Against All Odds: Job Search During the Great Recession*

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Abstract

The unemployed in the United States appear to allocate time to job search activities regardless of the stance of the economy. Drawing on the American Time Use Survey between 2003 and 2014, I document that the unemployed increase their search intensity only slightly if at all during recessions. Roughly, 30 minutes in a week is the additional search intensity attributed to the unemployed in response to the Great Recession. While their search intensity depends on a number of factors that would predict otherwise, such as the odds of finding work, one argument shows promise: the search costs that accumulate over an expected long period of unemployment make a job more valuable during recessions. I estimate the elasticity of the value of a job to changes in labor productivity to be at least -0.67 and at most -0.04. I point out some implications of this argument for our understanding of business cycles and for the design of unemployment insurance policy.

JEL codes : E24, E32, J22, J64

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Introduction

Economic fluctuations and the allocation of time remain high on the agenda of macroeconomics. The need for further examining uses of time other than paid work, exhorted by Hall (1997) almost two decades ago, still prevails. There is no doubt that the prolific research spawned by the study of the cyclical movements of hours worked, employment, and wages has shaped our understanding of business cycles. However, little is still known about how the unemployed workers in the U.S. spend time on sending out resumes, placing job adds, and networking during recession and recovery in the labor market.[1]

That this aspect of the workers' decision-making is of particular importance may be grasped from the range of views on how their efforts to escape from unemployment may condition the resilience of the economy. According to one view, the lesser degree of intensity at which the unemployed look for work, motivated by a variety of reasons, could fuel a long-lasting recovery. Discouragement over the slack of the labor market and a generous unemployment insurance policy are often advanced as possible reasons. At the other end of the spectrum are views which contend that the lack of job opportunities is to blame. Needless to say, economic policies aimed at helping the unemployed differ across these views.

By using the American Time Use Survey (ATUS) between 2003 and 2014, I document that the unemployed in the U.S. appear to allocate time to job search regardless of the stance of the economy. They increased search intensity only slightly if at all during recessions. Roughly, 30 minutes in a week is the additional search intensity attributed to the unemployed in response to the recession of 2008-2009.

It would be odd to interpret this evidence as if the unemployed were unaware of or unaffected by the changing conditions in the labor market. After all, the unemployed remain attached to the labor market and their chances of leaving the pool of unemployment vary with the business cycle. Moreover, their search intensity arguably depends on additional factors that do change with the swings in the economy, such as wages, unemployment benefits, and the value of non-working time.[2]

[1] Previous contributions include Shimer (2004), Mukoyama et al. (2017), DeLoach and Kurt (2013), and Gomme and Lkhagvasuren (2015) for unemployed workers. Aguiar et al. (2013b) estimate that job search absorbed between 2% and 6% of the foregone market work hours during the Great Recession. While Shimer (2004) and Mukoyama et al. (2017) argue along the lines of the present paper, DeLoach and Kurt (2013) and Gomme and Lkhagvasuren (2015) offer a dissenting view on the matter.

[2] As of the non-working time, Aguiar et al. (2013b) document that roughly 80% of the foregone market work time was allocated to leisure and home production during the recent recession.

The way I view this evidence clashes with some of the U.S. labor market facts as we know them. To see this, consider the following sketch of the balance of costs and benefits that an individual worker would consider in choosing her search intensity:

$$\underset{\text{cost of searching}}{\overset{(1)}{\text{current marginal}}} = \underset{\text{the odds of finding work}}{\overset{(2)}{\text{marginal increase in}}} \times \underset{\text{value of a job}}{\overset{(3)}{\text{expected}}}$$

The left side of the equation represents the foregone leisure time when the worker allocates an additional unit of time to job search. The right side of the equation highlights two benefits of doing so. Since looking for work is risky, the first motive is the possibility of boosting the chances of finding a job. The second motive is the ultimate payoff of having looked for work in the first place: the value of a job.

The value of a job is the benefits minus the opportunity costs of being employed. Having a job means receiving a wage in exchange for the hour worked. It also implies avoiding the search costs that could have been incurred had the unemployed failed to find a job and kept looking for work. On the other hand, the opportunity costs of being employed consist of the foregone nonwork-contingent benefits, e.g. contingent to unemployment and disability, and the foregone value of non-working time like leisure and home production.

The evidence I document implies that (1) above does not vary over the business cycle under preferences that are separable in leisure and consumption. Evidence reported by other authors has, however, different implications for the right side of the equation. For it is well-known that the probability of finding a job, in the U.S., tracks closely with the cyclical shifts of the economy, implying that (2) does vary (positively) with it (Shimer, 2005 and Shimer, 2012). In addition, (3) has been traditionally regarded as procyclical. By construction, the value of a job declines during recessions in the Mortensen and Pissarides (1994)'s search model, which is the workhorse of the macroeconomics of unemployment.[3]

To sum up, even if the unemployed in the U.S. do not spend neither more nor less time on job search over the business cycle, then we have a puzzle. I entertain two arguments to throw light on this puzzle by addressing (2) and (3) separately.

[3] This is less so in versions of the model that depart from the Nash bargaining rule in the determination of wages or allow for rigid wages in a rather exogenous way. Incidentally, the canonical search model of Mortensen and Pissarides (1994) will also predict that (2) is less procyclical than what it is observed. This counterfactual prediction was first pointed out by Shimer (2005).

The first argument states that the unemployed search for work with an intensity that varies according to the prevalent labor market conditions, in a way that makes search intensity more valuable when good job opportunities are lacking. The cyclicality of search intensity will be a direct consequence of assuming a key property in the so-called matching function. Admittedly, this is a rather exogenous way to model the cyclicality of search intensity, yet it has received some attention in the literature (see, for instance, Mukoyama et al., 2017).

My main argument pertains (3). From the standpoint of the worker, I will argue, a job is more valuable during recessions. Put simply, the unemployed cannot afford to be too patient and wait to see how the recession unfolds. Instead, they could avoid the future costs of being unemployed by embracing the hassle right away.

I begin in section 1 with a brief discussion of the ATUS, the advantages it offers and the difficulties it poses for the estimation of the time spent on job search. I then proceed by building unconditional and conditional estimates of this use of time according to some regional, demographic, and labor market experience variables of interest. Since this is not the first attempt of inferring these estimates, at the end of this section, I review previous findings in the literature in the light of the results presented here. The aim of this section is thus to ascertain, through novel arguments, the cyclical pattern of the time spent on job search by the unemployed. Relying on a comprehensive view on the job-seeking behavior of the unemployed, I investigate whether alternative measures of search intensity, including the number of search methods used previously by Shimer (2004), tell a coherent and compelling story with respect to those variables, including the temporal dimension.

However small it may seem, I argue that the additional allocation of time to job search in the period 2008-2009 is economically important, with the aid of the model introduced in section 2. In particular, I argue in sections 3 and 4 that between the two arguments outlined above the most compelling explanation is that the unemployed place a relatively high value on a job during recessions. Though a ringing argument for those who have ever experienced a jobless transition, here I discipline it by providing estimates of the cyclicality of the value of a job in the U.S., leaning on an expression for the value of a job that emerges from a search model. In doing so I build on Chodorow-Reich and Karabarbounis (2016) who construct estimates for the opportunity cost of employment. I develop a strategy to gauge an upper bound for the size of job search costs based on the size of the value of non-working time.

I estimate the elasticity of the value of a job to changes in labor productivity to be at least -0.67 and at most -0.04. The estimated value of a job is countercyclical for two reasons. First, working during recessions does not hurt much since otherwise workers would have plenty of leisure time. On the contrary, it helps since recessions are typically periods of depressed consumption. That is, the opportunity cost of being employed is relatively low.[4] The second reason is that the opportunity cost of postponing the decision to search for work is relatively high during recessions. The search costs that accumulate over an expected long period of unemployment deter unemployed workers from delaying their efforts.

Chodorow-Reich and Karabarbounis's (2016) estimates would imply that, in a search model with endogenous search effort which neglects the role of search costs, the value of a job is nearly acyclical or slightly countercyclical in the U.S. I show that the puzzle mentioned above could be better grasped when allowing search costs to play a role as well. I therefore argue that both the procyclicality of the opportunity cost of employment and the countercyclicality of future search costs are needed to show that a job is strongly valued during recessions.

Concluding remarks, together with some implications for our understanding of business cycles and the design of unemployment insurance policy are given in section 5.

1 Measurement of Search Intensity

1.1 Benefits and Pitfalls of the ATUS

The ideal measure of search intensity would be the time allocated to job search – for it is subject to scarcity — by each unemployed worker during a specific meaningful period. The closest to this benchmark can be measured using the ATUS, which since 2003 surveys how people in the U.S. spend their time during a typical day of the year. The sample is drawn from households that have completed their eighth month of interview in the Current Population Survey (CPS).[5] Two to five months later the designated person, who is chosen randomly with equal probability within the household, is asked to provide a detailed account of her activities on the day prior to

[4] Chodorow-Reich and Karabarbounis (2016) report that the time series of this cost is strongly procyclical in the U.S.

[5] In the CPS, members of each participating household are interviewed once a month for four consecutive months, dropped from the sample for the next eight months, and interviewed again for the final four consecutive months.

the interview.[6]

The list of job search activities is displayed in Table 1. It includes a variety of activities like placing or answering ads, auditioning for an acting role, and meeting with headhunter or temp agency. In addition, Table 1 includes both active and passive methods of search. Placing job ads and sending out resumes could be regarded as activities that could result in a job offer without further action by the jobseeker.[7] On the other hand, activities such as reading ads in newspapers or on the Internet or picking up job applications alone may be regarded as inconsequential but may nonetheless be part of the job hunting process. Thus, reading ads in newspapers could help identify promising job opportunities and, in the end, motivate the jobseeker to contact the employer. Unfortunately, from the ATUS the contribution of these exploratory methods to the success of more direct methods is impossible to assess. Finally, even activities like passing security procedures and commuting associated with job search are recorded in the ATUS. These activities are excluded from the main analysis, although additional results for the full set of activities in Table 1 are reported below.

The peculiarities of the survey pose a number of concerns that seem pertinent when interpreting the time spent on, say, child care and job search as measured by the ATUS. I dwell on some of these issues next.[8]

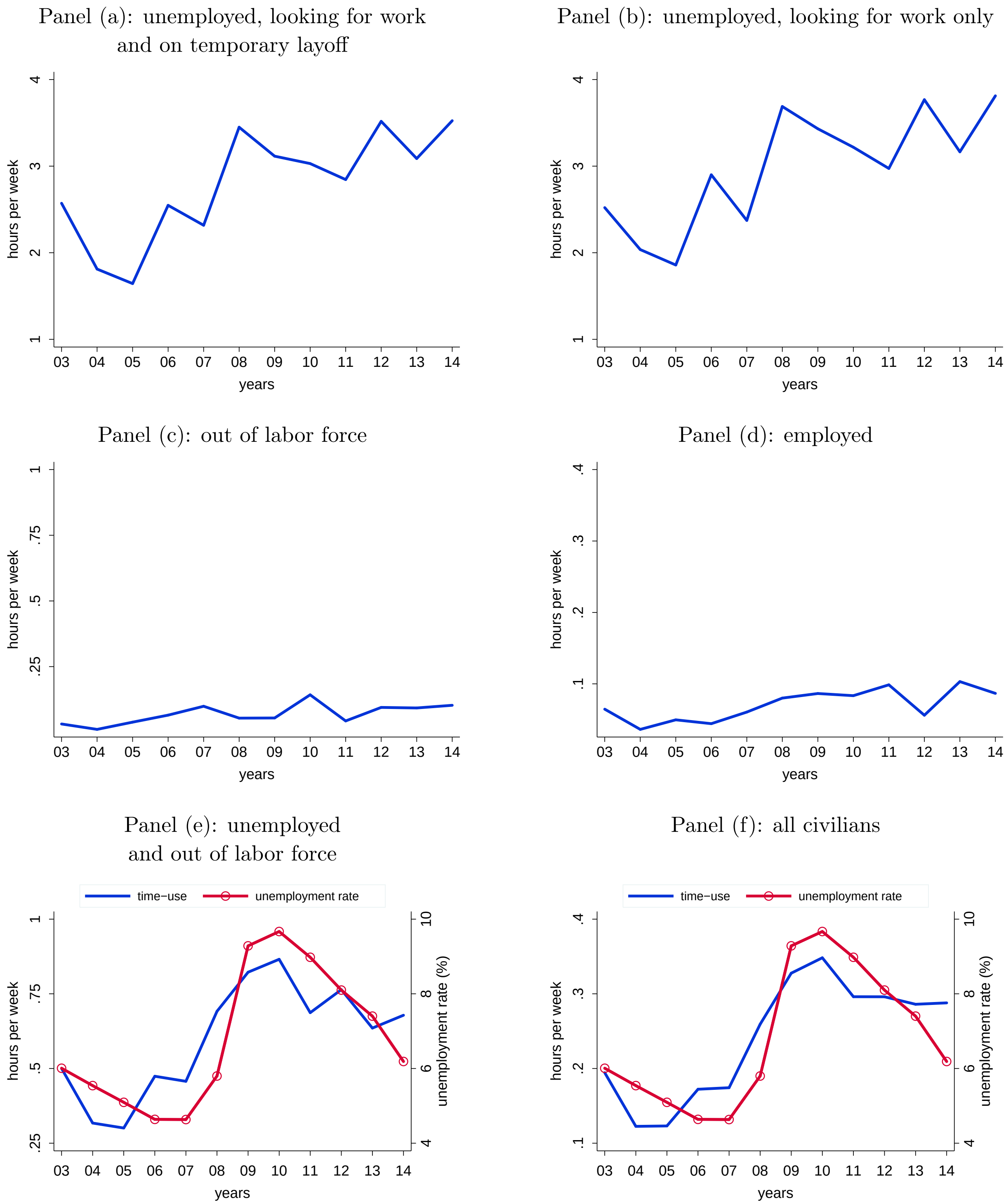
The first one seems to be justified since my interest is on how people allocate time in response to changes in the labor market conditions, which may call for a rather long time-use horizon surveyed through multiple days in, say, a week or a month, instead of a single day. Frazis and Stewart (2012) discuss the shortcomings from using short-term diary information to infer time-use in longer horizons, and the cases where these shortcomings are less of a problem. The calculation of the arithmetic mean is an example of the latter. Higher moments estimates should be taken with caution.

[6] The response rate in the ATUS is roughly 50%. For the CPS, the Census Bureau reports that this rate has been roughly 86% in the period July 2015 - June 2016. See U.S. Bureau of Labor Statistics (2016) and consult `www.census.gov`.

[7] Starting in 1994 the list of search methods makes a distinction between active and passive methods. The active search methods are contacted employer directly/interview, contacted public employment agency, contacted private employment agency, contacted friends or relatives, contacted school/university employment center, sent out resumes/filled out application, checked union/professional registers, placed or answered ads, and other active. Among the group of passive methods are looked at ads, attended job training programs/courses, and other passive. Polivka and Rothgeb (1993) discuss the 1994 redesign of the CPS questionnaire in detail.

[8] See Hamermesh et al. (2005) for a review of the ATUS survey and Hurst (2015) for a more recent account of the survey and the challenges in the measurement of uses of time.

Figure 1: Time Spent on Job Search by Six Population Groups



Notes: This figure plots the annual average weekly hours spent on job search over the period 2003-2014 by six population groups. Each panel shows estimates of year fixed effects from a regression of time spent on job search with no other controls. Regressions are estimated on weighted data. The sample comprises people aged between 16 and 74. In Panels (e) and (f) the annual unemployment rate is calculated using the CPS.

The previous point touches upon the substantial fraction of unemployed individuals who report zero minutes spent on search activities (83% in average in the period 2003-2014). According to Frazis and Stewart (2012) and Stewart (2013), these observations are to be regarded as the influence of day-to-day variation in the allocation of time, and not as a result of censoring. Thus, the decision of whether to look for work in a given day may respond to factors such as sickness, child care responsibilities, weather and economic conditions. The ATUS collects information that could be used to control for this source of variation.

Moreover, the recognition of this source of variation in the use of time aligns the empirical evidence with the theoretical framework discussed later, which rules out corner solutions in the individual allocation of time. That is, the presence of non-searchers among the unemployed is more an implication of the survey time frame than the outcome of a personal decision, since, by definition, all the unemployed must have spent some time on looking for work.

These first two issues point out the need to account for non-random daily variation. A third difficulty is the small sample bias. The combination of the low frequency of data and the short sample period makes it hard to smooth the trend away using standard filtering techniques. Time-diary information is available also at higher frequencies in the ATUS (monthly and quarterly) but at the risk of producing unrepresentative samples. Alternatively, I could exploit cross-section variation in both the use of time and a measure of slackness in the economy to extract a sort of cyclical pattern.[9] Later, I discuss the fruitfulness of this approach.

Next, I offer a preliminary view of the use of time in job search during the period 2003-2014. In Panel (a) of Figure 1 I plot this for unemployed workers who are currently looking for work and those who are on temporary layoff. The amount of time spent on job search is somewhat below 3 hours. This average, however, masks an apparent steady rise in this use of time, climbing from 2 to 3.5 hours between 2003 and 2014. In any case, it can be seen that the unemployed allocated slightly more time (30 minutes) in 2008 than what they did throughout the period. When restricting the sample to unemployed workers looking for work only, the temporal profile is virtually unchanged, as shown in Panel (b), suggesting that job search is a rare activity among workers who expect to be called back from the previous job.

Looking for work is, of course, not exclusive of the unemployed. Other things equal, jobless individuals who search passively for work are classified as out of the labor force. The joint labor

[9] An example of the application of this approach is Aguiar et al. (2013b).

supply of a household with one breadwinner may be affected by the recession, making (re)entering to the labor force look like an inevitable choice for the spouse or partner. Even for incumbent workers, search may result as a sensible choice in anticipation of a foreseen separation from the current job. Fortunately, all civilians are inquired about their search effort in the ATUS.

The time spent on job search by people out of the labor force is displayed in Panel (c). Perhaps not surprisingly, their time-use is meaningless, somewhat close to the equivalent of 4.2 minutes in a week. The more noticeable features are perhaps the drop in 2008, presumably a reflection of a discouragement effect, and the even more puzzling peak in 2010. Panel (d) does the same for the employed. Apparently, they spent an equal amount of time on these activities (4.3 minutes in a week). Once again, one may be inclined to rule out a discouragement effect on the job search behavior of the employed. For their use of time seems to follow an almost secular upward trend since 2004, with an important surge in 2007 and 2008, only interrupted in 2012. However, the small fraction of searchers in both population groups introduces bias and makes it difficult to be conclusive about the cyclical pattern of their search intensity. To be concrete, the fraction of searchers is 0.51% and 0.62%, respectively. Still, when I plot the search intensity of larger population groups an intriguing result emerges.

Panels (e) and (f) plot the uses of time by the non-employed and all civilians. The similarity of these two figures with the dynamics of the unemployment rate (depicted also in the panels) is striking. The general job-seeking behavior mirrors surprisingly well both the smoothness and turning points of the unemployment rate, suggesting that people based their job search intensity on the development of aggregate economic conditions. While the first group boosted their search intensity by 24.5 minutes, the other did it in 10.4 minutes between 2007 and 2010. It is hard to come up with an alternative explanation other than just sheer coincidence. I return to this point when I compare my results with those reported in previous works.

I complement the shortcomings of the ATUS with the use of an alternative measure of search intensity. To determine their non-employment status, CPS jobless respondents are inquired about the steps taken to find work during the four weeks prior to the interview, which are then fit to the methods listed in footnote 7. The alternative measure is constructed by counting the methods employed by each worker. Both the battery of questions and the layout of methods are also available in the ATUS, thus providing a unique opportunity to enrich the comparison.[10]

Mukoyama et al. (2017) have combined the use of time from the ATUS and the number of methods from the CPS into a single measure. Instead, I exploit the individual properties of each measure and investigate whether they tell a coherent and compelling story about the job search behavior of the unemployed who look actively for work.[11]

1.2 No Garden of Forking Paths

In this section I show that different measures of search intensity agree on the shaping of the job-seeking behavior of the unemployed, as depicted by a selected set of observables. The advantage of restricting the analysis to the region of residence of the jobseeker, her age, education, marital status, sex, spell of unemployment, and main occupation is that these characteristics are consistently available and directly comparable across the ATUS and the CPS. In principle, the latter two characteristics are less comparable but they will be so after exploiting the close link between the surveys, as described below. I report a selected group of descriptive statistics over these variables in the set of Tables 2-7 (shown in Appendix A, except for occupation).

The baseline sample comprises workers aged between 16 and 74, with all levels of education (high school dropouts, high school graduates, with some college, and college graduates), marital status (married, widowed, separated, divorced, and never married), all occupations, and with residence in all U.S. states. The size of the sample is 6,835 respondents in the ATUS and 545,736 in the CPS, representing 145 and 110 million people in the period 2003-2014.[12]

I highlight some of the salient features of the job-seeking behavior of the unemployed by displaying in Tables 2-7 the mean, standard deviation, standard error, skewness, kurtosis, maximum and minimum levels of each measure. In addition, I report the fraction of unemployed searchers (those who allocate some amount of time to job search), denoted by κ, the number of survey respondents, and the size of the unemployed population (in millions).

[10] The number of methods as a measure of search intensity is discussed in Shimer (2004). See U.S. Census Bureau (2013), pages C4-18 to C4-20, for a thorough description of each method.

[11] This group represents nearly 88.7% of the total unemployed population aged between 16 and 74 in the period 2003-2014.

[12] The discrepancy in the size of the unemployed population is apparently the result of the CPS allowing for proxy responses, a possibility that is precluded in the ATUS. This disagreement is pronounced for the very young (16-24), less educated (high school dropouts and graduates), and never married workers. See Tables 2-7. The represented population will vary when analizing the job search behavior over spell of unemployment and occupation, as explained later (for the former variable see Table 7).

I report those statistics according to the following criteria, displayed along 12 columns in each table. First, since the cyclical pattern of search intensity is the main theme of this paper, I split the sample by using the start of Great Recession as the dividing period. Second, even though it is unclear to which extent the number of methods conveys information about the time spent on the associated activities, it has been argued that since 1967 the unemployed had responded to every economic downturn by diversifying their methods of search (see Shimer, 2004).[13] I then report the statistics for the number of search methods in columns 7-12, while reserving columns 1-6 for the time-use measure. Third, the fraction of unemployed searchers might be cyclical as well. If so, the contention might be that the increase in the use of time around the recession is just compositional (changes in κ). I therefore report the statistics over the full sample of unemployed workers (columns 1-3) and the unemployed searchers only (columns 4-6). Finally, as both the ATUS and the CPS share the battery of questions which serve as the basis for the counting of search methods, I display the comparison in the set of columns 7-9 and columns 10-12.

I start with the job search behavior of the typical unemployed.[14] In the period 2003-2014 the unemployed in the U.S. spent roughly 3 hours per week in average, with a standard error of 7 minutes (0.11×60). The low standard error is not surprising given the large sample size (6,835 respondents).

To gain perspective on these magnitudes, I draw on the use of time in some of the activities performed by the employed and unemployed in the U.S. Take first the employed. Using the ATUS, Aguiar et al. (2013b) document for the period 2003-2010 that around 32 hours per week were accrued to market hours worked using a sample of individuals aged between 18 and 65. Using the same survey in the period of 2003-2013, Chodorow-Reich and Karabarbounis (2016) report that the unemployed aged 16 and over spent 24.6 hours on home production. The time spent on job search may therefore be deemed small. Later in section 4, I will argue that the allocation of time to this activity is economically meaningful, that is, at the margin.

Over time, the time spent on job search is slightly higher during the post-recession period. According to Table 3 (see at the bottom), the difference is 1 hour, although this additional time may be an artifact of the apparent upward trend (see again Panel (b) in Figure 1). If I concentrate

[13] The number of search methods has been previously used by Shimer (2004), Mukoyama et al. (2017), and Gomme and Lkhagvasuren (2015). Later, in section 1.3, I review the differences between these works and the present paper.

[14] For further reference, Table 2 and the rest of the tables, if space permits, present the full-sample statistics at the bottom.

on the unemployed searchers only, search intensity is also higher during that period. The difference is now 4 hours with an average base of 16.56 hours during the entire period.

As for the alternative measure, the unemployed would have used about 2 search methods during the same period. The averages do not differ by much across surveys, though, not surprisingly, the CPS average is estimated with much more precision than its ATUS counterpart. Over time and regardless of the survey, this measure suggests that the unemployed relied on a higher number of methods during the post-recession period, echoing the findings in Shimer (2004). Although the specific value for the number of methods depends on the survey, its absolute and the relative changes over time do not. The unemployed would have used 0.06 more methods after 2008, representing an increase in 6% in their search intensity. Admittedly, the use of more or less search methods is harder to interpret without knowing the time spent on each method and details on the search methods themselves. Still, it hints at a higher desire for diversifying their job search outcomes during recessions.[15]

Despite the differences, all measures suggest that the unemployed in the U.S. had searched for work more intensely in the post-recession period. Later, I provide a more careful argument in support of this rough conclusion.

Deviating from the representative worker, the distribution of search intensity looks atypical, and even more so when measured in weekly hours. The somewhat 82% of the unemployed who report any search activity already hinted at departures from a normal distribution. As it is clear from Tables 2-7, the distribution of this use of time is extremely tighter and less symmetric. Unusual values for the kurtosis and skewness are apparent everywhere, across all variables and their respective categories. This is a provisory call for the use of estimators that better deal with such departures when estimating the conditional measures of search intensity.

I proceed to document a set of job search profiles. Mean estimates reported in Tables 2-7 and plotted in Figure 2 could be thought as coefficients from the following pooled regression model:

$$s_i = \alpha + \sum_{k=1}^{K} \delta_k D_{ik}^{\nu} + \eta_i \quad \eta_i \sim (0, \sigma_\eta^2) \tag{1}$$

where s_i denotes either hours in a week or number of methods, D_{ik}^{ν} is a dummy variable that is equal to 1 if respondent i belongs to category k of variable ν={age, education, marital status, sex,

[15] Of course, a greater longing for diversification does not need to be at odds with an economic slump.

region, spell of unemployment, main occupation} and 0 otherwise, and η_i is the error term. To generate Table 2, for instance, one would set $K = 6$. The coefficient $\alpha + \delta_1$ will then capture the unconditional mean of the time spent on job search for workers aged between 16 and 24.

I estimate model (1) by Ordinary Least Squares (OLS) and plot the estimates $\hat{\alpha} + \hat{\delta}_k$ in Figure 2 (estimates for sex are not displayed).[16] Since my interest is in comparing these patterns across measures and surveys I dispense with referring to the units of each measure and instead present them normalized (see notes in Figure 2 for details about the normalization).

Panel (a) portraits a hump-shaped life-cycle profile across all measures of search intensity, with all of them suggesting a peak at 45-54.[17] Moreover, this profile seems to shift up during the post-recession period, in agreement with the general response discussed before (See Table 2). The profile of job search that relies on education is also consistent across measures; see columns 1, 7, and 10 of Table 3 and Panel (b) in Figure 2. There are at least two plausible explanations for the shape of this profile. Either chances to land into employment are higher or the opportunity costs of not searching hard enough are heavier for the better educated. For they may have to bear losses coming in the form of squandered human capital if they remain in prolonged joblessness.

When seen across marital status and sex, the job-seeking behavior of the unemployed offers some features of interest as well. According to Table 4, married jobseekers search more intensely than everybody else but the divorced. Across these categories, search intensity offers a coherent view, especially among the time-use measure and the CPS number of methods. As Panel (c) in Figure 2 shows, the profile of the ATUS number of methods appears to be disconnected from the other two, though it is not markedly different. Furthermore, men spend more time on job search than women do as shown by Table 5, a characteristic that is observed also across the other measures of search intensity (not plotted).

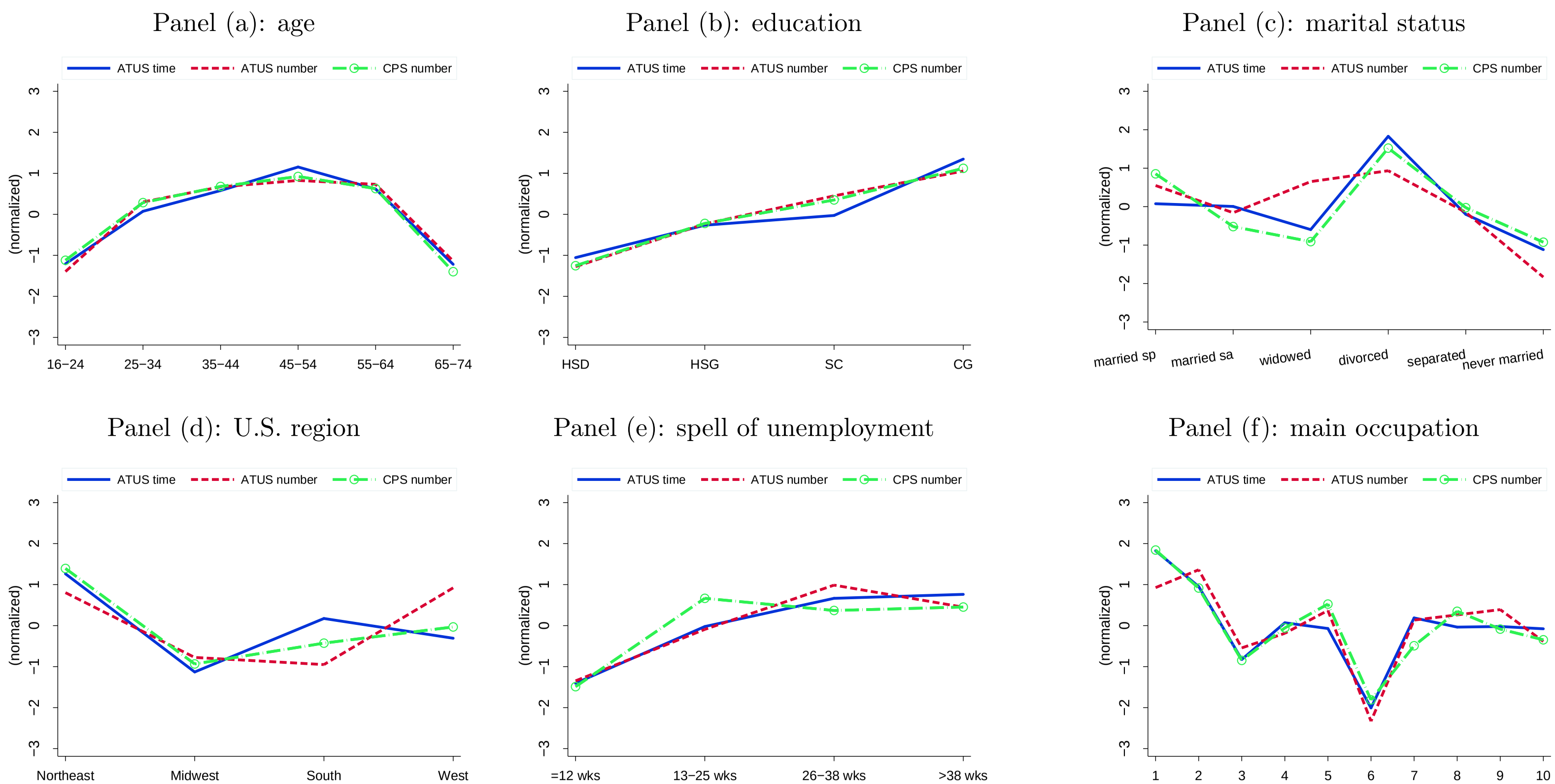
Regional variation does not seem to depict search intensity consistently across measures either, possibly reflecting the lack of representativeness of the ATUS at this level.[18]

[16] Both Shimer (2004) and Mukoyama et al. (2017) have previously reported some of these profiles for the number of methods as calculated using the CPS but not for the measures calculated using the ATUS (either number of methods or time-use).

[17] A similar shape has been documented by Aguiar et al. (2013a) for the time-use measure only.

[18] Less comparable are the profiles estimated over the U.S. states.

Figure 2: Patterns of Search Intensity Across Measures and Surveys: Unconditional Estimates



Notes: This figure depicts cross-sectional profiles over age, education, marital status, region, spell of unemployment, and occupation for three alternative measures of search intensity. Each panel shows estimates of cross-section fixed effects $(\alpha+\delta_k)$ from a regression of either number of methods or weekly hours on a constant only. Regressions are estimated using weighted data. For the sake of comparison, these fixed effects are normalized, that is, obtained by dividing the difference between the actual search intensity measure and its average by the corresponding standard deviation. The average and standard deviation are calculated over the respective groups. In Panel (b) education groups are high school dropouts (HSD) or with less than or equal to 11^{th} grade; high school graduates (HS) or with 12^{th} grade no diploma and high school grad-diploma or equivalent (GED); with some college (SC) or with some college but no degree, associate degree-occupational/vocational, and associate degree-academic program; and college graduates (CG) or with bachelor's degree (e.g. BA, AB, BS) and superior, including master's, professional school degree, and doctorate degree. In Panel (c), "sp" denotes spouse present and "sa" spouse absent. In Panel (e), spell of unemployment in the CPS is the interrupted spell of unemployment (truncated at 12 weeks). To estimate the spell of unemployment in the ATUS, I exploit the linkage between the two surveys and assume that the unemployed respondent in the ATUS maintained that status since her 8^{th} and final CPS interview. According to U.S. Bureau of Labor Statistics (2016), the elapsed time between the interviews is usually two to five months, with 3 months being the most representative (almost 70% of the ATUS interviews). Thus, if the respondent reported to be unemployed in both the ATUS and the final CPS interview, I add 11 weeks to the spell that she reported in the CPS. If the respondent reported to be unemployed in the ATUS but employed or out of the labor force in the CPS, I assigned her a spell of 12 weeks. In Panel (f), occupations are 1: Management, business, and financial, 2: Professional and related, 3: Service, 4: Sales and related, 5: Office and administrative support, 6: Farming, fishing, and forestry, 7: Construction and extraction, 8: Installation, maintenance, and repair, 9: Production, and 10: Transportation and material moving.

The profile estimated with the ATUS number of methods relatively underestimates the search intensity of the unemployed living in the South and overestimates that of the people residing in the West; see Table 6 and Panel (d).

The less directly comparable characteristics across surveys are the spell of unemployment and occupation of the jobseeker. In the CPS both are readily available. The spell of unemployment is the interrupted spell of unemployment and the occupation is the main occupation according to the 2002 Census classification system. In the ATUS, I construct these two variables by exploiting its close link with the CPS.

First, I look at the ATUS respondent's labor force status as recorded in her final CPS interview. If she was unemployed by then, I add three months to the spell of unemployment. Otherwise, I input those three months. In both cases, I am ignoring transitions between unemployment and employment or out of the labor force that might have occurred during the intermediate period that usually lasts 3 months (see U.S. Bureau of Labor Statistics, 2016).

Besides the coherency among the alternative measures of search intensity, Panel (e) displays an intriguing result. Search intensity of the unemployed appears to increase as the spell of unemployment lengthens, and as the likelihood of obtaining a job worsen (see, for instance, Shimer, 2008), casting doubts on the prevalence of discouragement. Surely, that profile flattens out as the unemployed persists in that condition, but it does not bend over. Moreover, in consonance with the previous estimates, this profile seems to shift up in the post-recession period (see Table 7).

Second, I look at the occupation recorded in the final CPS interview. If the final CPS interview does not help then I look at the previous months of interview by exploiting the rotation panel structure of the CPS exhausting all the possibilities, tracking people to their first interview if possible. To be sure, this procedure neglects the role of occupation mobility.[19]

The coherency among the alternative profiles speaks for itself, as revealed by Panel (f). According to all measures, there is a clear distinction of search intensity depending on the occupation. Workers occupied in management, professional, and related occupations search with an intensity level that stands out among rest of the sample. At the opposite tail of the distribution are those occupied in farming, fishing, and forestry occupations (coded 6 in the figure).

[19] Before 2003, occupations were classified following the 1990 Census system. I have reinterpreted to the best of my ability the occupations of ten people, out of 5104, who were interviewed before 2003 in the CPS. See Bowler et al. (2003) for a thorough account of the differences between the 1990 and 2002 Census industry and occupation classification systems. Kambourov and Manovskii (2008) document a rising occupation mobility in the U.S. in the period 1968-1997.

To sum up, I have so far documented suggestive patterns that shape the job search behavior of the unemployed across selected regional, demographic, and labor market experience variables. To this, I should add the apparent increase in the unemployed's search intensity in the period 2008-2014, consistent with the upward movement of the profiles calculated over those variables. No less important is the coherency of these findings produced by such different measures of search intensity. The estimates reported so far are however unconditional means. Next, I correct this shortcoming.

Model (1) is extended now to control for demographics (age, education, marital status, sex, and race), reason for unemployment, the unemployment rate at the state level, and state fixed effects. The patterns corresponding to these conditional estimates are displayed in Figure 6. Reassuringly, all variables still affect search intensity in the way that unconditional estimates illustrated before in Figure 2. Thus, the hump-shape of the life-cycle and the increasing profile on education seem to be robust to the inclusion of controls, so do the profiles over the region of residence, spell of unemployment, and main occupation. Marital status is the sole exception.

This agreement among the three measures of search intensity is indicative of a close connection between the number of search methods and the time spent on job search, that could potentially be extrapolated to the time dimension. Before exploring this possibility, I focus on the temporal shape of search intensity as measured by the time-use in search activities only.

The search intensity of the unemployed is sensibly affected by a variety of covariates as the foregoing discussion reveals. This is just one dimension over which it would be desirable to carry out a sensitivity analysis. In what follows, I use the extended model as a benchmark and guidance to conduct a sensitivity analysis along several dimensions: sample composition, set of covariates, measurement issues related to s_i, and estimation methods. To gain perspective on these robustness checks I display the resulting measures of search intensity in Figure 3 together with two benchmark measures, one labeled "raw" as its estimation is not conditioned to any variable but year fixed effects, and the other labeled "baseline", which is based on the full specification. Race and the unemployment rate are not included and spell of unemployment is substituted for reason of unemployment.

Sample Composition: The search behavior of very young and very old people may differ markedly from that of the rest of the population. While the first group is at the age of attending school and college, the latter is at the age of retirement. Some authors have trimmed the sample invoking an argument along these lines (see Shimer, 2004, Aguiar et al., 2013b, Gomme and Lkhagvasuren, 2015, and DeLoach and Kurt, 2013). Accordingly, I start by considering two alternative samples, composed of unemployed workers aged between 25 and 70, as in Shimer (2004), and between 18 and 65, following Aguiar et al. (2013b). Unlike the CPS, the ATUS it is meant to be representative at the national level only. The third alternative sample thus excludes respondents residing in small states such as Maine, Rhode Island, and Washington D.C.

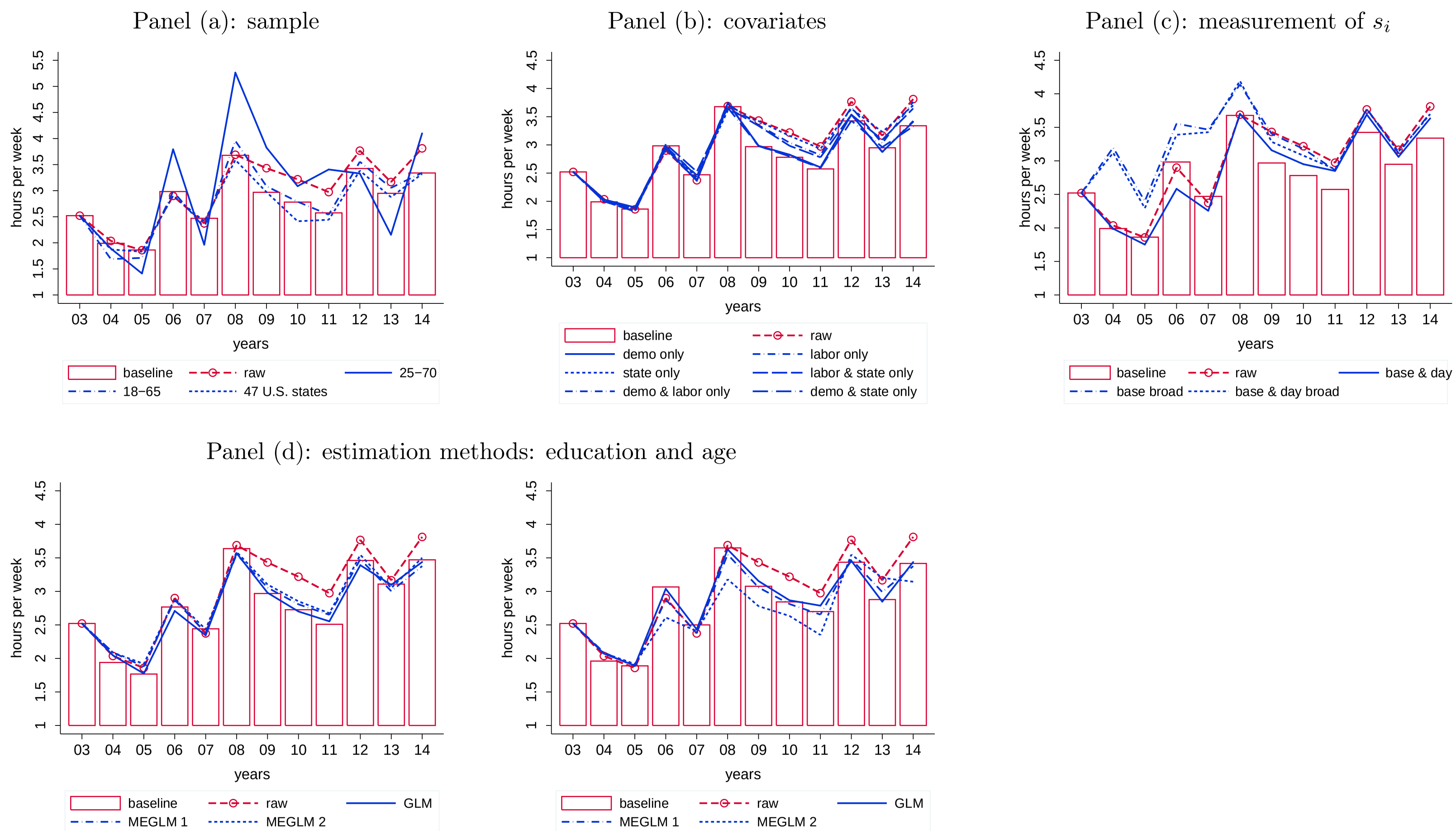
These three measures, together with the raw and baseline series are displayed in Panel (a). Features of interest, like the overall temporal evolution and, in particular, the spike observed in 2008, are pervasive across all the measures. The more noticeable departure is, however, depicted by the sample of workers aged between 25 and 70. The peak around the Great Recession is even more notorious and the resulting measure is more volatile. The latter property is not surprising for the dropped individuals (those aged in the ranges 16-24 and 71-74) represent 32.7% of the survey respondents and 44.2% of the unemployed population.

Set of Covariates: There is no sensible way to back one particular specification. I therefore carry out a sensitivity analysis by adding and dropping the set of variables introduced above and U.S. state dummies and combinations of them. The results, presented in Panel (b), are again reassuring: different ways of measuring search intensity lead to the same result. Only during the post-recession period, do the apparent composition bias stemming from changes in demographics, labor market experience, and regional variation seem to have played a role. Nevertheless, the discrepancy attributed to this bias is decidedly small, somewhat below 30 minutes in average.

Measurement of s_i: I first attempt to remove sources of systematic day-to-day variation in the allocation of time by including variables like the month, day of the interview, and whether the search took place in a holiday. As a second robustness check, I construct a broad measure of search intensity by considering the full list of activities in Table 1. Neither the inclusion of variables like the day and month where job search takes place, nor the comprehensive set of search activities makes a relevant difference with respect to the baseline measure, as shown in Panel (c).

The discrepancy of 30 minutes in average between this baseline and the broad measures in the period before 2009 is merely the result of the lack of consistency throughout the sample period in the recording of activities associated with security procedures and commuting.

Figure 3: Time Spent on Job Search: Sensitivity Analysis



Notes: This figure shows how changes in modeling assumptions reflect on the estimated conditional measure of search intensity in the period 2003-2014. Each panel shows estimates of year fixed effects from a regression of weekly hours on a constant and some covariates. These estimates are plotted relative to the raw time-use figure of 2003. In Panel (a) search intensity is shown under a variety of assumptions regarding the sample composition. To plot Panel (b), different combinations of the covariates are included in the estimation. In Panel (c) alternative measures of s_i that result from controlling for day-to-day variation and the inclusion of all the activities listed in Table 1 are displayed. Finally, estimators that are better equipped than OLS to deal with highly skewed data and that allow for cross-section variation are performed and their results presented in Panel (d). In each panel, the "raw" series is the unconditional time-use measure calculated directly from the ATUS and the "baseline" series conforms with the full specification. In Panel (d) the methods employed are OLS, for "raw" and "baseline", the Generalized Linear Model (GLM), and the Multilevel Mixed-Effects Generalized Linear Model (MEGLM). For the application of the latter estimator, I consider education (left) and age (right) as the variables inducing the cross-section variation in the second level of the hierarchical model. The education and age groups are those used in Figures 2 and 6. All regressions use weighted data. MEGLM1 corresponds to the estimation of the model with weighted data at the first level only (individual level) while MEGLM2 applies to weighted data at both levels. For the second level, the average of the individual weights over education or age groups is used. In Panel (c) "base" stands for "baseline".

Estimation Methods: OLS is usually the procedure of choice when estimating the effects of covariates on the use of time in activities with a quite low participation rate, such as child care and job search. Lending support to this practice, Stewart (2013) argues that the OLS, unlike for instance the Tobit model, generates unbiased estimates in experiments with simulated skewed observations. I heed the advice and, in addition, explore the robustness of the measure of search intensity to the class of generalized linear models (GLM), which offers flexibility to model the conditional mean of highly skewed distributions.[20]

Previously, I argued that search intensity in all of its versions varies greatly across age and education, which is something that was later confirmed by Figures 2 and 6. The last of the estimation methods I want to discuss is one which explicitly allows for modelling this sort of variation. The GLM model is extended in the following way:

$$\alpha_n = \mu + u_n, \quad u_n \sim \mathcal{N}(0, \sigma_u^2)$$

Now the constant of model (1) varies with groups indexed by n. I consider $n = 4$ education or $n = 6$ age groups and model the average search intensity at this level of variation. Under this specification individual search intensity is driven by two types of variation: the pooled variation represented by σ_η^2 and the cross-section variation represented by σ_u^2.[21] Estimates of the use of time in job search using these alternative estimators are displayed in Panel (d). For the latter class of models I use either education or age as determining the second level in the hierarchy. All measures are virtually identical with no striking differences whatsoever, with the innocuous exception of the measure delivered by the MEGLM that exploits the variation between age groups. Still, two takeaways can be drawn from this exercise. First, OLS keeps standing as a fit choice to deal with time-use diary observations. Second, cross-section variation that relies on either education or age is of no help to ascertain the cyclicality of the use of time in job search. Another way to put this is that between the pooled and cross-section variation, it is the first one that is relatively more important, which is supported by the estimated intra-class correlation $\hat{\rho}$ being virtually zero. This conclusion renders approaches like that explored by Aguiar et al. (2013b) unfruitful when applied

[20] I take the logarithmic function as the so-called link function and assume that search intensity is Poisson distributed.

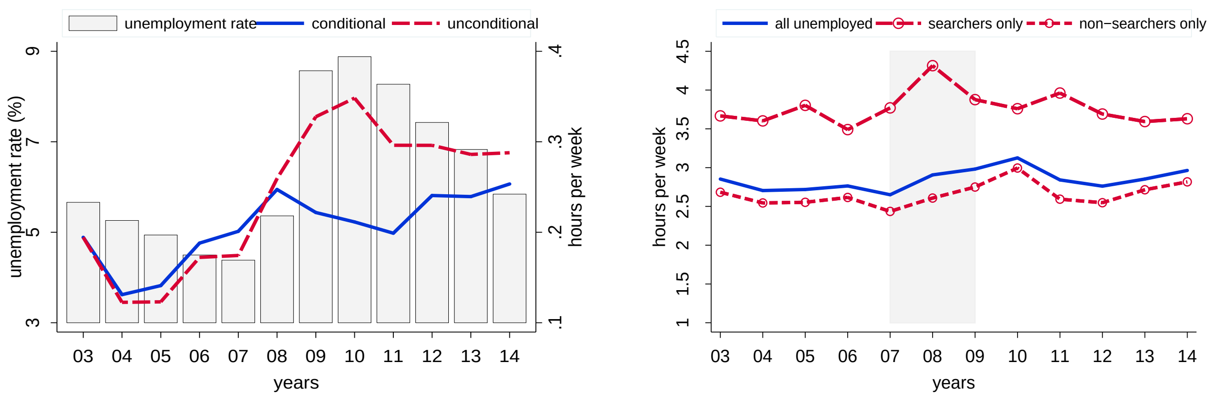
[21] Technically, n denotes the second level in the hierarchical model, u captures the between-variation and η denotes now the within-variation. It is possible to discern the relative role of the cross-section variation by calculating the intra-class correlation $\rho = \sigma_u^2/(\sigma_u^2 + \sigma_\eta^2)$. This structure delivers the class of models called Multilevel Mixed Effects Generalized Linear Models, or MEGLM, reviewed by Gelman and Hill (2007).

to job search time-diary information of the unemployed.[22]

To sum up, the spike of 30 minutes in search intensity around the Great Recession could have been an artifice of the sample composition, the specific set of covariates included, the way s_i is measured, or the estimation method employed. Yet on reflection, as the foregoing discussion suggests, this does not seem to be the case.

Figure 4: Time Spent on Job Search: Timing Matters

Panel (a): all civilian people — Panel (b): conditional predictions for unemployed only



Notes: Panel (a) shows the temporal profile of the unconditional and conditional time spent on job search, together with the unemployment rate, for the period 2003-2014. The unconditional measure is constructed using the estimates of year fixed effects from a regression of weekly hours on a constant only while the conditional measure includes in addition regional and demographic variables as controls. The unemployment rate is calculated using the CPS data. Panel (b) shows two in-sample predictions for search intensity conditional to whether the unemployed worker is a searcher — spent time on job search during the day previous to the ATUS interview. The weighted average of the two conditional predictions, where the weight is given by the measure of searchers, gives the predicted search intensity for all the unemployed (shown in the middle). This series is very close to the prediction for non-searchers only since the measure of these workers is almost 81% of the unemployed population in average. The positive time predicted for the non-searchers is the result of using OLS to make predictions of the conditional mean of a highly skewed distribution.

Still, this conclusion is not without difficulties. To be sure, the small sample bias along with the large number of non-searchers among the unemployed render the previous estimates highly imprecise. The spike of 30 minutes may be spurious, like apparently those witnessed in 2006 and 2012 (see Figure 3). Next, I discuss a provisional remedy. Before, I showed that all civilian people (unemployed, employed, and those out of the labor force) spent time on job search as if they were

[22]The estimate $\hat{\sigma}_u^2$ is approximately one quarter for both education and age, and regardless of the version of the MEGLM estimated. Compare this estimated value to the huge variance in the time-use reported at the bottom of Table 3 (S.D. in the full sample statistics section). See notes in Figure 3 for details on two versions of the MEGLM.

aware of the stance of the economy (see again Figure 1). I now regard the extended model as representative of all the civilian population and generate in-sample predictions for the unemployed only, with the benefit of producing less noisy estimates. The results from this exercise are reported in Figure 4.

Panel (a) displays three series. Two of them correspond to the unconditional and conditional measures of search intensity for all civilian people. The unconditional measure reproduces the profile plotted before in Panel (f) of Figure 1. The other measure is obtained after controlling for demographic and regional variables, and the labor market experience and labor force status of the jobseeker, as well as variables intended to capture non-random variation in the daily use of time. I plot also the unemployment rate as the preferred measure of idleness in the labor market.

The rough measure of search intensity resembles surprisingly well the dynamics of the unemployment rate, including the smooth transition towards its peak in 2010. Once the effect of the controls is removed, however, this association breaks up, more noticeably after the recession. While the unconditional and conditional measures of search intensity look virtually alike before 2008, the latter bounces back from its level in 2008 quickly until reaching its pre-recession level three years later. It thus appears that compositional changes lie at the root of this discrepancy between the conditional time-use, suggesting a quick response to the current economic conditions, as measured by the GDP for instance, and the unconditional series, moving along a lagging indicator of those conditions, such as the unemployment rate.

With this I come to the problem of discerning genuine changes in the individual search intensity from the aggregate measure, whose temporal evolution is affected also by the fraction of searchers among the unemployed. The measure of searchers increasing during a recession is by no means problematic, surely. The very finding that it may be so portraits a picture different than that held by the traditional view. For if the marginal return of searching for work would plummet during recessions, why would more people among the unemployed even bother spending some time on job search? As discussed below, the distinction between these two forces will prove crucial.

To shed light on this problem, I perform a prediction of the time spent on job search conditional on being unemployed, by using the extended regression model, and display it in form of a decomposition in Panel (b) with the recession shaded. To do that, I condition the latter prediction even further by considering whether the individual unemployed worker is a searcher. The prediction conditional on having spent some time on job search is what I call a genuine individual search intensity. For reference, I also show the prediction conditional on being unemployed, which is just the weighted average of the decomposition, with the weight being the fraction of searchers.

The decomposition reveals that it is both the individual search intensity and the measure of searchers that account for the dynamics of the aggregate measure of search intensity over the recession and subsequent recovery. Yet each component contributes to this measure differently along the business cycle. While the unemployed searchers appear to react almost contemporaneously, increasing their search intensity by 30 minutes at the very outset of the recession, the measure of searchers responds in a rather slowly way, mimicking the smoothness of the unemployment rate.[23]

The sharp awareness of the economic conditions on the part of the unemployed may sound surprising. Perhaps, what is behind the early impetus to find work is that job opportunities will eventually become scarcer as the recession unfolds, which would make the activity of searching more profitable at the very beginning of the recession. Alternatively, it may be that concerns about a gloomy future, marked by a long wait while incurring in costs of searching and facing either skills depreciation or non-accumulation of skills, is what drives this impetus early on. Both stories are consistent with the unemployed being attuned to the labor market developments.

The matter of timing just highlighted has important implications, especially for the comparison of the results presented in this section with those reported in the literature. I do this next.

1.3 Sturdiness or Discouragement?

It could be both that matter for a single unemployed worker. In average, however, it seems that the unemployed looked for work even against the odds. At face value, 30 minutes in a week is admittedly a small increase in response to the Great Recession.[24] Even so, it is rather surprising that the unemployed would have chosen not to cut the time spent on job search sharply and the measure of searchers would have not declined despite all the conventional arguments, the generosity of the unemployment insurance among them, suggesting otherwise, and in the light of the severity of the recent recession.

Shimer (2004) and Mukoyama et al. (2017) argue also in favor of the procyclicality of search

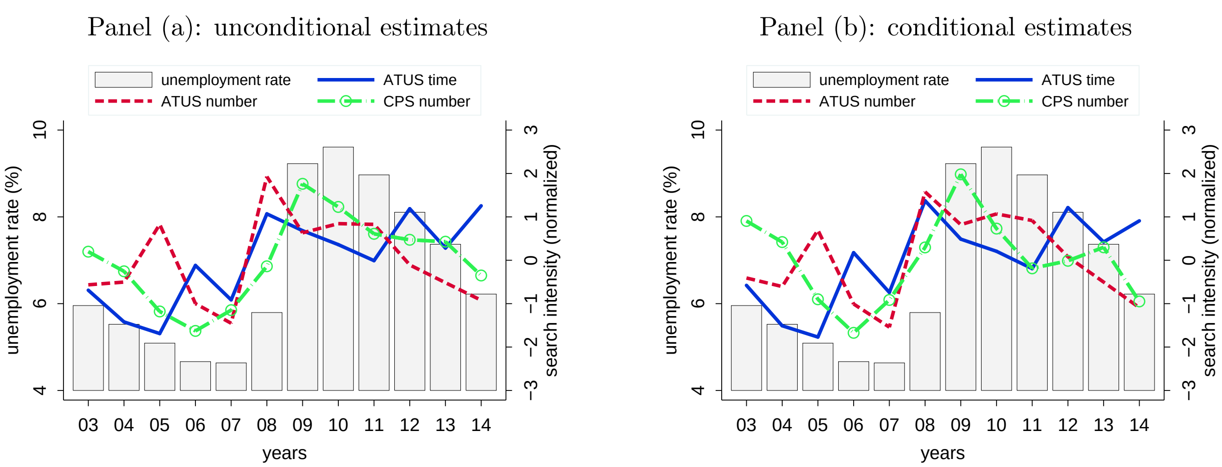
[23]The number of search methods resembles this immediate response. Its cyclical component is almost coincident with that of the GDP. See Shimer (2004). See also Figure 5 for a recent episode.

[24]This marginal increase must be put in context, however. Thirty minutes amounts to 16% of the average use of time in search activities. For comparison, take the market hours worked. Aguiar et al. (2013b) report that the decline in hours worked was 1 hour between 2007 and 2008 and 3 hours between 2007 and 2010. These two numbers represent 3% and 9% of the average weekly hours worked.

intensity. Shimer (2004) relies on the CPS number of search methods. Mukoyama et al. (2017) go further by constructing a measure of time-use search by linking time-use observations from the ATUS and the number of methods from the CPS. Though easier to interpret, the cyclical pattern of the combined measure is fully inferred from that of the number of methods.

Conversely, DeLoach and Kurt (2013) and Gomme and Lkhagvasuren (2015) throw doubt on that evidence. These two works are perhaps closer to the present paper since they use the ATUS almost exclusively. The way they assess the cyclical pattern of search intensity is by fitting the individual time spent on job search to the contemporaneous aggregate vacancy-unemployment ratio. Both agree on concluding that a higher unemployment rate imprints a discouragement effect on the unemployed. They indeed find that the linear fit is positive (negative) with respect to the vacancy-unemployment ratio (unemployment rate).

Figure 5: Different Timing in Search Intensity Across Measures and Surveys



Notes: This figure shows the timing of the three measures of search intensity described in the paper along with the unemployment rate. All measures lead the unemployment rate. But the lead is more pronounced for the measures based on the ATUS. Panel (a) shows estimates of year fixed effects from a regression of either number of methods or weekly hours with no other controls. Panel (b) shows estimates of year fixed effects from a regression of either number of methods or weekly hours on a constant, age, education, marital status, sex, race, U.S. state dummies, the unemployment rate at the state level, and a measure of attachment to the labor market. In the CPS, the latter variable is the reason of unemployment and in the ATUS it is constructed using the reason of unemployment in the final CPS interview. Regressions are estimated using weighted data. For the sake of comparison, these fixed effects are normalized, that is, obtained by dividing the difference between the actual search intensity measure and its average by the corresponding standard deviation. The average and standard deviation are calculated over time.

Central to this conclusion is the assumption that the unemployed would base their decision of time allocation on the concurrent changes in the economic conditions as measured by the unemployment rate, or for that matter, the tightness of the labor market, which typically lags other measures that are used to date the business cycle such as the GDP. But if individual awareness would precede the aggregate unemployment rate, as I suggested in the previous section, the procyclicality of search intensity found by DeLoach and Kurt (2013) and Gomme and Lkhagvasuren (2015) would be an artifice of timing. As I will argue next, this seems to be the case.

In Figure 5 I plot the temporal profile of the job search of those unemployed and looking for work as measured using both the ATUS and the CPS. For the sake of comparison, I normalize all these measures by using their respective means and standard deviations calculated over time. I display both unconditional and conditional measures.

I start with the number of search methods as calculated from the ATUS and the CPS. Even though the respondents in both surveys are subject to the same questionnaire regarding the methods of search, there are still some differences in the collection of the responses across surveys. While the CPS is conducted on a specific week of the month, the ATUS is conducted recurrently in a weekly basis. As a consequence, unlike the CPS, the time-diary information from the ATUS is best understood as measuring the allocation of time in a representative day of a given year. As it turns out, the survey frame is the first candidate to account for the discrepancy between two otherwise measures of the same phenomenon. Figure 5 shows this eloquently.

A first impression is that the ATUS number of methods is more compressed towards the recession period than its CPS counterpart. While the trough and peak of the CPS measure occur in 2006 and 2009, the respective turning points in the ATUS measure take place in 2007 and 2008. The discrepancy extends also to the recovery period. The CPS number of methods bounces back from its peak quickly, while the ATUS measure insinuates a prolonged recovery.

The culprit of this disagreement being the survey frame is further supported by the comparison between the time-use and number of methods as calculated both from the ATUS. Even though it is clear that the time-use measure is more volatile than the number of methods, presumably as a result of the large fraction of non-searchers, both measures coincide in the timing of their turning points around the recession period.[25]

This difference in timing might not matter had the unemployment rate evolved in a similar fashion. In face of the much smoother dynamics of the unemployment rate, which reaches its peak

[25]Notice that the standard deviation (S.D. in the set of Tables 2-7) of the ATUS number of methods (columns 7-9) is comparable, and even lower, than the deviation in the CPS number of methods (columns 10-12).

in 2010, the mismatch between its turning points and those of the CPS number of methods is less of a problem, since the gap between the two is one year long only. However, it does make it a difference when comparing the unemployment rate, or for that matter the vacancy-unemployment ratio, with the ATUS measures. Both the time spent on job search and the number of methods lead the unemployment rate by two years, which is a period longer than the duration of the recent great contraction in the economic activity according to the NBER (18 months). Therefore, it should not be surprising to find that the contemporaneous association between search intensity, regardless of how it is measured, and the vacancy-unemployment ratio (unemployment rate) is — weakly — positive (negative) in DeLoach and Kurt (2013) and Gomme and Lkhagvasuren (2015), leading them to assert that job search is procyclical.

With this I complete my argument supporting the main take away from this section: that the unemployed in the U.S. appear to increase their search intensity during recessions only slightly if at all. In the next section, I lay out a model to understand the reasons behind such a decision.

2 Model Economy

I follow the Mortensen and Pissarides (1994) canonical search model in some respects but depart from it in others. As in the canonical search model, I assume that workers and jobs meet according to a matching technology that captures the role of trading frictions in the labor market and, in particular, recognizes that the activity of searching for work is risky and costly. I depart from the canonical search model in that I ignore the role of firms in the creation of job vacancies. The source of aggregate fluctuations is then exogenous shocks to the tightness of the labor market.

The reason behind this abstraction is twofold. First, by drawing exclusive attention to the household I can study the main mechanisms that affect the job-seeking behavior of the unemployed over the business cycle in a transparent way. The second reason is that proceeding otherwise would divert my attention to the implication for wages of bargaining situations when workers and firms value a job differently over the business cycle. Incidentally, evidence documented by Yashiv (2015) suggests that firms recruit in a countercyclical fashion, contrary to what the canonical search model predicts.

Following Merz (1995) and Andolfatto (1996), consider a stand-in household with a unit measure of workers and a fraction $u \in (0, 1)$ of unemployed workers. Time is discrete. At any given time t, a worker is either unemployed or employed. If unemployed, the worker is endowed the exogenous process $y_t^u(\theta_t)$ that depends on the aggregate state of the economy. Otherwise, the worker is endowed $y_t^n(\theta_t)$, with $y_t^n(\theta_t) > y_t^u(\theta_t)$, for every realization of $\theta_t \in \Theta$. The wealth of the household thus results from pooling the endowments of its members:

$$W_t(u_t, \theta_t) = u_t y_t^u(\theta_t) + (1 - u_t) y_t^n(\theta_t),$$

where θ is the ratio of vacancies to unemployment, i.e., the tightness of the labor market. Here θ is permitted to follow an arbitrary exogenous process; it represents the aggregate shock in the economy which is taken as given by the household. By now, I do not take a stand on how wealth is allocated within the household. Later, I consider two alternative arrangements.

The household also takes the law of motion of unemployed workers as given. This measure evolves as follows:

$$u_{t+1} = u_t + (1 - u_t)\lambda - u_t f(s_t, \bar{s}_t, \theta_t) \equiv \lambda + \alpha(s_t, \bar{s}_t, \theta_t, \lambda) u_t, \tag{2}$$

where $\alpha(s, \bar{s}, \theta, \lambda) = 1 - \lambda - f(s, \bar{s}, \theta)$, λ is the job destruction rate, and $f(s, \bar{s}, \theta)$ is the probability of finding a job that depends on the individual search intensity s, the average search intensity $\bar{s}$, and the tightness of the labor market. Function f is strictly increasing in both s and θ, and strictly concave in s. I leave the complementarity between s and θ, or $f_{s\theta}$, unrestricted.

It will be important to appreciate beforehand the role of α. I make one factual comment and another interpretive. First, labor market flow estimates reported in the literature imply that $\alpha > 0$ (Shimer, 2005). Second, α may be regarded as driving the persistence of the law of motion of unemployment. If both λ and f are small then the process of destruction and creation of jobs is weak, in which case the worker would expect to remain in the unemployment pool for a longer time.[26]

Finally, the preferences of the household in any arbitrary period t are represented by the

[26] This is more eloquently shown in the decomposition of the unemployment rate in the steady state:

$$u^{ss} = \frac{\lambda}{\lambda + f(s^{ss}, \theta^{ss})} = \lambda \frac{1}{1 - \alpha(s^{ss}, \theta^{ss}, \lambda)} \equiv \underset{\text{unemployment}}{\text{incidence of}} \times \underset{\text{unemployment}}{\text{spell of}}$$

where λ is the incidence of new spells of unemployment and $1/(1 - \alpha)$ is the average spell of those out of work.

following utility function[27]

$$\mathcal{U}(c_t^u, c_t^n, s_t) = u_t\big(U(c_t^u) - V(s_t)\big) + (1 - u_t)\big(U(c_t^n) - \gamma\big)$$

where U is the utility function over consumption, V is the disutility over time spent on search activities, and $\gamma > 0$ is the disutility from working. Later, I allow γ to vary with θ. Function U is strictly increasing and strictly concave, and V is strictly increasing and weakly convex.

Although this is a partial equilibrium economy, I assume an implicit linkage between θ and a measure of aggregate productivity in the economy p, reflecting the creation of jobs that will show up naturally in a general equilibrium setup when firms face a positive productivity shock.

The representative household seeks to solve

$$\max_{\{c_t^u(\theta^t),\, c_t^n(\theta^t),\, s_t(\theta^t)\}_{t\geq 0}} \sum_{t=0}^{\infty} \sum_{\theta^t} \pi(\theta^t)\beta^t \Big[u_t(\theta^t)\big(U(c_t^u(\theta^t) - V(s_t(\theta^t))\big) + (1 - u_t(\theta^t))\big(U(c_t^n(\theta^t)) - \gamma\big) \Big]$$

subject to

$$\begin{aligned} u_{t+1}(\theta^{t+1}) &= \lambda + \alpha(s_t(\theta^t), \bar{s}_t(\theta^t), \theta_t), \lambda) u_t(\theta^t) \quad \forall t \geq 0 \\ \theta_t & \quad \text{follows a Markov chain} \end{aligned}$$

and taking $\bar{s}_t$ for any t, γ, λ, (u_0, θ_0) and processes for $y_t^n(\theta)$ and $y_t^u(\theta)$ as given. Additional technical constraints guarantee that $s_t \in [0, 1]$ and $u_{t+1} \in [0, 1]$ for all $t \geq 0$.

I accommodate two alternative arrangements that determine how wealth is allocated within the household, through the additional constraint

$$c^j(\theta^t) = \begin{cases} y^j(\theta^t) & \text{no full insurance} \quad \text{or} \\ W(u_t, \theta_t) & \text{full insurance,} \end{cases}$$

for $j \in \{u, n\}$.

Having set out the framework, now I characterize the optimal choice of search intensity. The

[27] Instead of laying out the problem of the individual worker (see for example, Pissarides (2000), Mortensen and Pissarides (1994), and Shimer (2004)) I adopt the big household interpretation pioneered by Merz (1995) and Andolfatto (1996), and subsequently used by Shimer (2010), Christiano et al. (2016), and Chodorow-Reich and Karabarbounis (2016). There are only gains by proceeding in this way. The preferred framework would allow me to discuss two alternative setups that differ in the possibility of pooling income within the household. More important, no intuition is lost.

Lagrangian function associated with the maximization problem could be written as follows:

$$\mathcal{L}\big(\{s_t(\theta^t), u_{t+1}(\theta^{t+1})\}_{t\geq 0}^{\infty}\big) =$$
$$\sum_{t=0}^{\infty}\sum_{\theta^t}\pi(\theta^t)\beta^t\Bigg\{\Big[u_t(\theta^t)\big(U(c_t^u(\theta^t) - V(s_t(\theta^t))\big) + (1-u_t(\theta^t))\big(U(c_t^n(\theta^t)) - \gamma\big)\Big]$$
$$+\mu_t(\theta^t)\Big[\lambda + \alpha(s_t(\theta^t), \bar{s}_t(\theta^t), \theta_t), \lambda)u_t(\theta^t) - u_{t+1}(\theta^{t+1})\Big]\Bigg\}.$$

where $\{\mu_t\}_{t\geq 0}$ is a sequence of Lagrange multipliers. According to the necessary first-order conditions, the solution of the problem $\{s_t^\star, \mu_t^\star\}_{t\geq 0}$ satisfies

$$V_s(s_t^\star(\theta^t)) \quad = \quad f_s(s_t^\star(\theta^t), \theta_t)\mu_t^\star(\theta^t) \tag{3}$$

and

$$\begin{aligned}\mu_t^\star(\theta^t)\pi(\theta^t) \quad &= \quad \sum_{\theta^{t+1}}\Big[\pi(\theta^{t+1})\beta\Delta^n\left(s_{t+1}^\star(\theta^{t+1}), u_{t+1}^\star(\theta^{t+1}), y_{t+1}^n(\theta^{t+1}), y_{t+1}^u(\theta^{t+1}), \gamma\right) \\ &+ \quad \pi(\theta^{t+1})\beta\alpha\big(s_{t+1}^\star(\theta^{t+1}), \bar{s}_{t+1}(\theta^{t+1}), \theta_{t+1}, \lambda\big)\mu_{t+1}^\star(\theta^{t+1})\Big],\end{aligned} \tag{4}$$

for every $t \geq 0$, where

$$\Delta^n(s, u, y^n, y^u, \gamma) = \begin{cases} U(y^n(\theta)) - U(y^u(\theta)) - \gamma + V(s) & \text{or} \\ (y^n(\theta) - y^u(\theta))U_c\left[W(u,\theta)\right] - \gamma + V(s) \end{cases}$$

It is understood that Δ^n is independent of u when every worker consumes their own endowment. Consumption allocations are determined according to the wealth allocation rules introduced before. Finally, notice that in symmetric equilibrium, $s_t = \bar{s}_t$ for every t.

Equation (3) describes the balance of the costs and benefits that an unemployed worker would consider before allocating additional time to job search. If she does so, the immediate benefit will be the contribution of these efforts in the marginal increase in the likelihood of obtaining a job f_s. The significance of the ultimate reward of such efforts requires more explanation. In the subsequent discussion, I construct a case in favor of appreciating the role that the multiplier μ plays in shaping the choice of search intensity. In doing so equation (4) will prove useful.

The Lagrange multiplier $\mu_t^\star$ represents the marginal utility of an infinitesimal decrease in the current measure of unemployed workers u_t. Precisely, equation (2) reads as follows:

$$u_{t+1} \geq \lambda + \alpha(s_t, \bar{s}_t, \theta_t, \lambda) u_t.$$

The direction of the inequality is not arbitrary. To see this, consider the following rearrangement:

$$\frac{u_{t+1} - \lambda}{\alpha(s_t, \bar{s}_t, \theta_t, \lambda)} \geq u_t.$$

The latter inequality can be viewed as a budget constraint, where the resource to be allocated is a good idiosyncratic shock, represented here by a decline in the measure of unemployed workers u_t. Suppose this measure shrinks by a small amount. Other things equal, this good shock will, according to equation (2), persist in the next period. The worker thus faces the following dilemma: She could take full advantage of experiencing such a good shock today by substituting leisure time for time spent on searching for work (reducing s_t at the expense of an increase in α, undoing the decline in u_{t+1}), or she may keep searching with the same intensity, thereby boosting even more her chances of landing into employment in the next period (reducing u_{t+1} even further). As can be seen, such a reduction in u_t, in any case, loosens the constraint.

How much is the worker willing to pay to experience such a a good shock? Not surprisingly, the answer is given by the multiplier μ_t. This price depends on a number of factors, which could be easily recognized by solving (4) recursively:[28]

$$\mu_t^\star(\theta^t) = \sum_{i=t+1}^{\infty} \sum_{\theta^{t+1}} \frac{\pi(\theta^i)}{\pi(\theta^t)} \beta^{i-t} \left(\prod_{j=t+1}^{i-1} \alpha(s_j^\star(\theta^j), \bar{s}_j(\theta^j), \lambda, \theta_j) \right) \Delta^n \left(s_i^\star(\theta^i), u_i^\star(\theta^i), y_i^n(\theta^i), y_i^u(\theta^i), \gamma \right) \quad (5)$$

There may be countless reasons to be willing to pay this price in real life. Equation (5) captures three: the discount factor β, the rewards to search efforts $\Delta^n(s, u, y^n, y^u, \gamma)$, and the persistence of the unemployment process $\alpha(s, \bar{s}, \theta, \lambda)$. Clearly, μ is simply the present value of the stream of

[28] I rule out "bubbles" (some may call it excessive anxiety to gain reemployment, beyond to what is dictated by time preferences and the determinants of the persistence of unemployment α) in μ, that is, I impose

$$\lim_{T \to \infty} \sum_{\theta^{t+1}} \pi\left(\theta^{s+T}\right) \prod_{j=t+1}^{t+T} \beta\alpha(s_j^\star, \bar{s}_j, \theta_j, \lambda) \mu_{t+T}^\star = 0$$

which establishes that μ does not grow faster than the discount gross rate given by $\left(\prod_{j=t+1}^{\infty} \beta\alpha(s_j^\star, \bar{s}_j, \theta_j, \lambda)\right)^{-1}$ as the future becomes more distant.

future benefits that a worker could seize if allocating additional time to job search. Workers with a particular longing for the future will place a higher value on their current efforts to escape from unemployment.

Second, the higher the reward $\Delta^n(s, u, y^n, y^u, \gamma)$, the higher the incentive to substitute search time for leisure time. If y^n is regarded as the reemployment wage, then this component resembles the usual opportunity cost of leisure, highlighted in the real business cycle literature. The disincentive effect of nonwork-contingent insurance benefits is captured by y^u. Notice that although an increase in y^u — say, the unemployment insurance benefit — would make the unemployed exert less effort, the generosity of the benefit is counterbalanced by the associated costs of being unemployed (the future effort costs denoted by $V(s_i)$ with i starting in $t+1$ in the above formula). Think of the unemployed worker who has to provide proof of an active job search in order to remain eligible to claim the benefits. That is, even collecting benefits is costly.

Third, workers looking for work in a labor market where the creation and destruction of jobs is described by a rather weak process (with a high α) will in particular weigh the stakes of being unemployed for a long time. Under such circumstances, a higher value for $\mu^\star$ should reflect the willingness to leave unemployment at any rate.

Put simply, μ is the present value of the future marginal benefits $\Delta^n(s, u, y^n, y^u, \gamma)$ and the marginal contribution of searching today to the *reduction* of future effort costs. This price will, therefore, have a correspondence with the value the unemployed worker place on a job. A neater expression for the value a job will be obtained with the aid of posing the household problem in recursive form. First let

$$B\left(u_0, \theta_0; y^n, y^u, \bar{s}, \gamma, \lambda\right) \;=\; E_0 \sum_{t=0}^{\infty} \beta^t \mathcal{U}(c_t^{u\star}, c_t^{n\star}, s_t^\star) \tag{6}$$

be the indirect utility of a household, upon following an optimal strategy for c^u, c^n, and s, that starts with measure of unemployed workers u_0 and shock θ_0, and takes $\bar{s}$, γ, λ, and processes for $y^n(\theta)$ and $y^u(\theta)$ as given. The problem of the household is to solve

$$B(u, \theta; y^n, y^u, \bar{s}, \gamma) = \max_{s, u'} \left\{ \mathcal{U}(c^u, c^n, s) + \beta \int_\Theta B(u', \theta'; y'^n, y'^u, \bar{s}', \gamma) Q(\theta, d\theta') \right\} \tag{7}$$

subject to $u' = \lambda + \alpha(s, \bar{s}, \theta, \lambda)u$ and the wealth allocation constraint, given $y^n(\theta)$, $y^u(\theta)$, $\bar{s}$, γ, λ, u_0 and θ_0, and the (monotone increasing) transition function Q. In (partial) equilibrium, $s = \bar{s}$.

The following two expressions will capture the determination of the optimal search intensity $h(u, \theta)$. For s to represent this optimal decision, it must satisfy:

$$V_s(h(u, \theta)) = \beta f_s(h(u, \theta), \bar{s}, \theta) \int_{\Theta} -B_u(u', \theta') Q(\theta, d\theta') \tag{8}$$

where, according to the envelope condition,

$$B_u(u, \theta) = -\Delta^n(h(u, \theta), u, y^n, y^u, \gamma) + \beta\alpha(h(u, \theta), \theta, \bar{s}, \lambda) \int_{\Theta} B_u(u', \theta') Q(\theta, d\theta') < 0 \tag{9}$$

which indirectly gives the value of a job, that is, $-B_u(u, \theta)$, or the cost of moving from employment to unemployment. As desired, adding an unemployed member to the household hurts, regardless of whether there is full insurance within the household (see Proposition 1 in Appendix B). Whether this pain grows with u does depend on the rule of wealth allocation (see Proposition 2).

From the comparison between the sequential problem and the recursive form problem, it can be seen that

$$\mu^\star = \beta \int_{\Theta} -B_u(u', \theta') Q(\theta, d\theta') \tag{10}$$

That is, as stated above, $\mu^\star$ which represents the willingness to pay (in units of leisure time) for a reduction in the measure of unemployed worker has to be equal to the expected value of a job $\int_{\Theta} -B_u(u', \theta') Q(\theta, d\theta')$, discounted by β, for $s^\star$ to be the optimal choice. At this point, it is worth noting that it is this price which is meant to be lower during recessions according to the canonical search model that ignores search costs. This is one of the reasons why staying in the pool of unemployment is so comfortable in that model.

Search intensity will respond to two types of shock: idiosyncratic u and aggregate θ. Although my interest is in how $h(u, \theta)$ moves along changes in θ, it would be instructive to learn how idiosyncratic shocks affect the optimal decision of search intensity. Facing a decline in the measure of unemployed workers, I argued above, the household has the choice of either reaping the benefits today, by substituting leisure time for search time, or by allowing such a decline in u passing through the odds of leaving unemployment in the next period. In the absence of full insurance, these forces cancel each other out. With full insurance, it is optimal to search less intensely as u declines (see Proposition 3).

To address the response of search intensity to changes in θ I will focus on two aspects that make searching for work a rewarding activity. The arguments on which I elaborate in the next section corresponds to these two aspects, which are better summarized by combining the optimal and envelope conditions

$$V_s(s^\star) = f_s(s^\star, \theta)\, \underbrace{\beta \int_\Theta \left\{ \Delta'^n(s'^\star, u'^\star, y'^n, y'^u, \gamma) + \alpha\big(s'^\star, \theta', \lambda\big) \frac{V_s(s'^\star)}{f_s(s'^\star, \theta')} \right\} Q(\theta, d\theta')}_{\text{expected value of a job} \equiv \mu_t^\star} \tag{11}$$

At the beginning of this section, I left the sign of $f_{s\theta}$ unrestricted. In the next section, I make an explicit assumption on it. I argue that even though the tailoring of this assumption has received some attention in the literature, it would not constitute a fruitful exercise. As part of my second argument, I measure the value of a job and determine its apparent direction over the business cycle. In doing so I argue that there is a smoothing motive in the allocation of efforts over time.[29] This motive, in part, accounts for the desire of the unemployed for having a job when it is precisely hard to find one.

3 Substitutability in the Matching Function: A Critique

A standard assumption in the literature is that the search effort and the tightness of the labor market are complements in the matching function, that is $f_{s\theta} > 0$ holds. Put it differently, searching for work becomes more valuable in booms than in recessions. Thus, the substitutability between s and θ, or $f_{s\theta} < 0$, would seem to be a natural candidate to explain why unemployed workers search for work in a countercyclical fashion.

Substitutability in the matching function may be interpreted in at least two ways. First, from the perspective of the unemployed, it could simply mean that they view searching time as a substitute for the prevalent labor market conditions in the economy. Thus, in recessions, they will search more intensely to compensate for the decline in their chances to find work. Conversely, in booms, the unemployed will minimize the hassle and enjoy additional leisure time instead.

[29] Even though Merz (1995) acknowledges the presence of this smoothing motive, I offer reasons to underscore the quantitative importance of this intertemporal decision along the business cycle.

The alternative interpretation rests upon the firm's side. Recessions will be times when firms post fewer vacancies since the fact that workers are particularly eager to take a job will make those job openings easier to fill in. In any case, one would observe the unemployed allocating more time to search activities in recessions despite the limited availability of jobs.

Although the substitutability in the matching function is a rather exogenous way to model the cyclicality of search intensity, it has received some attention in the literature (Mukoyama et al., 2017).[30] Below, I extend some previous results in the literature and offer a cautious note on the empirical scope of this hypothesis as it is stated here.[31] For consistency, I omit the underlying mechanisms that may explain how this substitutability arises.

In the remainder of this section, I argue that the procyclicality of search intensity relies exclusively on complementarities in the matching function.[32] Two assumptions are essential. First, I assume each worker within the household consumes their own endowment. Second, I assume that wages minus unemployment benefits are more procyclical than the value of non-working time (including search costs). This second assumption is key for the following claim:

PROPOSITION 4: The value of a job $-B_u(u, \theta)$ is increasing in θ.
PROOF: See Appendix B.

That is, the value of a job is procyclical as in the canonical general equilibrium search model. To gain insight on how s and θ are combined, consider the following functional form for the individual probability of finding a job:

$$f(s, \bar{s}, \theta) = s\frac{m(\bar{s}u, \theta)}{\bar{s}u},$$

where

$$m(\bar{s}u, \theta) = \left((\bar{s}u)^{\frac{\sigma-1}{\sigma}} + \theta^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}}$$

[30] Building on Stigler (1961), Shimer (2004) shows that a countercyclical search intensity may show up in a general equilibrium search model as a natural consequence of the discrete time setting. In his model, search intensity, which is approximated by the number of search methods, depends on the job finding probability in a nonlinear fashion. Search intensity is countercyclical for values of the job finding rate exceeding 81%, a bound that does not seem to bind in the light of the evidence on transition probabilities in the U.S. (see Shimer, 2005 and Shimer, 2012).

[31] That is, ruling out arguments that rest upon microfoundations of the matching function.

[32] I am treating the remaining assumptions as unassailable. I state these assumptions in detail in the Appendix.

is the matching function proposed by den Haan et al. (2000). Combining the previous two expressions yields

$$f(s,\bar{s},\theta) = \frac{s}{\bar{s}}\left(\bar{s}^{\frac{\sigma-1}{\sigma}} + \theta^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}}.$$

The parameter $\sigma \in (0,1)$ is the constant elasticity of substitution between the average search intensity and the labor market tightness. If $\sigma < 1$, then the job finding probability is guaranteed to be less than one. For a proof of this, see Appendix B.

In symmetric equilibrium, $s = \bar{s}$, so the probability function reduces to

$$f(s,\theta) = \left(s^{\frac{\sigma-1}{\sigma}} + \theta^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}} \tag{12}$$

The purpose of the next proposition is to establish the sufficiency of a complementarity condition in the matching technology to show that the unemployed will search more intensely during booms, regardless of stochastic nature of θ.

PROPOSITION 5: If $f_{s\theta} > 0$ then $h(u,\theta)$ is strictly increasing in θ regardless of the nature of θ.
PROOF: See Appendix B.
REMARK: When θ is I.I.D. $f_{s\theta} > 0$ is also a necessary condition.

The latter result resembles Proposition 1 in Mukoyama et al. (2017) when θ is I.I.D. Proposition 5 thus extends their results by stating that the latter property remains sufficient for recessions of any type of persistence.[33]

The irrelevance of the type of the recession in the previous claim may seem surprising. When θ is I.I.D. the cyclicality of search intensity is inherited from the complementarity between search effort and the aggregate shock. When θ is correlated, the expected value of a job now plays a role. But since the value of a job is procyclical, by Proposition 4, and search intensity is insensitive to changes in u, by Proposition 3, all forces stemming from θ and channelled to both θ' and u' lead to unequivocal changes in $h(u,\theta)$.[34]

[33] In the empirical section, Mukoyama et al. (2017) assume a flexible constant elasticity of substitution (CES) matching function, permitting $f_{s\theta} < 0$.

[34] The result will not longer hold if there is full insurance within the household. For the smoothing of consumption motive will work against the procyclicality of search intensity (effect of u' on B_u) as Proposition 6 in Appendix

As decisive as it seems, I argue that the sufficient condition $f_{s\theta} > 0$ cannot be disciplined by the facts. The reason is twofold. First, as suggested by the latter proposition, the procyclicality of the optimal search intensity relies exclusively on the complementarities in the matching function, giving the theory little opportunity to fail. Second, it is hard to come up with independent information to judge whether complementarities in s and θ capture how workers and jobs meet in an actual labor market. Such a hypothesis could not be subject to criticism.

I conclude that entertaining the presence or absence of complementarities in the matching function is not a fruitful exercise in trying to account for the cyclicality of search intensity. Of course, this conclusion does not rule out arguments that find support in microfoundations of the matching function. These efforts would raise important avenues for future research.

Broadly speaking, this pessimistic conclusion is not definitive if we consider alternative and perhaps more interesting explanations on why the unemployed may search harder in recessions. Intuitively, future search costs may play a role in the decision of workers who are particularly uneasy about prolonged joblessness. I elaborate on this next.

4 Measuring the Value of a Job Along the Business Cycle

The previous argument relies on the proposition that the value of a job is procyclical, which in turn rests upon a key assumption that lies at the core of old and heated debates in macroeconomics: whether real wages are strongly or mildly procyclical.[35]

While the strong procyclicality of wages is an assumption in a partial equilibrium setup, that cyclicality would be an outcome in a framework that incorporates firms' decisions as well. In particular, it is well-known that in the canonical search model, wages absorb most of the productivity shocks when the former are settled using the Nash bargaining rule (see Shimer, 2005).

As stated before, the procyclicality of wages would make the unemployed search less intensely during recessions. Shimer (2004), for instance, asserts that the value of a job is almost, by definition, procyclical in the canonical search model as a direct consequence of assuming the Nash bargaining rule. He also notes that in accounting for the countercyclicality of search intensity, which he documents using the number of search methods used by the unemployed in the U.S.,

B shows.

[35]Recently, Beraja et al. (2016) have revived the debate by showing that wages estimated from cross-state variation are more flexible than wages estimated from aggregate time-series.

wages would need to be strongly countercyclical to offset the procyclicality of f_s.

I show that this claim does not necessarily hold true when search intensity is an endogenous variable and the opportunity cost of delaying search efforts plays a role in shaping the value of a job.

In this section, recessions are times when postponing the decision to look for work is costly. When the recession is persistent enough, the unemployed would expect to remain jobless for a long time. Since the worker will need to give up leisure in every period during the spell of unemployment, the allocation of time in search activities becomes an intertemporal decision: the marginal contribution of the current search is the reduction of future search costs. Other things equal, a strong motive to smooth search costs will make a job highly valuable in recessions.

Using U.S. time series and estimates on the value of non-working time from Chodorow-Reich and Karabarbounis (2016), I find that the opportunity cost of postponing the decision to look for work is countercyclical.

Unemployment, in the real world, is costly for a variety of reasons, ranging from the foregone wage to wider psychological implications. In this model, being unemployed is costly because of the foregone wage and the search costs. Certainly, a complete picture of the costs of unemployment will have to allow for the benefits of being out of work, such as nonwork-contingent insurance benefits and the dislike about working. Next, I formalize this picture.

I begin by invoking the envelope condition, which I rewrite for the sake of exposition

$$B_u(u,\theta) = (y^u(\theta) - y^n(\theta))U_c(c^\star) + \gamma - V(s^\star) + \alpha(s^\star,\theta,\lambda)\int_\Theta B_u(u',\theta')Q(\theta,d\theta')$$

Using the optimal condition for search intensity gives

$$B_u(u,\theta) = (y^u(\theta) - y^n(\theta))U_c(c^\star) + \gamma - V(s^\star) - \alpha(s^\star,\theta,\lambda)\frac{V_s(s^\star)}{f_s(s^\star,\theta)}$$

From now on I will assume that there is full insurance within the household. As in Chodorow-Reich and Karabarbounis (2016), I express this value in consumption units:

$$J(u,\theta) = y^n(\theta) - y^u(\theta) - \frac{\gamma}{U_c(c^\star)} + \frac{V(s^\star)}{U_c(c^\star)} + \alpha(s^\star,\theta,\lambda)\frac{V_s(s^\star)}{U_c(c^\star)}\frac{1}{f_s(s^\star,\theta)}$$

This is the equation that formally portrays the accounting of (marginal) unemployment costs. The first term is the foregone wage minus nonwork-contingent insurance benefits. This is perhaps the component that has received particular attention in the literature.

The status of unemployment is less costly if the alternative involves some costs as well. The cost of being employed in units of consumption is denoted by γ/U_c. Chodorow-Reich and Karabarbounis (2016) study how this cost varies over the business cycle in the U.S.

The last two terms in the equation denote broadly the costs of searching. I make a distinction between total and marginal search costs. Although both reflect the leisure foregone, they differ in one important respect. Marginal costs are conditioned to the persistence of the unemployment process. If unemployment becomes highly persistent, that adds value to the only decision that could redound to reemployment: allocating time to the job at the margin.

An interval estimate of $J(u, \theta)$ is obtained by adopting an eclectic approach. Recently, Chodorow-Reich and Karabarbounis (2016) provide estimates of the size of y^u and γ/U_c, relative to the size of a unit of (after-tax) marginal productivity. I borrow these estimates. In addition, I make a sensible assumption on the size of y^n. Finally, I make an inference on the magnitude of total and marginal search costs, based on the assumption that search costs cannot exceed employment costs.

I proceed to describe this approach in detail. In a recently influential paper, Chodorow-Reich and Karabarbounis (2016) argue that the opportunity cost of employment, most prominently the non-working time, is strongly procyclical in the U.S. They show that it is as cyclical as a measure of labor productivity. Being employed is then less costly during recessions since workers have plenty of non-working time.[36] As a by-product of their methodology, they provide estimates on the size of the value of the cost of employment and the value of nonwork-contingent insurance benefits. I reproduce these estimates here:

$$\frac{\gamma}{pU_c} \in (0.41, 0.9) \quad \text{and} \quad \frac{y^u}{p} = 0.06$$

where these numbers are expressed in units of marginal productivity, which I should call p.

Among these, the size of γ is the less precise under a range of different assumptions. High values will work in my benefit, making the value of a job more countercyclical.

The second piece of information is the size of y^n. I simply assume that the wage is as large

[36] They also show that the role of nonwork-contingent insurance benefits is rather minor.

as p. There could be more than one reason to speculate that this assumption is not called for. For instance, wages would not entirely reflect gains in labor productivity in the presence of hiring costs.[37] In any case and in the light of the size of $\gamma/(pU_c)$, $y^n/p = 1$ does not seem to be an unsound assumption.

Now, I turn to search costs

$$\frac{V}{U_c} + \alpha \frac{V_s}{U_c} \frac{1}{f_s} \tag{13}$$

where I save notation for the sake of clarity. I start by noting that the expression for the marginal search costs could be expressed as a function of total search costs, thus

$$\alpha \frac{V_s}{f_s} \frac{1}{U_c} = \alpha \varepsilon_{V,s} \frac{s}{f} \frac{V}{s} \frac{1}{U_c}, \quad \text{where} \quad \varepsilon_{V,s} = \frac{dV}{ds} \frac{s}{V} \quad \text{and} \quad f_s = \frac{f}{s} \tag{14}$$

Intuitively, $\varepsilon_{V,s}$, which is the ratio of marginal to average search costs, stands for how fast search costs increase when adding an additional time unit to job search. I now invoke an assumption which is key for what follows. I assume that $V/U_c < \gamma/U_c$, that is, searching costs cannot exceed employment costs, both represented by the foregone leisure time and expressed in units of consumption. This assumption together with equation (14) imply the following inequality

$$\alpha \varepsilon_{V,s} f^{-1} \frac{V}{U_c} < \alpha \varepsilon_{V,s} f^{-1} \frac{\gamma}{U_c}$$

I can now add the remaining component V/U_c to the previous expression to obtain an upper bound for (13)

$$\frac{V}{U_c} + \alpha \varepsilon_{V,s} f^{-1} \frac{V}{U_c} < \frac{\gamma}{U_c} + \alpha \varepsilon_{V,s} f^{-1} \frac{\gamma}{U_c} \equiv \left(1 + \alpha \varepsilon_{V,s} f^{-1}\right) \frac{\gamma}{U_c}$$

With the aid of this inequality, I am ready to restrict sensible values for the size of search costs (in terms of p) from above. I make the following conservative assumption

$$V(s) = \chi s, \quad \chi > 0$$

[37] See, for example, Pissarides (2000).

which agrees with the weakly convexity assumption made on V. With this specification, $\varepsilon_{V,s} = 1$. To estimate α, the persistence of unemployment, I rely on the flow market transition probabilities calculated using Shimer (2012)'s methodology.[38] The probability of transiting from employment to unemployment and the job finding probability are $\lambda = 0.02$ and $f = 0.31$.[39] Thus

$$\alpha = 0.67 \quad \text{and} \quad f^{-1} = 0.31^{-1} = 3.23$$

To conclude, I find that the following inequality holds

$$\frac{V}{pU_c} + \alpha \frac{V_s}{pU_c} \frac{1}{f_s} < 1.30 \tag{15}$$

where I have used the more conservative value $\gamma/(pU_c) = 0.41$ estimated by Chodorow-Reich and Karabarbounis (2016).

I can now proceed to calculate how cyclical the value of a job is. I use the previous estimates to calculate bounds for the elasticity of $J(u, \theta)$ with respect to θ. For the sake of clarity, I adopt the following notation:

$$\begin{aligned} \text{TSC} &= \frac{V(s^\star)}{U_c(c^\star)} \\ \text{MSC} &= \alpha(s^\star, \theta, \lambda) \frac{V_s(s^\star)}{U_c(c^\star)} \frac{1}{f_s(s^\star, \theta)} \end{aligned}$$

where TSC and MSC stand for total search costs and marginal search costs. I calculate the elasticity of the value of a job with respect to changes in the tightness of the labor market as follows

$$\varepsilon_{J,\theta} = \varepsilon_{y^n,\theta} \frac{y^n}{J} - \varepsilon_{z,\theta} \frac{z}{J} + \varepsilon_{\text{TSC},\theta} \frac{\text{TSC}}{J} + \varepsilon_{\text{MSC},\theta} \frac{\text{MSC}}{J}$$

where $z = y^u + \gamma/U_c$. Dividing both sides of the equation by $\varepsilon_{J,\theta}$ gives

$$1 = \varepsilon_{y^n,J} \frac{y^n}{J} - \varepsilon_{z,J} \frac{z}{J} + \varepsilon_{\text{TSC},J} \frac{\text{TSC}}{J} + \varepsilon_{\text{MSC},J} \frac{\text{MSC}}{J}$$

[38] I have used his Stata files available in his personal website.

[39] These values imply a steady-state unemployment rate of 6.1% in the period 1967.II-2012.IV.

For the sake of consistency with estimates available in the literature, I express the elasticities with respect to p. Thus

$$\varepsilon_{J,p} = \varepsilon_{y^n,p}\,\frac{y^n}{J} - \varepsilon_{z,p}\,\frac{z}{J} + \varepsilon_{\mathrm{TSC},p}\,\frac{\mathrm{TSC}}{J} + \varepsilon_{\mathrm{MSC},p}\,\frac{\mathrm{MSC}}{J} \tag{16}$$

I provide lower and upper bounds for the cyclicality of J, captured here by the elasticity $\varepsilon_{J,p}$. As before, I will consider the assumption that the foregone leisure time, in units of consumption, is larger for the employed than for the unemployed to generate a lower bound for $\varepsilon_{J,p}$. An upper bound will naturally arise by assuming that search is needless to find work.

Results presented in the previous subsection imply that the accounting of unemployment costs looks like

$$\frac{J(u,\theta)}{p} = \underbrace{\frac{y^n}{p}}_{1} - \underbrace{\frac{z}{p}}_{0.47} + \underbrace{\frac{\mathrm{TSC}}{p}}_{0.41} + \underbrace{\frac{\mathrm{MSC}}{p}}_{0.89} = 1.83$$

which means that a job is valued as twice as the marginal productivity of labor. If finding a job were a trivial matter and working were a nirvana, an average job in the economy will worth p. The excess in value that workers place in a job is the result of the benefits in the avoidance of both current and future search costs brought as a result of having a job.

Hagedorn and Manovskii (2008) and Chodorow-Reich and Karabarbounis (2016) provide estimates on the elasticity of wages and z with respect to a measure of marginal productivity, respectively. They find that

$$\varepsilon_{y^n,p} = 0.449 \quad \text{and} \quad \varepsilon_{z,p} = 1$$

What remains to be determined are the search cost elasticities. I start by simplifying the expression for the total search costs, which yields

$$\varepsilon_{\mathrm{TSC},\theta} = \underbrace{\left\{\frac{V_s}{U_c}h_\theta + \frac{V}{U_c}\frac{\sigma_c\varepsilon_{c,\theta}}{\theta}\right\}}_{\partial\mathrm{TSC}/\partial\theta}\frac{\theta}{\mathrm{TSC}}$$

The marginal costs could be written as

$$\varepsilon_{\text{MSC},\theta} = \left\{ \frac{1}{U_c} \underbrace{\left[\frac{\alpha h_\theta}{f_s} \left(V_{ss} - \frac{V_s f_{ss}}{f_s} \right) - \alpha V_s \frac{f_{s\theta}}{f_s^2} - V_s \left(h_\theta + \frac{f_\theta}{f_s} \right) \right]}_{\partial \text{MSC}/\partial\theta} + \frac{\alpha V_s}{f_s U_c} \frac{\sigma_c \varepsilon_{c,\theta}}{\theta} \right\} \frac{\theta}{\text{MSC}}$$

where $h_\theta(u, \theta)$ denotes the optimal response of search intensity to changes in the aggregate labor market conditions. In section 1, I argued that the unemployed increased their search intensity only slightly if at all during the recent recession, suggesting that h_θ is negligible, or $h_\theta = 0$. I use the index on the number of vacancies constructed by Barnichon (2010) and divide it by the unemployment rate to obtain a measure of θ. Information used so far implies that

$$\begin{aligned} \varepsilon_{\text{TSC},\theta} &= \sigma_c \varepsilon_{c,\theta} \\ &= \sigma_c \rho_{\tilde{c},\tilde{\theta}} \frac{\text{sd}(\tilde{c})}{\text{sd}(\tilde{\theta})} \\ &= 2 \left(0.797 \frac{0.870}{24.432} \right) \\ &= 0.06 \end{aligned}$$

and

$$\begin{aligned} \varepsilon_{\text{MSC},\theta} &= -\left(\frac{\alpha + f}{\alpha} \right) \varepsilon_{f,\theta} + \sigma_c \varepsilon_{c,\theta} \\ &= -\left(\frac{0.67 + 0.31}{0.67} \right) \left(0.894 \frac{8.746}{24.432} \right) + 0.06 \\ &= -0.41 \end{aligned}$$

where I consider a CRRA utility function and use $\sigma_c = 2$ as in most business cycle studies. Multiplying these elasticities by the elasticity of θ to p gives

$$\varepsilon_{\text{TSC},p} = 0.224 \quad \text{and} \quad \varepsilon_{\text{MSC},p} = -1.533$$

It should not be surprising to learn that the sensitivity of TSC to productivity changes is negligible. In fact, it is reflecting the relatively smooth cyclical pattern of consumption only, thus its positive sign. The low elasticity is a direct consequence of my conservative assumption about the optimal cyclical movements of search intensity. Perhaps less obvious is to see why, even under this assumption, MSC is strongly countercyclical. Note that per every 1% decrease in labor productivity, the MSC increases in 1.5%.

The unemployed, by definition, spend some time on job search. As tiny as it may be, this allocation of time to job search may make a meaningful difference in the prospects of finding work. The crucial point is this: even if the worker does not change her search intensity over the business cycle, as my conservative assumption states, her chances of leaving the pool of unemployment and the costs of remaining in that pool do. In short, function matters, not size (Cochrane, 2013).[40]

Plugging the latter elasticities into (16) gives

$$\varepsilon_{J,p} = -0.67$$

In the absence of search costs on the part of the unemployed, the accounting of unemployment costs is simply

$$\frac{J(u,\theta)}{p} = \underbrace{\frac{y^n}{p}}_{1} - \underbrace{\frac{z}{p}}_{0.47} = 0.53$$

I recalculate the elasticity of the value of a job, obtaining

$$\varepsilon_{J,p} = -0.04$$

Thus, Chodorow-Reich and Karabarbounis (2016) estimates would imply that, in a search model with an endogenous search effort which however ignores search costs, the value of a job is nearly acyclical or slightly countercyclical in the U.S.

The bounds calculated for the cyclicality of $J(u, \theta)$ should be taken in perspective.[41] If finding a job were a frictionless activity, the value of a job would move slightly along the business cycle. In the other extreme, if searching for work were as costly as working, in terms of the foregone leisure time, the value of a job would be highly countercyclical. Per every 1% in increase in the labor productivity, the value of a job would decrease by almost two-thirds.

[40] This is just another way to argue in favor of the size of the job search activity. It is numerically small but it turns out that it is economically significant.

[41] Notice that what matters for the decision of search intensity is the expected value of a job and not its contemporaneous value. The argument stills holds, however, given the monotonicity assumption made on the transition probability Q.

A reasonable guess would be placing the relative importance of search costs something in between, and therefore, conclude that the value of a job in the U.S. is somewhat countercyclical. It should be recalled, however, that the procedure followed to arrive at these bounds was, in every stage, conservative or modest. In order to calculate the relative size of search costs, I assumed particular preferences that allow search costs to increase at a constant rate as more time is allocated to job search while it is reasonable to think that costs increase at a faster rate.

In this paper, the persistence of unemployment has been given a primary role in accounting for the countercyclicality of job search intensity. One may naturally wonder whether a more persistent recession (productivity shock) would do in a general equilibrium framework. It would not under a Nash bargaining rule, since wages will turn out to be highly flexible. Under alternative settings, wages will at best be rigid and the search decision will still be responsive to the procyclical job finding probability.

This is not a paper that sought to tailor the wage mechanism to make the search model conform with the evidence reported at the beginning. One should view this paper as shedding light on a novel argument based on the costs of not searching rather than on the benefits of doing so. Another argument that goes along the lines of this paper would be the depreciation of skills that would be prohibitively costly to warrant a passive attitude towards searching for work at the outset of a recession. Davis and von Wachter (2011) incorporates this motive in a variety of general equilibrium search models and conclude that unemployment seems to be a rather inconsequential event for the unemployed. I have argued that the cyclicality of the value of a job may be key to understand the latter pessimistic result. Doing this in a general equilibrium model is beyond this paper and is thus left for future research.

5 Concluding Remarks

I began this paper by documenting that the unemployed in the U.S. appear to allocate time to job search regardless of the business cycle. Roughly, 30 minutes in a week is the additional time attributed to the unemployed in response to the Great Recession of 2008-2009. This finding poses a puzzle in the light of some of the U.S. labor market facts as we know them. I then turned to the exposition of two arguments aimed at understanding this puzzle. I conclude that the countercyclicality of the value of a job is the most compelling explanation to assess the evidence. In particular, I estimate the elasticity of the value of a job to changes in labor productivity to be at least -0.67 and at most -0.04.

In closing, I share some thoughts on the implications of the results presented in this paper for business cycles and the design of unemployment insurance policy. I start with the implications for our understanding of business cycles in the U.S.

The first implication is that my preferred argument throws light on an additional motivation behind the allocation of time, in particular, to job search. As argued throughout the paper, the more persistent the recession, the higher the incentives to invest time in searching for work. One broad interpretation is that fears of placing themselves in a trap from which is difficult to scape provide the unemployed the impetus to look for work. Consistent with this view, Davis and von Wachter (2011) show that workers' anxieties and perceptions about labor market conditions track closely with actual economic conditions, and that prime-age workers' anxieties are highly correlated to the unemployment rate in the U.S. in the period of 1977-2010. This evidence would support the idea that the price willing to be paid in order to be reemployed, μ in the text, is countercyclical.

A more related interpretation is the following. Given that in a recession the cumulative future search costs, expressed in units of consumption, expected to be relatively high, and in response, the unemployed will choose to give up leisure time to look for work, one may conclude that income effects dominate substitution effects. Again, this implication clashes with the primary role assigned to a strong intertemporal substitution of leisure and procyclical real wages in generating procyclical responses in the labor supply in the real business cycle literature. That view of the world echoes the pessimism of Mankiw (1989), who provides a critical assessment of this mechanism in the real business cycle model.

At the same time, my estimated value of a job downsizes the prominent role attributed to relative prices since the inception of the real business cycle literature. Wages and unemployment benefits appear to play a role as important as that played by persistent effects, emphasized quite time long ago by Clark and Summers (1982).

One more implication, pointed out also by Chodorow-Reich and Karabarbounis (2016), is that if the value of a job is countercyclical, then productivity shocks in the canonical search model will generate still milder fluctuations in the unemployment rate and number of vacancies in a general equilibrium setup. Some may contend that this implication is pessimistic, leading to a dead end. If the unemployed spend more time on job search in recessions, this result adds fire to the Shimer's puzzle. But even fruitfulness could grow in the land of pessimism. For my results would suggest that we still need to learn much about the labor market in the U.S.

Implications are no less important for the design of the optimal unemployment insurance policy over the business cycle. Certainly, the interplay between search effort and unemployment insurance has been part of an old debate. This paper seeks to contribute to this still lively debate. Questions that remained to be asked are the following: How should we react if the unemployed are searching hard enough even when the odds are patently against them? More specifically, should the unemployment insurance policy be procyclical as Mitman and Rabinovich (2015) suggest? or should it vary along the unemployment rate as the discussion in Kroft and Notowidigdo (2016) implies? I leave these questions for future research.

Finally, Davis and von Wachter (2011) recently conclude that in the canonical search model, job loss is a rather inconsequential event for the unemployed. In the light of the findings of this paper, the culprit behind such implication of the search model might be the procyclicality of the value of a job. Put it differently, in the canonical search model unemployment is relatively less costly in recessions, which is something that may sound odd for anyone acquainted with the stakes of being unemployed for a long time. I venture to say that to make the search model conform to the main findings of this paper, it will require changes that go beyond mere twists on its key underlying mechanisms.

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ONLINE APPENDIX FOR

Against All Odds: Job Search During the Great Recession

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Table 1: List of Job Search Activities in the ATUS 2014

Job search activities (050401)
Formerly called "Active job search (050401)" before 2005
Contacting employer
Sending out resumes
Sending resumes to employers
Placing/answering ads
Researching details about a job
Asking about job openings
Researching an employer
Making phone calls to prospective employer
Asking former employers to provide references
Auditioning for acting role (non-volunteer)
Auditioning for band/symphony (non-volunteer)
Filling out job application
Meeting with headhunter/temp agency
Formerly called "Other job search activities (050402)" before 2005
Reading ads in paper/on Internet
Checking vacancies
Writing/updating resume
Picking up job application
Submitting applications
Job interviewing (050403)
Interviewing by phone or in person
Scheduling/canceling interview (for self)
Preparing for interview
Waiting associated with job search or interview (050404)
Waiting to go in for an interview
Security procedures related to job search/interviewing (050405)
Opening bags for security search (job search)
Being searched at security checkpoint (job search)
Passing through metal detector (job search)
Job search and interviewing, not elsewhere classified (050499)
Travel related to job search & interviewing (180504)

Notes: As an example, this table displays the list of search activities and their classification according to the ATUS in 2014. In the period 2003-2014 there have been minor changes in the listing and classification of activities. In 2004 the wording of a couple of activities was slightly modified. Starting in 2005, categories 050401 and 050402 were combined into 050401. Notice that all activities in the category 050402 seem to refer exclusively to passive search, the exception perhaps being "Submitting applications". Although I could have left this category out, it would have been possible only before 2005 as explained above. Besides, there is nothing wrong with using passive methods whenever these are complemented with at least one active method. Unfortunately, such cases are not possible to be identified in the ATUS.

Table 2: Descriptive Stats for Age

criteria	ATUS time-use (full) (1)	ATUS time-use (03-07) (2)	ATUS time-use (08-14) (3)	ATUS time-use (full) (4)	ATUS time-use (03-07) (5)	ATUS time-use (08-14) (6)	ATUS number (full) (7)	ATUS number (03-07) (8)	ATUS number (08-14) (9)	CPS number (full) (10)	CPS number (03-07) (11)	CPS number (08-14) (12)
mean	1.34	1.20	1.42	12.56	9.80	14.42	1.78	1.73	1.81	2.06	1.99	2.10
S.D	5.93	5.13	6.33	13.75	11.50	14.84	0.93	0.91	0.95	1.13	1.07	1.17
S.E	0.13	0.17	0.18	1.04	1.26	1.55	0.02	0.03	0.03	0.00	0.00	0.00
skew.	6.69	6.34	6.66	2.07	2.00	1.99	1.34	1.45	1.28	1.16	1.19	1.14
kurt.	59.60	49.90	59.26	8.28	6.74	7.96	4.98	5.43	4.77	4.17	4.38	4.04
max.	98.00	60.55	98.00	98.00	60.55	98.00	6.00	6.00	6.00	7.00	6.00	7.00
min.	0.00	0.00	0.00	0.12	0.23	0.12	1.00	1.00	1.00	1.00	1.00	1.00
κ	0.11	0.12	0.10	1.00	1.00	1.00						
resp.	2,182.00	946.00	1,236.00	176.00	84.00	92.00	2,182.00	946.00	1,236.00	164,811.00	61,302.00	103,509.00
pop.	63.14	22.28	40.86	6.75	2.72	4.03	63.14	22.28	40.86	34.04	11.73	22.31
mean	3.67	3.05	3.91	17.17	15.63	17.69	2.26	2.18	2.29	2.36	2.30	2.39
S.D.	9.53	8.43	9.92	13.93	13.00	14.23	1.18	1.05	1.23	1.27	1.22	1.29
S.E.	0.26	0.40	0.33	0.92	1.60	1.11	0.03	0.05	0.04	0.00	0.01	0.00
skew.	3.79	3.44	3.83	1.95	1.10	2.16	1.10	0.76	1.15	0.93	0.96	0.91
kurt.	23.67	16.20	24.58	10.31	4.15	11.55	4.14	3.00	4.24	3.38	3.57	3.30
max.	114.68	78.17	114.68	114.68	78.17	114.68	6.00	6.00	6.00	7.00	6.00	7.00
min.	0.00	0.00	0.00	0.23	0.23	0.35	1.00	1.00	1.00	1.00	1.00	1.00
κ	0.21	0.20	0.22	1.00	1.00	1.00						
resp.	1,318.00	441.00	877.00	230.00	66.00	164.00	1,318.00	441.00	877.00	116,545.00	36,577.00	79,968.00
pop.	25.80	7.20	18.60	5.51	1.41	4.11	25.80	7.20	18.60	24.69	7.33	17.36
mean	4.58	3.38	5.22	16.65	15.27	17.18	2.36	2.31	2.39	2.43	2.39	2.46
S.D.	11.01	8.99	11.90	15.49	13.60	16.15	1.24	1.30	1.21	1.31	1.26	1.34
S.E.	0.31	0.40	0.42	0.90	1.29	1.19	0.03	0.06	0.04	0.00	0.01	0.01
skew.	3.35	3.49	3.20	1.65	1.35	1.68	0.91	1.04	0.84	0.89	0.91	0.87
kurt.	15.95	16.39	14.69	5.70	4.38	5.72	3.38	3.49	3.31	3.23	3.37	3.16
max.	79.10	64.17	79.10	79.10	64.17	79.10	6.00	6.00	6.00	7.00	6.00	7.00
min.	0.00	0.00	0.00	0.12	0.23	0.12	1.00	1.00	1.00	1.00	1.00	1.00
κ	0.28	0.22	0.30	1.00	1.00	1.00						
resp.	1,295.00	510.00	785.00	296.00	111.00	185.00	1,295.00	510.00	785.00	97,927.00	33,221.00	64,706.00
pop.	21.65	7.51	14.14	5.96	1.66	4.30	21.65	7.51	14.14	19.33	6.16	13.17
mean	5.63	4.40	6.11	19.94	17.60	20.72	2.40	2.36	2.42	2.48	2.41	2.50
S.D.	12.54	10.77	13.16	16.52	15.30	16.87	1.24	1.32	1.21	1.33	1.28	1.35
S.E.	0.38	0.57	0.49	1.03	1.83	1.24	0.04	0.07	0.05	0.00	0.01	0.01
skew.	2.79	2.92	2.71	1.20	0.96	1.24	0.99	1.18	0.90	0.86	0.89	0.84
kurt.	11.44	11.86	10.93	4.28	3.48	4.35	3.77	4.09	3.60	3.15	3.30	3.08
max.	95.67	71.52	95.67	95.67	71.52	95.67	6.00	6.00	6.00	7.00	6.00	7.00
min.	0.00	0.00	0.00	0.35	1.17	0.35	1.00	1.00	1.00	1.00	1.00	1.00
κ	0.28	0.25	0.29	1.00	1.00	1.00						
resp.	1,076.00	354.00	722.00	256.00	70.00	186.00	1,076.00	354.00	722.00	94,477.00	28,554.00	65,923.00
pop.	18.99	5.38	13.61	5.36	1.34	4.01	18.99	5.38	13.61	18.19	5.10	13.09
mean	4.65	3.41	5.07	18.62	15.23	19.62	2.38	2.27	2.41	2.43	2.34	2.46
S.D.	11.49	8.46	12.33	16.43	11.94	17.45	1.26	1.32	1.24	1.32	1.26	1.34
S.E.	0.43	0.59	0.55	1.35	2.05	1.63	0.05	0.09	0.06	0.01	0.01	0.01
skew.	3.34	3.24	3.21	1.50	1.40	1.41	0.89	1.20	0.77	0.90	0.97	0.88
kurt.	15.57	14.32	14.36	5.06	4.26	4.63	3.31	3.95	3.09	3.25	3.51	3.17
max.	87.50	49.58	87.50	87.50	49.58	87.50	6.00	6.00	6.00	7.00	6.00	7.00
min.	0.00	0.00	0.00	1.75	2.33	1.75	1.00	1.00	1.00	1.00	1.00	1.00
κ	0.25	0.22	0.26	1.00	1.00	1.00						
resp.	713.00	209.00	504.00	148.00	34.00	114.00	713.00	209.00	504.00	57,961.00	15,094.00	42,867.00
pop.	11.48	2.91	8.57	2.87	0.65	2.22	11.48	2.91	8.57	10.87	2.65	8.22
mean	1.32	0.58	1.56	13.55	5.70	16.17	1.85	1.95	1.82	2.06	1.95	2.10
S.D.	6.11	2.35	6.88	14.97	5.32	16.34	0.93	0.97	0.92	1.17	1.12	1.18
S.E.	0.39	0.28	0.52	2.99	1.88	3.96	0.06	0.11	0.07	0.01	0.02	0.01
skew.	6.59	5.48	5.94	1.78	1.44	1.45	1.32	0.79	1.51	1.24	1.46	1.19
kurt.	51.16	36.21	41.15	5.07	3.97	3.78	5.13	3.12	6.01	4.33	5.11	4.17
max.	53.08	18.08	53.08	53.08	18.08	53.08	6.00	5.00	6.00	6.00	6.00	6.00
min.	0.00	0.00	0.00	1.75	1.75	2.33	1.00	1.00	1.00	1.00	1.00	1.00
κ	0.10	0.10	0.10	1.00	1.00	1.00						
resp.	251.00	73.00	178.00	25.00	8.00	17.00	251.00	73.00	178.00	14,015.00	3,230.00	10,785.00
pop.	3.60	0.87	2.73	0.35	0.09	0.26	3.60	0.87	2.73	2.60	0.55	2.05

Notes: Age groups are, in order, 16-24, 25-34, 35-44, 45-54, 55-64, and 65-74. Time-use is expressed in hours per week, κ is the fraction of unemployed people who spent some time looking for work in the day previous to the interview, resp. is the number of survey respondents, and pop. denotes population (in millions). All numbers, except resp., were obtained using appropriate weights. S.D. and S.E. denote standard deviation and standard error.

Table 3: Descriptive Stats for Education

criteria	ATUS time-use (full) (1)	ATUS time-use (03-07) (2)	ATUS time-use (08-14) (3)	ATUS time-use (full) (4)	ATUS time-use (03-07) (5)	ATUS time-use (08-14) (6)	ATUS number (full) (7)	ATUS number (03-07) (8)	ATUS number (08-14) (9)	CPS number (full) (10)	CPS number (03-07) (11)	CPS number (08-14) (12)
mean	1.07	0.82	1.22	12.25	9.04	14.23	1.71	1.65	1.74	1.95	1.88	2.00
S.D.	5.17	4.10	5.69	13.03	10.67	13.99	0.93	0.92	0.93	1.07	0.99	1.11
S.E.	0.12	0.14	0.17	1.13	1.45	1.57	0.02	0.03	0.03	0.00	0.00	0.00
skew.	7.10	6.82	6.88	1.90	1.61	1.89	1.60	1.77	1.51	1.23	1.22	1.21
kurt.	71.41	54.60	67.72	8.94	4.68	9.10	6.05	6.56	5.81	4.45	4.51	4.32
max.	98.00	40.83	98.00	98.00	40.83	98.00	6.00	6.00	6.00	7.00	6.00	7.00
min.	0.00	0.00	0.00	0.12	0.23	0.12	1.00	1.00	1.00	1.00	1.00	1.00
κ	0.09	0.09	0.09	1.00	1.00	1.00						
resp.	1,908.00	828.00	1,080.00	133.00	54.00	79.00	1,908.00	828.00	1,080.00	108,973.00	42,637.00	66,336.00
pop.	44.53	16.41	28.13	3.89	1.48	2.41	44.53	16.41	28.13	22.00	8.06	13.94
mean	3.01	2.13	3.41	15.34	11.61	16.87	2.08	2.02	2.11	2.26	2.19	2.29
S.D.	9.21	6.62	10.14	15.61	11.38	16.82	1.07	1.06	1.07	1.22	1.16	1.25
S.E.	0.21	0.25	0.29	0.88	1.10	1.17	0.02	0.04	0.03	0.00	0.00	0.00
skew.	4.41	4.50	4.17	1.80	1.81	1.66	1.06	1.10	1.04	0.99	1.02	0.97
kurt.	25.57	27.04	22.58	6.03	6.36	5.27	4.08	4.01	4.11	3.62	3.81	3.53
max.	77.00	60.55	77.00	77.00	60.55	77.00	6.00	6.00	6.00	7.00	6.00	7.00
min.	0.00	0.00	0.00	0.23	0.23	0.35	1.00	1.00	1.00	1.00	1.00	1.00
κ	0.20	0.18	0.20	1.00	1.00	1.00						
resp.	1,963.00	707.00	1,256.00	315.00	107.00	208.00	1,963.00	707.00	1,256.00	199,517.00	63,816.00	135,701.00
pop.	46.27	14.33	31.94	9.08	2.63	6.45	46.27	14.33	31.94	40.11	12.02	28.09
mean	3.59	3.68	3.56	16.20	15.82	16.36	2.32	2.28	2.34	2.41	2.36	2.43
S.D.	9.31	9.65	9.17	13.68	14.45	13.35	1.21	1.21	1.22	1.30	1.24	1.31
S.E.	0.22	0.39	0.26	0.70	1.29	0.83	0.03	0.05	0.03	0.00	0.01	0.00
skew.	3.46	3.27	3.55	1.45	1.15	1.62	1.00	1.27	0.90	0.90	0.91	0.88
kurt.	17.02	14.15	18.39	5.34	3.58	6.34	3.78	4.65	3.45	3.28	3.41	3.22
max.	87.50	64.17	87.50	87.50	64.17	87.50	6.00	6.00	6.00	7.00	6.00	7.00
min.	0.00	0.00	0.00	0.12	0.23	0.12	1.00	1.00	1.00	1.00	1.00	1.00
κ	0.22	0.23	0.22	1.00	1.00	1.00						
resp.	1,831.00	609.00	1,222.00	383.00	125.00	258.00	1,831.00	609.00	1,222.00	147,203.00	44,614.00	102,589.00
pop.	35.13	10.17	24.96	7.79	2.37	5.43	35.13	10.17	24.96	29.70	8.43	21.27
mean	6.97	5.09	7.70	21.62	19.23	22.33	2.54	2.54	2.53	2.62	2.60	2.63
S.D.	13.87	11.24	14.71	16.76	14.38	17.37	1.30	1.29	1.30	1.41	1.38	1.42
S.E.	0.41	0.57	0.54	0.97	1.54	1.19	0.04	0.07	0.05	0.00	0.01	0.01
skew.	2.61	2.65	2.52	1.47	1.04	1.50	0.88	0.81	0.91	0.76	0.78	0.75
kurt.	11.28	10.44	10.72	6.12	4.01	6.16	3.35	3.15	3.42	2.83	2.93	2.79
max.	114.68	78.17	114.68	114.68	78.17	114.68	6.00	6.00	6.00	7.00	6.00	7.00
min.	0.00	0.00	0.00	0.35	0.35	0.93	1.00	1.00	1.00	1.00	1.00	1.00
κ	0.32	0.26	0.34	1.00	1.00	1.00						
resp.	1,133.00	389.00	744.00	300.00	87.00	213.00	1,133.00	389.00	744.00	90,043.00	26,911.00	63,132.00
pop.	18.72	5.24	13.49	6.04	1.39	4.65	18.72	5.24	13.49	17.91	5.02	12.89
Full Sample												
mean	3.07	2.34	3.41	16.56	13.73	17.73	2.08	2.00	2.12	2.30	2.22	2.34
S.D.	9.20	7.51	9.87	15.27	13.23	15.91	1.13	1.12	1.14	1.26	1.20	1.29
S.E.	0.11	0.15	0.15	0.45	0.69	0.58	0.01	0.02	0.02	0.00	0.00	0.00
skew.	4.19	4.27	4.06	1.64	1.40	1.66	1.19	1.32	1.13	0.99	1.04	0.97
kurt.	24.47	23.56	23.08	6.28	4.60	6.31	4.33	4.71	4.18	3.53	3.76	3.43
max.	114.68	78.17	114.68	114.68	78.17	114.68	6.00	6.00	6.00	7.00	6.00	7.00
min.	0.00	0.00	0.00	0.12	0.23	0.12	1.00	1.00	1.00	1.00	1.00	1.00
κ	0.19	0.17	0.19	1.00	1.00	1.00						
resp.	6,835.00	2,533.00	4,302.00	1,131.00	373.00	758.00	6,835.00	2,533.00	4,302.00	545,736.00	177,978.00	367,758.00
pop.	144.66	46.15	98.51	26.80	7.87	18.93	144.66	46.15	98.51	109.72	33.52	76.20

Notes: Education groups are, in order, high school dropouts, high school graduates, with some college, and college graduates. Time-use is expressed in hours per week, κ is the fraction of unemployed people who spent some time looking for work in the day previous to the interview, resp. is the number of survey respondents, and pop. denotes population (in millions). All numbers, except resp., were obtained using appropriate weights. S.D. and S.E. denote standard deviation and standard error.

Table 4: Descriptive Stats for Marital Status

criteria	ATUS time-use (full) (1)	ATUS time-use (03-07) (2)	ATUS time-use (08-14) (3)	ATUS time-use (full) (4)	ATUS time-use (03-07) (5)	ATUS time-use (08-14) (6)	ATUS number (full) (7)	ATUS number (03-07) (8)	ATUS number (08-14) (9)	CPS number (full) (10)	CPS number (03-07) (11)	CPS number (08-14) (12)
mean	3.84	3.72	3.90	17.21	17.69	17.00	2.29	2.21	2.33	2.41	2.34	2.44
S.D.	9.62	9.72	9.57	13.58	14.25	13.29	1.20	1.25	1.17	1.31	1.26	1.33
S.E.	0.21	0.35	0.26	0.68	1.24	0.82	0.03	0.04	0.03	0.00	0.01	0.00
skew.	3.11	3.07	3.14	1.13	0.83	1.29	1.00	1.18	0.92	0.92	0.96	0.90
kurt.	13.36	12.17	13.97	3.85	2.64	4.54	3.79	4.09	3.66	3.30	3.49	3.22
max.	66.50	56.00	66.50	66.50	56.00	66.50	6.00	6.00	6.00	7.00	6.00	7.00
min.	0.00	0.00	0.00	0.58	1.17	0.58	1.00	1.00	1.00	1.00	1.00	1.00
κ	0.22	0.21	0.23	1.00	1.00	1.00						
resp.	2,086.00	779.00	1,307.00	393.00	133.00	260.00	2,086.00	779.00	1,307.00	175,919.00	55,372.00	120,547.00
pop.	40.25	13.12	27.12	8.98	2.76	6.22	40.25	13.12	27.12	34.81	10.28	24.53
mean	3.75	3.52	3.85	15.79	14.02	16.62	2.19	1.85	2.33	2.28	2.21	2.30
S.D.	8.95	8.73	9.10	12.27	13.26	12.22	1.07	0.89	1.12	1.24	1.17	1.27
S.E.	0.89	1.59	1.09	2.56	5.41	2.96	0.11	0.16	0.13	0.01	0.02	0.02
skew.	2.97	2.54	3.12	1.19	0.43	1.60	0.93	1.04	0.82	1.01	1.01	1.01
kurt.	13.03	8.27	14.64	4.79	1.74	6.08	4.06	3.59	3.97	3.65	3.75	3.58
max.	57.05	32.08	57.05	57.05	32.08	57.05	6.00	4.00	6.00	7.00	6.00	7.00
min.	0.00	0.00	0.00	0.23	0.23	1.17	1.00	1.00	1.00	1.00	1.00	1.00
κ	0.24	0.25	0.23	1.00	1.00	1.00						
resp.	100.00	30.00	70.00	23.00	6.00	17.00	100.00	30.00	70.00	8,475.00	2,561.00	5,914.00
pop.	1.57	0.47	1.10	0.37	0.12	0.25	1.57	0.47	1.10	1.75	0.51	1.24
mean	2.94	1.96	3.27	16.87	10.46	19.27	2.31	2.44	2.26	2.25	2.13	2.29
S.D.	8.73	4.75	9.72	14.51	6.01	16.12	1.43	1.31	1.47	1.24	1.13	1.28
S.E.	0.70	0.72	0.91	3.17	2.69	4.03	0.11	0.20	0.14	0.01	0.02	0.02
skew.	3.82	2.54	3.55	1.24	0.55	0.88	1.43	1.51	1.43	1.06	1.10	1.03
kurt.	18.26	8.47	15.42	3.36	1.52	2.39	4.29	4.68	4.21	3.73	4.09	3.57
max.	54.25	18.08	54.25	54.25	18.08	54.25	6.00	6.00	6.00	6.00	6.00	6.00
min.	0.00	0.00	0.00	2.33	4.67	2.33	1.00	1.00	1.00	1.00	1.00	1.00
κ	0.17	0.19	0.17	1.00	1.00	1.00						
resp.	157.00	44.00	113.00	21.00	5.00	16.00	157.00	44.00	113.00	9,103.00	2,714.00	6,389.00
pop.	2.07	0.52	1.54	0.36	0.10	0.26	2.07	0.52	1.54	1.70	0.46	1.23
mean	6.21	3.13	7.53	21.27	14.95	23.01	2.35	2.31	2.37	2.48	2.41	2.51
S.D.	14.03	8.93	15.55	18.86	14.37	19.59	1.25	1.24	1.25	1.32	1.28	1.34
S.E.	0.47	0.51	0.65	1.32	1.81	1.65	0.04	0.07	0.05	0.01	0.01	0.01
skew.	2.74	3.95	2.40	1.07	1.60	0.93	0.86	1.12	0.75	0.84	0.89	0.82
kurt.	10.25	21.51	8.10	3.15	5.80	2.75	3.23	4.00	2.93	3.13	3.31	3.06
max.	78.17	78.17	72.33	78.17	78.17	72.33	6.00	6.00	6.00	7.00	6.00	7.00
min.	0.00	0.00	0.00	0.12	0.35	0.12	1.00	1.00	1.00	1.00	1.00	1.00
κ	0.29	0.21	0.33	1.00	1.00	1.00						
resp.	875.00	307.00	568.00	204.00	63.00	141.00	875.00	307.00	568.00	65,588.00	21,006.00	44,582.00
pop.	11.88	3.57	8.31	3.47	0.75	2.72	11.88	3.57	8.31	12.35	3.70	8.66
mean	3.47	2.24	3.93	18.05	12.65	19.89	2.19	2.15	2.20	2.32	2.24	2.35
S.D.	10.66	6.48	11.85	18.24	10.44	20.05	1.25	1.29	1.24	1.25	1.17	1.28
S.E.	0.67	0.68	0.93	2.72	2.53	3.79	0.08	0.13	0.10	0.01	0.01	0.01
skew.	4.84	3.64	4.57	2.24	1.17	2.06	1.14	1.14	1.15	0.96	0.99	0.94
kurt.	34.13	17.05	29.76	9.87	3.51	8.42	3.88	3.85	3.89	3.51	3.70	3.40
max.	98.00	40.02	98.00	98.00	40.02	98.00	6.00	6.00	6.00	7.00	6.00	7.00
min.	0.00	0.00	0.00	0.23	0.23	0.35	1.00	1.00	1.00	1.00	1.00	1.00
κ	0.19	0.18	0.20	1.00	1.00	1.00						
resp.	253.00	92.00	161.00	45.00	17.00	28.00	253.00	92.00	161.00	18,602.00	6,120.00	12,482.00
pop.	3.85	1.06	2.79	0.74	0.19	0.55	3.85	1.06	2.79	3.85	1.19	2.66
mean	2.23	1.57	2.55	14.75	10.87	16.48	1.93	1.85	1.97	2.19	2.11	2.23
S.D.	7.86	5.89	8.63	14.96	11.82	15.88	1.05	1.00	1.07	1.21	1.14	1.24
S.E.	0.14	0.16	0.19	0.71	0.97	0.92	0.02	0.03	0.02	0.00	0.00	0.00
skew.	5.35	5.55	5.07	2.05	1.95	1.99	1.31	1.32	1.30	1.07	1.12	1.04
kurt.	40.08	40.88	36.08	8.66	7.35	8.21	4.86	4.77	4.85	3.79	4.04	3.67
max.	114.68	71.52	114.68	114.68	71.52	114.68	6.00	6.00	6.00	7.00	6.00	7.00
min.	0.00	0.00	0.00	0.12	0.23	0.12	1.00	1.00	1.00	1.00	1.00	1.00
κ	0.15	0.14	0.15	1.00	1.00	1.00						
resp.	3,364.00	1,281.00	2,083.00	445.00	149.00	296.00	3,364.00	1,281.00	2,083.00	268,049.00	90,205.00	177,844.00
pop.	85.05	27.40	57.65	12.88	3.96	8.92	85.05	27.40	57.65	55.25	17.38	37.87

Notes: Marital status groups are, in order, married, widowed, separated, divorced, and never married. Time-use is expressed in hours per week, κ is the fraction of unemployed people who spent some time looking for work in the day previous to the interview, resp. is the number of survey respondents, and pop. denotes population (in millions). All numbers, except resp., were obtained using appropriate weights. S.D. and S.E. denote standard deviation and standard error.

Table 5: Descriptive Stats for Sex

criteria	ATUS time-use (full) (1)	ATUS time-use (03-07) (2)	ATUS time-use (08-14) (3)	ATUS time-use (full) (4)	ATUS time-use (03-07) (5)	ATUS time-use (08-14) (6)	ATUS number (full) (7)	ATUS number (03-07) (8)	ATUS number (08-14) (9)	CPS number (full) (10)	CPS number (03-07) (11)	CPS number (08-14) (12)
mean	3.65	2.91	3.98	17.07	14.27	18.26	2.10	2.03	2.13	2.31	2.23	2.35
S.D.	10.12	8.31	10.83	15.83	13.31	16.66	1.15	1.15	1.15	1.27	1.21	1.30
S.E.	0.18	0.25	0.24	0.64	0.96	0.82	0.02	0.03	0.03	0.00	0.00	0.00
skew.	3.90	3.62	3.86	1.68	1.20	1.72	1.20	1.34	1.14	0.98	1.04	0.95
kurt.	21.82	17.16	21.23	6.58	3.86	6.60	4.32	4.69	4.18	3.49	3.74	3.38
max.	114.68	71.52	114.68	114.68	71.52	114.68	6.00	6.00	6.00	7.00	6.00	7.00
min.	0.00	0.00	0.00	0.12	0.23	0.12	1.00	1.00	1.00	1.00	1.00	1.00
κ	0.21	0.20	0.22	1.00	1.00	1.00						
resp.	3,054.00	1,084.00	1,970.00	607.00	194.00	413.00	3,054.00	1,084.00	1,970.00	291,063.00	92,430.00	198,633.00
pop.	73.48	22.90	50.58	15.70	4.67	11.04	73.48	22.90	50.58	59.86	17.82	42.04
mean	2.47	1.78	2.80	15.82	12.95	16.98	2.07	1.98	2.11	2.29	2.22	2.32
S.D.	8.08	6.60	8.69	14.43	13.12	14.78	1.12	1.09	1.13	1.25	1.19	1.28
S.E.	0.13	0.17	0.18	0.63	0.98	0.80	0.02	0.03	0.02	0.00	0.00	0.00
skew.	4.50	5.25	4.21	1.54	1.71	1.49	1.17	1.28	1.12	1.00	1.04	0.98
kurt.	26.84	35.49	23.76	5.40	5.88	5.23	4.32	4.69	4.18	3.58	3.78	3.48
max.	78.17	78.17	72.33	78.17	78.17	72.33	6.00	6.00	6.00	7.00	6.00	7.00
min.	0.00	0.00	0.00	0.12	0.23	0.12	1.00	1.00	1.00	1.00	1.00	1.00
κ	0.16	0.14	0.16	1.00	1.00	1.00						
resp.	3,781.00	1,449.00	2,332.00	524.00	179.00	345.00	3,781.00	1,449.00	2,332.00	254,673.00	85,548.00	169,125.00
pop.	71.18	23.25	47.93	11.09	3.20	7.89	71.18	23.25	47.93	49.86	15.70	34.16
Full Sample												
mean	3.07	2.34	3.41	16.56	13.73	17.73	2.08	2.00	2.12	2.30	2.22	2.34
S.D.	9.20	7.51	9.87	15.27	13.23	15.91	1.13	1.12	1.14	1.26	1.20	1.29
S.E.	0.11	0.15	0.15	0.45	0.69	0.58	0.01	0.02	0.02	0.00	0.00	0.00
skew.	4.19	4.27	4.06	1.64	1.40	1.66	1.19	1.32	1.13	0.99	1.04	0.97
kurt.	24.47	23.56	23.08	6.28	4.60	6.31	4.33	4.71	4.18	3.53	3.76	3.43
max.	114.68	78.17	114.68	114.68	78.17	114.68	6.00	6.00	6.00	7.00	6.00	7.00
min.	0.00	0.00	0.00	0.12	0.23	0.12	1.00	1.00	1.00	1.00	1.00	1.00
κ	0.19	0.17	0.19	1.00	1.00	1.00						
resp.	6,835.00	2,533.00	4,302.00	1,131.00	373.00	758.00	6,835.00	2,533.00	4,302.00	545,736.00	177,978.00	367,758.00
pop.	144.66	46.15	98.51	26.80	7.87	18.93	144.66	46.15	98.51	109.72	33.52	76.20

Notes: Sex groups are, in order, males and females. Time-use is expressed in hours per week, κ is the fraction of unemployed people who spent some time looking for work in the day previous to the interview, resp. is the number of survey respondents, and pop. denotes population (in millions). All numbers, except resp., were obtained using appropriate weights. S.D. and S.E. denote standard deviation and standard error.

Table 6: Descriptive Stats for U.S. Region

criteria	ATUS time-use (full) (1)	ATUS time-use (03-07) (2)	ATUS time-use (08-14) (3)	ATUS time-use (full) (4)	ATUS time-use (03-07) (5)	ATUS time-use (08-14) (6)	ATUS number (full) (7)	ATUS number (03-07) (8)	ATUS number (08-14) (9)	CPS number (full) (10)	CPS number (03-07) (11)	CPS number (08-14) (12)
mean	3.67	2.58	4.19	17.46	12.76	19.59	2.12	2.09	2.13	2.39	2.28	2.44
S.D.	10.21	6.96	11.41	15.99	10.51	17.55	1.14	1.09	1.17	1.29	1.23	1.32
S.E.	0.30	0.33	0.43	1.09	1.20	1.49	0.03	0.05	0.04	0.00	0.01	0.00
skew.	3.90	3.64	3.65	1.66	1.53	1.46	1.14	1.25	1.10	0.92	1.00	0.88
kurt.	20.94	19.29	18.06	5.90	6.18	4.86	4.17	4.77	3.92	3.33	3.64	3.20
max.	95.67	57.17	95.67	95.67	57.17	95.67	6.00	6.00	6.00	7.00	6.00	7.00
min.	0.00	0.00	0.00	0.58	1.17	0.58	1.00	1.00	1.00	1.00	1.00	1.00
κ	0.21	0.20	0.21	1.00	1.00	1.00						
resp.	1,163.00	458.00	705.00	216.00	77.00	139.00	1,163.00	458.00	705.00	106,997.00	35,034.00	71,963.00
pop.	25.33	8.20	17.14	5.33	1.66	3.67	25.33	8.20	17.14	19.01	5.94	13.07
mean	2.57	2.13	2.81	15.75	13.47	16.88	2.06	2.02	2.08	2.25	2.22	2.27
S.D.	8.04	7.01	8.52	13.75	12.66	14.15	1.12	1.17	1.10	1.24	1.20	1.26
S.E.	0.20	0.28	0.27	0.89	1.41	1.12	0.03	0.05	0.03	0.00	0.01	0.00
skew.	4.53	4.15	4.56	1.85	1.13	2.10	1.23	1.34	1.17	1.05	1.07	1.04
kurt.	30.28	21.06	31.25	8.38	3.23	9.66	4.53	4.61	4.48	3.72	3.84	3.66
max.	98.00	49.58	98.00	98.00	49.58	98.00	6.00	6.00	6.00	7.00	6.00	7.00
min.	0.00	0.00	0.00	0.12	0.23	0.12	1.00	1.00	1.00	1.00	1.00	1.00
κ	0.16	0.16	0.17	1.00	1.00	1.00						
resp.	1,600.00	607.00	993.00	241.00	81.00	160.00	1,600.00	607.00	993.00	121,891.00	43,606.00	78,285.00
pop.	33.81	11.59	22.22	5.52	1.83	3.70	33.81	11.59	22.22	23.93	7.90	16.03
mean	3.17	2.30	3.57	17.03	14.49	17.95	2.06	1.89	2.13	2.28	2.16	2.33
S.D.	9.57	8.01	10.17	16.00	15.15	16.23	1.12	1.04	1.14	1.27	1.18	1.31
S.E.	0.20	0.27	0.26	0.81	1.38	0.98	0.02	0.04	0.03	0.00	0.01	0.00
skew.	4.22	4.57	4.05	1.65	1.37	1.73	1.17	1.26	1.13	1.01	1.08	0.97
kurt.	25.16	25.91	23.81	6.56	4.17	7.12	4.25	4.38	4.17	3.54	3.87	3.39
max.	114.68	71.52	114.68	114.68	71.52	114.68	6.00	6.00	6.00	7.00	6.00	7.00
min.	0.00	0.00	0.00	0.12	0.23	0.12	1.00	1.00	1.00	1.00	1.00	1.00
κ	0.19	0.16	0.20	1.00	1.00	1.00						
resp.	2,407.00	866.00	1,541.00	392.00	120.00	272.00	2,407.00	866.00	1,541.00	170,451.00	53,726.00	116,725.00
pop.	50.48	15.67	34.81	9.40	2.49	6.92	50.48	15.67	34.81	38.97	11.70	27.27
mean	2.95	2.45	3.17	15.81	13.85	16.61	2.12	2.09	2.13	2.31	2.26	2.32
S.D.	8.88	7.70	9.35	14.83	13.36	15.34	1.16	1.18	1.16	1.25	1.21	1.26
S.E.	0.22	0.31	0.29	0.88	1.37	1.12	0.03	0.05	0.04	0.00	0.01	0.00
skew.	4.00	4.13	3.90	1.40	1.36	1.38	1.20	1.36	1.13	0.97	0.99	0.96
kurt.	20.52	22.36	19.41	4.28	4.58	4.06	4.34	4.78	4.14	3.52	3.63	3.47
max.	78.17	78.17	68.25	78.17	78.17	68.25	6.00	6.00	6.00	7.00	6.00	7.00
min.	0.00	0.00	0.00	0.23	0.23	0.58	1.00	1.00	1.00	1.00	1.00	1.00
κ	0.19	0.18	0.19	1.00	1.00	1.00						
resp.	1,665.00	602.00	1,063.00	282.00	95.00	187.00	1,665.00	602.00	1,063.00	146,397.00	45,612.00	100,785.00
pop.	35.04	10.70	24.34	6.54	1.89	4.65	35.04	10.70	24.34	27.81	7.98	19.83
Full Sample												
mean	3.07	2.34	3.41	16.56	13.73	17.73	2.08	2.00	2.12	2.30	2.22	2.34
S.D.	9.20	7.51	9.87	15.27	13.23	15.91	1.13	1.12	1.14	1.26	1.20	1.29
S.E.	0.11	0.15	0.15	0.45	0.69	0.58	0.01	0.02	0.02	0.00	0.00	0.00
skew.	4.19	4.27	4.06	1.64	1.40	1.66	1.19	1.32	1.13	0.99	1.04	0.97
kurt.	24.47	23.56	23.08	6.28	4.60	6.31	4.33	4.71	4.18	3.53	3.76	3.43
max.	114.68	78.17	114.68	114.68	78.17	114.68	6.00	6.00	6.00	7.00	6.00	7.00
min.	0.00	0.00	0.00	0.12	0.23	0.12	1.00	1.00	1.00	1.00	1.00	1.00
κ	0.19	0.17	0.19	1.00	1.00	1.00						
resp.	6,835.00	2,533.00	4,302.00	1,131.00	373.00	758.00	6,835.00	2,533.00	4,302.00	545,736.00	177,978.00	367,758.00
pop.	144.66	46.15	98.51	26.80	7.87	18.93	144.66	46.15	98.51	109.72	33.52	76.20

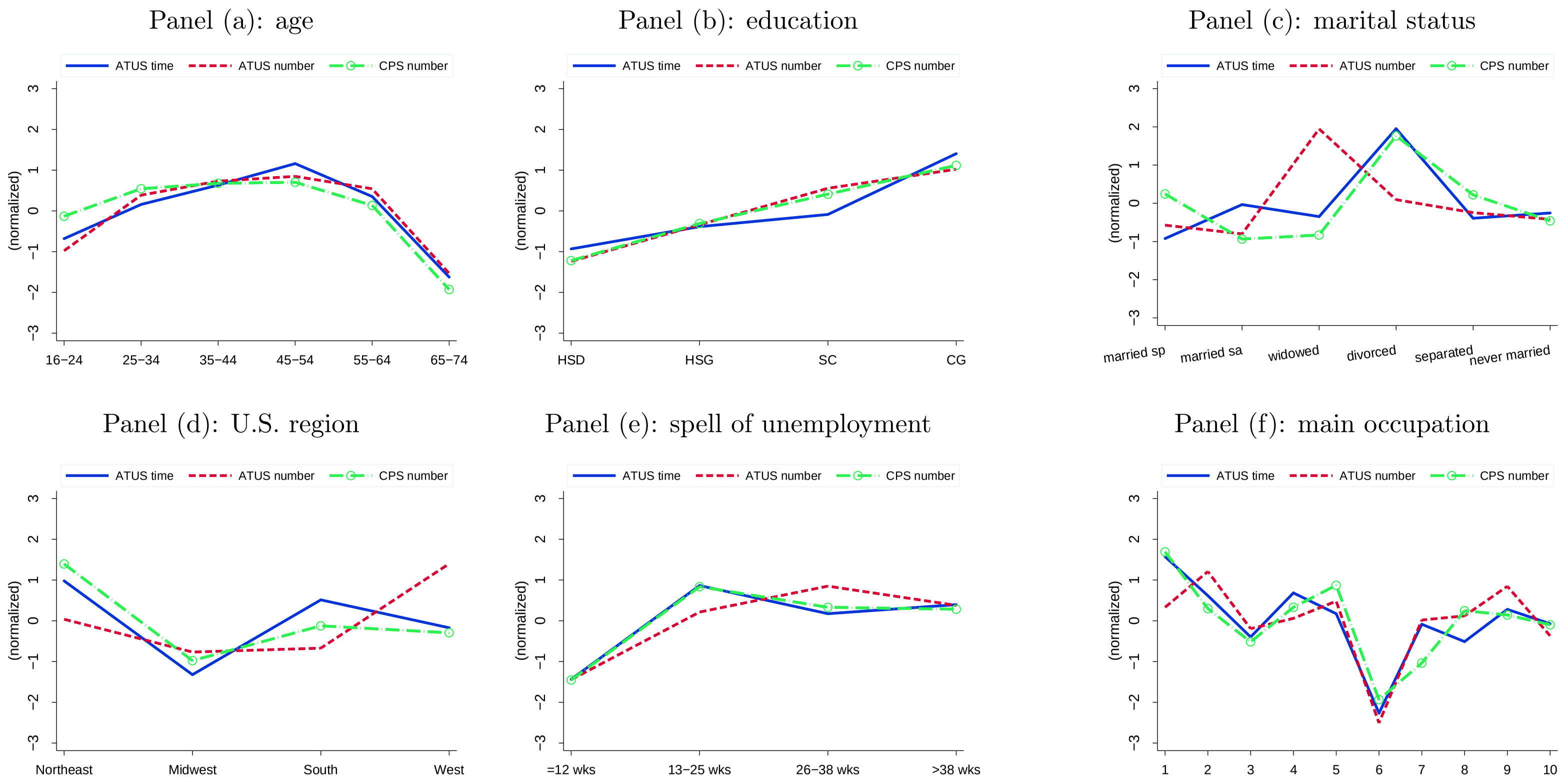
Notes: Regions are, in order, Northeast, Midwest, South, and West. Time-use is expressed in hours per week, κ is the fraction of unemployed people who spent some time looking for work in the day previous to the interview, resp. is the number of survey respondents, and pop. denotes population (in millions). All numbers, except resp., were obtained using appropriate weights. S.D. and S.E. denotes standard deviation and standard error.

Table 7: Descriptive Stats for Spell of Unemployment

criteria	ATUS time-use (full) (1)	ATUS time-use (03-07) (2)	ATUS time-use (08-14) (3)	ATUS time-use (full) (4)	ATUS time-use (03-07) (5)	ATUS time-use (08-14) (6)	ATUS number (full) (7)	ATUS number (03-07) (8)	ATUS number (08-14) (9)	CPS number (full) (10)	CPS number (03-07) (11)	CPS number (08-14) (12)
mean	2.68	2.24	2.91	16.40	13.91	17.69	1.97	1.92	1.99	2.26	2.23	2.28
S.D.	8.61	7.35	9.20	15.15	13.17	15.95	1.08	1.07	1.09	1.24	1.20	1.27
S.E.	0.13	0.17	0.18	0.60	0.83	0.81	0.02	0.02	0.02	0.01	0.01	0.01
skew.	4.59	4.42	4.54	1.74	1.45	1.77	1.30	1.41	1.25	1.02	1.02	1.02
kurt.	29.31	25.64	28.63	6.87	5.01	6.91	4.77	5.10	4.62	3.65	3.73	3.59
max.	114.68	78.17	114.68	114.68	78.17	114.68	6.00	6.00	6.00	6.00	6.00	6.00
min.	0.00	0.00	0.00	0.12	0.23	0.12	1.00	1.00	1.00	1.00	1.00	1.00
κ	0.16	0.16	0.16	1.00	1.00	1.00						
resp.	4,554.00	1,850.00	2,704.00	641.00	254.00	387.00	4,554.00	1,850.00	2,704.00	25,983.00	9,976.00	16,007.00
pop.	99.91	34.64	65.27	16.30	5.58	10.72	99.91	34.64	65.27	5.21	1.89	3.32
mean	3.63	2.55	4.24	16.71	13.41	18.21	2.25	2.25	2.25	2.41	2.37	2.42
S.D.	10.24	8.06	11.24	16.28	14.09	17.04	1.17	1.26	1.11	1.29	1.25	1.31
S.E.	0.35	0.44	0.49	1.27	1.94	1.62	0.04	0.07	0.05	0.00	0.01	0.01
skew.	3.69	3.87	3.49	1.36	1.12	1.37	1.04	1.07	1.02	0.89	0.91	0.88
kurt.	18.43	18.24	16.67	4.70	3.12	4.70	3.96	3.63	4.14	3.29	3.40	3.24
max.	87.50	56.00	87.50	87.50	56.00	87.50	6.00	6.00	6.00	7.00	6.00	7.00
min.	0.00	0.00	0.00	0.58	0.58	0.58	1.00	1.00	1.00	1.00	1.00	1.00
κ	0.22	0.19	0.23	1.00	1.00	1.00						
resp.	865.00	339.00	526.00	164.00	53.00	111.00	865.00	339.00	526.00	85,947.00	27,608.00	58,339.00
pop.	18.09	6.46	11.62	3.93	1.23	2.70	18.09	6.46	11.62	17.33	5.24	12.09
mean	4.11	2.85	4.49	14.97	13.58	15.27	2.49	2.31	2.54	2.39	2.34	2.41
S.D.	9.91	9.18	10.11	14.01	16.18	13.56	1.27	1.19	1.28	1.29	1.24	1.31
S.E.	0.48	0.82	0.59	1.32	3.11	1.47	0.06	0.11	0.07	0.01	0.01	0.01
skew.	3.24	3.92	3.09	1.49	1.24	1.59	0.72	0.96	0.65	0.90	0.94	0.89
kurt.	15.38	18.23	14.81	5.58	3.22	6.46	3.00	3.69	2.86	3.30	3.47	3.24
max.	72.33	55.42	72.33	72.33	55.42	72.33	6.00	6.00	6.00	7.00	6.00	7.00
min.	0.00	0.00	0.00	0.35	0.58	0.35	1.00	1.00	1.00	1.00	1.00	1.00
κ	0.27	0.21	0.29	1.00	1.00	1.00						
resp.	423.00	125.00	298.00	112.00	27.00	85.00	423.00	125.00	298.00	60,012.00	16,887.00	43,125.00
pop.	7.54	1.75	5.79	2.07	0.37	1.70	7.54	1.75	5.79	12.26	3.27	8.99
mean	4.18	2.71	4.48	17.71	12.95	18.58	2.37	2.26	2.39	2.40	2.30	2.43
S.D.	10.59	7.16	11.16	15.38	10.67	15.96	1.21	1.15	1.22	1.30	1.23	1.31
S.E.	0.34	0.48	0.40	1.05	1.71	1.21	0.04	0.08	0.04	0.00	0.01	0.00
skew.	3.51	3.62	3.39	1.62	1.62	1.55	1.01	1.18	0.98	0.92	0.99	0.90
kurt.	17.74	17.90	16.53	6.03	5.17	5.69	3.77	4.59	3.63	3.33	3.61	3.26
max.	98.00	50.75	98.00	98.00	50.75	98.00	6.00	6.00	6.00	7.00	6.00	7.00
min.	0.00	0.00	0.00	0.12	1.75	0.12	1.00	1.00	1.00	1.00	1.00	1.00
κ	0.24	0.21	0.24	1.00	1.00	1.00						
resp.	992.00	219.00	773.00	214.00	39.00	175.00	992.00	219.00	773.00	143,617.00	27,474.00	116,143.00
pop.	19.05	3.30	15.76	4.49	0.69	3.80	19.05	3.30	15.76	30.10	5.40	24.69
Full Sample												
mean	3.07	2.34	3.41	16.56	13.73	17.73	2.08	2.00	2.12	2.30	2.22	2.34
S.D.	9.20	7.51	9.87	15.27	13.23	15.91	1.13	1.12	1.14	1.26	1.20	1.29
S.E.	0.11	0.15	0.15	0.45	0.69	0.58	0.01	0.02	0.02	0.00	0.00	0.00
skew.	4.19	4.27	4.06	1.64	1.40	1.66	1.19	1.32	1.13	0.99	1.04	0.97
kurt.	24.47	23.56	23.08	6.28	4.60	6.31	4.33	4.71	4.18	3.53	3.76	3.43
max.	114.68	78.17	114.68	114.68	78.17	114.68	6.00	6.00	6.00	7.00	6.00	7.00
min.	0.00	0.00	0.00	0.12	0.23	0.12	1.00	1.00	1.00	1.00	1.00	1.00
κ	0.19	0.17	0.19	1.00	1.00	1.00						
resp.	6,835.00	2,533.00	4,302.00	1,131.00	373.00	758.00	6,835.00	2,533.00	4,302.00	545,736.00	177,978.00	367,758.00
pop.	144.66	46.15	98.51	26.80	7.87	18.93	144.66	46.15	98.51	109.72	33.52	76.20

Notes: Spell of unemployment groups are, in order, 12 weeks, 13-25 weeks, 26-38 weeks, and greater than or equal to 39 weeks. Time-use is expressed in hours per week, κ is the fraction of unemployed people who spent some time looking for work in the day previous to the interview, resp. is the number of survey respondents, and pop. denotes population (in millions). All numbers, except resp., were obtained using appropriate weights. S.D. and S.E. denote standard deviation and standard error.

Figure 6: Patterns of Search Intensity Across Measures and Surveys: Conditional Estimates



Notes: This figure depicts cross-sectional profiles over age, education, marital status, region, spell of unemployment, and occupation for three alternative measures of search intensity. Each panel shows estimates of cross-section fixed effects (e.g., either $\alpha + \delta_m$ or $\alpha + \phi_l$) from a regression of either number of methods or weekly hours on a constant, age, education, marital status (when appropriate), sex, race, U.S. state dummies (except for region), time dummies, the unemployment rate at the state level, and a measure of attachment to the labor market. In the CPS, the latter variable is the reason of unemployment and in the ATUS it is constructed using the reason of unemployment in the final CPS interview. Regressions are estimated using weighted data. For the sake of comparison, these fixed effects are normalized, that is, obtained by dividing the difference between the actual search intensity measure and its average by the corresponding standard deviation. The average and standard deviation are calculated over the respective groups. In Panel (b) education groups are high school dropouts (HSD) or with less than or equal to 11$^{\text{th}}$ grade; high school graduates (HS) or with 12$^{\text{th}}$ grade no diploma and high school grad-diploma or equivalent (GED); with some college (SC) or with some college but no degree, associate degree-occupational/vocational, and associate degree-academic program; and college graduates (CG) or with bachelor's degree (e.g. BA, AB, BS) and superior, including master's, professional school degree, and doctorate degree. In Panel (c), "sp" denotes spouse present and "sa" spouse absent. In Panel (e), spell of unemployment in the CPS is the interrupted spell of unemployment (truncated at 12 weeks). To estimate the spell of unemployment in the ATUS, I exploit the linkage between the two surveys and assume that the unemployed respondent in the ATUS maintained that status since her 8$^{\text{th}}$ and final CPS interview. According to U.S. Bureau of Labor Statistics (2016), the elapsed time between the interviews is usually two to five months, with 3 months being the most representative (almost 70% of the ATUS interviews). Thus, if the respondent reported to be unemployed in both the ATUS and the final CPS interview, I add 11 weeks to the spell that she reported in the CPS. If the respondent reported to be unemployed in the ATUS but employed or out of the labor force in the CPS, I assigned her a spell of 12 weeks. In Panel (f), occupations are 1: Management, business, and financial, 2: Professional and related, 3: Service, 4: Sales and related, 5: Office and administrative support, 6: Farming, fishing, and forestry, 7: Construction and extraction, 8: Installation, maintenance, and repair, 9: Production, and 10: Transportation and material moving.

Main Propositions

In this section I prove the main propositions in the paper concerning the case of full insurance within the household. Proofs of the propositions for the alternative arrangement are omitted since they can be easily inferred from the more general case. When pertinent, I remark on the different implications of both arrangements.

Let the unit interval $[0, 1]$ be the set of possible values for the state u. Let

$$\Gamma(u, \theta; \bar{s}, \lambda) = \left[\lambda + \alpha(1, \bar{s}, \theta, \lambda)u, 1\right]$$

be the feasibility set, which comprises all the possible values that the measure u could take in the next period given that the current state is given by u and θ, and given values for $\bar{s}$ and λ.

Consider the following assumptions:

Assumption 1: $\Gamma(u, \theta; \bar{s}, \lambda)$ is monotone decreasing in u for fixed θ and given $\bar{s}$ and λ; that is, $u^2 > u^1$ implies $\Gamma(u^2, \theta; \bar{s}, \lambda) \subseteq \Gamma(u^1, \theta; \bar{s}, \lambda)$.

Assumption 2: $U(c)$, $V(s)$, and $f(s, \bar{s}, \theta)$ are once-differentiable functions with respect to the first argument. Further $U(c)$ is strictly increasing, $V(s)$ is strictly increasing, and $f(s, \bar{s}, \theta)$ is strictly increasing in s for fixed $\bar{s}$ and θ. Also, $\beta \in (0, 1)$.

Assumption 3: $y^n(\theta) > y^u(\theta)$ for fixed θ and $(y^n(\theta) - y^u(\theta))U_c(c) - \gamma + V(s) > 0$ for fixed u and θ.

Assumption 4: $\alpha(s, \theta, \bar{s}, \lambda) \equiv 1 - \lambda - f(s, \bar{s}, \theta) > 0$ for every λ, s, $\bar{s}$, and θ.

This assumption ensures that the time persistence of u is positive.

The following Lemma will be useful to prove the subsequent proposition:

Lemma 1: Let U, V, f, y^n, y^u, γ, and λ satisfy Assumptions 2-4. Then $\mathcal{U}(u, u', \theta)$ is strictly decreasing in u for fixed u' and θ.

Proposition 1 (*Strict decreasing monotonicity of $B(u, \theta)$ with respect to u*): Let Γ, U, V, f, y^n, y^u, γ, λ and β satisfy Assumptions 1-4. Then $B(u, \theta)$ is strictly decreasing in u for fixed θ.

PROOF: I rely on the theory developed by Lucas et al. (1989), Chapter 4. In particular, I invoke Theorem 4.7 (Lucas et al., 1989, p. 80). First, I note that since the set $[0, 1]$ is compact then the boundedness assumption on the return function $\mathcal{U}$ could be easily disregarded for the application of Theorem 4.7.

Continuity of $\mathcal{U}$ is implied by Assumption 2. Lemma 1 establishes that $\mathcal{U}$ is strictly decreasing in u for fixed u' and θ. Indeed, notice that

$$\frac{\partial \mathcal{U}}{\partial u} = (y^u(\theta) - y^n(\theta))U_c + \gamma - V(s) - \alpha(s, \bar{s}, \theta, \lambda)\frac{V_s(s)}{f_s(s, \bar{s}, \theta)} < 0$$

under Assumptions 2-4. In the previous expression, I have benefited from an intermediate result,

$$\frac{\partial s}{\partial u} = \frac{\alpha(s, \bar{s}, \theta, \lambda)}{u f_s(s, \bar{s}, \theta)} > 0$$

which is obtained by applying the Implicit Function Theorem to the law of motion of unemployment and holding u fixed.

Assumption 1 requires that the feasibility set satisfies a monotonicity condition with respect to u. It is straightforward to verify, from the law of motion of unemployment, that $u^2 \geq u^1$ implies $\Gamma(u^2, \theta; \bar{s}, \lambda) \subseteq \Gamma(u^1, \theta; \bar{s}, \lambda)$. That is, $\Gamma(u, \theta; \bar{s}, \lambda)$ is in this sense monotone decreasing in u.

Using Theorem 4.7 in Lucas et al. (1989), I conclude that $B(u, \theta)$ is *strictly decreasing* in u.
REMARK: In the absence of full insurance within the household, $B(u, \theta)$ is also strictly decreasing in u for fixed θ.

ASSUMPTION 5: $U(c)$, $V(s)$, and $f(s, \bar{s}, \theta)$ are twice-differentiable functions with respect to the first argument. $U(c)$ is strictly concave, $V(s)$ is weakly convex and $f(s, \bar{s}, \theta)$ is strictly concave in s for fixed $\bar{s}$ and θ.

The following Lemma and Assumption will be useful to prove the subsequent proposition:
LEMMA 2: Let V and f satisfy Assumptions 2 and 5. Then $\mathcal{U}(u, u', \theta)$ is strictly concave in u and u' for fixed θ.
REMARK: In the absence of full insurance within the household, $\mathcal{U}$ is weakly concave.

ASSUMPTION 6: $\Gamma(u, \theta; \bar{s}, \lambda)$ is convex in u for fixed θ and given $\bar{s}$ and λ.

PROPOSITION 2 (*Strict concavity of $B(u,\theta)$ with respect to u*): Let Γ, U, V, f, y^n, y^u, γ, λ and β satisfy Assumptions 1-6. Then $B(u, \theta)$ is strictly concave in u for fixed θ.

PROOF: I invoke Theorem 4.8 from Lucas et al. (1989), Chapter 4, p. 81. Lemma 2 guarantees that $\mathcal{U}(u, u', \theta)$ is strictly concave with respect to u and u' for fixed θ. I show this by constructing the Hessian matrix. I first compute

$$\begin{aligned}
\frac{\partial \mathcal{U}}{\partial u} &= -(y^n - y^u)U_c + \gamma - V - \frac{\alpha V_s}{f_s} \\
\frac{\partial \mathcal{U}}{\partial u'} &= \frac{V_s}{f_s},
\end{aligned}$$

from which I calculate the entries of the Hessian matrix

$$\begin{aligned}
\frac{\partial^2 \mathcal{U}}{\partial u^2} &= (y^n - y^u)^2 U_{cc} + \frac{\alpha^2}{u f_s^2}\left[\frac{V_s f_{ss}}{f_s} - V_{ss}\right] \\
\frac{\partial^2 \mathcal{U}}{\partial u'^2} &= \frac{1}{u f_s^2}\left[\frac{V_s f_{ss}}{f_s} - V_{ss}\right] \\
\frac{\partial^2 \mathcal{U}}{\partial u' \partial u} &= \frac{-\alpha}{u f_s^2}\left[\frac{V_s f_{ss}}{f_s} - V_{ss}\right]
\end{aligned}$$

Assumptions 2 and 5 ensure that $\frac{\partial^2 \mathcal{U}}{\partial u^2} < 0$. In addition, notice that $\frac{\partial^2 \mathcal{U}}{\partial u^2}\frac{\partial^2 \mathcal{U}}{\partial u'^2} - \left(\frac{\partial^2 \mathcal{U}}{\partial u' \partial u}\right)^2 = \frac{(y^n - y^u)^2 U_{cc}\psi}{u f_s^2} > 0$, where $\psi = \frac{V_s f_{ss}}{f_s} - V_{ss} < 0$, under those assumptions. Thus, the Hessian matrix is negative definite. I conclude that $\mathcal{U}(u, u', \theta)$ is strictly concave in u and u' for fixed θ.

Finally, $\Gamma(u, \theta; \bar{s}, \lambda)$ is convex in the sense that if $u' \in \Gamma(u, \theta; \bar{s}, \lambda)$ and $w' \in \Gamma(w, \theta; \bar{s}, \lambda)$ then $\phi u' + (1-\phi)w' \in \Gamma(\phi u + (1-\phi)w, \theta; \bar{s}, \lambda)$ for any $\phi \in (0,1)$. Hence Assumption 6 is verified.

Using Theorem 4.8 in Lucas et al. (1989), I conclude that $B(u, \theta)$ is *strictly concave* in u for fixed θ.

REMARK: In the absence of full insurance within the household, $B(u,\theta)$ is linear in u for fixed θ. I use the equivalence (10) highlighted earlier in the paper. By using equations (5) and (10), it is easy to see that B_u is a constant.

Next, I make an assumption that will ensure the interiority and uniqueness of the optimal search intensity even under the linearity of the value function.

ASSUMPTION 7: $f(s, \bar{s}, \theta)$ satisfies the Inada's conditions with respect to s.

NOTE: Two of the conditions are implied by Assumptions 2 and 5. It remains to require that

$$\lim_{s \to 0} f_s(s, \bar{s}, \theta) = \infty$$

NOTE: Even if $B(\cdot, \theta)$ and $V(s)$ are linear, Assumption 7 guarantees a unique interior solution. To see this recall equation (8). The intuition is simply that a little bit of effort is highly valuable. That is, the unemployed worker would be better-off if exerting a minimal level of effort.

The following assumption is crucial to prove the subsequent proposition:

ASSUMPTION 8: Let the value function $B(u, \theta)$ be a smooth function with respect to u and θ.

Let $l(u, \theta)$ denote the next period's optimal measure of unemployed workers as a function of the state (u, θ). The policy function $l(u, \theta)$ is linked to the optimal search intensity $h(u, \theta)$ through the law of motion of unemployment:

$$l(u, \theta) = \lambda + \alpha \left(h(u, \theta), \bar{s}, \theta, \lambda \right) u$$

PROPOSITION 3 (*Strict monotonicity of $h(u, \theta)$ with respect to u*): Let B, Γ, U, V, f, y^n, y^u, γ, λ and β satisfy Assumptions 1-8. Then the optimal search intensity is a strictly increasing function of u for fixed θ.

PROOF: I use the optimal condition for search intensity and apply the Implicit Function Theorem to obtain:

$$h_u(u,\theta)\Big[\underbrace{V_{ss}(h(u,\theta))}_{\geq 0} + \underbrace{\beta}_{+}\underbrace{f_{ss}(h(u,\theta),\bar{s},\theta)}_{-}\underbrace{B_u(u',\theta')}_{-} - \underbrace{\beta}_{+}\underbrace{u}_{+}\underbrace{f_s(h(u,\theta),\bar{s},\theta)^2}_{+}\underbrace{B_{uu}(u',\theta')}_{-}\Big] = - \underbrace{\beta}_{+}\underbrace{f_s(h(u,\theta),\bar{s},\theta)}_{+}\underbrace{B_{uu}(u',\theta')}_{-}\underbrace{\alpha(h(u,\theta),\bar{s},\theta,\lambda)}_{+}$$

The assumptions made on the primitive functions U, V, and f lead to the conclusion that $h(u, \theta)$ is strictly increasing in u for fixed θ.

REMARK: In the absence of full insurance within the household, $h(u, \theta)$ is constant in u for fixed θ. The reason why the optimal search intensity does not depend on u is twofold. Neither do the marginal costs nor the marginal benefits of searching depend on the state. The latter is a direct consequence of the absence of full insurance within the household.

One of the hypotheses entertained in the paper uses the procyclicality of the value of a job as an assumption. Next, I provide conditions that guarantee this to happen. I rely on supermodularity techniques developed by Topkis's (1998). To use his theorems, I express the objective function as dependent of n', n, and θ, where $n = 1 - u$ is the measure of *employed* workers. Let

$$\tilde{H}(n, n', \theta) = \tilde{\mathcal{U}}(n, n', \theta) + \int_{\Theta} \tilde{B}(n', \theta') Q(\theta, d\theta')$$

be the objective function (the right side of the Bellman equation), where the tilde denotes that the problem is restated in terms of the measure of employed workers. Consider the following assumptions:

ASSUMPTION 9: f is strictly increasing in θ.
ASSUMPTION 10: The transition probability Q is monotone increasing.
ASSUMPTION 11: $f(s, \theta)$ has strictly increasing differences in s and θ, i.e., $f_{s\theta} > 0$.
ASSUMPTION 12:

$$\frac{\partial \tilde{\mathcal{U}}(n, n', \theta)}{\partial n \partial \theta} = \frac{y^n(\theta)}{\partial \theta} - \frac{y^u(\theta)}{\partial \theta} - \frac{\partial \gamma}{\partial \theta} + \frac{\partial V}{\partial \theta} + \frac{\partial(\alpha V_s / f_s)}{\partial \theta} > 0$$

where

$$\frac{\partial V}{\partial \theta} + \frac{\partial(\alpha V_s / f_s)}{\partial \theta} = -\frac{V_s f_\theta}{f_s} + \alpha \left(\frac{f_\theta}{f_s^2} \left[\frac{V_s f_{ss}}{f_s} - V_{ss} \right] - \frac{V_s f_{s\theta}}{f_s^2} \right)$$

Then under Assumption 12, wages minus unemployment benefits are more procyclical that the value of non-working time when moving from unemployment to employment. The next proposition asserts than with the aid of the latter assumptions the value of a job is procyclical, as in the canonical general equilibrium search model.

PROPOSITION 4 (*Strict increasing monotonicity of* $\tilde{B}_n(n, \theta)$): Let Q, U, V, f, and λ satisfy

Assumptions 2, 4, 5, 9, 10, and 11. Then $\tilde{B}(n,\theta)$ is supermodular in n and θ, i.e., $\tilde{B}_{n,\theta} > 0$.
PROOF: First I show that $\tilde{\mathcal{U}}(n,n',\theta)$ is strictly supermodular in (n,θ) and has strictly increasing differences in (n',n) and (n',θ). Notice that

$$\begin{aligned} \frac{\partial^2 \tilde{\mathcal{U}}}{\partial n' \partial n} &= -\frac{\alpha}{u f_s^2}\left[\frac{V_s f_{ss}}{f_s} - V_{ss}\right] > 0 \\ \frac{\partial^2 \tilde{\mathcal{U}}}{\partial n' \partial \theta} &= -\frac{f_\theta}{f_s^2}\left[\frac{V_s f_{ss}}{f_s} - V_{ss}\right] + \frac{V_s f_{s\theta}}{f_s^2} > 0 \end{aligned}$$

establishes that $\tilde{\mathcal{U}}$ has strict increasing differences in (n',n) and (n',θ), respectively. The sign of the following expression

$$\frac{\partial^2 \tilde{\mathcal{U}}}{\partial n \partial \theta} = \frac{\partial \Delta U(\theta)}{\partial \theta} - \alpha\left(-\frac{f_\theta}{f_s^2}\left[\frac{V_s f_{ss}}{f_s} - V_{ss}\right] + \frac{V_s f_{s\theta}}{f_s^2}\right) - \frac{V_s f_\theta}{f_s},$$

where $\Delta^n(\theta) \equiv (y^n - y^u)U_c + V(s(\theta)) - \gamma$ or $\Delta^n(\theta) \equiv U(y^n(\theta)) - U(y^u(\theta)) + V(s(\theta)) - \gamma$ (depending on whether full insurance within the household is possible), is not clear. Under Assumption 12, the first term in the above equation outweighs the remaining term so that $\tilde{\mathcal{U}}$ is supermodular in (n,θ). Finally, by Proposition 2 in Hopenhayn and Prescott (1992), it follows that $\tilde{B}(n,\theta)$ is supermodular in (n,θ).

Now, I am ready to state the main propositions concerning the choice of search intensity in response to changes in θ.

PROPOSITION 5 (*Strict increasing monotonicity of $h(u,\theta)$ with respect to θ*): Let Q, B, Γ, U, V, f, λ, γ, and β satisfy Assumptions 1-11. Further let θ be either I.I.D. or correlated. Then $h(u,\theta)$ is strictly increasing in θ if $f_{s\theta} > 0$ in the absence of full insurance within the household.
PROOF: The optimal condition reads as follows

$$V_s(h(u,\theta)) = -\beta f_s(h(u,\theta),\theta)\int_\Theta B_u(u',\theta')Q(\theta,d\theta')$$

where $u' = \lambda + \alpha(s,\bar{s},\theta,\lambda)u$. Taking derivatives with respect to θ gives:

$$V_{ss}h_\theta = -\beta(f_{ss}h_\theta + f_{s\theta})\int_\Theta B_u(u',\theta')Q(\theta,d\theta') - \beta f_s \frac{\partial \int_\Theta B_u(u',\theta')Q(\theta,d\theta')}{\partial \theta}$$

or

$$h_\theta \left[\underbrace{V_{ss}}_{\geq 0} + \underbrace{\beta}_{+} \underbrace{f_{ss}}_{-} \underbrace{\int_\Theta B_u(u',\theta')Q(\theta,d\theta')}_{-} - \underbrace{\beta}_{+} \underbrace{u}_{+} \underbrace{f_s^2}_{+} \underbrace{\int_\Theta B_{uu}(u',\theta')Q(\theta,d\theta')}_{0} \right] =$$

$$- \underbrace{\beta}_{+} \left[\underbrace{f_{s\theta}}_{+} \underbrace{\int_\Theta B_u(u',\theta')Q(\theta,d\theta')}_{-} \right.$$

$$\left. - \underbrace{u}_{+} \underbrace{f_s}_{+} \underbrace{f_\theta}_{+} \underbrace{\int_\Theta B_{uu}(u',\theta')Q(\theta,d\theta')}_{0} + \underbrace{f_s}_{+} \underbrace{Q'(\theta)}_{+} \underbrace{\frac{\partial \int_\Theta B_u(u',\theta')Q(\theta,d\theta')}{\partial \theta'}}_{-} \right]$$

where the signs are added in the light of the assumptions previously made and the results proved so far. Recall that, in the absence of full insurance within the household, $B(u,\theta)$ is linear in u for fixed θ. With the value of moving from unemployment to employment procyclical (i.e., $\tilde{B}_{n\theta}(n,\theta) > 0$ or $B_{u\theta}(u,\theta) < 0$), the procyclicality of search intensity depends almost exclusively on the procyclicality of the marginal return of searching f_s.

Remark: When θ is I.I.D. $f_{s\theta} > 0$ is also a necessary condition.

Note: The sufficiency and necessity of $f_{s\theta} > 0$ for the deterministic case is shown by Mukoyama et al. (2017) in their Proposition 1.

For completeness, I also include the proposition that holds when there is full insurance within the household.

Proposition 6 (*Strict increasing monotonicity of $h(u,\theta)$ with respect to θ*): Let Q, B, Γ, U, V, f, λ, γ, and β satisfy Assumptions 1-11. Further let θ be either I.I.D. or correlated. Then $h(u,\theta)$ is strictly increasing in θ if $f_{s\theta} > 0$ and

$$\frac{f_{s\theta}}{f_s f_\theta} > \frac{u \int_\Theta B_{uu}(u',\theta')Q(\theta,d\theta')}{\int_\Theta B_u(u',\theta')Q(\theta,d\theta')}$$

in the presence of full insurance within the household.

PROOF: The optimal condition reads as follows

$$V_s(h(u,\theta)) = -\beta f_s(h(u,\theta),\theta)\int_\Theta B_u(u',\theta')Q(\theta,d\theta')$$

where $u' = \lambda + \alpha(s,\bar{s},\theta,\lambda)u$.

Taking derivatives with respect to θ gives:

$$V_{ss}h_\theta = -\beta(f_{ss}h_\theta + f_{s\theta})\int_\Theta B_u(u',\theta')Q(\theta,d\theta') - \beta f_s \frac{\partial \int_\Theta B_u(u',\theta')Q(\theta,d\theta')}{\partial\theta}$$

or

$$h_\theta\left[\underbrace{V_{ss}}_{\geq 0} + \underbrace{\beta}_{+}\underbrace{f_{ss}}_{-}\underbrace{\int_\Theta B_u(u',\theta')Q(\theta,d\theta')}_{-} - \underbrace{\beta}_{+}\underbrace{u}_{+}\underbrace{f_s^2}_{+}\underbrace{\int_\Theta B_{uu}(u',\theta')Q(\theta,d\theta')}_{-}\right] =$$

$$-\underbrace{\beta}_{+}\left[\underbrace{f_{s\theta}}_{+}\underbrace{\int_\Theta B_u(u',\theta')Q(\theta,d\theta')}_{-}\right.$$

$$\left. - \underbrace{u}_{+}\underbrace{f_s}_{+}\underbrace{f_\theta}_{+}\underbrace{\int_\Theta B_{uu}(u',\theta')Q(\theta,d\theta')}_{-} + \underbrace{f_s}_{+}\underbrace{Q'(\theta)}_{+}\underbrace{\frac{\partial\int_\Theta B_u(u',\theta')Q(\theta,d\theta')}{\partial\theta'}}_{-}\right]$$

where the signs are added in the light of the assumptions previously made and the results proved so far and just discussed.

REMARK: When θ is I.I.D. the latter condition is also a necessary condition.

Ancillary Proofs

PROPOSITION 7: Consider the following expression for the probability of finding a job of an individual unemployed worker under symmetric equilibrium ($s = \bar{s}$):

$$f(s,\bar{s},\theta)|_{s=\bar{s}} = \left(\bar{s}^{\frac{\sigma-1}{\sigma}} + \theta^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}}$$

If $\sigma < 1$ then $f \leq 1$.

PROOF: First, I note that f can be alternatively expressed as follows:

$$f(s, \bar{s}, \theta) = \frac{\bar{s}\theta}{\bar{s}^{\frac{1-\sigma}{\sigma}} + \theta^{\frac{1-\sigma}{\sigma}}},$$

which is the matching function proposed by den Haan et al. (2000). With this observation, the proof is straightforward. Suppose, by using an argument by contradiction, that $f > 1$. This implies that

$$\bar{s}\theta > \left(\bar{s}^{\frac{1-\sigma}{\sigma}} + \theta^{\frac{1-\sigma}{\sigma}}\right)^{\frac{\sigma}{1-\sigma}}.$$

Now define $\tilde{s} = \bar{s}^{\frac{1-\sigma}{\sigma}}$ and $\tilde{\theta} = \theta^{\frac{1-\sigma}{\sigma}}$ and notice that the right side of the inequality could be written as $\bar{s}\theta = (\tilde{s}\tilde{\theta})^{\frac{\sigma}{1-\sigma}}$. Take logs to the right side of the inequality and invoke the Jensen inequality to conclude that

$$\frac{\sigma}{1-\sigma}(\ln \tilde{s} + \ln \tilde{\theta}) \leq \frac{\sigma}{1-\sigma} \ln (\tilde{s} + \tilde{\theta})$$

where I have used $\sigma < 1$. By taking exponentials to both sides of the latter inequality

$$(\tilde{s}\tilde{\theta})^{\frac{\sigma}{1-\sigma}} \leq \left(\tilde{s} + \tilde{\theta}\right)^{\frac{\sigma}{1-\sigma}}$$

we reach a contradiction.

NOTE: It can be verified that this function is of the constant returns to scale type and increasing in both arguments as noted by den Haan et al. (2000). It also exhibits decreasing returns to each argument. Desirable properties of the CES function have also been pointed out by Menzio and Shi (2010).