact of liquidity on unemployment duration and reemployment wages. The parameters of the model are calibrated to a monthly frequency. Table 3 summarizes the model parameters and their values.

[10] From Equations (27) and (28), the indifference condition immediately implies that

$$c_E^*\left(a, w_r(a)\right) = c_U^*(a). \tag{32}$$

Evaluating Equation (26) at $w_r(a)$, and using $c_E^*\left(a, w_r(a)\right) = c_U^*(a)$ and $W_a\left(a, w_r(a)\right) = U_a(a)$, we get

$$\begin{aligned} \rho W(a, w_r(a)) =& u(c_U^*(a)) - k_E(s_E^*(a, w_r(a))) + \lambda_E(s_E^*(a, w_r(a))) \int_{w_r(a)} \Big(W(a,\widetilde{w}) - U(a)\Big) dF(\widetilde{w}) \\ &+ U_a(a)\big[w_r(a) + ra - c_U^*(a)\big]. \end{aligned} \tag{33}$$

Equating this to the value of unemployment in Equation (25)

$$\rho U(a) = u(c_U^*(a)) - k_U(s_U^*(a)) + \lambda_U(s_U^*(a)) \int_{w_r(a)} \Big(W(a,\widetilde{w}) - U(a)\Big) dF(\widetilde{w}) + U_a(a)\big[b + ra - c_U^*(a)\big], \tag{34}$$

from which follows the reservation wage expression as formulated in the main text.

Table 3: Model parameters

Parameter	Description	Value	Source/Target
σ	Risk aversion parameter	2	Standard
r	Interest rate	0.0017	2% annual risk-free interest rate
ρ	Discount rate	0.0079	10% annual discount rate
b	UI benefit	0.4	
$\underline{a}$	Borrowing limit	-3	
λ_U	Unemployed contact rate	0.2877	25% monthly UE probability
λ_E	Employed contact rate	0.2877	
σ_z	Standard deviation of wage draw	0.265	
μ_z	Mean of wage draw	-0.0351	Mean of log-normal normalized to 0.
κ_U, κ_E	Scale parameter of search cost	$0.5, 0.5$	Quadratic search cost function
γ_U, γ_E	Elasticity parameter of search cost	$1.0, 1.0$	Quadratic search cost function
α_U, α_E	Intercept of offer arrival rate	$0, 0$	
β_U, β_E	Slope of offer arrival rate	$1, 1$	

Notes: This table summarizes the model parameters and their values.

Pre-set parameters. We assume a CRRA utility function, $u(c) = c^{1-\sigma}/(1-\sigma)$ and set the risk aversion parameter to $\sigma = 2$. We set the real interest rate to $r = 1/12 \log(1 + 0.02)$ to generate a 2 percent annual risk-free interest rate. We set the discount rate to $\rho = 1/12 \log(1 + 0.10)$ to generate an annual discount rate of 10 percent resulting in a high MPC. We set the borrowing limit to $\underline{a} = -3$, which corresponds roughly to 100% of the average quarterly wage. We discretize the asset grid with 100 nodes with more grid points placed near the borrowing constraint to accurately capture non-linearities in the value and policy functions.

We set the offer arrival rates per unit of search effort for the unemployed to $\lambda_U = -\log(1 - 0.25)$ to roughly generate an unemployment-to-employment probability of 25 percent per month. In our baseline parameterization, we assume that OJS is as effective as search in unemployment, $\lambda_E = \lambda_U$. We assume that the search cost function takes the form $k_i(s) = \kappa_i s^{1+1/\gamma_i}$ for $i \in \{U, E\}$. In the baseline, we assume that search cost is quadratic by setting $\kappa = 0.5$ and $\gamma = 1$ for both the unemployed and employed workers. We further assume that $\lambda_i(s) = \alpha_i + \beta_i s$ as in Faberman et al. (2022) for $i \in \{U, E\}$. The overall offer arrival rate as a function of search is then given by $\lambda_i \cdot \lambda_i(s) = \lambda_i \times (\alpha_i + \beta_i s)$. This specification implies that some offers arrive passively without any active search effort, governed by the intercept term α_i, while workers can increase offer arrival rates by exerting search effort dictated by the slope term β_i. In the baseline, we assume $\alpha_i = 0$ and $\beta_i = 1$ for both the employed and unemployed, implying that the overall offer arrival rates are given by $\lambda_i s$ for $i \in \{U, E\}$.

Wage w is drawn from a log-normal distribution upon contact. We set the standard deviation parameter to $\sigma_w = 0.265$ and the location parameter to $\mu_w = -\sigma_z^2$ chosen such that the mean w draw is 1. We discretize the wage grid with 100 equally-spaced nodes between the 0.01th and 99.99th percentiles of the distribution. Finally, we set the UI benefit level to $b = 0.4$.

Estimated parameters. For now we set all the parameters externally.

4.3 Quantitative analysis *[work-in-progress]*

Search behavior and liquidity. Figure 2 shows the decisions by assets for our calibration model—for two versions, with and without OJS. For the OJS case, we showcase the specific case of equal job search efficiency. The heterogeneity by assets stand in for liquidity effects (but also capture wealth effects).

The panels show that search effort falls in effort in both models, with and without OJS. But the reservation wage is insensitve to assets with OJS. As a result, there is a quantitative attenuation of the unemployment duration gradient in assets, but the reemployment wage is flat.

Figure 3 traces out how the liquidity (wealth) effects on job search effort, reservation wages, unemployment duration and average reemployment wages, depend on the relative efficiency of job search on the job compared to unemployed search. When these parameters are equal, the reservation and and reemployment wage are insensitive to assets and liquidity, while job search effort and unemployment duration are not.

[In the next version, we will parameterize the model to match the empirical estimates on duration and reemployment wages, and quantitatively assess the power of our mechanism.]

5 Conclusion

We propose a simple resolution of a long-standing empirical puzzle in public finance and unemployment insurance (UI) research: unemployed job seekers prolong their unemployment duration in response to more liquidity (cash on hand), but do not appear to select better jobs.

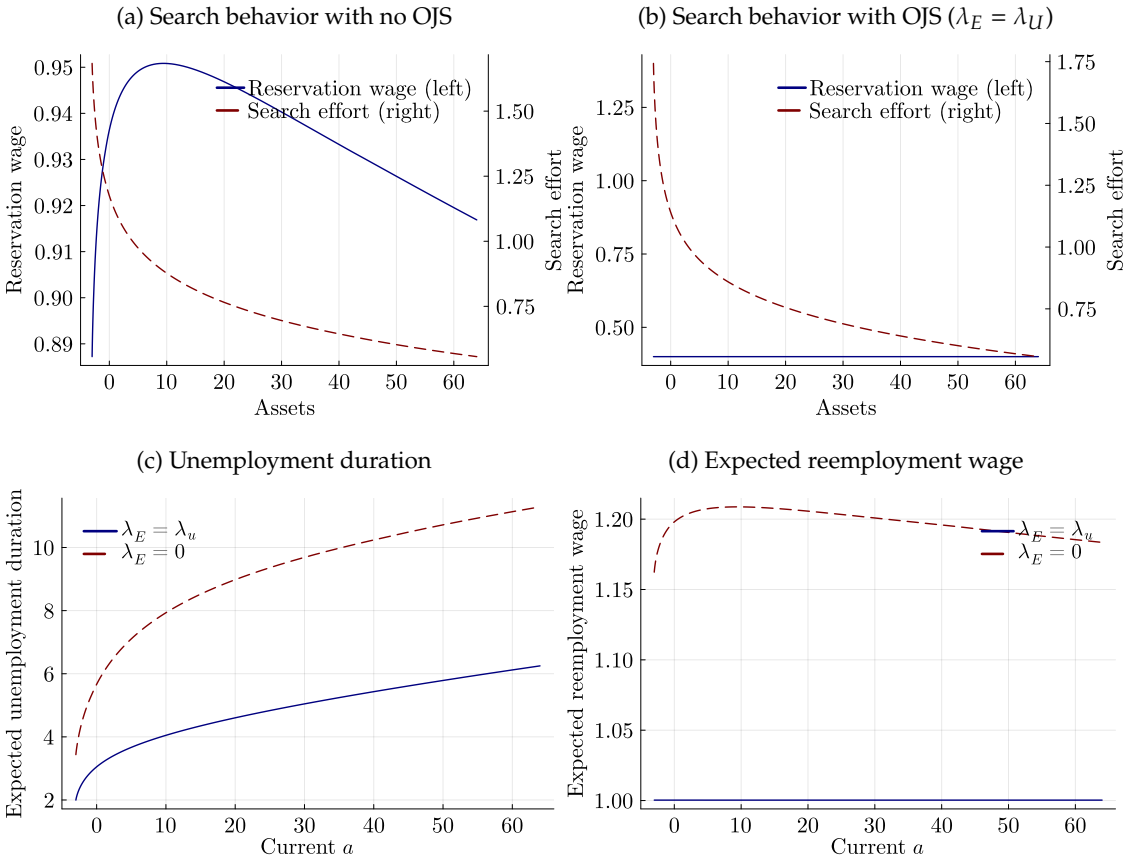
This pattern is surprising in light of the micro models of job search commonly used in this literature. These search models predict that liquidity constraints should prompt workers to rush to reemployment not only by increasing search effort but also by lowering their reservation wages.

Our resolution builds on incorporating on-the-job search (OJS): the ability to continue to search once reemployed. This feature is standard in modern search models featuring job ladders, but is omitted in the public finance literature that focuses on UI policy design and the job search behavior of the unemployed.

OJS can eliminate the dynamic trade-off between accepting a given job over potential alternative job offers in the future—and hence can neutralize the intertemporal distortion from liquidity constraints.

We formalize this resolution in a parsimonious McCall sequential search model with two features: endogenous search effort (so that higher liquidity increases unemployment duration) and OJS (so that higher liquidity need not increase new job quality). The calibrated model reconciles the large positive duration effects of liquidity and its zero wage effects.

Figure 2: Search behavior vs liquidity



Notes: This figure plots unemployed search behavior as a function of assets. Panel (a) shows how the reservation wage out of unemployment and unemployed search effort change with assets in a model with no OJS ($\lambda_E = 0$). Panel (b) does the same in a model where OJS is as effective as job search in unemployment ($\lambda_E = \lambda_U$). Panel (c) plots expected unemployment duration with respect to assets for the two model variants. Panel (d) plots average wages accepted out of unemployment.

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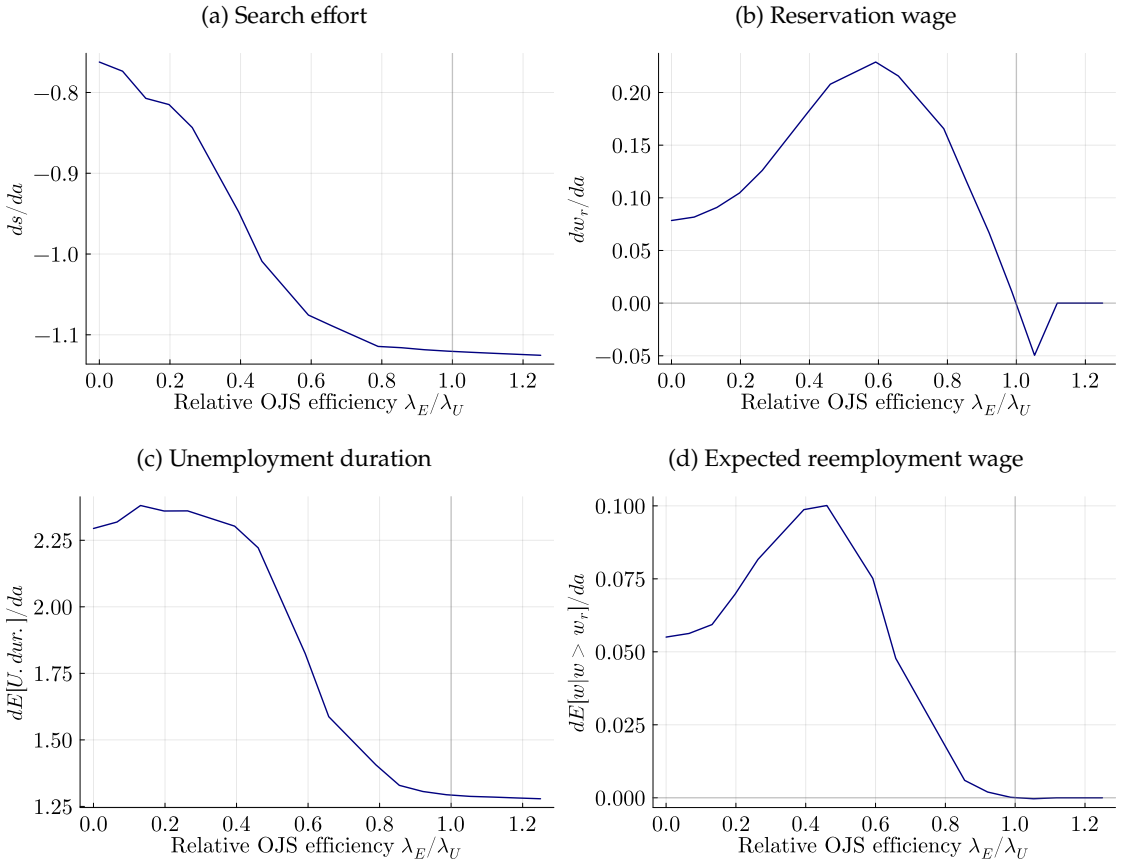
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Figure 3: Responses of search outcomes to liquidity by OJS effectiveness



Notes: This figure plots the derivatives of various search outcomes with respect to assets for the lowest and highest asset workers for a) search effort, b) reservation wage, c) expected unemployment duration, and d) expected reemployment wage.

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