Job Search and Subsistence Constraints *

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Abstract

This article analyzes the behavioral effects of unemployment benefits (UB) and it characterizes their optimal level when jobless people only survive if they have access to a minimum or subsistence consumption level in each period. To survive when the level of UB is very low, they carry out a subsistence activity. Our model shows that if the level of UB is very low, increasing the level of UB or providing liquidity to the agent from any source can *decrease* the duration in unemployment; for higher levels of UB we reencounter the standard properties that increasing UB increases duration (Mortensen, 1977) and that providing liquidity from any source to the agent increases duration (Chetty, 2008). We also show that the optimal level of UB satisfies the Baily Chetty formula (Baily, 1978, Chetty, 2006), but contrary to what Chetty (2008) found, in our model the gain from insurance cannot be rewritten using sufficient statistics; we show that this decomposition put forward by Chetty (2008) is not general, it requires specific assumptions.

1 Introduction

Unemployment insurance is not present in a number of countries (Vodopivec, 2013, Bosch and Esteban-Pretel, 2015) and, where it is in place, the level of benefits is sometimes low (Kupets, 2006). This raises the question of the subsistence of jobless people. This article analyzes the behavioral effects of unemployment benefits (UB) and it characterizes their optimal level when jobless people only survive if they have access to a minimum or subsistence consumption level in each period. Even though the existence of subsistence constraints has been recognized in the economic literature,[1] to the best of our knowledge, the design of unemployment insurance schemes has not explicitly integrated daily subsistence requirements.[2] Our model shows that if the level of UB is very low, increasing its level can *decrease* the duration in unemployment; for higher levels of UB we reencounter the standard property that increasing UB increases duration (Mortensen, 1977 [3]). Our model also shows that if the level of UB is very low, providing liquidity to the agents, coming from any source, can actually *decrease* the duration in unemployment; for higher levels of UB we reencounter the stardard property that liquidity increases duration (Chetty, 2008). Furthermore, compared to a framework

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[1] In the literature of development economics, see for instance: Dercon (1998) and Zimmerman and Carter (2003) about the role of subsistence constraints on assets accumulation for the poor and Bhalotra (2007) about the link between subsistence constraints and child work. In the literature of social insurance it has been mentioned by Chetty (2006) and Chetty and Looney (2006).

[2] As will soon be clear, this goes beyond the assumption that the marginal utility of consumption becomes huge when the level of consumption tends to zero. Pavoni (2007) analyzes the design of unemployment insurance when the planner must respect a lower bound on the expected discounted utility of the agent. The unemployed agent decides whether to search, or not (binary decision) subject to the scheme proposed by the planner.

[3] In Mortensen (1977)'s model the cost of job search is forgone leisure. He finds that duration increases with UB whenever leisure is a normal good, which is a well established property.

where minimum consumption is ignored, the optimal level of UB can be larger. We also show that the optimal level of UB satisfies the Baily Chetty formula (Baily, 1978, Chetty, 2006), but contrary to what Chetty (2008) found, in our model the gain from insurance cannot be rewritten using sufficient statistics; we show that this decomposition put forward by Chetty (2008) is not general, it requires specific modeling assumptions.

To look at the implications of a minimum consumption level, the jobless agent needs a way of reaching this minimum when the level of UB is not high enough, the unemployment risk is not covered by private insurers and credit markets are imperfect of absent. Consequently, in our model jobless people can conduct an activity which provides some consumption in addition to what UB, if any, allow to buy. This activity should be understood as a daily-life activity (for example, looking for discounts in the supermarket, fixing old clothes, etc) or as a casual informal activity (for example, selling home-made food, subsistence farming, etc). By introducing this subsistence activity, we introduce a neglected margin of self-insurance against unemployment.

Producing this subsistence consumption requires some input. The standard choice would probably be time and it is fairly obvious that the above-mentioned activities typically take time.[4] However, is time the relevant scarce resource to focus on? Several studies highlight that unemployed agents do not devote more than a few hours per week (or even less) to look for a job. For instance, Krueger and Muller (2010) report that the average unemployed person searches 4 minutes a day in Nordic countries, 10 minutes in the rest of Europe and 30 minutes in North America (see also Manning, 2011 for a synthesis of five studies, and more recently Aguiar et al., 2013). Accordingly, jobless people have plenty of time left and hence we do not assume that time is the pertinent input of the subsistence activity. More generally, we do not endogenize time allocation in our framework.

Following Shah et al. (2012) , Mullainathan and Shafir (2013), Mani et al. (2013), Shah et al. (2015), and Schilbach et al. (2016), who develop a number of experiments both in the United States and in developing countries, we consider instead that any individual has a limited "bandwidth". "Bandwidth measures our computational capacity, our ability to pay attention, to make good decisions, to stick with our plans, and to resist temptations" (Mullainathan and Shafir, 2013, p.41). So, the above-mentioned input needed to produce subsistence consumption is seen as a share of this bandwidth. When the level of UB is not high enough to cover the subsistence needs, the jobless individual has no choice but to pay *attention* to this vital problem. In the words of (Mullainathan and Shafir, 2013, p. 42), "scarcity taxes our bandwidth, and as a result, inhibits our most fundamental capacities."

Looking for a job requires both "effort" but also attention. On the one hand, effort includes sending one's résumé, knocking at the door of employers to ask whether they have job vacancies and the like but also a psychological cost.[5] On the other hand, the more jobless people carry out subsistence activities, the less attention they are able to put into the job search process, attention is needed to look for a job in order not to miss deadlines, to concentrate on details, to be more efficient, etc. This is an intuitive, yet neglected, trade-off whose consequences are at the heart of our analysis.

Related Literature

As we mentioned, in our model, when UB are low, an increase in its level could decrease the duration in unemployment. For higher values of the UB, we re-encounter the standard effect, i.e that increasing the level of UB increases duration. Several studies in the literature show that increments in the level of the UB increase duration in unemployment (See Tatsiramos and van Ours, 2014 for a survey), nevertheless, none of these studies focuses on modifications of the UB for levels that are below or very close to the subsistence requirements. The only study that we found where UB are not enough to cover subsistence is Kupets (2006), who made a duration analysis for Ukraine. She

[4]Several studies report that unemployed agents devote more time to household production, see for instance Krueger and Muller (2012), Aguiar et al. (2013) and Gimenez-Nadal and Molina (2013).

[5]"However, the time cost of job search may be higher than one might think as Krueger and Mueller (2010) find that levels of sadness and stress are high for the unemployed while looking for a job and levels of happiness are low. If these emotional costs are high, the cost of job search will be higher" Manning (2011), see also Krueger and Muller (2012).

found that the receipt of UB does not have a significant effect on duration for agents who carry out subsistence activities. We will comment in more detail this paper in section 4.1.

In our model, when UB are low, providing liquidity to the agents can actually help them to find a job. For higher values of UB, we re-encounter the standard effect, i.e that providing liquidity or cash transfers to agents increase their duration in unemployment. In fact, several studies (Chetty, 2008, Card et al., 2007, Basten et al., 2014) report that the probability of finding a job decreases when cash-constrained agents receive cash transfers (severance payments, or annuities of any kind). On the other hand, several studies show that cash transfers to people who live in poverty (conditional cash transfer (CCT), usually conditional on family structure, and/or maintaining kids on school, or unconditional cash transfers (UCT)) do not have a negative effect on employment outcomes or may even have positive ones (Banerjee et al., forthcoming, for an analysis of seven CCT and UCT, Barrientos and Villa, 2015 who analyzes a CCT in Colombia,[6] and Franklin, forthcoming who analyze a short-time subsidy for unemployed people in Ethiopia). We will comment in more detail the effect that liquidity has on the probability of finding a job in section 4.2

Our setup is formally similar to a framework in which job search requires effort and a *flow* expenditure of money. The framework in which job search requires both money and effort (or time) has been largely ignored by the literature, with some exceptions, namely: Barron and Mellow (1979), Tannery (1983) and Schwartz (2015). The two first papers assume that search requires *time* and money. Barron and Mellow (1979) does not assume any complementarity between time and money. Tannery (1983) criticizes that assumption but does not develop a theoretical analysis. Schwartz (2015) assumes that looking for a job requires effort (not time) and money. He assumes that job search can be influenced through search capital, which requires monetary expenditures to be maintained; in his framework, the monetary expenditure is *not* a flow per period; he develops a theoretical analysis for a simple two period setting, and he produces a numerical analysis.

Some papers consider that job search requires *only* money, namely: Ben-Horim and Zuckerman (1987), Decreuse (2002), Mazur (2016). These papers, as ours, highlight the positive effect that UB *can have* on the duration in unemployment. Nevertheless, if job search only requires money, the cost of search is a decreasing function of cash-on-hand. In this specification providing liquidity to the agents *always*[7] increases the probability of finding a job, which is at odds with empirical evidence which finds that cash-transfers increase duration (Chetty, 2008, Card et al., 2007, Basten et al., 2014), and with empirical evidence that shows that richer agents experience longer unemployment spells (Algan et al., 2003, Lentz and Tranaes, 2005, Lentz, 2009 and Centeno and Novo, 2014).

Finally, the literature about the design of the UB has always put forward the trade-off caused by it. The standard view is that the role of UB is to smooth consumption, the price being a distortion of incentives. See among many others Frederiksson and Holmlund (2006), Tatsiramos and van Ours (2014), Spinnewijn (2015), Schmieder and Watcher (2016). Our model suggests that for some low values of UB, this trade-off may not be present: increasing the level of this benefit increases the possibilities of the agent to smooth consumption and *also* increases her probability of finding a job. This implies that for low levels of b there is no behavioral cost, instead, there could be a behavioral gain. If that is the case, the role of UB would be not only to allow the agent to smooth consumption but also to provide her with tools that help her to find a job.

The paper is organized as follows: In Section 2 we start by presenting two standard results of the

[6]These CCT or UCT usually last for long periods of time, and do not change with the income level, Banerjee et al., forthcoming state: "Once a household becomes eligible for any of the programs that we study, the amount of benefit that one receives is the same regardless of actual income level and lasts at least a period between 2 and 9 years, depending on the program. This differs from many U.S. transfer programs (e.g. EITC, SNAP), where the stipend depends (either positively or negatively) on family income, and is updated frequently"

[7]The effect of providing liquidity to the agent, regardless of the employment status, is in principle ambiguous. Nevertheless, one can show that for a utility function that exhibits constant relative risk aversion (CRRA), providing liquidity to the agent increases job search effort and therefore decreases the expected duration in unemployment. If the utility function exhibits constant absolute risk aversion (CARA), providing liquidity to the agent has no effect on job search effort. These results are available from the authors upon request.

literature. Then we introduce our baseline model and do comparative statics. We further analyze the differences and similarities between our baseline model and a model in which job search requires both search and monetary expenditures and we discuss four extensions to our baseline model. In Section 3 we solve the planner's problem and find the Baily-Chety (Baily, 1978 and Chetty, 2006) formula, we also discuss the conditions that would allow to write the gain of insurance in terms of sufficient statistics. In section 4 we solve the baseline model and its extensions numerically, we show that when UB are low our model question the two standard properties with which we started the paper and we comment some empirical results found in the literature consistent with these findings. We finally conclude.

2 Positive Analysis

In this section we start by presenting two standard results of the literature: (1) a higher level of UB increases the expected duration unemployment and (2) providing liquidity to the agent increases the expected duration in unemployment. Then, we introduce our baseline model, which incorporates subsistence requirements and a subsistence activity, we analyze the optimal choices of the agent in that context. We continue by pointing out the similarities and differences between our baseline model and a model in which finding a job requires both job search and monetary expenses. Finally we introduce four extensions to our baseline model.

2.1 Standard Job Search Model [SM]

We start by introducing what we call the "standard model". It is a partial equilibrium job search model in a stationary discrete-time setting. Infinitely-lived, homogeneous and hand-to-mouth unemployed workers choose their search effort intensity, s. $\lambda(s)$ denotes the cost of job search effort and it is assumed that $\lambda(0) = 0$, $\lambda_s > 0$, $\lambda_{ss} \geq 0$. Unemployed workers are entitled to a flat unemployment benefit, b, with no time limit.[8] In each period the consumption of the unemployed agent, c^u, is equal to b. It is further assumed that the agent is risk averse, implying that her utility function is increasing and concave $u_c(c) > 0$, $u_{cc}(c) \leq 0$. In each period job offers arrive with a probability $P(s)$ and it is assumed that $P(0) = 0$, $P_s > 0$, $P_{ss} \leq 0$. The net wage associated to a job offer is equal to $w - \tau$, where w is the gross wage, and τ is the level of taxes needed to finance the UB scheme; the consumption when employed, c^e, is equal to $w - \tau$.[9] The disutility of the in-work effort is normalized to zero and it is assumed that the employed agent loses her job with an exogenous probability of ϕ.

The agent discounts the future at a rate $\beta = \frac{1}{1+r}$ where r is the interest rate. The timing is as follows: the unemployed chooses s in the current period, if she receives an offer, she starts working in the *next* period.

The Bellman equations of the the unemployed, and employed agent in the "Standard Model" [SM] are defined as:

$$[SM] = \begin{cases} V^U = \max_s \quad u(c^u) - \lambda(s) + \beta[P(s)V^E + (1 - P(s))V^U] \\ V^E = u(c^e) + \beta[\phi V^U + (1 - \phi)V^E] \end{cases} \tag{1}$$

Where $u(c^u) = u(b)$, $u(c^e) = u(w - \tau)$.

Subject to: $V^E - V^U \geq 0$, $s \geq 0$.

[8] Note that this implies that there's no room for an "entitlement effect" Mortensen (1977).

[9] As in Chetty (2008) or Hopenhayn and Nicolini (1997), we consider a degenerate distribution of wage offers. Moreover, as it is standard, the wage is the only feature that characterizes the job.

We want to highlight two well-known properties of an interior solution to problem [SM]:

(1) Increasing b increases D, the expected duration in unemployment, where $D = \sum_{t=0}^{\infty}(1-P)^t = \frac{1}{P}$. This property is standard in the literature since Mortensen (1977).

(2) Providing liquidity to the agent increases the duration in unemployment. This was pointed out by Chetty (2008).

To analyze the effect of liquidity, Chetty (2008) introduces an annuity in a set-up essentially equal to the [SM] just presented. This annuity is a lump-sum income (independent from the UB scheme) received by the agent regardless of her employment status, so that $c^u = b + annuity$ and $c^e = w - \tau + annuity$. In Chetty's model, providing liquidity to the agent always has a negative effect on the probability of finding a job, and therefore it unambiguously increases duration.

2.2 Baseline Model [BM]

Our baseline model builds upon the [SM], we incorporate four differences: First, the agent has a subsistence requirement c_{min}, which means that her total consumption in each period has to be greater than or equal to c_{min}. Second, we assume that the unemployed agent can carry out a subsistence activity to meet the subsistence requirements. Third, we assume that the agent has a stock of attention (or a "bandwidth") that we normalize to 1; the agent has to split her attention among two activities: job search and the subsistence activity.[10] Fourth, the job finding probability P has two inputs: job search, and attention. The problem of the unemployed agent is to choose the search effort intensity, s, and the proportion of attention devoted to subsistence activities, a, to maximize her expected discounted lifetime utility.

More formally: We assume that the agent has a utility function of the Stone-Geary type $u(c - c_{min})$. The consumption when unemployed becomes:

$c^u = b + g(a)$

where $g(a)$ is the subsistence activity, with: $g(0) = 0$, $g_a > 0$, $g_{aa} \leq 0$. This means that $b + g(a)$ has to be greater than or equal to c_{min}, therefore having $b + \lim_{a\to 1} g(a) \geq c_{min}$ is a requirement to have a solution with survival. We assume that all the attention that is not devoted to subsistence is devoted to job search; attention is not costly by itself, every person has a stock of attention that should be distributed among all the performed activities.

In each period job offers arrive with a probability $P(s,a)$ which increases with job search effort, and with attention devoted to job search $1-a$: $P_s > 0$, $P_{ss} \leq 0$, $P_a > 0$, $P_{aa} \leq 0$, moreover we assume that job search effort and attention devoted to search are complements, meaning that $P_{as} \leq 0$.[11] We also assume that *both* job search and attention are *needed* to find a job: $P(0,a) = P(s,1) = 0$.

We further assume that $g(a) \equiv 0$ when the agent is employed, meaning that all the attention of the employed agent is devoted to work.[12]

We assume that the subsistence activity $g(a)$ has *only* a trade-off cost (the attention devoted to it is not devoted to job search) but it does not have any direct cost. This is the case because the subsistence

[10] "Scarcity in one walk of life means we have less attention, less mind, in the rest of life." Mullainathan and Shafir (2013) pg. 42

[11] van den Berg and van der Klaauw (2006) consider a model with two search channels (formal and informal). Contrary to us their two channels are independent, one leads to a formal job and the other one to an informal job. Moreover, each channel has its own cost in terms of utility. In our baseline setup, attention is a stock, and thus there is only a trade-off cost of allocating it, and not an explicit cost in terms of utility. In section 2.4 we extend the model to consider the case where on top of demanding attention, the subsistence activity has a direct cost.

[12] Otherwise the attention allocation of the employed agent should also be analyzed. In such a setup, the probability of losing the job, ϕ, would be a function of the attention devoted to work. Given our focus on the problem of the unemployed, this analysis is beyond our scope.

activity is assumed to be a daily-life activity, or a casual informal activity whose cost should not be higher than the one of a formal job (whose cost is normalized to zero). Nevertheless, in the extensions to the baseline model [BM] we relax this assumption, and we allow for a direct cost of this subsistence activity (this direct cost may be present if the subsistence activity is an activity which is dangerous, demeaning and/or physically tiring). Moreover, all along the paper we assume that a and s are not observable by the government or UI agency, [13] therefore there are no fines or punishments associated to $g(a)$ or to the lack of s.

The Bellman equations of the the unemployed, and employed agent in the "Baseline Model" [BM] are defined as:

$$[BM] = \begin{cases} V^U = \max_{s,a} \quad u(c^u) - \lambda(s) + \beta[P(s,a)V^E + (1-P(s,a))V^U] \\ V^E = u(c^e) + \beta[\phi V^U + (1-\phi)V^E] \end{cases} \tag{2}$$

where $u(c^u) = u(b + g(a) - c_{min})$, $u(c^e) = u(w - \tau - c_{min})$.

Subject to: $c^u \geq c_{min}$, $V^E - V^U \geq 0$, $0 \leq a \leq 1$ and $s \geq 0$.

Our specification pretends to be in line with the scarcity literature, from which we extract four stylized facts: (1) Scarcity captures the mind automatically:[14] in our model if $b < c_{min}$ the agent *must* devote some attention to subsistence, and in that sense, scarcity captures the mind automatically. (2) Scarcity makes us better at solving problems related with scarcity (*focus* effect):[15] in our model by devoting attention to the subsistence activity the agent is able to increase her consumption.[16] (3) Scarcity leaves less bandwidth (less attention) to other aspects of our life (*tunnel* effect):[17] in our model devoting attention to subsistence leaves less attention available for job search. (4) None of these characteristics are personal traits: *any* person faced with scarcity would act in this way:[18] we model homogeneous agents, we do not claim that just one type (namely "poor agents") behave in this way.

Comparative Statics in the Baseline Model The first order conditions of this maximization program, if the solution is interior, are:[19]

$$G_a \equiv u_c(c^u)g_a + \beta P_a[V^E - V^U] = 0 \tag{3}$$

$$G_s \equiv -\lambda_s + \beta P_s[V^E - V^U] = 0 \tag{4}$$

[13] On the difficulty of observing job search effort without errors, see for instance Cockx et al. (2017).

[14] "Scarcity captures our mind automatically. And when it does, we do not make trade-offs using a careful cost-benefit calculus. We tunnel on managing scarcity both to our benefit and to our detriment"), pg. 34-35 Mullainathan and Shafir (2013).

[15] "The very lack of available resources makes each expense more insistent and more pressing. A trip to the grocery store looms larger, and this month's rent constantly seizes our attention. Because these problems feel bigger and capture our attention, we engage more deeply in solving them. This is our theory's core mechanism: Having less elicits greater focus." Shah et al. (2012)

[16] One could also capture this effect by having that $g(a,b)$ with $g_a > 0$ and $g_b < 0$, that is, the more scarcity the agent faces (smaller b) the higher is her ability to transform attention into consumption. Having $g(a,b)$ instead of $g(a)$ reinforces our findings. The development is available from the authors upon request.

[17] "Focusing on something that matters to you makes you less able to think about other things you care about. Psychologists call this *goal inhibition*. Goal inhibition is the mechanism underlying tunneling.", pg.31 Mullainathan and Shafir (2013).

[18] "Being poor means coping not just with a shortfall of money, but also with a concurrent shortfall of cognitive resources. The poor, in this view, are less capable not because of inherent traits, but because the very context of poverty imposes load and impedes cognitive capacity. The findings, in other words, are not about poor people, but about any people who find themselves poor." Mani et al. (2013).

[19] Corner solutions are discussed in Appendix A.1.

Where $V^E - V^U = \frac{u(c^e)-u(c^u)+\lambda(s)}{1-\beta[1-P(s,a)-\phi]}$.

We are particularly interested in the reaction of the agent when b changes, i.e, in $\frac{da}{db}$ and in $\frac{ds}{db}$. In general, an increment in b induces ambiguous effects over s and over a, which implies that the standard property of the literature $\frac{dP}{db} < 0$ is not *necessarily* met. In what comes, we discuss the condition under which $\frac{da}{db} < 0$, and we comment on the fact that $\frac{ds}{db}$ is almost always negative.

The marginal effect of the UB level on attention devoted to job search The following expression summarizes the necessary and sufficient conditions under which an increase in b causes an increase in the attention devoted to job search, $1-a$, i.e, such that $da/db < 0$:[20] (see Appendix A.1 for the general formula)

$$\underbrace{\underbrace{-u_{cc}(c^u)g_a > \beta\frac{\partial(V^E - V^U)}{\partial b}}_{\textit{necessary condition}}(P_a - P_{as}\frac{P_s}{P_{ss}})}_{\textit{sufficient condition}} \tag{5}$$

When b increases, two different forces affect a. Consider first the left hand side of the inequality: it tells us that when b increases the marginal utility gain of devoting attention to the subsistence activity while jobless is smaller. This is because the marginal utility of consumption is decreasing (concave utility). This effect goes in the direction of reducing a, that is, in the direction of increasing the quantity of attention that is devoted to job search. We call this an *income effect*: having additional money ($db > 0$), reduces the marginal utility of further consumption.

Consider now the right hand side of the inequality: $\beta\frac{\partial(V^E-V^U)}{\partial b} < 0$ implies that an increment in b distorts the relative value of being employed vs. being unemployed.[21] This effect is weighted by two factors. The first one, P_a: since employment is less attractive, devoting attention to job search is less rewarding. The second one, $P_{as}\frac{P_s}{P_{ss}}$: acts through the complementarity between s and $1-a$ in $P(a,s)$: if $P_{as} = 0$ this effect would be zero. An increase in b has a negative direct impact on s (The partial derivative of the FOC of s with respect to b, G_{sb}, is negative; see in Appendix A.1), which reduces the marginal contribution of devoting attention to job search if, as we assume, $P_{as} < 0$. Consequently, all the RHS goes in the direction of increasing a. We call this a *substitution effect*: increasing b distorts the relative value of being employed vs. being unemployed.[22]

In our numerical exercise we observe, for a broad set of parameters, that for low values of b the *income effect* dominates the *substitution effect*, causing $\frac{da}{db}$ to be negative.[23] That is, for low values of b increasing it increases the quantity of attention that the agent devotes to job search. For high values of b, this is no longer the case.

[20]Note that, if $\lambda_{ss} = 0$ the conditions would stay equal. Instead, if $P_{ss} = 0$, then the term $\frac{-P_s}{P_{ss}}$ in the condition above must be replaced by the term $\frac{\lambda_s}{\lambda_{ss}}$ (see Appendix A.1 for the details).

[21]This effect is of course reinforced if we consider that financing a higher b requires higher taxes, and thus the net wage $w-\tau$ is smaller.

[22]Note that $\frac{\partial(V^E-V^U)}{\partial b}$ is negative not only because of "moral hazard". To see this, imagine that db is provided to the agent regardless of her employment status (i.e, her income when unemployed increases by db but also her income when employed), in such a case still $\frac{\partial(V^E-V^U)}{\partial b} < 0$. That would be the case as long as perfect smoothing between employment and unemployment were not possible, because without perfect smoothing the additional income raises V^E and V^U in different amounts.

[23] We observe this not only for the parametrization of the baseline model exposed in Table 1, but also for all the 35 cases summarized in Table 2.

The marginal effect of the UB level on search effort The total expression for $\frac{ds}{db}$ is equation (31) in Appendix A.1. All forces in that equation, except one, push it to be negative. The only force against is due to the complementarity between $1-a$ and s. When $\frac{da}{db} < 0$ the quantity of attention devoted to job search increases with b. This together with $P_{as} < 0$ cause the marginal contribution of s to $P(a,s)$ to be higher, and this pushes s upwards. This is only possible, of course, when $P_{as} < 0$ and when $\frac{da}{db} < 0$. Nevertheless, in the numerical exercise for the baseline model [BM], this effect was never big enough to compensate for the fact that a higher b makes employment less attractive as compared with unemployment.

2.3 Monetary Cost of Job Search [MC]

The Bellman equations of the the unemployed, and employed agent in the "Model with monetary costs of job search" [MC] are defined as:

$$[MC] = \begin{cases} V^U = \max\limits_{s,m} \quad u(c^u) - \lambda(s) + \beta[P(s,m)V^E + (1-P(s,m))V^U] \\ V^E = u(c^e) + \beta[\phi V^U + (1-\phi)V^E] \end{cases} \tag{6}$$

Where $u(c^u) = u(b - d(m))$, $u(c^e) = u(w - \tau)$ and $d(m)$ is the quantity of money devoted to job search, and $d_m > 0, d_{mm} \leq 0$

Subject to: $V^E - V^U \geq 0$ and $s \geq 0$.

As we highlighted before, our baseline model [BM] is formally similar to a framework in which job search requires effort and a *flow* expenditure of money as [MC]. The difference compared with the baseline model [BM] is that $g(a) \equiv -d(m)$, $P(s,a) \equiv P(s,m)$ where now $P_m > 0$, i.e spending money in job search increases the probability of finding a job, and there's no subsistence requirement c_{min}. By giving the agent a way to cope with subsistence requirements, the baseline model [BM] generates a trade-off which is equivalent: when the agent has enough money to subsist, she has to decide whether she wants to maintain, up to some degree, this subsistence activity or not. If she maintains it, she will have more consumption, but less attention to look for a job. Equivalently, when search requires money and effort, as in [MC], the agent has to decide whether to devote money to job search, and thus reduce consumption, or not.

Problems [BM] and [MC] can be seen as equivalent if one ignores c_{min}. When c_{min} is taken into account in [BM], the difference between the two setups is deeper than it appears at first glance, because $b - d(m) \leq b$ and subsistence cannot be guaranteed if $b < c_{min}$.

2.4 Extensions to the Baseline Model [BM]

In this section we introduce four extensions to the baseline model [BM], whose aim is to allow for a more realistic setup. First, we maintain the stationary setup and we consider the case in which the subsistence activity $g(a)$ has a cost beyond the decline in the exit probability. The other three extensions abandon the stylized stationary setup we had so far; in all of them time is finite, the agent lives for T periods (from period 0 to period $T-1$) and we introduce finite entitlement to the flat b, the presence of incomplete financial markets and stochastic wage offers, respectively. In the second extension we assume that the agent is entitled to the UB for $B < T$ periods, we call it "model with finite entitlement" [FE]. In the third one, we allow for the presence of incomplete financial markets: the agent starts her life with an exogenous level of assets, she can save and get indebted up to a certain limit L, that she has to repay at the end of period $T-1$, we call it "model with incomplete financial markets" [FM]. In the fourth one, we assume that there is a distribution of wage offers (McCall, 1970); when the agent receives an offer she has to decide whether to accept it or to reject it, she follows a stopping rule: she rejects offers which are below the endogenously chosen reservation wage, we call this model "stochastic wage offers" [SWO]. We will now introduce the first extension, in Appendix A.1.2 we develop the other three settings theoretically.

Direct cost of the activity $g(a)$ Note that our baseline model [BM] does not consider the fact that the subsistence activity may have a cost beyond the decline in the exit probability. In some situations the subsistence activity, $g(a)$, can have a direct cost; [24] for example, it may be dangerous, demeaning or physically tiring.

We define a "model with direct costs of the activity $g(a)$" [DC $g(a)$] as:

$$[\text{DC } g(a)] = \begin{cases} V^U = \max\limits_{s,a} \quad u(c^u) - \lambda(s) - \eta(a) + \beta[P(s,a)V^E + (1-P(s,a))V^U] \\ V^E = u(c^e) + \beta[\phi V^U + (1-\phi)V^E] \end{cases} \tag{7}$$

where $u(c^u) = u(b + g(a) - c_{min})$, $u(c^e) = u(w - \tau - c_{min})$. And $\eta(a)$ is the direct cost of the activity $g(a)$, with $\eta(0) = 0$, $\eta_a > 0$, $\eta_{aa} > 0$.

Subject to: $c^u \geq c_{min}$, $V^E - V^U \geq 0$, $0 \leq a \leq 1$ and $s \geq 0$.

3 Optimal Unemployment Insurance

3.1 The Planner's Problem

We consider here the basic setting with a hand-to-mouth and infinitely lived agent. The optimal level of the flat benefit b maximizes the lifetime utility of the unemployed subject to a budget-balanced condition for the Government (that is, the agent covers all the expected costs of the UB scheme).

To construct the budget-balanced condition we transpose the approach of Shimer and Werning (2007) to a discrete time setup. The idea is that the net actualized cost of the job seeker should be null. Let C^U be the net actualized cost of the UB scheme for a job seeker, and C^E be the net actualized cost of a wage earner written in a recursive way. For simplicity, we write P instead of $P(s,a)$:

$$C^U = b + \beta[P\,C^E + (1-P)C^U] \tag{8}$$

$$C^E = -\tau + \beta[\phi\, C^U + (1-\phi)C^E] \tag{9}$$

The net actualized cost of the job seeker should be zero. Then, $C^E = \frac{-\tau}{1-\beta(1+\phi)}$. Plugging this last expression and $C^U = 0$ in (8), gives us:

$$\frac{b}{\beta P} = \frac{\tau}{1-\beta(1-\phi)}$$

The expected duration of *one episode* of unemployment is equal to $D = \sum_{t=0}^{\infty}(1-P)^t = \frac{1}{P}$. Considering this, τ can be written as:[25]

$$\tau = \frac{1-\beta(1-\phi)}{\beta} b\,D \tag{10}$$

[24] We maintain the original assumption that attention is not costly by itself; what is costly in this new setup is the subsistence activity $g(a)$ to which attention is assigned.

[25] This is the quantity of taxes that has to be paid during one episode of employment to cover the costs of one episode of unemployment. Job destruction, i.e, $\phi \neq 0$, means that there will be *several* employment and unemployment spells. Nevertheless, since time is infinite, this formula remains valid: the *total* expenditure in unemployment will be paid during the *total* time the agent is employed.

We are now ready to compute the optimal level of b, i.e, the one that maximizes V^U subject to (10).

$$\max_b V^U = \quad u(c^u) - \lambda(s) + \beta[PV^E + (1-P)V^U] \tag{11}$$

The problem is stationary, therefore, V^U can be written as:

$$V^U = \frac{1-\beta(1-\phi)}{(1-\beta)(1-\beta+\beta\phi+\beta P)}\left(u(c^u) + \frac{\beta P}{1-\beta(1-\phi)}u(c^e) - \lambda(s)\right)$$

We need to look only at the direct impact of a change of b, because the envelope conditions eliminate the first-order effects of the behavioral responses (Chetty, 2006). Deriving the previous expression with respect to b gives:

$$\frac{dV^U}{db} = \quad \frac{1-\beta(1-\phi)}{(1-\beta)(1-\beta+\beta\phi+\beta P)}\left(u'(c^u) - \frac{\beta P}{1-\beta(1-\phi)}u'(c^e)\frac{d\tau}{db}\right) \tag{12}$$

Take $\frac{dV^U}{db} = 0$, and note from (10) that $\frac{d\tau}{db} = \frac{1-\beta(1-\phi)}{\beta}\left(\frac{-1}{p^2}\frac{dP}{db}b + \frac{1}{p}\right)$. Plugging this in (12) and simplifying gives:

$$0 = u'(c^u) - u'(c^e)\left(\frac{-1}{p}\frac{dP}{db}b + 1\right) \tag{13}$$

Note that the elasticity of duration with respect to b, i.e $\varepsilon_{D,b}$ is equal to $\frac{-b}{P}\frac{dP}{db}$. So, the optimal level of b verifies the following implicit equation:

$$\frac{u'(c^u) - u'(c^e)}{u'(c^e)} = \varepsilon_{D,b} \tag{14}$$

This is the Baily Chetty formula (Baily, 1978 and Chetty, 2006). It's interpretation is the standard one, the left hand side (LHS) of the equation is equal to the *gain* of providing a higher b: consumption smoothing. The right hand side (RHS), in turn, is equal to the cost of providing a higher b: the behavioral reaction of the agent; it is typically assumed that a higher b reduces the job search efforts of the agent, causing her to remain longer in unemployment, this negative reaction to the distorted incentives is the cost captured by the RHS.[26]

Appendix A.2.2 generalizes this analysis in a non-stationary setup. The resulting formula has only slight modifications, the most important being that, since $c_t \neq c_{t+1}$, then what is relevant is the *average* consumption when employed and when unemployed.

If the underlying model is the standard model [SM] -or a model like the one of Chetty (2008)-, the previous formula can be rewritten as:

$$\frac{\text{liquidity effect}}{\text{moral hazard effect}} = -bD(\text{liquidity effect} + \text{moral hazard effect}) \tag{15}$$

[26] Schmieder and von Watcher (2017) highlight that the RHS can be written as the behavioral cost of changing b divided by the mechanical cost of changing b, where the mechanical cost is defined as "by how much the policy change actually increases the transfer to the unemployed in the absence of behavioral responses".

Where liquidity effect = $\frac{\partial P}{\partial \text{annuity}}$ and moral hazard effect $\frac{\partial P}{\partial w}$.

The decomposition of the LHS is put forward by Chetty (2008), the decomposition of RHS is evident from the fact that $\varepsilon_{D,b} = -bD\frac{dP}{db}$, and from the fact that $\frac{dP}{db}$ = liqudity effect + moral hazard effect. From this expression it is very clear that *conditionally* on $\varepsilon_{D,b}$, the higher the liquidity effect, the higher the optimal level of b, and in this sense "if an agent chooses a longer duration primarily because he has more cash on hand (as opposed to distorted incentives), we infer that UI benefits bring the agent closer to the social optimum." Chetty (2008). Note, nevertheless, that unconditionally, a higher liquidity effect does not necessarily imply a higher optimal level of b.

As Chetty highlights, the "sufficient statistics" approach is very useful, but since all the inputs ($\varepsilon_{D,b}$, the moral hazard effect and the liquidity effect) are endogenous to the level of b, an empirical analysis that follows this sufficient approach applies only locally.

Moreover, the "sufficient statistics" approach is less model dependent than other alternatives (structural estimation or numerical simulations), as Chetty (2008) claims. Nevertheless, it should be noticed that the LHS decomposition crucially depends on some modeling assumptions: (1) the probability of finding a job, P, cannot be affected by more than one variable: When b changes, all variables except for one, should remain constant, (2) The cost of search needs to be separable from consumption. This means that if looking for a job implies, up to a certain degree, a cost in terms of consumption , then it is no longer possible to re-write the LHS of the Baily-Chetty formula using sufficient statistics, i.e, as the ratio of the liquidity effect and the moral hazard effect.

In our setting (baseline model [BM] and its extentions) these two conditions are not satisfied: devoting attention to job search has a cost that is not separable from consumption and the probability of finding a job is affected by two choice variables (P is a function of a and s), meaning that the decomposition in sufficient statistics is not possible (See Appendix A.2.1 for the proof).[27]

3.2 Interpretation and the role of c_{min} and $g(a)$

Starting from our baseline model [BM], the Baily-Chetty formula, can be written as:

$$\frac{u'(b+g(a)-c_{min})-u'(w-\tau-c_{min})}{u'(w-\tau-c_{min})} = \varepsilon_{D(a,s),b} \tag{16}$$

Even if the formula for the optimal b is the standard one, our baseline model [BM] incorporates two new elements with respect to the standard model [SM]: c_{min} and $g(a)$, which introduce changes both to the left and to the right hand side of the equation. In the following paragraphs we study the impact of each of them first separately and then together.

The role of c_{min}: If we consider the standard model [SM], and we introduce a subsistence requirement, the LHS of (14) will be higher because of the concavity of $u(c)$. Regarding the RHS, which can be written as: $\varepsilon_{D,b} = \frac{-b}{P}\frac{dP}{db} = \frac{b}{P}\frac{dP}{ds}(\frac{-ds}{db})$, one can show that in the presence of c_{min}, s is higher,[28] and thus $P(s)$ is higher, this causes the two first terms of this expression to be lower, but it is not clear

[27] Gerard and Gonzaga (2016) also report that the decomposition is not possible in their setting because, as we do, they consider several choice variables. If one is willing to assume that when b changes one of the two variables remain constant -as Chetty (2008) does when he incorporates the reservation wage (a second variable) in his setup- then the decomposition remains possible, if the variable that changes has cost which is separable from consumption.

[28] Consider the standard model [SM], The FOC is: $G_s \equiv -\lambda_s + \beta P_s(V^E - V^U) = 0$, and $\frac{ds}{dc_{min}} = -\frac{G_{s,c_{min}}}{G_{s,s}}$. We know that $G_{ss} < 0$, and $G_{s,c_{min}} = \frac{\beta P_s}{1-\beta[1-P(s)-\phi]}(-u'(c^e)+u'(c^u)) > 0$, therefore $\frac{ds}{dc_{min}} > 0$.

whether $\frac{-ds}{db}$ is also lower in the presence of c_{min}, meaning that the effect over the RHS is ambiguous. Nevertheless, numerically we always find that a higher c_{min} implies a *higher* optimal b.[29]

The role of $g(a)$: If we take the standard model [SM] and (1) add the subsistence activity $g(a)$, (2) consider a specification for $P(s,a)$ such that when the quantity of attention devoted to job search is the maximum, i.e $a = 0$, the function reduces to the same function of the standard model $P(s)$ (for example $Bs^{\beta_1}(1-a)^{\beta_2}$, if $a = 0$, the function becomes $P(s) = Bs^{\beta_1}$), then the optimal level of b will be *lower* in the resulting model, ceteris paribus. This is because the resulting model is more general, in the sense that the agent always has the option of devoting all her attention to job search and by doing so to go back to the standard model. The introduction of the subsistence activity $g(a)$ gives room for improving the consumption level in unemployment.[30]

c_{min} and $g(a)$ together: As we just saw, a higher c_{min} pushes the optimal b upwards. Instead a higher $g(a)$ pushes the optimal b downwards. This in turn means that when we consider the two features together, the effect over the optimal b, as compared with the standard model [SM], is ambiguous. In Section 4.3 will provide orders of magnitude.

4 Numerical Exercise

In this section we solve the optimization problem numerically. Our aim with the numerical analysis is three-fold. First, we want to show that the property of a hump-shaped $P(s,a)$ is present in the baseline model and it is robust to a wide number of parametrizations, and to the extensions that have been introduced. Second, in section 2 we showed which is the effect of providing liquidity to the agent in the baseline model [BM], in this section we want to analyze the effect of providing liquidity to the agent in the different extensions to the baseline model [BM]. Third, we want to make an ordinal comparison of the optimal level of b, that is, we want to analyze in which cases the optimal level of b in the baseline model [BM] is higher/lower than the one in the standard model [SM].

The benchmark parametrization takes the functions and parameters specified in Table 1. We take the time unit to be a week. The values of ϕ and r are taken from Shimer and Werning (2007) and the value of σ is taken from Chetty (2008); the chosen parametrization applied to the Baseline Model [BM] gives, for the optimal level of b (which is $b = 0.57w$, i.e, a replacement rate (RR) of 0.57) an expected duration of one episode of unemployment equal to of 18.65 weeks, which is reasonable.[31]

4.1 Impact of b on the Duration in Unemployment

In this section we solve the baseline model [BM], its extensions ([DC g(a)],[FE], [FM] and [SWO]) and the model with monetary costs of job search [MC] numerically, and we analyze the relationship between the level of b and the expected duration in unemployment. Solving the [BM] numerically we find that the relationship between P and the level of b is hump-shaped: when b is low enough, increasing it increases the probability of finding a job; instead, when b is big enough, increasing it, reduces the probability of finding a job. This property is robust to the presented extensions of the model. In this section we also comment some empirical results found in the literature.

[29] Recall that the standard model with subsistence requirements, without any mechanism to cope with those subsistence requirements, is only defined for levels of $b > c_{min}$.

[30] In a setup with home production Taskin (2011) finds a similar result.

[31] Chetty (2008) calibrates his model for the US to have an average unemployment duration of 15.8 weeks.

	Description	Functional Form	
$u(c^u)$	Utility Function	$\frac{c^{1-\sigma}}{1-\sigma}$	Chetty (2008)
$\lambda(s)$	Cost of Search effort	$e^{\mu s}-1$	Cockx et al. (2017)
$g(a)$	Subsistence Production	$G a^{\gamma}$	Our choice
$P(s,a)$	Prob. of finding a job	$B s^{\beta_1}(1-a)^{\beta_2}$	Cobb Douglas, our choice

		Parameters (baseline)	
ϕ	Job Destruction rate	0.00443	Shimer and Werning (2007)
r	Interest rate	0.001	Shimer and Werning (2007)
β	Discount rate	0.999	$1/1+r$
E	Coefficient accompanying $P(s,a)$	0.2	
β_1	Exponent of the isoelastic s in $P(s,a)$	0.5	
β_2	Exponent of the isoelastic a in $P(s,a)$	0.8	
w	Wage	100	
c_{min}	Subsistence constraint	20	
σ	RRA	1.75	Chetty (2008)
μ	Parameter of $\lambda(s)$	0.3	
G	Scale parameter of $g(a)$	22	
γ	Exponent if $g(a)$ is isoelastic	0.8	

Table 1: Functional Forms and Parameters

Baseline Model [BM]: In section 2.2 we showed that in the baseline model [BM] an increment in b has an ambiguous effect on P, the probability of finding a job, contrary to the standard job search model [SM], where increasing b unambiguously reduces P; recall that the expected duration in unemployment is equal to $\frac{1}{P}$. We now solve the problem numerically to provide more insight behind the ambiguity. In this section, contrary to what was done in section 2.2, we analyze budget-balanced changes of b, that is, whenever b changes, τ changes accordingly; this implies that formula 5 in section 2.2 has one modification: the term $\frac{\partial(V^E-V^U)}{\partial b}$ has to be replaced with $\frac{d(V^E-V^U)}{db}$, i.e what is relevant now is the total, and not the partial derivative.

The graph on the left of Fig 1 shows the variation in the quantity of attention devoted to subsistence as a function of the level of b. When b is 0, the agent devotes most of her attention to subsistence. When b increases, the *income effect* dominates the *substitution effect* (See section 2.2), meaning that the agent devotes less attention to subsistence, and thus more attention is released for job search. Instead, from $b=50$ onwards the *income effect* is very small (smaller than $\beta\frac{\partial(V^E-V^U)}{\partial b}P_a$), this is because the level of b is already high enough to make the agent feel comfortable when unemployed, and thus the marginal gain in terms of lifetime utility of finding a job is small, this causes an increment in the quantity of attention devoted to subsistence.

The graph in the middle of Fig 1 shows the variation in the quantity of job search effort as function of the level of b. As we can see, the quantity of job search effort monotonically decreases when b increases for all the range of levels of b.

Finally, the graph to the right of Fig 1 shows $P(s,a)$, which is hump-shaped. When the value of b is small enough, below 24 in this graph, an increase in b *increases* the probability of finding a job. For those values of b the increment in the quantity of attention devoted to job search more than compensates the reduction in the job search effort. From $b=24$ onwards, this is no longer the case. Even if the quantity of attention devoted to job search increases, this increment is no longer enough to compensate the reduction in job search effort, causing $P(s,a)$ to decrease when b increases.

Changing the values of the parameters changes the levels of b for which $P(s,a)$ is maximal and for which the level of attention devoted to job search is maximal. Nevertheless, the *qualitative shape* of the graphs remains the same for a broad set of parameters. Table 2 reports the results for 35 different specifications. In this table, the 12 first columns show the values of the parameters, and the last five the results."P max", is the level of b for which $P(s,a)$ reaches the maximum (the equivalent to 24 in the previous graph)."a min" is the level of b for which a reaches the minimum (the equivalent to 50 in the previous graph)."Gross RR*" is the optimal gross replacement rate: $\frac{b}{w}$, respectively "Net RR*", is the optimal net replacement rate $\frac{b}{w-\tau}$. Finally, "c_u/c_e" is the ratio of the consumption in unemployment $c^u = b + g(a)$ divided by the consumption in employment $c^e = w - \tau$, when b is the optimal one.

In all but two of the specifications of Table 2 the hump-shape of $P(s,a)$ is preserved. It is not preserved when β_1, the exponent of the isoelastic a in $P(s,a)$ is very low (equal to 0.2) and when G, the scale parameter of $g(a)$, is very high (equal to 70). In the first case, it is because the contribution of attention to the job finding probability is relatively small. So even if the *income effect* over a is strong enough to dominate the *substitution effect* for levels of b below $b = 37$, it is always dominated by $\frac{ds}{db} < 0$, because the contribution of s to $P(s,a)$ is much higher, this explains the negative slope for all values of b. In the second case, the agent has a very big capacity to self-insure, this implies that the *income effect* caused by a higher b is very low, which also explains the negative slope for all values of b.

Even though there is a large evidence showing that duration increases when b increases, see Tatsiramos and van Ours (2014) for a survey, to the best of our knowledge none of the original studies this papers cites has looked at the effects of b when its level is "low", i.e below subsistence requirements. The closest one among those is Lalive et al. (2006), who analyze the effect of a rise in UBs in Austria in 1989 of 4.6 percentage points, starting from a replacement rate of 41%, to people with *low* wages (below 12 610 ATS, the median was 16 400 ATS), who on top of the UB receive family allowances. They found using a diff-in-diff approach that the increment in the UB increased duration in 0.38 weeks (from 20.60 -treated- to 20.97 -control- weeks), which implies an elasticity of about 0.15.[32] The analyzed people are probably above the subsistence level, (because the pre-reform level of the UB is already substantial and because on top of that they have family allowances). Nevertheless, the effect of an increase of UB is very small. The rest of the studies, which do not consider low income people, have estimates which are higher.

The only study we found that evaluates the impact of b when it is not enough to cover subsistence is the one of Kupets (2006). Kupets makes a duration analysis for Ukraine, using the Ukranian Longitudinal Monitoring Survey for the years 1998-2002. The level of UB is low, of around 25-28% of the official average wage. Only 4.6% of the sample reported UB to be their main source of support, 13.9% of the sample states that casual activities or subsistence farming constitute their main source of subsistence. Information about the level of the UB for each person was not available, only whether the person was receiving UBs or not was known. She finds that: "The estimate of the variable on receipt of unemployment benefits fails to reject our hypothesis of insignificant effect of unemployment benefits on reemployment probability in the case of the total sample of unemployed. However, the effect of unemployment benefits is found to be significant and negative if we take only "standard" unemployed without any income from casual work". Moreover, she finds a negative effect of the presence of casual work on the finding rate probability, she states: "On the other hand, those usually unemployed persons who are occasionally engaged in unreported activities or subsistence farming tend to search for regular jobs less intensively and, therefore, they are less likely to receive a job offer." This last result suggests a substitution of resources from job search to survival activities. We claimed that time is not a binding constraint for a job seeker, but according to the scarcity literature, cognitive resources such as attention are a binding constraint. Therefore, this result of Kupets (2006) illustrates the trade-off put forward by our baseline model.

Monetary Costs of Job search [MC]: Even without subsistence requirements, in a framework in which looking for a job requires effort and money, the relationship between b and the probability of finding a job can also be hump-shaped. To show this we solve the problem numerically using the functions and parameters of Table 1, where now instead of a we have m: money devoted to job search and we change four things: (1) the probability of finding a job is now $P(s,m) = Bs^{\beta_1} m^{\beta_2}$, which is a

[32] In their sensitivity analysis they use a RDD and find that the effect is even smaller, of 0.31 weeks.

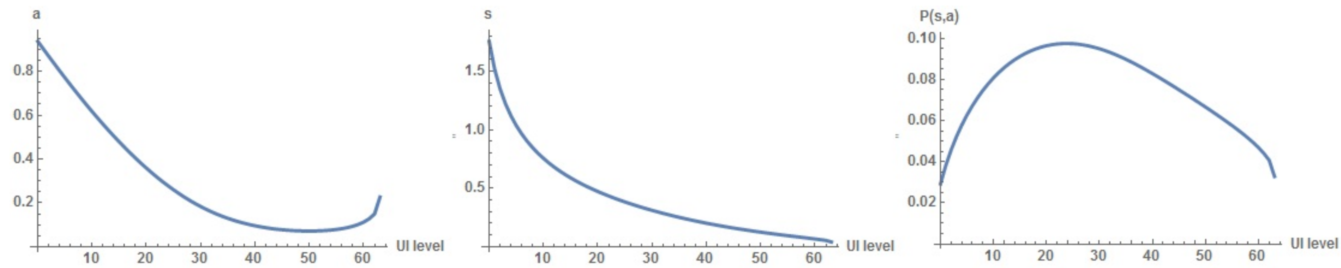

Figure 1: **Baseline Model [BM]**: The three graphs show the optimal level of a, s and $P(s,a)$ respectively, in the baseline model [BM] for different values of b. The functions and parameters are the ones presented in Table 1.

ϕ	r	β	E	β_1	β_2	w	c_{min}	σ	μ	G	γ	P max	a min	Gross RR*	Net RR*	c_u/c_e
0.00443	0.001	0.999	0.2	0.5	0.8	100	20	1.75	0.3	22	0.8	24	50	0.57	0.60	0.65
			0.4									24	53	0.61	0.63	0.65
			0.6									24	55	0.62	0.63	0.65
			0.8									24	55	0.63	0.64	0.66
			1									24	56	0.64	0.65	0.67
				0.1								42	49	0.61	0.63	0.72
				0.3								30	49	0.58	0.61	0.67
				0.7								22	32	0.32	0.32	0.35
				1								23	34	0.34	0.34	0.34
					0.2							0	37	0.47	0.50	0.67
					0.5							14	45	0.52	0.55	0.64
					0.7							22	49	0.56	0.59	0.64
					1							26	51	0.59	0.62	0.64
						50						12	19.5	0.42	0.44	0.71
						80						20.8	39.2	0.55	0.58	0.66
						130						26	63.7	0.58	0.62	0.63
						150						27	72	0.58	0.62	0.63
							0					5	40	0.54	0.58	0.60
							5					10	43	0.55	0.60	0.61
							10					15	45	0.55	0.58	0.61
							15					19	48	0.56	0.59	0.62
								0.5				25	41	0.58	0.58	0.60
								1				28	50	0.61	0.62	0.63
								1.5				26	52	0.6	0.62	0.64
								2				20	46	0.52	0.57	0.63
								2.5				8	25	0.28	0.34	0.50
									0.1			24	53	0.61	0.63	0.66
									0.5			24	48	0.55	0.59	0.63
									0.7			23	47	0.52	0.56	0.60
									0.9			23	45	0.48	0.52	0.56
										30		20	44	0.51	0.54	0.63
										50		4	25	0.33	0.35	0.65
										70		0	5	0.12	0.12	0.61
											0.2	6	39	0.5	0.53	0.68
											0.4	12	43	0.52	0.55	0.65
											0.6	18	47	0.55	0.58	0.65
											0.85	26	51	0.58	0.61	0.64

Table 2: Sensitivity Analysis for the Baseline Model [BM]: This table reports the results for 35 different specifications. The 12 first columns show the values of the parameters, and the last five the results."P max", is the level of b for which $P(s,a)$ reaches the maximum."a min" is the level of b for which a reaches the minimum."Gross RR*" gives, for each specification, the optimal gross replacement rate: $\frac{b}{w}$, respectively "Net RR*", the optimal net replacement rate $\frac{b}{w-\tau}$. Finally, "c_u/c_e" gives the ratio of the consumption in unemployment $c^u = b + g(a)$ divided by the consumption in employment $c^e = w - \tau$, when b is the optimal one.

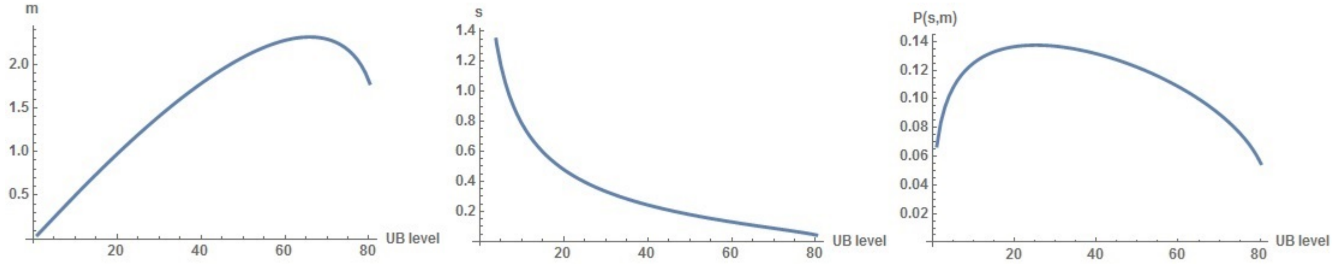

Figure 2: **Monetary Costs of Job Search [MC]**: The three graphs show the optimal level of m, s and $P(s,m)$ respectively, in the model with monetary costs of job search [MC] for different values of b. The functions and parameters are the ones presented in Table 1 with four changes: (1) the probability of finding a job is now $P(s,m) = Bs^{\beta_1}m^{\beta_2}$, (2) Instead of $g(a)$ we have now $-d(m)$ which is the quantity of money spent in job search and it is equal to $d(m) = \frac{w}{10}m$ (3) $c_{min} = 0$ and finally (4) we set $\beta_1 = \beta_2 = 0.5$.

positive function of m (2) Instead of $g(a)$ we have now $-d(m)$ which is the quantity of money spent in job search and it is equal to $d(m) = \frac{w}{10}m$, meaning that if $m = 1$ the agent spends in job search one tenth of the wage that she would earn if employed [33] (note that the parameters G and γ are no longer needed) (3) $c_{min} = 0$, that is, there are no subsistence requirements and finally (4) we set $\beta_1 = \beta_2 = 0.5$ which means that job search effort and monetary expenditures contribute equally to the probability of finding a job.

To have a hump-shaped $P(s,m)$, the monetary expenditure needs to have an important contribution to the job finding probability $P(s,m)$, that is β_2 cannot be negligible compared with β_1. In Fig 2, $\beta_1 = \beta_2 = 0.5$, this is enough to generate the hump-shape. Nevertheless, if $\beta_2 = 0.2$, for instance, then we would not have the hump-shape any more, and $P(s,m)$ would always be decreasing with respect to b. Also the functional form of $P(s,m)$ in general is important, if we would have instead $P(a,s) = Bs^{\beta_1}(1+a)^{\beta_2}$ for instance, which means that, even when the monetary expenditure increases the probability of finding a job, it's role is not crucial, then we would not have a hump-shaped curve either.

Direct Costs of $g(a)$ **[DC g(a)]:** The model with direct costs of $g(a)$ considers the case in which the subsistence activity is costly by itself (See section 2.4). We solve this problem numerically, using the functions and parameters of Table 1 with two changes: the total cost function is set equal to $\lambda(s) + \eta(a) = e^{(\mu_1 s + \mu_2 a)} - 1$ and, we set $\mu_1 = \mu_2 = 0.3$. Fig 3 shows the quantity of attention devoted to the subsistence activity, the quantity of job search and finally the probability of finding a job $P(s,a)$.

As can be seen from the graph to the LHS, in this case the agent almost renounces to the subsistence activity when the level of b increases; for levels of b above 31, the engagement of the agent in the subsistence activities is very close to zero.

In this set-up the hump-shape of $P(s,a)$ is even more robust than before, in particular, it remains when β_2 the contribution of attention to the job finding probability is very low (equal to 0.2).

For the coming three extensions, unless stated otherwise, we use the functions and parameters specified on Table 1, with one exception: For simplicity (as Hopenhayn and Nicolini, 1997, Chetty, 2008, Shimer and Werning, 2008, Schmieder et al., 2012, Kolsrud et al., 2015, Kroft and Notowidigdo, 2016) we consider that employment is an absorbing state ($\phi = 0$). We take the time unit to be a week and we set $T = 200$ (from $t = 0$ to $t = 199$), as the total quantity of time.

[33] There is very few data about how much money is spent in job search. One of the few estimates is the one of Stephenson (1976) who finds that white youth use 25% of their income to find work. Schwartz (2015) uses a baseline expenditure of 30% of the level of the UB. Since in our graph the level of UB is changing, then we set the maximum expenditure equal to one tenth of the wage, as a rough approximation.

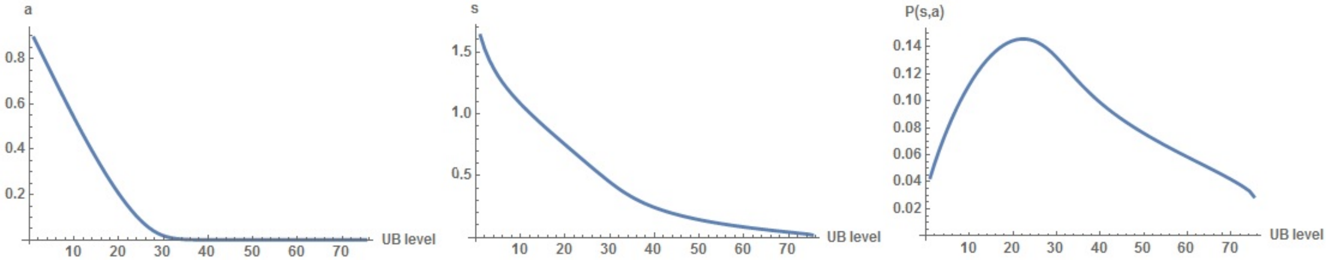

Figure 3: **Direct costs of g(a) [DC g(a)]**: The three graphs show the optimal level of a, s and $P(s,a)$ respectively, in the model with a direct cost of $g(a)$ for different values of b. The functions and parameters are the ones presented in Table 1 with two changes: the total cost function is set equal to $\lambda(s)+\eta(a) = e^{(\mu_1 s+\mu_2 a)} - 1$ and, we set $\mu_1 = \mu_2 = 0.3$.

Finite Entitlement [FE]: The model with finite entitlement considers the case in which the agent is entitled to a flat benefit b for a number of periods B strictly smaller than T. We solve this problem numerically, using the functions and parameters of Table 1, moreover, we set to $B = 100$ (from $t = 0$ to $t = 99$).[34] To show how the behavior of the agent changes when the end of entitlement is approaching, in Fig 4 we report the optimal choice of the agent in several periods (period 0, 24, 74 and 99). As can be observed, the graph at the beginning of the unemployment spell (period 0) looks very similar to the graph for the case where we had stationarity (Fig 1), in particular the hump-shape of $P(s,a)$ is preserved. In period 74 (after 75 elapsed) there's a segment in which s has a positive slope, the mechanism behind this is the complementarity between $1-a$ and s, and thus the enhanced marginal productivity of s given the sharp increase in $1-a$. In period 99, the last period in which the agent receives b, $\frac{d(V^E_{t+1} - V^U_{t+1})}{db} = 0$ this causes s to have a weakly positive slope for all b (see equation (33) in the Appendix A.1.2).

Incomplete Financial Markets [FM]: The model with incomplete financial markets considers the case in which the agent starts her life with an exogenous level of assets A_0, and she can get indebted up to a certain limit L (binding constraint), we assume that she has to repay the debt at the end of the last period $T-1$. We solve this problem numerically, using the functions and parameters of Table 1, moreover, we assume that the agent starts the unemployment spell with an exogenous level of assets $A_0 = 0$, and we allow her to get indebted up to 200, that is, up to two times the wage she would have if employed. In each period the agent chooses a_t and s_t, moreover, she also chooses the optimal level of assets for the next period, k_{t+1} from a grid of different values of assets that goes from -200 to 0. In Fig 5, we report the optimal choices of a_t, s_t and the probability of finding a job $P(s_t, a_t)$ at the beginning of the unemployment spell. As Fig 5 shows, the hump shape of the exit rate from unemployment is preserved in this context.

Stochastic Wage Offers [SWO]: The model with stochastic wage offers considers the case in which the distribution of offers is not degenerate, i.e, the agent may receive job offers with different wages; we assume that the distribution of wages is known. If an offer is received, the agent follows a stopping rule: she accepts the job offer if the wage is above her reservation wage (an additional choice variable), otherwise she rejects it. We solve this problem numerically, using the functions and parameters of Table 1, moreover we assume that wages are Pareto distributed with parameters $w_{min} = 66.66$ and $\alpha = 3$, so that the average wage is equal to 100. We set the coefficient of relative risk aversion $\sigma = 2$ because an integer allows us to find a closed form expression for V_t^U, which simplifies the numerical analysis. In Fig 6 we report the optimal choices of a_t, s_t and the exit rate from unemployment $P(s_t, a_t) * (1 - H(x_t))$ at the beginning of the unemployment spell, where $H(x_t)$ is the cumulative distribution function of the Pareto distribution, evaluated at the optimal reservation wage x_t. As

[34] We are aware that both B and b are part of the optimal unemployment insurance design (see for instance Hopenhayn and Nicolini (1997)), nevertheless in this paper we look at the optimal level of b conditional on B, as Baily (1978), Chetty (2006) and Chetty (2008) do.

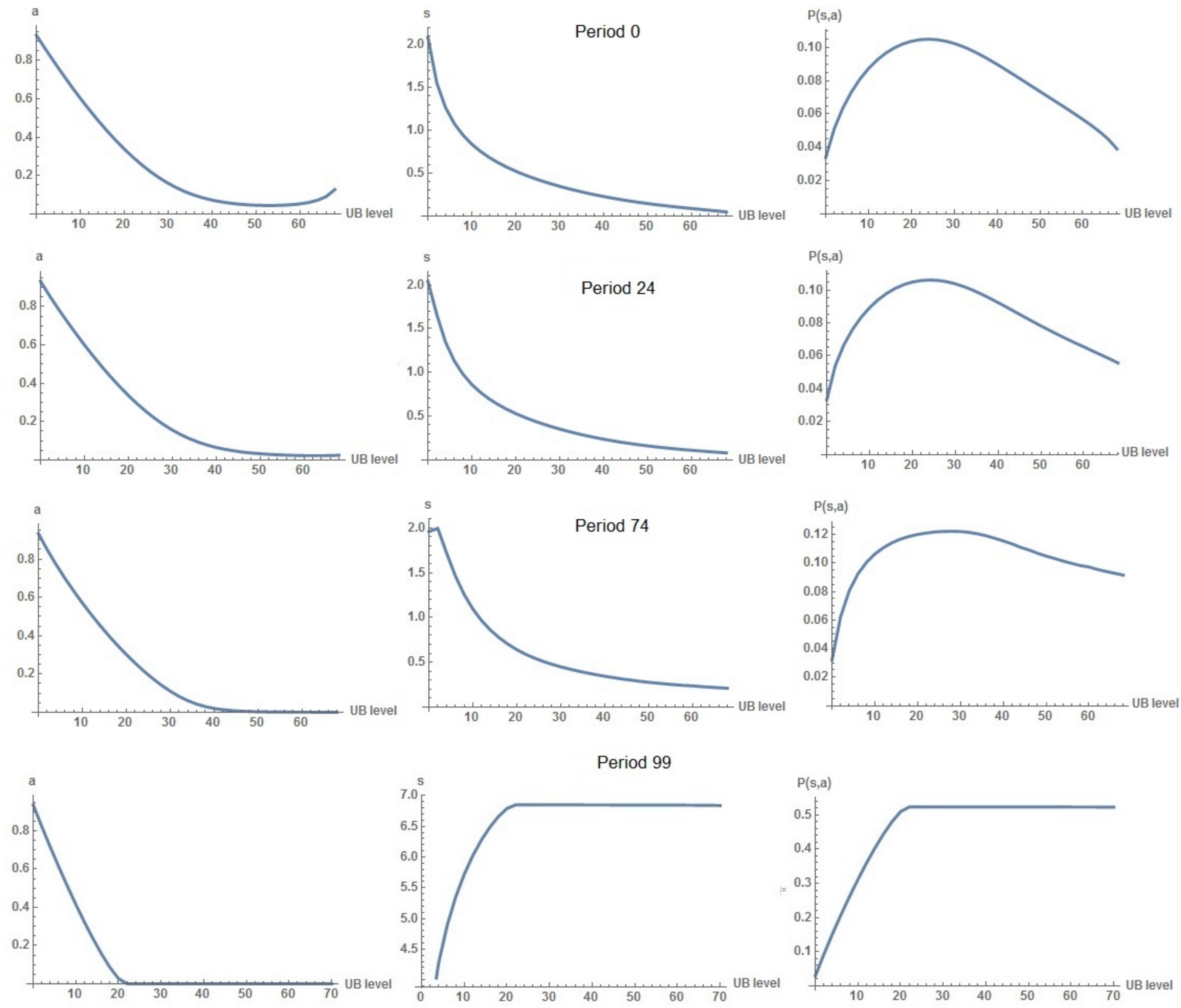

Figure 4: **Finite Entitlement [FE]**: Each column has three graphs that show the optimal level of a_t, s_t and $P(s_t, a_t)$ respectively, in the model finite entitlement [FE] for different values of b. We report in each line the results for period 0, 24, 74 and 99, respectively. The functions and parameters are the ones presented in Table 1, except for ϕ which is now equal to zero. We set $T = 200$, the total quantity of time, and $B = 100$, the number of periods in which the agent is entitled to the flat benefit b.

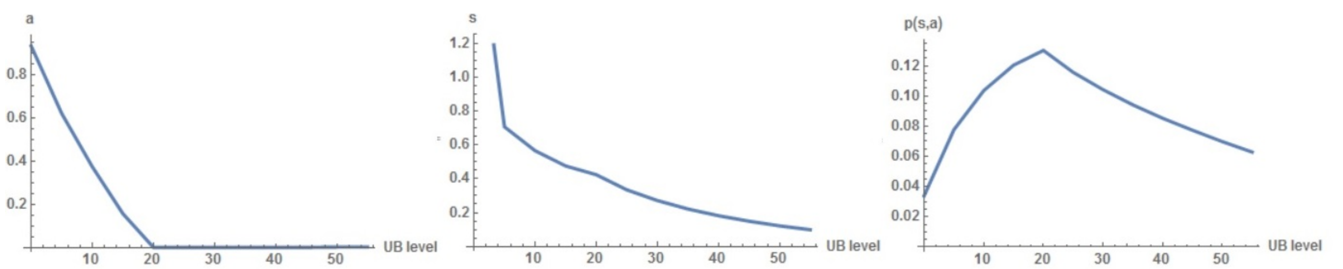

Figure 5: **Incomplete Financial Markets [FM]**: The three graphs show the optimal level of a_t, s_t and $P(s_t, a_t)$ respectively, in the model with incomplete financial markets [FM] for different values of b. The functions and parameters are the ones presented in Table 1, except for ϕ which is now equal to zero, moreover we allow the agent to get indebted up to 200 (two times the wage) and we assume that the agent has to repay her debt at the and of the $T = 200$ periods.

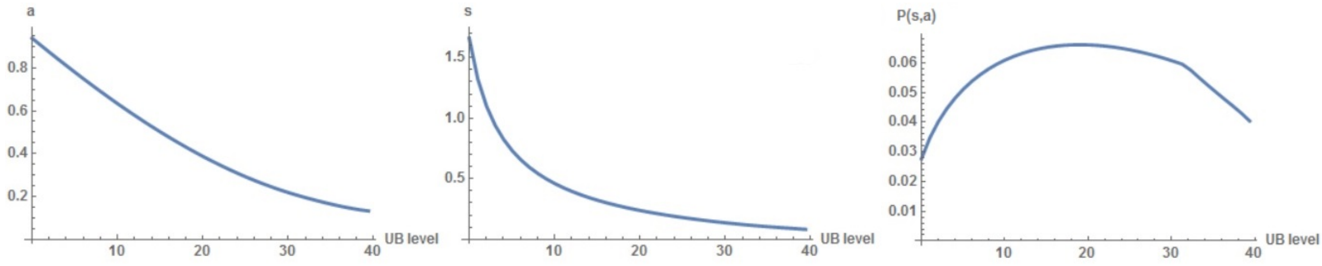

Figure 6: **Stochastic Wage Offers [SWO]**: The three graphs show the optimal level of a_t, s_t and $P(s_t, a_t) * (1 - H(x_t))$ respectively, at the begining of the unemployment spell, in the model with stochastic wage offers for different values of b. The functions and parameters are the ones presented in Table 1, except for ϕ which is now equal to zero, and $\sigma = 2$. We set $T = 200$, the total quantity of time. We assume that wages are Pareto distributed with parametes $w_{min} = 66.66$ and $\alpha = 3$.

Fig 6 shows, the hump shape of the exit rate from unemployment is preserved when wage offers are stochastic.

4.2 Liquidity Effect

In this section we solve the baseline model [BM], its extensions ([DC g(a)],[FE], [FM] and [SWO]) and the model with monetary costs of job search [MC] numerically, and we analyze the effect of providing an annuity to the agent in each period, regardless of her employment status, on the expected duration in unemployment.

Solving the [BM] numerically we find that the when b is low enough, providing an annuity to the agent increases the probability of finding a job; instead, when b is big enough, providing an annuity to the agent reduces the probability of finding a job. This property is robust to the presented extensions of the model. In this section we also comment some empirical results found in the literature.

Let us start by analyzing the effect of an annuity in the baseline model [BM]. In the baseline model [BM] providing an annuity to the agent has an ambiguous effect on P, contrary to what one finds in the standard job search model [SM], where providing an annuity to the agent unambiguously reduces P. We now solve the problem numerically to provide more insight behind the ambiguity. We analyze the effect of the annuity for each possible budget-balanced level of b.

Consider Fig. 7, where all the functions and the parameters are the ones described in Table 1. In this graph we show which is the effect of providing liquidity to the agent.[35] To do that we compare two cases: (1) the only income of the agent is b (the continuous line) and (2) on top of b the agent receives an annuity of 10 from any source different from the UB scheme (the dashed line). Both curves intersect in a point close to $b = 21$. When b is above 21, providing liquidity to the unemployed decreases her expected probability of finding a job (the dashed line is below the continuous line). Nevertheless, when b is below 21, providing an annuity to the agent *increases* her probability of finding a job (the dashed line is above the continuous line). The intuition behind this effect is the fact that for low levels of b subsistence is not guaranteed: providing money to the agent when b is low, allows her to devote more cognitive resources to job search (and less cognitive resources to guarantee subsistence). This effect is also present in the extensions to the baseline model, as will be shown below.

There is some recent evidence showing that when people are close to subsistence levels of consumption, providing money may help them to leave unemployment: Franklin (forthcoming) develops experiment in Ethiopia where he gives money (intended to cover transportation costs) to young jobless people, he finds that four months after the start, people who received the subsidy were seven

[35] "The ideal way to estimate the liquidity effect would be a randomized experiment in which some job losers are given lump-sum grants or annuity payments but others are not." Chetty (2008)

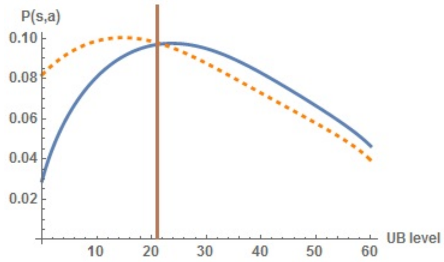

Figure 7: **Liquidity Effect [BM]**: This graph shows the optimal value of $P(s,a)$ for different values of b. The continuous line is generated with the functions and parameters showed in Table 1, the dashed line uses the same functions and parametes the only difference is that the agent receives an annuity of 10 regardless of her employment status.

percentage points more likely to have a permanent work. He states: "The positive impacts on employment seem to be driven directly by increased job search in response to subsidies. Weekly data from the phone surveys show that treatment has a significant impact on job search, and an even larger impact on search in city centre, and search through formal methods." and "Finally the treatment effects on search and employment are particularly strong among the relatively poor and cash constrained". Barrientos and Villa (2015) find, using a regression discontinuity design, that a conditional anti-poverty cash transfer in Colombia (conditional on maintaining kids in school) [36] had positive effects not only on labor force participation, but also on the level of employment of adult males. On the same line, Banerjee et al. (forthcoming) analyze the effect of conditional and unconditional cash transfers to low income families of seven different programs in developing countries on work outside the household (which includes casual or permanent employment, and excludes any self-employed activity), [37] after pooling the samples of the five comparable programs they do not find evidence of a negative effect, moreover, when treating each program separately in some cases they found a positive effect. Finally, Morris and Wilson (2014) studies the impact of a reduction in the level of unemployment assistance "Newstart" in Australia ("The Newstart payment at AUD255.25 per week for a single person (March 2014) is well below the poverty line even when government rent assistance is included.") using a survey and in-depth interviews, they state: "Insufficient income contributed to stress, and it added to circumstances in which interviewees struggled to maintain their confidence in a job interview (if they even reached that point). Physical appearance particularly suffered; interviewees told of how difficult it was to keep themselves groomed, appropriately attired and motivated". This evidence is not in line with the [SM] or a model like the one of Chetty (2008) in which providing an annuity to the agent always have negative effects on the probability of finding a job.

We now provide the numerical results for the other models that were analyzed: [MC],[DC g(a)], [FE], [FM] and [SWO]. The parametrization for each model is equal to the one used in the previous subsection, where the effect of b on the expected duration was analyzed.

Fig 8 shows the results. For the model with monetary costs [MC] the intuition is the following: when the level of b is very low, the marginal utility of consumption is very high, which causes that just a small amount of money is devoted to job search; the presence of the annuity relaxes this trade-off and allows the agent to devote more money to job search. For all the other specifications, the intuition is the same as for the baseline model [BM]: for low levels of b, subsistence is not guaranteed, then providing money to the agent allows her to devote more cognitive resources to job search (and less

[36] The program is called "Familias en Acción", "Familias en Accion was introduced in 2001 by the government of Colombia with the aim of strengthening human capital investment among children in poorest households in rural areas and small towns" Barrientos and Villa (2015).

[37] Regarding these programs Banerjee et al. (forthcoming) state: "Once a household becomes eligible for any of the programs that we study, the amount of benefit that one receives is the same regardless of actual income level and lasts at least a period between 2 and 9 years, depending on the program. This differs from many U.S. transfer programs (e.g. EITC, SNAP), where the stipend depends (either positively or negatively) on family income, and is updated frequently."

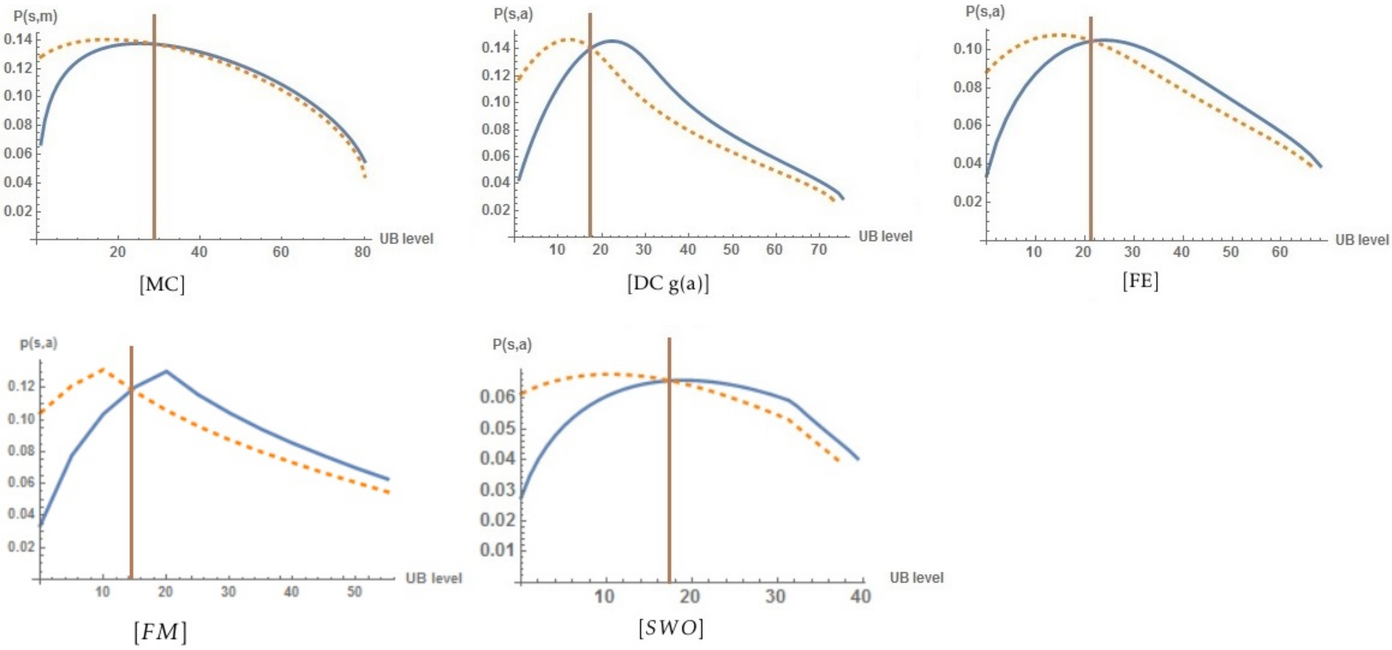

Figure 8: **Liquidity Effect**: These graphs show the optimal value of P for different values of b, for the different models: [MC], [DC g(a)],[FE] and [FM]. It also shows the value of $P*(1-H(x))$ for the optimal x, for the model with stochastic wage offers [SWO]. The continuous line is generated with the functions and parameters discussed in the previous section for each model, the dashed line is generated with the same parameters except for the fact that the agent receives an annuity of 10 regardless of her employment status.

to guarantee subsistence).

4.3 The Optimal level of b as compared with the Standard Model [SM]

In section 3.2 we showed that the new elements of the baseline model [BM] (c_{min} and $g(a)$) have an ambiguous effect over the optimal level of b. In this section we show the optimal value of b for different values of c_{min} and G -the scale parameter of $g(a)$-, and we compare them with those obtained the standard model [SM].

Since we want to give the agent a way to cope with the subsistence requirements, whenever we increase c_{min}, we need to increase G also, so that $G \cdot 1^{\mu} \geq c_{min}$.

In Table 3 we report the optimal replacement rate for different levels of c_{min} and G. There the values of all the parameters are the ones of Table 1, except for the values of c_{min} and G which are changing.

Our numerical exercise shows that if the capacity of the agent to generate subsistence consumption is not very high (i.e, G is below 20% of the gross wage) then the optimal level of b is higher in our framework as compared with the standard model. Instead, if the agent has a great capacity to self-insure (i.e, a high G), then the level of the optimal b in our framework is lower.

Let us now analyze the case in which the subsistence activity has a direct cost, as in model [DC g(a)] presented in Section 2.4. The role of the subsistence requirements in this setup [DC g(a)] is crucial: the direct cost of the subsistence activity will not produce a higher optimal b (as compared with the standard model [SM]) if there are no subsistence requirements (because the agent has the option of not engaging in this subsistence activity by setting $a = 0$, and by doing this, going back to the standard model).[38] Instead, if subsistence requirements are present (as it is the case in the [DC g(a)] model) and relevant, then the agent *needs* to engage in the subsistence activity, and if this activity has

[38]This is the case as long as $P(s,a)$ is such that when the quantity of attention devoted to job search is the maximum, i.e $a = 0$, the function reduces to the same function of the standard model $P(s)$, for example $Bs^{\beta_1}(1-a)^{\beta_2}$.

c_{min}	G	Optimal RR [BM]	Optimal RR [DC $g(a)$]
5	7	0.58	0.59
10	12	0.59	0.59
15	17	0.59	0.60
18	20	0.58	0.61
20	22	0.57	0.62
25	28	0.53	0.63
30	33	0.50	0.64
35	38	0.46	0.66
40	43	0.41	0.68
50	54	0.31	0.71

Standard Model [SM]: with c_{min}=0, G = 0, optimal RR = 0.57

Table 3: Comparison of the optimal replacement rates

a direct cost, this pushes the optimal b upwards. The intuition is that this costly subsistence activity will allow the agent to smooth consumption but it will do it at a high *unavoidable* cost (because of subsistence requirements), which pushes up the value of social insurance, in line with the intuition of Chetty and Looney (2006).[39]

The last column of Table 3 reports the optimal level of b in the [DC g(a)] model: the optimal level of b is always above the optimal one in the standard model [SM]. In this setup with direct costs for $g(a)$, the optimal level of b increases when c_{min} increases.

5 Conclusion

In a number of countries (including most of the countries in Latin America) unemployment benefits are low or absent. It is well known by the literature that this is problematic from a consumption-smoothing perspective, mostly if the access to the capital market is far from perfect. Our research shows that, if subsistence is not guaranteed, not having any type of insurance or having a very low one may *also* be a problem to find a job. In our baseline model [BM], when agents have to struggle for subsistence an important part of their attention is devoted to this task, and thus less attention is available for job search. Under these circumstances an increment in b increases the quantity of attention that the agent devotes to job search causing the expected duration in unemployment to decrease.[40]

For higher values of b we re-encounter the standard properties of the literature: increasing b and/or providing liquidity to the agent increases expected duration in unemployment.

Our analysis also shows that if subsistence not only requires higher attention in daily-life activities, but also is by itself costly (for example, because it is dangerous, demeaning or physically tiring) as in the [DC g(a)] model , then the *optimal* level of the UB is always higher than the one of the "standard model".

Additionally, we show that if job search requires effort *and* money, and in [MC], the relationship between b and duration can also hump-shaped, even in the absence of subsistence requirements. This is interesting, because a different explanation, which is very appealing but that has widely being ignored by the literature, also suggest that b may be important not only for consumption smoothing, but also for the job search process itself.

[39] The intuition of Chetty and Looney (2006) is that, when agents are close to subsistence levels of consumption, they are reluctant to cut consumption further for fear of starvation, therefore these agents use whatever methods to avoid a consumption drop. In this context social insurance could yield large welfare gains.

[40] Mani et al. (2013) state in their paper: "The data suggest a rarely considered benefit to policies that reduce economic volatility: They are not merely contributing to economic stability -they are actually enabling greater cognitive resources."

A Appendix

A.1 Positive Analysis

A.1.1 The Baseline Model [BM]

The first order conditions are already stated in the main text (3, 4). The second order conditions are:

$$G_{ss} \equiv -\lambda_{ss} + \beta P_{ss}(V^E - V^U) < 0 \tag{17}$$

$$G_{sa} \equiv \beta P_{sa}(V^E - V^U) < 0 \tag{18}$$

$$G_{as} \equiv \beta P_{sa}(V^E - V^U) < 0 \tag{19}$$

$$G_{aa} \equiv u_{cc}(c^u)g_a + u_c(c^u)g_{aa} + \beta P_{aa}(V^E - V^U) < 0 \tag{20}$$

$$G_{sb} \equiv \beta P_s \frac{\partial(V^E - V^U)}{\partial b} = \frac{-\beta P_s}{1-\beta[1-(P(a,s)-\phi]} u_c(c^u) < 0 \tag{21}$$

$$G_{ab} \equiv u_{cc}(c^u)g_a + \beta P_a \frac{\partial(V^E - V^U)}{\partial b} = u_{cc}(c^u)g_a - \frac{\beta P_a}{1-\beta[1-(P(a,s)-\phi]} u_c(c^u) \gtreqless 0 \tag{22}$$

$$G_{sw} \equiv \beta P_s \frac{\partial(V^E - V^U)}{\partial w} = \frac{\beta P_s}{1-\beta[1-(P(a,s)-\phi]} u_c(c^e) > 0 \tag{23}$$

$$G_{aw} \equiv \beta P_a \frac{\partial(V^E - V^U)}{\partial w} = \frac{\beta P_a}{1-\beta[1-(P(a,s)-\phi]} u_c(c^e) < 0 \tag{24}$$

$$G_{s\,\text{annuity}} \equiv \beta P_s \frac{\partial(V^E - V^U)}{\partial\,\text{annuity}} = \frac{\beta P_s}{1-\beta[1-(P(a,s)-\phi]} [u_c(c^e) - u_c(c^u)] < 0 \tag{25}$$

$$G_{a\,\text{annuity}} \equiv u_{cc}(c^u)g_a + \beta P_a \frac{\partial(V^E - V^U)}{\partial\,\text{annuity}} = u_{cc}(c^u)g_a + \frac{\beta P_a}{1-\beta[1-(P(a,s)-\phi]} [u_c(c^e) - u_c(c^u)] \gtreqless 0 \tag{26}$$

Where $V^E - V^U = \frac{1}{1-\beta[1-P(s,a)-\phi]}(u(c^e) - u(c^u) + \lambda(s))$.

The following conditions are sufficient to guarantee that a solution, if any, to the system (3, 4) is a unique maximum: $G_{ss} < 0$ (so that P_{ss}, λ_{ss} cannot simultaneously be zero), $G_{aa} < 0$ and $G_{ss}G_{aa} - G_{as}^2 > 0$.

To find $\frac{da}{db}$ and $\frac{ds}{db}$, total differentiation is needed. We consider this system of equations:

$$\begin{cases} G_{ss}ds + G_{sa}da + G_{sb}db = 0 \\ G_{as}ds + G_{aa}da + G_{ab}db = 0 \end{cases} \tag{27}$$

Using substitution, or Cramer's rule, we obtain:

$$\frac{da}{db} = \frac{-G_{ss}G_{ab} + G_{as}G_{sb}}{G_{ss}G_{aa} - G_{as}^2} \tag{28}$$

$$\frac{ds}{db} = \frac{-G_{aa}G_{sb} + G_{sa}G_{ab}}{G_{ss}G_{aa} - G_{as}^2} \tag{29}$$

Where, the denominator of both expressions needs to be positive by the second order conditions.

The sign of $\frac{da}{db}$:

Since the denominator needs to be positive, let's concentrate on the numerator of $\frac{da}{db}$.

$$-\underbrace{[-\lambda_{ss} + \beta P_{ss}(V^E - V^U)]}_{\text{Gss: -}}\underbrace{[u_{cc}(c^u)g_a + \beta P_a \frac{\partial(V^E - V^U)}{\partial b}]}_{\text{Gab}} + \underbrace{\beta P_s \frac{\partial(V^E - V^U)}{\partial b}}_{\text{Gsb: -}} \underbrace{\beta P_{sa}(V^E - V^U)}_{\text{Gas: -}}$$

Note first that having $G_{ab} < 0$ is a necessary condition to have $\frac{da}{db} < 0$, nevertheless it is not sufficient. In what comes, we look for a sufficient condition such that $\frac{da}{db} < 0$.

The previous expression can be re-written as:

$$\underbrace{\lambda_{ss}u_{cc}(c^u)g_a}_{\text{1: negative}} + \underbrace{\beta \frac{\partial(V^E - V^U)}{\partial b} P_a \lambda_{ss}}_{\text{2: positive}} \underbrace{-\beta P_{ss}[V^E - V^U]u_{cc}(c^u)g_a}_{\text{3: negative}} \underbrace{-\beta^2 \frac{\partial(V^E - V^U)}{\partial b}[V^E - V^U][P_a P_{ss} - P_s P_{as}]}_{\text{4: positive}} \tag{30}$$

The expression above is negative if the terms $1 + 2 < 0$ and $3 + 4 < 0$.

First condition: $1 + 2 < 0$

$\lambda_{ss}u_{cc}(c^u)g_a + \beta \frac{\partial(V^E - V^U)}{\partial b} P_a \lambda_{ss} < 0$ iff

$-u_{cc}(c^u)g_a > \beta \frac{\partial(V^E - V^U)}{\partial b} P_a$

Second condition: $3 + 4 < 0$

$-\beta P_{ss}[V^E - V^U]u_{cc}(c^u)g_a - \beta^2 \frac{\partial(V^E - V^U)}{\partial b}[V^E - V^U][P_a P_{ss} - P_s P_{as}] < 0$ iff

$P_{ss}u_{cc}(c^u)g_a + \beta \frac{\partial(V^E - V^U)}{\partial b}[P_a P_{ss} - P_s P_{as}] > 0$ iff

$u_{cc}(c^u)g_a + \beta \frac{\partial(V^E - V^U)}{\partial b}[P_a - \frac{P_s P_{as}}{P_{ss}}] < 0$ iff

$-u_{cc}(c^u)g_a > \beta \frac{\partial(V^E - V^U)}{\partial b}[P_a - P_{as}\frac{P_s}{P_{ss}}]$

As we can see, the second condition is stronger than the first one. Then the only sufficient condition to have that $\frac{da}{db} < 0$ is condition 2 above, which is the same as (5) in the main text.

If $P_{ss} = 0$, that is, if the probability of finding a job is linear with respect to s, the term 3 of equation (30) above disappears, and also a part of term 4. After some simplifications, we are left with this condition:

$-u_{cc}(c^u)g_a > \beta \frac{\partial(V^E - V^U)}{\partial b}[P_a + \beta(V^E - V^U)P_{as}\frac{P_s}{\lambda_{ss}}]$

Replacing the first order condition with respect to s, i.e (4), into the expression above, we get:

$-u_{cc}(c^u)g_a > \beta \frac{\partial(V^E - V^U)}{\partial b}[P_a + P_{as}\frac{\lambda_s}{\lambda_{ss}}]$

The sign of $\frac{ds}{db}$:

Since the denominator needs to be positive, let's concentrate on the numerator of $\frac{ds}{db}$.

$$\underbrace{-\beta P_s \frac{\partial(V^E - V^U)}{\partial b}}_{\text{-Gsb: +}} \underbrace{[u_{cc}(c^u)g_a + u_c(c^u)g_{aa} + \beta P_{aa}(V^E - V^U)]}_{\text{Gaa: -}} + \underbrace{\beta P_{sa}(V^E - V^U)}_{\text{Gsa: -}} \underbrace{[u_{cc}(c^u)g_a + \beta P_a \frac{\partial(V^E - V^U)}{\partial b}]}_{\text{Gab}} \tag{31}$$

Note that $ds/db > 0$ *could* be possible only when G_{ab} is negative, which is a necessary condition to have $da/db < 0$. But, even in that case, there are several terms pushing in the direction of having $ds/db < 0$.

Corner Solutions:

The previous analysis assumed that $0 < a < 1$ and $s > 0$, i.e, that we had an internal solution. Let's analyze now the possibility of having corner solutions:

- Note first that choosing $a = 0$ when $b < c_{min}$ is not possible. In that case, the agent needs to generate some subsistence consumption.
- If $b > c_{min}$ and if the agent chooses $a = 0$, then the problem becomes exactly equal the standard model [SM], where attention is not modeled and hence (4) is the unique FOC (the only difference with respect to the standard model being the presence of c_{min}).
- If $a = 1$ then the probability of finding a job will be equal to 0. The budget-balanced condition to finance such a scheme would require very high taxes, up to the point in which $V^E < V^U$ and in that case the problem is not defined.
- We avoid having $s = 0$ by imposing $-\lambda_s(0) < \beta P_s(0, a)[V^E - V^U]$ for all possible values of a.

A.1.2 The non-stationary case

In this section we consider the problem of the unemployed when time is finite and equal to T periods (from $t = 0$ to $t = T-1$). If time is finite, then the analysis is not stationary anymore, that means that $a_t \neq a_{t+1}$, same for s. The structure of the problem, nevertheless, remains very similar. In the coming section we analyze the problem where the agent is entitled to a flat b during B periods, $B < T$. In the next one, we incorporate assets into the setting with finite horizon and flat b for T periods, finally, we introduce stochastic wage offers, in this environment the agent chooses a reservation wage, x_t, below which job offers are rejected (McCall, 1970).

Model with Finite entitlement [FE]

Using the same notations as before, the lifetime values in unemployment and in employment solve respectively the following Bellman equations:

$$[FE] = \begin{cases} V_t^U = \max\limits_{s_t, a_t} \quad u(c_t^u) - \lambda(s_t) + \beta[P(s_t, a_t)V_{t+1}^E + (1 - P(s_t, a_t))V_{t+1}^U] \\ V_t^E = u(c_t^e) + \beta[\phi V_{t+1}^U + (1-\phi)V_{t+1}^E] \end{cases} \tag{32}$$

where $c_t^u = b + g(a_t)$ if $t \leq B-1$ and $c_t^u = g(a_t)$ if $B-1 < t < T$, $c_t^e = w - \tau$.

Subject to: $c_t^u \geq c_{min}$, $V_{t+1}^E - V_{t+1}^U \geq 0$, $0 \leq a_t \leq 1$, $s_t \geq 0$ and $V_T^U = V_T^E = 0$

The First Order Conditions:

$$G_a \equiv u_c(c_t^u)g_a(a_t) + \beta P_a[V_{t+1}^E - V_{t+1}^U] = 0$$

$$G_s \equiv -\lambda_s + \beta P_s[V_{t+1}^E - V_{t+1}^U] = 0$$

Which are the same as in the stationary case (except from the fact that now the timing for V^U and V^E is relevant). The same happens with the second order partial derivatives:

$$G_{ss} \equiv -\lambda_{ss} + \beta P_{ss}(V_{t+1}^E - V_{t+1}^U)$$

$$G_{sa} \equiv \beta P_{sa}(V_{t+1}^E - V_{t+1}^U)$$

$$G_{as} \equiv \beta P_{sa}(V_{t+1}^E - V_{t+1}^U)$$

$$G_{aa} \equiv u_{cc}(c_t^u)g_a(a_t) + u_c(c_t^u)g_{aa}(a_t) + \beta P_{aa}(V_{t+1}^E - V_{t+1}^U)$$

$$G_{sb} \equiv \beta P_s \frac{\partial(V_{t+1}^E - V_{t+1}^U)}{\partial b}$$

$$G_{ab} \equiv u_{cc}(c_t^u)g_a(a_t) + \beta P_a \frac{\partial(V_{t+1}^E - V_{t+1}^U)}{\partial b}$$

And, therefore, a sufficient condition to have $da/db < 0$ is the same as before:

$$-u_{cc}(c_t^u)g_a(a_t) > \beta \frac{\partial(V_{t+1}^E - V_{t+1}^U)}{\partial b}\left(P_a - P_{as}\frac{P_s}{P_{ss}}\right)$$

Note, nevertheless, that the expression $\frac{\partial(V_{t+1}^E - V_{t+1}^U)}{\partial b}$ is different from the expression that we had before. While the expression is relatively simple when employment is an absorbing state, it gets more complicated when $\phi \neq 0$.

Equivalently, $ds/db < 0$ is equal to:

$$\underbrace{-\beta P_s \frac{\partial(V_{t+1}^E - V_{t+1}^U)}{\partial b}}_{\text{-Gsb: +}} \underbrace{[u_{cc}(c_t^u)g_a(a_t)) + u_c(c_t^u)g_{aa}(a_t) + \beta P_{aa}(V_{t+1}^E - V_{t+1}^U)]}_{\text{Gaa: -}} + \underbrace{\beta P_{sa}(V_{t+1}^E - V_{t+1}^U)}_{\text{Gsa: -}} \underbrace{[u_{cc}(c_t^u)g_a(a_t) + \beta P_a \frac{\partial(V_{t+1}^E - V_{t+1}^U)}{\partial b}]}_{\text{Gab}} \tag{33}$$

Model with Incomplete Financial Markets [FM]

Consider now the problem where the time horizon is finite and equal to T (from $t = 0$ to $t = T - 1$) and the agent is entitled to a flat benefit for $B = T$ periods. The difference now is that agents have access to an asset traded on an imperfect credit market. For simplicity (as Hopenhayn and Nicolini, 1997, Chetty, 2008, Shimer and Werning, 2008, Schmieder et al., 2012, Kolsrud et al., 2015, Kroft and Notowidigdo, 2016) we consider that employment is an absorbing state ($\phi = 0$). Using the same notations as before, and denoting by k_t the level of assets in each period, the lifetime values in unemployment and in employment solve respectively the following Bellman equations:

$$[FM] = \begin{cases} V_t^U = \max\limits_{s_t, a_t, k_{t+1}} & u(c_t^u) - \lambda(s_t) + \beta[P(s_t, a_t)V_{t+1}^E + (1 - P(s_t, a_t))V_{t+1}^U] \\ V_t^E = \max\limits_{k_{t+1}} & u(c_t^e) + \beta V_{t+1}^E \end{cases} \tag{34}$$

where $c_t^u = b + g(a_t) + (1 + r)k_t - k_{t+1}$ and $c_t^e = w - \tau + (1 + r)k_t - k_{t+1}$.

Subject to: $c_t^u \geq c_{min}$, $V_{t+1}^E - V_{t+1}^U \geq 0$, $0 \leq a \leq 1$, $s \geq 0$, $V_T^U = V_T^E = k_T = 0$ and $k_{t+1} \geq L$, this last condition can be interpreted as a capital market imperfection.[41]

Note that since $\phi = 0$ when the agent is employed the setup is deterministic. The optimal consumption path satisfies the Euler equation:

$$u_c(c_t^e) = \beta(1 + r)u_c(c_{t+1}^e)$$

We assume that $\beta = \frac{1}{1+r}$, this implies that the agent has a constant level of consumption when she is employed, i.e, $c_t^e = c^e$.

In order to find c_t^e, let us consider the budget constraint of the employed agent: $c_t^e = w - \tau + (1+r)k_t - k_{t+1}$. This expression can be rewritten as: $k_t = \frac{c_t^e - (w-\tau) + k_{t+1}}{i+r}$. By iterating forward (that is, by replacing $k_{t+1} = \frac{c_{t+1}^e - (w-\tau) + k_{t+2}}{i+r}$ on the previous expression, and then replacing k_{t+2}, etc...) and since $k_T = 0$, we have that:

$$k_t(1 + r) = c_t^e - (w - \tau) + \frac{c_t^e - (w - \tau)}{1 + r} + ... + \frac{c_t^e - (w - \tau)}{(1 + r)^{(T-1)-t}} \quad = [c_t^e - (w - \tau)] \sum_{j=0}^{(T-1)-t} \frac{1}{1 + r}$$

Which implies that:

$$c_t^e = k_t \left(\frac{r}{1 - (\frac{1}{1+r})^{(T-1)-t+1}} \right) + w - \tau$$

Where k_t is the level of assets the agent had in the moment in which she started working. Consumption is constant in employment, meaning that if the agent becomes employed in t, her consumption from that point onwards is constant. Now, c_t^e is a function of t because it depends on the moment in which the agent started working: If the agent got employed in $t+1$ her constant level of consumption when employed is different than the one she would have if she got employed in t.

Moreover, since consumption is constant from the moment in which the agent is employed, we can write:

$$V_t^E = \sum_{j=0}^{(T-1)-t} \beta^j u(c_t^e) \quad = u(c_t^e)\frac{1 - \beta^{(T-1)-t+1}}{1 - \beta}$$

The First Order Conditions:

$$G_{a_t} \equiv u_c(c_t^u)g_a(a_t) + \beta P_a[V_{t+1}^E - V_{t+1}^U] = 0$$

[41] As highlighted by Chetty (2008), it is easy to show that V_t^E is concave, because there is no uncertainty following reemployment; however,V_t^U *could be* convex. Nevertheless, this is not the case in our simulations -non concavity never arises in Chetty (2008) nor in Lentz and Tranaes (2005) either.

$$G_{s_t} \equiv -\lambda_s + \beta P_s[V^E_{t+1} - V^U_{t+1}] = 0$$

$$G_{k_{t+1}} \equiv -u_c(c^u_t) + \beta\left(P(s_t, a_t)\frac{\partial V^E_{t+1}}{\partial k_{t+1}} + (1 - P(s_t, a_t))\frac{\partial V^U_{t+1}}{\partial k_{t+1}})\right) = 0$$

where:

$$\frac{\partial V^E_{t+1}}{\partial k_{t+1}} = u_c(c^e_{t+1})\frac{1-\beta^{(T-1)-t}}{1-\beta}\frac{\partial c^e_{t+1}}{\partial k_{t+1}} \quad = u_c(c^e_{t+1})\frac{1-\beta^{(T-1)-t}}{1-\beta}\frac{r}{1-(\frac{1}{1+r})^{(T-1)-t}} = \frac{u_c(c^e_{t+1})}{\beta}$$

and:

$$\frac{\partial V^U_{t+1}}{\partial k_{t+1}} = u_c(c^u_{t+1})(1+r) \quad = \frac{u_c(c^u_{t+1})}{\beta}$$

Which allows to re-write $G_{k_{t+1}}$ as:

$$G_{k_{t+1}} \equiv -u_c(c^u_t) + P(s_t, a_t)u_c(c^e_{t+1}) + (1 - P(s_t, a_t))u_c(c^u_{t+1}) = 0$$

The comparative statics are now more complex, since we have three choice variables. In section 4, we will solve this problem numerically.

Model with Stochastic Wage Offers [SWO]

Consider now the problem where the time horizon is finite and equal to T (from $t = 0$ to $t = T - 1$) and the agent is entitled to a flat benefit for $B = T$ periods. The difference now is that wage offers are stochastic (McCall, 1970). The distribution of wage offers is known, we denote the cumulative distribution function (CDF) by $H(w)$ and the probability density function (PDF) by $h(w)$. If an offer is received, the agent follows a stopping rule: if the wage offer is higher than the reservation wage, x_t, she accepts the offer, otherwise, she rejects it. Using the same notations as before, the lifetime values in unemployment and in employment solve respectively the following Bellman equations:

$$[SWO] = \begin{cases} V^U_t = \max\limits_{s_t, a_t, x_t} \quad u(c^u_t) - \lambda(s_t) + \beta[P(s_t, a_t)V^\theta_{t+1} + (1 - P(s_t, a_t))V^U_{t+1}] \\ V^E_t = \max\limits_{k_{t+1}} \quad u(c^e_t) + \beta V^E_{t+1} \end{cases} \tag{35}$$

where $V^\theta_{t+1} = E_w max\{V^E_{t+1}(w), V^U_{t+1}\} = \int_0^{x_t} V^U_{t+1}dH(w) + \int_{x_t}^{\bar{w}} V^E_{t+1}(w)dH(w)$

Subject to: $c^u_t \geq c_{min}$, $0 \leq a \leq 1$, $s \geq 0$, $V^U_T = V^E_T = 0$.

V^U_t can be rewritten as:

$$V^U_t = \max_{s_t, a_t, x_t} \quad u(c^u_t) - \lambda(s_t) + \beta\left[P(s_t, a_t)\int_{x_t}^{\bar{w}}(V^E_{t+1}(w) - V^U_{t+1})dH(w) + V^U_{t+1}\right]$$

The First Order Conditions:

$$G_{a_t} \equiv u_c(c^u_t)g_a(a_t) + \beta P_a\int_{x_t}^{\bar{w}}(V^E_{t+1}(w) - V^U_{t+1})dH(w) = 0$$

$$G_{s_t} \equiv -\lambda_s + \beta P_s\int_{x_t}^{\bar{w}}(V^E_{t+1}(w) - V^U_{t+1})dH(w) = 0$$

$$G_{x_t} \equiv \beta P(s_t, a_t)\left(V^E_{t+1}(x) - V^U_{t+1}\right)h(x_t) = 0$$

The comparative statics are now more complex, since we have three choice variables. In section 4, we will solve this problem numerically.

A.2 Optimal Unemployment Insurance

A.2.1 Impossibility to write $\frac{u_c(c^u)-u_c(c^e)}{u_c(c^e)} = \frac{\textbf{liquidity effect}}{\textbf{moral hazard effect}}$

In our baseline model

$$
\begin{aligned}
\frac{\text{liquidity effect}}{\text{moral hazard effect}} &= \frac{P_a \frac{da}{d(-c_{min})} + P_s \frac{ds}{d(-c_{min})}}{-(P_a \frac{da}{dw} + P_s \frac{ds}{dw})} \\
&= \frac{P_a[-G_{ss}G_{a(-c_{min})} + G_{as}G_{s(-c_{min})}] + P_s[-G_{aa}G_{s(-c_{min})} + G_{sa}G_{a(-c_{min})}]}{-(P_a[-G_{ss}G_{aw} + G_{as}G_{sw}] + P_s[-G_{aa}G_{sw} + G_{sa}G_{aw}])}
\end{aligned} \tag{36}
$$

Which cannot be reduced to $\frac{u_c(c^u)-u_c(c^e)}{u_c(c^e)}$.

Nevertheless, if we assume that when b changes only s changes (a remains constant), then the previous expression becomes:

$$
\frac{\text{liquidity effect}}{\text{moral hazard effect}} = \frac{P_s \frac{ds}{d(-c_{min})}}{-P_s \frac{ds}{dw}} = \frac{\frac{-G_{s(-c_{min})}}{Gss}}{\frac{G_{sw}}{G_{ss}}} = \frac{-G_{s(-c_{min})}}{G_{sw}} = \frac{u_c(c^u) - u_c(c^e)}{u_c(c^e)} \tag{37}
$$

Instead, if we assume that when b changes only a changes (s remains constant), then (36) becomes:

$$
\frac{\text{liquidity effect}}{\text{moral hazard effect}} = \frac{P_a \frac{da}{d(-c_{min})}}{-P_a \frac{da}{dw}} = \frac{\frac{-G_{a(-c_{min})}}{Gaa}}{\frac{G_{aw}}{G_{aa}}} = \frac{-G_{a(-c_{min})}}{G_{aw}} = \frac{-u_{cc}(c^u)g_a}{\frac{\beta P_a u_c(c^e)}{1-\beta[1-P-\phi]}} + \frac{u_c(c^u) - u_c(c^e)}{u_c(c^e)} \tag{38}
$$

This shows that, $\frac{u_c(c^u)-u_c(c^e)}{u_c(c^e)} = \frac{\text{liquidity effect}}{\text{moral hazard effect}}$ if one assumes that only one choice variable changes when b changes *and* this variable is such that the utility function is separable in consumption and the cost of this variable (37). Instead, $\frac{u_c(c^u)-u_c(c^e)}{u_c(c^e)} \neq \frac{\text{liquidity effect}}{\text{moral hazard effect}}$ if there are two choice variables that change when b changes (36) *or* there is just one variable that changes, but such that the utility function is not separable in consumption and the cost of this variable (38).

A.2.2 Optimal UI in a non-stationary setting

In this section we assume that time is finite, and equal to T (from $t = 0$ to $t = T-1$). For simplicity (as Chetty, 2008, Schmieder et al., 2012, Kolsrud et al., 2015, Kroft and Notowidigdo, 2016) we assume that there is no job destruction ($\phi = 0$).

Because of the envelope conditions, the following analysis is independent of the underlying structure of the model behind it (see Chetty, 2006 and Chetty, 2008), in particular on whether or not the agent is allowed to save, or whether or not she chooses a reservation wage in a context of stochastic wage offers. In the development below, we assume that there is finite entitlement, meaning that the UB is paid during B periods where $B < T$ (If one wants to assume that $B = T$, it suffices to replace B for T everywhere).

On top of the underlying model, our analysis for the optimal UB differs from the one of Chetty (2008) in two respects: (1) $\beta = \frac{1}{1+r} \neq 1$ and more importantly (2) our timing assumption: in our model, if the agent finds a job in t, she starts working in $t+1$.

The optimal level of UB is the level of b that maximizes the inter-temporal utility of the job seeker subject to the budget balanced condition. Formally:

$$\max_b V_0^U = u(c_0^u) - \lambda(s_0) + \beta[P_0 V_1^E + (1-P_0)V_1^U]$$

Subject to: $D_B\, b = (T-D)\,\tau$, where D is the expected duration in unemployment, $D = 1 + \sum_{t=0}^{T-1}\prod_{i=0}^{t}(1-P_i)$ and D_B is equal to the expected *compensated* duration in unemployment $D_B = 1 + \sum_{t=0}^{B-1}\prod_{i=0}^{t}(1-P_i)$. In these expressions P is a short notation for $P(s,a)$.

Applying the envelope theorem, the derivative of the previous expression with respect to b gives:

$$\frac{dV_0^U}{db} = u'(c_0^u) - \beta P_0 \frac{dV_1^E}{dw}\frac{d\tau}{db} + \beta(1-P_0)\left[\frac{dV_1^U}{db} - \frac{dV_1^U}{dw}\frac{d\tau}{db}\right]$$

where $\frac{dV_1^J}{dw} = \sum_{t=1}^{T-1}\frac{dV_1^J}{dw_t}$, for $J \in \{E,U\}$ and $\frac{dV_1^U}{db} = \sum_{t=1}^{B-1}\frac{dV_1^U}{db_t}$

Which could be rewritten as:

$$\frac{dV_0^U}{db} = u'(c_0^u) - \frac{d\tau}{db}\left[\beta P_0 \frac{dV_1^E}{dw} + \beta(1-P_0)\frac{dV_1^U}{dw}\right] + \beta(1-P_0)\frac{dV_1^U}{db} \tag{39}$$

We now need to find the values of $\frac{dV_1^E}{dw}$, $\frac{dV_1^U}{dw}$ and $\frac{dV_1^U}{db}$ to plug them in the expression above. We obtain the following derivatives for the value functions (assuming $T \geq B > 2$) :[42]

$$\frac{dV_1^U}{db} = u'(c_1^u) + \sum_{t=1}^{B-2}\beta^t \prod_{j=1}^{t}(1-P_j)u'(c_{t+1}^u)$$

$$\frac{dV_1^E}{dw} = u'(c_1^e)\sum_{t=0}^{T-2}\beta^t$$

$$\frac{dV_1^U}{dw} = P_1 u'(c_2^e)\sum_{t=2}^{T-1}\beta^{t-1} + \sum_{t=2}^{T-2}\left[\prod_{i=2}^{t}(1-P_{i-1})P_t\, u'(c_{t+1}^e)\sum_{j=t+1}^{T-1}\beta^{j-1}\right]$$

Now, let us compute the unconditional average marginal utility while employed:

$$\begin{aligned} E_{0,T-1}u'(c_t^e) &= \frac{1}{T-D}\left[P_0\, u'(c_1^e)\sum_{t=1}^{T-1}\beta^t + (1-P_0)P_1\, u'(c_2^e)\sum_{t=2}^{T-1}\beta^t + \ldots + \prod_{i=0}^{T-3}(1-P_i)P_{T-2}\,\beta^{T-1}u'(c_{T-1}^e)\right] \\ &= \frac{1}{T-D}\left[\beta P_0 \frac{dV_1^E}{dw} + \beta(1-P_0)\frac{dV_1^U}{dw}\right] \end{aligned} \tag{40}$$

[42]Note that since $\beta = \frac{1}{1+r}$, and since employment is an absorbing state, the agent will have a constant level of consumption since the moment at which she starts to work.

The unconditional average marginal utility while unemployed over the first B periods is equal to:

$$\begin{aligned} E_{0,B-1}u'(c_t^u) &= \frac{1}{D_B}\left[u'(c_0^u)+(1-P_0)\beta u'(c_1^u)+...+\beta^{B-1}\prod_{t=0}^{B-2}(1-P_t)u'(c_{B-1}^u)\right] \\ &= \frac{1}{D_B}\left[u'(c_0^u)+\beta(1-P_0)\frac{dV_1^U}{db}\right] \end{aligned} \tag{41}$$

Plugging (40) and (41) in (39) gives:

$$\frac{dV_0^U}{db} = D_B\,E_{0,B-1}u'(c_t^u)-(T-D)\,E_{0,T-1}u'(c_t^e)\frac{d\tau}{db} \tag{42}$$

where $\frac{d\tau}{db}=\frac{D_B}{T-D}\left(1+\varepsilon_{D_B,b}+\varepsilon_{D,b}\frac{D}{T-D}\right)$, and $\varepsilon_{D_B,b}=\frac{dD_B}{db}\frac{b}{D_B}$, $\varepsilon_{D,b}=\frac{dD}{db}\frac{b}{D}$.

Plugging $\frac{d\tau}{db}$ in (42), simplifying and setting $\frac{dV_0^U}{db}=0$ gives:

$$\frac{E_{0,B-1}u'(c_t^u)-E_{0,T-1}u'(c_t^e)}{E_{0,T-1}u'(c_t^e)} = \varepsilon_{D_B,b}+\varepsilon_{D,b}\frac{D}{T-D} \tag{43}$$

Consider $\sigma=\frac{T-D}{T}$, then the previous expression can be written as:

$$\frac{E_{0,B-1}u'(c_t^u)-E_{0,T-1}u'(c_t^e)}{E_{0,T-1}u'(c_t^e)} = \frac{1}{\sigma}\left(\sigma\varepsilon_{D_B,b}+(1-\sigma)\varepsilon_{D,b}\right) \tag{44}$$

Having $B<T$ has two implications: (1) The LHS of the formula takes the average consumption while unemployed and *entitled to* b minus the average consumption when employed and (2) the RHS is a weighted average of $\varepsilon_{D_B,b}$ and $\varepsilon_{D,b}$, because the cost of the insurance depends not only on the time the agent is unemployed and compensated (D_B) but also on the time the agent is not paying taxes D. If $B=T$, that is, without finite entitlement, the previous expression becomes:

$$\frac{E_{0,T-1}u'(c_t^u)-E_{0,T-1}u'(c_t^e)}{E_{0,T-1}u'(c_t^e)} = \varepsilon_{D,b}\frac{T}{T-D} \tag{45}$$

Moreover, without finite entitlement and if $T=\infty$ we are back to the stationary case analyzed in the main text, where $E_{0,T-1}u'(c_t)=u'(c)$ -because consumption is constant-, and $\lim_{T\to\infty}\frac{T}{T-D}=1$. This reduces the previous expression to the formula (14) in the main text.

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