Search and Multiple Jobholding*

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Abstract

A search-theoretic model of the labor market with endogenous variations in hours worked, search both off- and on-the-job, and multiple jobholding is developed. Taking on a second job entails a commitment to hold onto the primary employer, enabling the worker to use the primary job as her outside option to bargain with the secondary employer. The model performs well at explaining multiple jobholding inflows and outflows, and it is informative for understanding the secular decline in multiple jobholding. While some worry that this decline heralds a less-flexible labor market, the model reveals that it has contributed to reducing search frictions.

JEL codes: E24, J21, J62

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1 Introduction

How and to what extent individuals are able to adjust their working hours are important questions in labor economics. The answers matter for understanding the empirical dynamics of hours per worker, and for addressing policy issues such as the effects of payroll taxes, fringe benefits and working-hours legislation. A long-standing view posits that workers need to change job in order to adjust their hours (e.g., Altonji and Paxson [1988, 1992], Blundell et al. [2008]), although certain empirical evidence somewhat qualifies this (Borowczyk-Martins and Lalé [2019]). There is also a pervasive view that multiple jobholding is an effective channel through which individuals can adjust their hours (Paxson and Sicherman [1996], Kahn and Lang [1991, 2001]), since taking on a second job might offer a valuable alternative to an employer change. Yet we known little about the relationship between hours adjustments, job-to-job changes, and multiple jobholding. In particular, there is no theory of how this relationship affects labor market equilibrium, and of how it is in turn shaped by aggregate search frictions.

In this paper we attempt to develop such a theory. We propose a general equilibrium model of the labor market with variations in hours per worker, search both off- and on-the-job, and multiple jobholding. The model enables us to shed light, firstly, on the microdeterminants of the decision to hold several jobs; and secondly, to examine and quantify the implications of multiple jobholding on aggregate labor market outcomes.

A central tenet of the theory is worker-firm bargaining – notably, that multiple jobholders bargain with their multiple (two in our case) employers. Allowing for this type of interaction is not trivial. Consider, for instance, models descended from Burdett and Mortensen [1998], or models in the vein of Postel-Vinay and Robin [2002a,b], where on-the-job search and employer-to-employer transitions play a prominent role. A worker receiving an outside job offer moves to the new firm right away, or holds onto the incumbent employer and has her wage raised while immediately losing contact with the other employer. There is hence no prolonged interaction between the worker and the two employers. This feature is not specific to wage posting or sequential auctions. In Dey and Flinn [2005] and Cahuc et al. [2006], a worker is at some point in contact with two firms and wages are set through bargaining. But there, again, the sequence is played instantaneously until one of the employers can no longer bid up, meaning that the tripartite interaction lasts for an infinitesimal portion of time. To our knowledge, the challenge of modeling a prolonged interaction between a worker and her several employers has not been addressed fully, and certainly it has not been addressed along the lines that we set out below.

Specifically, the interaction rules of our model work as follows. Upon getting an outside job offer, the employed worker is allowed to either move to the new employer, combine the new job with her current job, or discard these two options and stay with the incumbent employer. If she chooses multiple jobholding, she must then stay with the older employer (called 'primary employer') until this job is no longer viable, while she may give up the second job at any time. In return for this commitment, the worker is able to use the primary job as her outside option to extract a higher wage from the bargain with the outside (called 'secondary') employer, subject to a participation constraint on the employer's side. In some ways, this configures an environment that is the antipode to a Postel-Vinay and Robin [2002a,b, 2004] world, where the worker would use the outside employer to improve wages at the incumbent employer.[1] We verify whether these interaction rules are reasonable by studying their implications with respect to worker flows in and out of secondary jobs. We purposely do not target these data moments in the model's calibration and find that it performs well at predicting them.

Another pillar of the proposed theory is hours worked, which are idiosyncratic to the match between the worker and the firm and vary over time subject to some constraints.[2] The motivation for this is straightforward: whether or not a worker is able to take on a second job depends heavily on the hours schedule of her primary job. In the model, in addition to bargaining on wages, workers and firms also bargain on hours. We postulate a discontinuity in the mapping between hours worked and labor market services that induces worker-firm pairs to adopt high hours. This feature enables us to make important connections with the data, by generating a meaningful distinction between full-time and part-time employment which is relevant for explaining multiple jobholding inflows and outflows.[3] More broadly, it offers a simple solution to capture certain aspects of the intensive margin of labor adjustment (hours per worker) doc-

[1]In certain economic environments, the action of the incumbent employer of matching the outside job offers received by the worker is actually an assumption, and alternatively one could assume that the employer is unable to commit to such an arrangement. In other settings, whether or not firms make these commitments is an endogenous model outcome. In Postel-Vinay and Robin [2004] for instance, certain firms choose not to match outside job offers to deter their workers from making extra on-the-job search efforts. They prefer to lose workers to their competitors, albeit at a slow rate, rather than make frequent wage increases.

[2]Borowczyk-Martins and Lalé [2019] document a substantial variation in hours worked among *job stayers*.

[3]Using a Markov-chain model to estimate transitions in and out of multiple jobholding, we document that while full-time workers make up a larger share of multiple jobholding at the cross section, part-time workers are more likely to flow in and flow out (Appendix B of this paper).

umented in Borowczyk-Martins and Lalé [2019], and that the recent vintage of search models featuring fluctuations in hours (e.g., Bils et al. [2012], Kudoh and Sasaki [2011], Kudoh et al. [2019], Dossche et al. [2019]) is unable to produce.[4] We believe this makes a useful, independent contribution of the paper to this class of models.

In sum, the theoretical framework combines a Mortensen and Pissarides [1994]-like model with a structure of very rich adjustments along the intensive margin: in addition to flows in and out of employment, the model features worker movements within the distribution of working hours, across employers, as well as movements in and out of multiple jobholding. All these variables are determined endogenously. The key notions related to multiple jobholding, such as the primary and secondary jobs, are also endogenous to the model. And since the model is general equilibrium, it is easy to calibrate and usable for counterfactual analysis.

To illustrate the usefulness of our theory, we focus on understanding the secular decline of multiple jobholding in the U.S. labor market. We investigate the sources of this evolution jointly with those of declining job-to-job transition rates. We have two main sets of results. The first one concerns the microdeterminants of multiple jobholding. According to our model, a key parameter influencing that decision is the flow cost of working a *second* job, which comes in addition to the flow cost of working the first job (measured by the flow value of unemployment in the canonical search model). First, we find that it is sizable both compared to workers' earnings and relative to the flow cost of working the first job. To fix ideas, we estimate that the cost of working a second job amounts to 17 percent of average monthly earnings. We cannot separate out monetary and nonmonetary components since utility is linear, but, given plausible estimates of the expenditures necessitated by work, we think this suggests a substantial role for nonmonetary factors. Second, search frictions, as measured by on-the-job search effort, play a minor role in determining workers' transitions into and out of multiple jobholding. Third, and somewhat in contrast to the previous result, search frictions are important to draw proper inference on the change in multiple jobholding over time. The reason is that we uncover a substantial reduction in on-the-job search effort during the past 20 years based on declining job-to-job transition rates: search effort has decreased by 47 percent among men and by 38

[4] Borowczyk-Martins and Lalé [2019] show that a large share of cyclical adjustments in hours per worker reflect (within-firm) transitions between full-time and part-time employment, and that these entail sizable and lumpy adjustments in individuals' working hours. Search models with hours fluctuations are unlikely to predict similar patterns as they typically view hours as the outcome of a smooth optimization problem.

percent among women. Ignoring such changes would lead to underestimating the concurrent increase in the flow cost of working a second job. We find that increases of this cost by 12 percent for men and 5-6 percent for women account for the change of the employment share of multiple jobholders since the mid-1990s in the U.S.

The second set of results relates to the implications of multiple jobholding for search frictions. We investigate how and through which channels changes in the cost of working a second job affect vacancy posting. Our results indicate that the increase contributed positively to vacancy-posting efforts, and therefore reduced search frictions from a worker's perspective. Several mechanisms are involved. First, when fewer employed workers are involved in multiple jobs, a larger fraction of them engage into on-the-job search, meaning the aggregate number of job seekers increases. This generates a positive externality on the decision of firms to open up vacancies through the matching function. Second, conditional on meeting an employed worker, there is a higher probability that she gives up her current job to accept the outside job offer if the cost of the other option (working two jobs) has become higher. We call these two channels 'extensive' and 'intensive' margins of search, respectively. There is a third mechanism at work. The increase in the cost of working a second job reduces the total surplus of employment, and therefore lowers an employer's surplus of filling a vacant position. In the quantitative assessment, this third, negative effect is always dominated by the positive response of the extensive and intensive margins of search.

The model has some additional implications that we explore in the paper. First, we fit the model separately for men and women, and for each gender we analyze calibrations that differ with respect to the Frisch elasticity of labor supply. What is noteworthy is that the values of two key parameters remain virtually constant over those variants. The first one is the flow cost of working a second job, which we described above. The other parameter is search effort on the job. Its value consistently tells that the probability that an employed worker receives a job offer is about 40 percent of the probability that a nonemployed worker gets an offer. Despite this, the job-to-job transition rate is 15 times lower than the nonemployment-to-employment transition rate. One reason suggesting that this estimate of on-the-job search effort is more reliable than many available in the literature is that it takes accounts of both job-to-job transitions and multiple jobholding. We also study implications related to a long-standing question in the literature, namely whether workers take on a second job in order to alleviate the hours constraints they face in their primary job (Shishko and Rostker [1976], O'Connell [1979], Krishnan [1990]). The model is able to speak to this issue. It predicts that, relative to multiple jobholders, single jobholders are more likely to be dissatisfied with the number of hours they work. Moreover, multiple jobholders who would like to work more hours would prefer to do so on their second job, as this job is likely to have a high hourly wage rate (an endogenous model outcome). Last, the model is ambivalent (depending on the Frisch labor supply elasticity) on whether workers who are dissatisfied with their hours would like to work more vs. fewer hours. It seems that the data is equivocal too, although according to Kahn and Lang [2001] most workers in the U.S. would prefer to work more, not fewer, hours.

Our paper contributes to three strands of literature. First and foremost, we substantially expand existing research on working hours and multiple jobholding. In early work by Shishko and Rostker [1976], O'Connell [1979] and Krishnan [1990], the authors rely on simple static labor-supply models to guide their empirical investigations. More recent studies by Oaxaca and Renna [2006] and Hlouskova et al. [2017] also use static labor-supply models to organize thinking about 'job portfolios'. Paxson and Sicherman [1996] construct a partial-equilibrium dynamic model, but they do not study its implications quantitatively, and their main results are based on empirical data. Closer to our paper, Mancino and Mullins [2019] develop a dynamic search model of multiple jobholding, which they use to analyze the effects of income tax incentives on labor supply. However, their analysis remains partial equilibrium. As far as we are aware, our paper is the first to offer a full-fledged dynamic model of multiple jobholding cast in a general equilibrium setting.[5,6] Hours constraints, which are intimately related to the study of multiple jobholding, have been the topic of a large literature (see Conway and Kimmel [1998] and Johnson [2011], and the references cited in the opening paragraph). As will be illustrated below, the theory we propose is also relevant to study this

[5]From a purely formal point of view, the work closest to ours is Guler et al. [2012]. The authors offer an in-depth study of a search model of a household formed by a couple. In a subsection of their paper, they note resemblances with a search model with a single agent who would be able to hold two jobs at the same time. They do not push this analogy further, as their focus is to understand the reservation-wage behavior of the household under assumptions on risk preferences or on job offers being from multiple locations. Besides this, there are many important differences between Guler et al. [2012] and this paper: *inter alia*, they have a partial equilibrium model with exogenous wage-offer distributions and do not consider hours worked.

[6]Here we cite only the references on multiple jobholding that develop a formal theoretical model. The literature also includes numerous empirical studies that are useful for understanding the determinants of multiple jobholding; e.g. Kimmel and Powell [1999], Conway and Kimmel [2001] and Panos et al. [2014].

relationship. Second, beyond the applications proposed in the paper, our model can be used to analyze flexible work arrangements such are those brought about by the rise of the 'gig' economy (Jackson et al. [2017], Katz and Krueger [2019]). Indeed, an important share of gig work is performed as a second job. The model further yields predictions about workers' valuation of nonstandard work arrangements and provides a structural framework for studying elasticities at low vs. highly flexible working hours. This heterogeneity in labor supply elasticities, revealed and studied in experimental data, has become a highly researched topic in recent years (Angrist et al. [2017], Koustas [2018], Mas and Pallais [2017]). Last, the paper is related to the much-debated decline in dynamism of the U.S. labor market. This debate focuses on the large decreases in job creation and destruction rates, in unemployment outflows, in the job separation rate, and in multiple jobholding as well as job-to-job transitions (e.g., Davis and Haltiwanger [2014], Hyatt and Spletzer [2013], Molloy et al. [2016]). The literature devoted to this topic, cited in Sections 2 and 6, is primarily empirical. Our contribution to this research is to study the changing dynamism of the labor market through the lens of a theoretical, quantitative model.

The paper is organized as follows. Section 2 lists a series of empirical facts about multiple jobholding to contextualize this study. Sections 3 and 4 describe, respectively, the model and its equilibrium. Section 5 proceeds with the calibration of the model. Section 6 contains the main numerical experiments and a discussion of the results. Section 7 concludes.

2 Stylized facts

The empirical facts listed in this section are based on Paxson and Sicherman [1996], Conway and Kimmel [1998, 2001], Lalé [2015], Hirsch et al. [2016, 2017], and Appendix B of this paper. Prior to presenting these facts, we must explain how multiple jobholding is defined and measured empirically. According to the U.S. Bureau of Labor Statistics, multiple jobholders are those individuals who hold more than one job during some reference period (for instance the reference week of the Current Population Survey) and who usually receive a wage or salary from the primary job. The vast majority of them (over 90 percent) hold only two jobs. A key related definition is that of the primary job, which is the job with the greatest number of hours worked during the reference period.

The first set of facts relates to the allocation of time to market activities and to workers' underlying motives for holding more than one job at a time:

1. In the cross section, multiple jobholders account for between 5 and 6 percent of total employment. The reason why this number is not higher is that most workers hold a second job for a short period of time (typically less than 3 months).

2. Single jobholders face a significant probability of taking on a second job. As a result, when following a worker over her whole working lifetime, there is close to a 50 percent chance that she becomes a multiple jobholder at some point.

3. The typical multiple jobholder works full-time on her primary job and part-time on her second job. Workers who combine two part-time jobs to make a full-time income only account for 20 to 25 percent of all multiple jobholders.

4. There are mainly two motives for taking on a second job: economic reasons – e.g., earning extra money, meeting expenses or paying off debt –, and job heterogeneity – e.g., the attributes of the second job are different from those of the primary job, and workers value these job attributes. Economic reasons tend to be the dominant factor.[7]

Notice that, according to Fact 4, job heterogeneity is of secondary importance for understanding multiple jobholding. For many multiple jobholders, the evidence shows that the primary and second jobs belong to the same or closely related markets: e.g., a hospitalist provides outpatient services, a teacher conducts a private tutoring business, etc.

The next set of facts relates to the characteristics of multiple jobholders. In particular, Fact 6 ('multiple jobholding is positively correlated with education') provides further motivation for focusing on a model with wage bargaining, given that more educated individuals are more likely to hold jobs where wages are set through bargaining (Hall and Krueger [2012]):

5. The employment share of multiple jobholders – a quantity that we call *the multiple jobholding share* – is similar across male and female workers, across married and single individuals, and across young, prime-age, and older individuals.

[7]Evidence in support of this fact comes in several forms. In labor force surveys, multiple jobholders are sometimes asked about their main motive for holding two jobs. Only about 15 percent report doing so because of the enjoyment they receive from the second job; see Hipple [2010]. Conway and Kimmel [1998] set up an econometric model of multiple jobholding with both economic and job heterogeneity motives. Their results indicate that the primary motive for most workers is the economic one.

6. Multiple jobholding shares vary significantly with education; they are much higher among more educated individuals. Related, multiple jobholding shares are higher among individuals whose primary job is in professional and service occupations. A likely explanation for this is the greater flexibility of the work schedule afforded by these occupations.

7. The other key variable accounting for large variations in multiple jobholding shares is labor market size, viz. multiple jobholding decreases with market size. This feature is likely related to certain types of congestion such as time spent in commute-to-work trips.

The last set of empirical facts pertains to the behavior of multiple jobholding over time:

8. There is very little correlation between multiple jobholding and the business cycle.[8]

9. The main time variation is that the multiple jobholding share has decreased by between 20 and 30 percent over the past 20 years.[9] This decline is broad-based: it affects all groups of individuals – men and women, lower-skilled and high-skilled workers, etc. The decline has been more pronounced among men than among women.

10. The primary factor explaining the decline of multiple jobholding is the change in the probability of taking on a second job. Conditional on being a multiple jobholder (though without controlling for self-selection into multiple jobholding), it does not seem that workers have become more likely to give up the second job.

Facts 9 and 10 have raised concerns that these might be symptoms of a less dynamic labor market. They also echo findings that workers are shifting away from allocating hours to market work (see Aguiar and Hurst [2007] and Ramey and Francis [2009], and the discussion provided at the end of Subsection 6.3). What is more, Fact 10 is suggestive of some of the likely driving forces. It seems to run counter to a demand-side explanation based on the decline of short-term jobs (e.g., single-quarter jobs such as those studied by Hyatt and Spletzer [2017]), but it dovetails with the decline in U.S. worker mobility that has been documented in other areas.

[8] This could be due to the weak cyclicality of the factors that push individuals toward and away from working multiple jobs. Alternatively, it could be that these factors are strongly cyclical but are of similar magnitude, and balance the effects of each other out.

[9] See Figure 3 in Section 6. It seems that this time trend is not specific to the U.S. labor market. In Canada, multiple jobholding shares have come to a halt after being on an upward course that started in the 1970s. In the United Kingdom, the multiple jobholding share has decreased over the past 15 to 20 years. The evolution is different in Germany, where multiple jobholding has increased. As far as we are aware, this pattern has been entirely driven by the tax incentives generated by the German "mini-job" reform.

In particular, the decline of multiple jobholding goes hand-in-hand with the fall in job-to-job transitions that took place in the 2000s. The latter phenomenon has attracted considerable attention and is an oft-cited symptom of declining labor market dynamism (Bjelland et al. [2011], Hyatt and McEntarfer [2012] , Hyatt and Spletzer [2013]).

In the next sections, we set out a model that provides a framework for understanding these stylized facts.

3 The economy

Time $t = 0, 1, \ldots$ is discrete and runs forever. The economy is populated by a unit continuum of workers and by an endogenous measure of employers, both of whom are infinitely lived and discount the future at rate $\beta^{-1} - 1$.

Workers derive utility from market and nonmarket consumptions. They seek to maximize

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left(c_t^m + c_t^n \right). \tag{1}$$

Market consumption, c_t^m, consists of labor earnings net of a fixed cost of working ω_j, which is incurred for each job that the individual works. The number of jobs held is capped at two, meaning that $j \in \{1, 2\}$. Workers are endowed with one unit of time per period, and h_t denotes hours allocated to market work. Nonmarket consumption, c_t^n, consists of a home-produced good. The production of the home good depends on productivity in the home sector, z_t, which is idiosyncratic to the worker, and on the nonmarket hours of the worker, $1 - h_t$. Specifically, the production function of the home good is $z_t g\left(1 - h_t\right)$, where $g\left(\cdot\right)$ has the standard form

$$g\left(1 - h_t\right) = \frac{\left(1 - h_t\right)^{1 - \frac{1}{\gamma}} - 1}{1 - \frac{1}{\gamma}}. \tag{2}$$

Idiosyncratic home productivity z_t evolves over time according to a persistent stochastic process with transition function G, i.e. $G\left(z'|z\right) = \Pr\left\{z_{t+1} < z' | z_t = z\right\}$.

The objective of employers is to maximize the expected present value of profit streams π_t:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \pi_t. \tag{3}$$

Each employer has at most one job that is either filled or vacant. A vacant job costs the employer κ units of output per period. A filled job produces a flow of output $y_t f(h_t)$, where y_t denotes idiosyncratic match productivity. $f(\cdot)$ is the function that maps hours worked h_t onto labor services. We assume the following, non-convex mapping:[10]

$$f(h_t) = \begin{cases} (1-\psi)\, h_t & \text{if } h_t < \bar{h} \\ (1-\psi)\, h_t + \psi & \text{if } h_t \geq \bar{h} \end{cases}. \tag{4}$$

$\psi \geq 0$ and $\bar{h} \geq 0$ are exogenous parameters. The role of ψ is to 'bunch' the hours of work of agents towards $\bar{h}$. Match productivity y_t is stochastic and exhibits some persistence over time. Its transition function is denoted as F. Employers enter the labor market until the value of holding a vacant job equals zero.

Workers and employers come together via search. The number of contacts per unit of time depends on the number of vacancies and number of job seekers. This relationship is governed by a constant-returns-to-scale function, meaning that the job-filling probability depends only on labor market tightness θ_t, i.e. the ratio between vacancies and job seekers. Both nonemployed workers and single jobholders search for jobs. Multiple jobholders, on the other hand, must give up either one or both jobs to start receiving job offers. The probabilities that a nonemployed worker and a single jobholder meet an employer with a vacant job are, respectively,

$$\lambda_{0,t} = \theta_t q(\theta_t) \;\text{ and }\; \lambda_{1,t} = s_e \lambda_{0,t}. \tag{5}$$

s_e measures the relative efficiency of on-the-job search. On meeting, match productivity y_t is sampled from a distribution denoted as F_0. After observing the initial y_t, the worker and the employer either walk away from each other or stay together.

We need certain model assumptions in order to accommodate the option of holding more than one job and operationalize key notions related to multiple jobholding:

(A1) On receiving an outside job offer, the worker is allowed to either move to the new employer (job-to-job transition), combine the new job with her current job (multiple jobholding),

[10] Prescott et al. [2009], Rogerson and Wallenius [2009] and Chang et al. [2019] rely on a non-convex mapping from hours to labor services in order to distinguish the extensive and intensive margins of labor supply. We build on this idea to generate a meaningful distinction between part-time and full-time employment.

or discard these two options.

(A2) If the worker chooses multiple jobholding, she must then stay with her older employer – henceforth the *primary employer* – until the primary job is no longer viable, but she may choose to give up the second job at any time.

(A3) The multiple jobholder uses the primary job as her outside option when she bargains with the new employer – henceforth the *secondary employer*.

Anticipating on Section 4, we have mentioned worker-firm bargaining in the assumptions above. Let us make a few remarks to complement these assumptions. First, bargaining will be set up so that the participation constraints are satisfied on both employers' sides. Second, it is assumed that if the worker makes a job-to-job transition, she loses contact with the former employer, and therefore cannot use her previous employment status to bargain for a higher wage at the new employer. Third, in addition to the timing assumptions, we will assume that workers and firms continually rebargain, so that there is no role for wages to reduce worker quitting. Fourth, if the worker discards the option of moving to the new employer, then her bargaining position remains unchanged at the current employer. In particular, she cannot increase her wage at the primary employer by holding a second job, meaning that we preclude the worker from exploiting a bargaining opportunity. Fifth, we exclude the possibility for the secondary employer of inducing a quit by paying the worker a wage bonus. This arrangement is ruled out at the time of meeting the worker and in future periods, as the secondary employer must recognize that the worker is committed to her primary employer.

Assumptions (A1)–(A3) have material implications for turnover in and out of second jobs. One way to test these assumptions is thus to compare the model's predictions against data on the inflows and outflows of multiple jobholding. We undertake this comparison further below.

4 Equilibrium

4.1 Asset values and joint match surplus

In order to describe the behavior of workers who populate this economy, we denote by $N(z)$, $E(y_1, z)$ and $E(y_1, y_2, z)$ the asset values of, respectively, nonemployed individuals, single jobholders, and multiple jobholders. For firms, we use $J(y_1, z)$ to denote the asset value of an employer matched to a single jobholder. For those matched to a multiple jobholder, we denote by $J_1(y_1, y_2, z)$ and $J_2(y_1, y_2, z)$ the asset values of the primary and secondary employers, respectively. The asset value of holding a vacancy is always zero.

There are two joint match surpluses that need to be defined. The first one is the match surplus of employment with a single jobholder, $S(y_1, z)$. It is given by

$$S(y_1, z) = J(y_1, z) + E(y_1, z) - N(z). \tag{6}$$

Next, the assumptions laid out in Section 3 imply that the surplus of employment with a multiple jobholder, denoted as $S(y_1, y_2, z)$, is

$$S(y_1, y_2, z) = J_2(y_1, y_2, z) + E(y_1, y_2, z) - E(y_1, z). \tag{7}$$

That is, the surplus of multiple jobholding consists of the surplus of the secondary employer and the worker's asset value of holding two jobs, net of the value of working only on her primary job. Notice that $J_1(y_1, y_2, z)$ does not appear in the system of equations (6) and (7).

4.2 Bargaining

We assume that workers and employers Nash-bargain on wages period by period to split the surplus. Letting $\phi \in (0, 1)$ denote the bargaining power of workers, we have

$$(1-\phi)(E(y_1, z) - N(z)) = \phi J(y_1, z) \tag{8}$$

and

$$(1-\phi)(E(y_1, y_2, z) - E(y_1, z)) = \phi J_2(y_1, y_2, z). \tag{9}$$

These equations hold at an interior solution, noting that the surpluses on each side must be nonnegative. In addition, Equation (9) is subject to the condition that $J(y_1, z)$ be nonnegative to ensure participation from the primary employer. The wage schedules associated with Equations (8) and (9) are denoted as $w(y_1, z)$ and $w(y_1, y_2, z)$, respectively.

Working hours are also set through bargaining. In contrast to wages, which address the dynamic aspect of the relationships between employers and workers, hours are pinned down by static conditions: they equalize marginal productivity in the market and the home sector. There is a discontinuity in the mapping between match productivity and hours worked coming from the specification of $f(\cdot)$ (Equation (4)). That is, when the productivity of a single jobholder in the home sector is z, the worker-firm pair is better off holding hours worked at $\bar{h}$ for values of match productivity y_1 between $y_{\bar{h}}(z)$ and $\widetilde{y}(z)$, where $y_{\bar{h}}(z)$ is implicitly defined by

$$y_{\bar{h}}(z) f\left(h\left(y_{\bar{h}}(z), z\right)\right) + zg\left(1 - h\left(y_{\bar{h}}(z), z\right)\right) = y_{\bar{h}}(z) f\left(\bar{h}\right) + zg\left(1 - \bar{h}\right). \tag{10}$$

Let $\widetilde{y}(z)$ denote the level of match productivity so that $\bar{h}$ coincides with $1 - \left(\frac{z}{(1-\psi)y_1}\right)^{\gamma}$, the optimal hours schedule of the worker-firm pair when the discontinuity of the function $f(\cdot)$ is not binding. We have:

$$\widetilde{y}(z) = \frac{z\left(1 - \bar{h}\right)^{-\frac{1}{\gamma}}}{1 - \psi}. \tag{11}$$

Putting it all together, the hours schedule of single jobholders is given by[11]

$$h(y_1, z) = \begin{cases} \bar{h} & \text{if } y_{\bar{h}}(z) \leq y_1 < \widetilde{y}(z) \\ 1 - \left(\frac{z}{(1-\psi)y_1}\right)^{\gamma} & \text{otherwise} \end{cases} \tag{12}$$

for all positive y_1 and z. Next, consider the second job of a multiple jobholder. We define likewise a cutoff $y_{\bar{h}}(y_1, z)$ which satisfies

$$\begin{aligned} y_{\bar{h}}(y_1, z) f\left(h\left(y_1, y_{\bar{h}}(y_1, z), z\right)\right) + zg\left(1 - h(y_1, z) - h\left(y_1, y_{\bar{h}}(y_1, z), z\right)\right) \\ = y_{\bar{h}}(y_1, z) f\left(\bar{h}\right) + zg\left(1 - h(y_1, z) - \bar{h}\right). \end{aligned} \tag{13}$$

Observe that $1 - h(y_1, z)$ gives an upper bound on the hours that can be allocated to the second job. By this token, the upper threshold $\widetilde{y}(y_1, z)$ is given by

$$\widetilde{y}(y_1, z) = \frac{z\left(1 - h(y_1, z) - \bar{h}\right)^{-\frac{1}{\gamma}}}{1 - \psi}. \tag{14}$$

The thresholds described by Equations (13) and (14) yield the following hours schedule for the

[11] If $y_1 \leq 0$ then it is optimal for the worker-firm pair to set $h(y_1, z) = 0$. Likewise in Equation (15), it is optimal to set $h(y_1, y_2, z) = 0$ if $y_2 \leq 0$ (since the flow of output on the second job is $y_2 f(h(y_1, y_2, z))$).

second job of multiple jobholders:

$$h(y_1, y_2, z) = \begin{cases} \bar{h} & \text{if } y_{\bar{h}}(y_1, z) \leq y_2 < \widetilde{y}(y_1, z) \\ 1 - h(y_1, z) - \left(\frac{z}{(1-\psi)y_2}\right)^\gamma & \text{otherwise} \end{cases} \tag{15}$$

defined for all positive y_1, y_2, and z.

4.3 Bellman equations[12]

To write the Bellman equations, we need to first define the relevant policy functions. As we show momentarily, we can focus on the following three functions that correspond to binary decisions: (i) an employer's decision to keep a job alive, $p(y_1, z) = \mathbb{1}\{J(y_1, z) \geq 0\}$; (ii) a worker's decision to take on a second job, $d(y_1, y_2, z) = \mathbb{1}\{E(y_1, y_2, z) \geq E(y_1, z)\}$; (iii) a worker's decision to leave the current job upon meeting an incumbent employer, $\ell(y_1, y_2, z) = \mathbb{1}\{\max\{E(y_2, z), N(z)\} \geq \max\{E(y_1, z), E(y_1, z) + p(y_1, z)(E(y_1, y_2, z) - E(y_1, z)), N(z)\}\}$. Observe that inside the 'max' operator $p(y_1, z)$ multiplies $E(y_1, y_2, z) - E(y_1, z)$ as per assumption (A2): the option of having a second job holds as long as the first job is viable. Proposition 1 will prove very useful to characterize the equilibrium:

Proposition 1. *Under Nash bargaining, the policy functions $p(y_1, z)$, $d(y_1, y_2, z)$, $\ell(y_1, y_2, z)$ can be expressed jointly as functions of the match surpluses $S(y_1, z)$, $S(y_1, y_2, z)$. Specifically,*

$$p(y_1, z) = \mathbb{1}\{S(y_1, z) \geq 0\} \tag{16}$$

$$d(y_1, y_2, z) = \mathbb{1}\{S(y_1, y_2, z) \geq 0\} \tag{17}$$

$$\ell(y_1, y_2, z) = \mathbb{1}\{p(y_2, z) S(y_2, z) \geq p(y_1, z)(S(y_1, z) + d(y_1, y_2, z) S(y_1, y_2, z))\} \tag{18}$$

Proof. See Appendix A.1. □

With these policy functions at hand, we are in a position to write the system of Bellman equations. There are three asset values that matter in the economy's equilibrium: $S(y_1, z)$, $S(y_1, y_2, z)$, and $J_1(y_1, y_2, z)$. To simplify notations, we also include $N(z)$, the value of being

[12] In this section, we focus on the Bellman equations for $S(y_1, z)$, $S(y_1, y_2, z)$, and $J_1(y_1 y_2, z)$, because these asset values are sufficient to describe the equilibrium of the model. $S(y_1, z)$ and $S(y_1, y_2, z)$ are derived from the Bellman equations that define $N(z)$, $E(y_1, z)$, $E(y_1, y_2, z)$, $J(y_1, z)$, $J_1(y_1, y_2, z)$, $J_2(y_1, y_2, z)$ through calculations presented in Appendix A.2.

nonemployed, in the system of equations below. $N(z)$ solves

$$N(z)=\beta\int\left(N(z')+\lambda_0\phi\int p(y_1',z')\,S(y_1',z')\,dF_0(y_1')\right)dG(z'|z). \tag{19}$$

The continuation value of nonemployment includes the surplus of becoming a single jobholder multiplied by the worker's bargaining power.

The joint surplus of employment with a single jobholder is

$$\begin{aligned}S(y_1,z)&=y_1f(h(y_1,z))+zg(1-h(y_1,z))-(N(z)+\omega_1)+\beta\Bigg(S_e^+(y_1,z)+S_j^+(y_1,z)\\&+\int\left(\int p(y_1',z')\left(1-\lambda_1\int\ell(y_1',y_2',z')\,dF_0(y_2')\right)S(y_1',z')\right)dF(y_1'|y_1)\Bigg)dG(z'|z)\Bigg)\end{aligned} \tag{20}$$

where

$$\begin{aligned}S_e^+(y_1,z)=\int\Bigg(N(z')+\phi\lambda_1\int\int&(\ell(y_1',y_2',z')\,p(y_2',z')\,S(y_2',z')+(1-\ell(y_1',y_2',z'))\\&\times p(y_1',z')\,d(y_1',y_2',z')\,S(y_1',y_2',z'))\,dF_0(y_2')\,dF(y_1'|y_1)\Bigg)dG(z'|z)\end{aligned} \tag{21}$$

and

$$\begin{aligned}S_j^+(y_1,z)=\lambda_1\int\int\int&((1-\ell(y_1',y_2',z'))\,p(y_1',z')\,d(y_1',y_2',z')\,(J_1(y_1',y_2',z')\\&-(1-\phi)\,S(y_1',z')))\,dF_0(y_2')\,dF(y_1'|y_1)\,dG(z'|z).\end{aligned} \tag{22}$$

There are three components in the continuation value of a match with a single jobholder. The first one is the worker's component $S_e^+(y_1,z)$ defined in Equation (21), which captures the option that a single job might allow the worker to switch employer or take on a second job in the future. Second, the employer's component $S_j^+(y_1,z)$ shown in Equation (22) measures the fact that, if the worker takes on a second job, then the incumbent firm becomes the primary employer, the net surplus of which is $J_1(y_1,y_2,z)-(1-\phi)\,S(y_1,z)$. Third, if the worker neither leaves nor becomes a multiple jobholder, then in Equation (20) the worker-firm pair receives the surplus $S(y_1,z)$ in the subsequent period if the job is kept alive.

Next, consider the match surplus between a secondary employer and a multiple jobholder,

$S(y_1, y_2, z)$. Its asset value is given by

$$S(y_1, y_2, z) = y_2 f(h(y_1, y_2, z)) + zg(1 - h(y_1, z) - h(y_1, y_2, z)) - \omega_2$$
$$- (\phi S(y_1, z) + N(z) + \omega_1 - w(y_1, z)) + \beta \left(S_e^+(y_1, y_2, z) + \int \left(\int \int p(y_1', z') \right.\right.$$
$$\times d(y_1', y_2', z') S(y_1', y_2', z') dF(y_1'|y_1) dF(y_2'|y_2)$$
$$\left.\left. + \left(\int (1 - p(y_1', z')) dF(y_1'|y_1) \right) \left(\int p(y_2', z') S(y_2', z') dF(y_2'|y_2) \right) \right) dG(z'|z) \right) \quad (23)$$

where

$$S_e^+(y_1, y_2, z) = \int \left(N(z') + \phi \int p(y_1', z') S(y_1', z') dF(y_1'|y_1) \right) dG(z'|z). \quad (24)$$

In the continuation value of $S(y_1, y_2, z)$, $S_e^+(y_1, y_2, z)$ defined in Equation (24) captures the option value of the worker who might return to her primary employer should the spell of multiple jobholding come to an end. The remaining part in Equation (23) shows that the employment relationship might continue as a spell of multiple jobholding or be transformed into single employment at the secondary employer (who would then become the sole employer of the worker).

Last, the asset value of being the primary employer of a multiple jobholder solves

$$J_1(y_1, y_2, z) = y_1 f(h(y_1, z)) - w(y_1, z) + \beta \int \int p(y_1', z') \left((1 - \phi) S(y_1', z') + \int (d(y_1', y_2', z') \right.$$
$$\left. \times (J_1(y_1', y_2', z') - (1 - \phi) S(y_1', z')) dF(y_2'|y_2) \right) dF(y_1'|y_1) dG(z'|z). \quad (25)$$

That is, in the subsequent period the employer might become the only employer of the worker if the worker gives up her second job. Otherwise, she will continue as her primary employer and receive the net surplus value $J_1(y_1, y_2, z) - (1 - \phi) S(y_1, z)$.

It is useful to note similarities and differences between $J_1(y_1, y_2, z)$ and $(1 - \phi) S(y_1, z) = J(y_1, z)$. First, the profit flows $y_1 f(h(y_1, z)) - w(y_1, z)$ are the same because the wage and hours of a multiple jobholder at her primary employer are unaffected by the second job. Second, in the continuation value of $J_1(y_1, y_2, z)$, $(1 - \phi) S(y_1, z)$ is only subjected to the condition $p(y_1, z) = 1$ (i.e., the job remains viable), whereas in the continuation value of $J(y_1, z)$ this is also multiplied by $1 - \lambda_1 + \lambda_1 (1 - \ell(y_1, y_2, z)) < 1$. That is, a multiple jobholder holds onto her primary employer, and therefore she is less mobile than a single jobholder. Third, and related,

$J_1(y_1, y_2, z) - (1-\phi) S(y_1, z)$ in Equation (25) is multiplied by $d(y_1, y_2, z) p(y_1, z) = 1$ whereas in the continuation value of $J(y_1, z)$ it is also multiplied by $\lambda_1 (1 - \ell(y_1, y_2, z)) < 1$. The other difference here is that y_2' is drawn from the transition function $F(y_2'|y_2)$ in the continuation value of $J_1(y_1, y_2, z)$, while it is drawn from F_0 in the calculation of $J(y_1, z)$. Since the second job must be sufficiently productive to be operated under the hours schedule $h(y_1, y_2, z)$, it is likely that $F(y_2'|.)$ dominates $F_0(.)$ (in a first-order stochastic sense) for the range of relevant values of y_2. Putting it all together, we expect $J_1(y_1, y_2, z) - (1-\phi) S(y_1, z)$ to be positive for those values of y_2 such that a worker with current state variables y_1 and z chooses to hold a second job.

In order to compute the joint surplus value of multiple jobholding (Equation (23)), we need to determine the wage of a single jobholder, $w(y_1, z)$. From the asset value of employing a single jobholder, it follows that

$$w(y_1, z) = y_1 f(h(y_1, z)) - (1-\phi) S(y_1, z) + \beta \Bigg(S_j^+(y_1, z) + (1-\phi) \times \int \left(\int p(y_1', z') \left(1 - \lambda_1 \int \ell(y_1', y_2', z') \, dF_0(y_2') \right) S(y_1', z') \right) dF(y_1'|y_1) \Bigg) dG(z'|z) \quad (26)$$

for all y_1 and z. It is also straightforward to recover $w(y_1, y_2, z)$, the wage of a multiple jobholder, using the asset value of secondary employers. $w(y_1, y_2, z)$ is given by

$$\begin{aligned} w(y_1, y_2, z) = y_2 f(h(y_1, y_2, z)) - (1-\phi) S(y_1, y_2, z) + \beta(1-\phi) \int \Bigg(\int \int p(y_1', z') \\ \times d(y_1', y_2', z') S(y_1', y_2', z') \, dF(y_1'|y_1) \, dF(y_2'|y_2) \\ + \left(\int (1 - p(y_1', z')) \, dF(y_1'|y_1) \right) \left(\int p(y_2', z') S(y_2', z') \, dF(y_2'|y_2) \right) \Bigg) dG(z'|z) \quad (27) \end{aligned}$$

for all y_1, y_2 and z.

4.4 Free entry condition

To write the free entry condition, we let $\varphi_0(z)$ and $\varphi_1(y_1, z)$ denote the population measure of nonemployed workers and single jobholders, respectively. Below we will denote by $\varphi_2(y_1, y_2, z)$

the population measure of multiple jobholders. The free entry condition yields

$$\frac{\kappa}{q(\theta)} = \beta(1-\phi)\Bigg(\int\int p(y_1', z') S(y_1', z') dF_0(y_1') dG(z'|z) \frac{\varphi_0(z)}{\bar{\varphi}_0 + s_e\bar{\varphi}_1} dz + \int\int\int S_j^+(y_1', y_2', z') dF_0(y_2') dF(y_1'|y_1) dG(z'|z) \frac{s_e\varphi_1(y_1, z)}{\bar{\varphi}_0 + s_e\bar{\varphi}_1} dy_1 dz\Bigg) \quad (28)$$

where

$$S_j^+(y_1, y_2, z) = \ell(y_1, y_2, z) p(y_2, z) S(y_2, z) + (1-\ell(y_1, y_2, z)) p(y_1, z) d(y_1, y_2, z) S(y_1, y_2, z). \quad (29)$$

$(1-\phi) S_j^+(y_1, y_2, z)$ is the asset value of an employer with a vacant position who meets an employed worker: she takes as given the decision of the worker to leave the previous employer or to piece together the two jobs. In Equation (28), $\bar{\varphi}_0$ is the cumulated measure of nonemployed workers, i.e. $\bar{\varphi}_0 = \int \varphi_0(z) dz$. Likewise, $\bar{\varphi}_1$ is the cumulated measure of single jobholders. $\bar{\varphi}_0 + s_e\bar{\varphi}_1$ gives the number of job seekers, which is used to obtain the conditional distribution on the right-hand side of Equation (28) (and compute tightness $\theta = {}^{v}/_{\bar{\varphi}_0 + s_e\bar{\varphi}_1}$, where v denotes the measure of vacancies).

4.5 Equilibrium

We define a steady-state equilibrium of the economy as follows:

Definition. A steady-state equilibrium is a list of asset values $N(z)$, $E(y_1, z)$, $E(y_1, y_2, z)$, $J(y_1, z)$, $J_1(y_1, y_2, z)$, $J_2(y_1, y_2, z)$; a list of wage schedules $w(y_1, z)$, $w(y_1, y_2, z)$ and schedules of hours worked $h(y_1, z)$, $h(y_1, y_2, z)$; a list of policy functions for match formation and continuation, $p(y_1, z)$, multiple jobholding $d(y_1, y_2, z)$ and leave decisions $\ell(y_1, y_2, z)$; a population distribution $\varphi_0(z)$, $\varphi_1(y_1, z)$, $\varphi_2(y_1, y_2, z)$; and a value of tightness θ such that:

1. Given wages $w(y_1, z)$, $w(y_1, y_2, z)$ and schedules of hours $h(y_1, z)$, $h(y_1, y_2, z)$, the policy functions $p(y_1, z)$, $d(y_1, y_2, z)$, $\ell(y_1, y_2, z)$, and tightness θ, the asset values $N(z)$, $E(y_1, z)$, $E(y_1, y_2, z)$, $J(y_1, z)$, $J_1(y_1, y_2, z)$, $J_2(y_1, y_2, z)$ solve the Bellman equations that add up to (20), (23) and (25) through the surplus sharing Equations (8) and (9).

2. Given the asset values $N(z)$, $E(y_1,z)$, $E(y_1,y_2,z)$, $J(y_1,z)$, $J_1(y_1,y_2,z)$, $J_2(y_1,y_2,z)$, and tightness θ, the wage schedules $w(y_1,z)$, $w(y_1,y_2,z)$ yield the surplus sharing Equations (8) and (9), and the schedules of hours worked $h(y_1,z)$, $h(y_1,y_2,z)$ are given by Equations (12) and (15).

3. Given the asset values $N(z)$, $E(y_1,z)$, $E(y_1,y_2,z)$, $J(y_1,z)$, $J_2(y_1,y_2,z)$ combined into joint surpluses via Equations (6) and (7), the policy functions $p(y_1,z)$, $d(y_1,y_2,z)$, $\ell(y_1,y_2,z)$ are given by Equations (16), (17) and (18), respectively.

4. Given the policy functions $p(y_1,z)$, $d(y_1,y_2,z)$, $\ell(y_1,y_2,z)$, and tightness θ, the population distribution $\varphi_0(z)$, $\varphi_1(y_1,z)$, $\varphi_2(y_1,y_2,z)$ is time invariant with respect to the set of stock-flow equations of the economy.

5. Given the asset values $J(y_1,z)$ and $J_2(y_1,y_2,z)$ combined into joint match surpluses through Equations (8) and (9), and population distribution $\varphi_0(z)$, $\varphi_1(y_1,z)$, labor-market tightness θ solves Equation (28).

The stock-flow equations across the different states of nature (condition 4 in the above definition) can be deduced from the model's description. Given a population distribution $\varphi_0(z)$, $\varphi_1(y_1,z)$, $\varphi_2(y_1,y_2,z)$ and a value of market tightness θ, Proposition 1 enables us to compute the equilibrium by solving Equations (20), (23), (25) (for instance using value-function iterations) while recovering the wage schedule $w(y_1,z)$ using Equation (26).

5 Calibration and validation

In this section, we proceed with the model's calibration and validate it by comparing a set of model-generated moments against their empirical counterparts. The calculation of several key data moments is based on the empirical framework presented in Appendix B.

Specification and calibration. We need a number of preliminary specifications in order to list the parameters of the model. As is standard, we assume that match productivity y evolves according to a first-order autoregressive process. We denote by μ_y the unconditional mean of the process, $\rho_y \in (0,1)$ the persistence, and let σ_ε^2 denote the variance of the innovation term. We must also specify F_0, the distribution from which y is drawn upon meeting. For simplicity we assume that $F_0(\cdot) = F(\cdot|\mu_y)$. Next, we need to specify the stochastic process of home productivity, z. We use a first-order Markov process defined in the following way: the value of z remains unchanged with probability ρ_z, while with probability $1 - \rho_z$ a new value z' is drawn from a Normal distribution with mean μ_z and variance σ_z^2, truncated to the interval $[\mu_z - 2\sigma_z, \mu_z + 2\sigma_z]$.[13,14] Last, we assume a standard Cobb-Douglas matching function so that the job-filling probability is $q(\theta) = \chi\theta^{-\alpha}$.

Under these specification choices, the number of model parameters is seventeen: γ, β, $\bar{h}$, μ_y, ρ_y, α, ϕ, χ, ρ_z, μ_z, σ_z, ψ, κ, σ_ε, s_e, ω_1, ω_2. The first one of this list is the curvature parameter γ that regulates the Frisch elasticity of labor supply.[15] As is well known, the value of this elasticity is subject to controversies in the literature. Microeconometric studies of panel data find that the elasticity is rather low, i.e. not higher than 0.40 and in many instances not even higher than 0.20. In light of this evidence we consider a Frisch elasticity of 0.30. Macroeconomic studies, on the other hand, often rely on a much higher value of this elasticity. We think studying the implications of a larger Frisch elasticity is interesting in its own rights, and so we also consider an elasticity that is twice the baseline value (0.60). With a slight abuse of language, we will refer to 0.30 and 0.60 as low and high values of the Frisch elasticity. We use external information to select parameter values for β, $\bar{h}$, μ_y, ρ_y, α, ϕ, χ, which are held constant across the different calibrations. The remaining parameters (thus corresponding to a specific value of γ) are calibrated to match several data moments that we discuss below. Throughout the analysis, the model period is set to be one month.

We choose a discount factor β of 0.9951 to accord with an annualized real interest rate of 6 percent. To choose $\bar{h}$, we note there are about 430 hours of substitutable time per month and the standard full-time work schedule amounts to 172 hours of work per month. So, we set $\bar{h} = 0.40$ given that the time endowment of workers has been normalized to 1 (Equation (2)). The model allows for one more normalization, namely the unconditional mean of match productivity, μ_y. We set its value equal to 1. Next, observe that both ρ_y and ρ_z are related to the persistence of wages, which suggests fixing one of these two parameters. The most common of them is the persistence of match productivity, ρ_y. This parameter is usually set to a high

[13] Lalé [2018] proposes a model with shocks to workers' preferences for leisure that produce gross worker flows in and out of the labor force. The stochastic process for these shocks is similar to the one used here.

[14] Notice that Equations (12) and (15) require that z be nonnegative. It turns out that this condition is always satisfied, as the calibrated parameter values are such that $\mu_z - 2\sigma_z > 0$.

[15] Under the preferences that we have assumed, the Frisch elasticity of labor supply is $\gamma\frac{1-h_t}{h_t}$.

value based on the observation that wage shocks are approximately unit root process. Thus we choose $\rho_y = 0.975$. As is conventional in the literature, we set the elasticity of the vacancy-filling probability with respect to labor market tightness α and the bargaining power of workers ϕ equal to 0.5. Finally, we fix the matching efficiency parameter χ to 0.50, as we calibrate the vacancy-posting cost below to match a specific data moment.

Separately for each gender group, we calibrate the remaining parameters, namely ρ_z, μ_z, σ_z, ψ, κ, σ_ε, s_e, ω_1, ω_2, to match nine data moments. These moments are:

1–4. The probability that a single jobholder moves from full-time to part-time work; the part-time employment share (i.e., the share of employed workers whose total number of hours worked is strictly under $\bar{h}$ hours); average hours per worker; the share of employed workers bunching at full-time hours ($\bar{h}$ hours in the model). For these data moments, we calculate averages over the years 1994 to 2018 of the corresponding time series analyzed in Borowczyk-Martins and Lalé [2019].

5. The cost of job creation. We follow Elsby and Michaels [2013] and calibrate κ so that the expected job creation cost ($\kappa/q(\theta)$) amounts to 14 percent of average quarterly earnings.[16]

6. The job separation rate. In the model, this data moment is mostly related to the variance of idiosyncratic shocks to match productivity. To avoid obtaining very different values of this technology parameter, we target the same data moment for both gender groups (both for low and high values of the Frisch elasticity), namely a job separation rate of 2.5 percent per month as in Bils et al. [2011].

7. The job-to-job transition rate. We calculate the average over the years 1994 to 2018 of the job-to-job transition probabilities displayed in Figure 3.

8. The job-finding rate. As in Bils et al. [2011], we target a monthly job-finding rate of 31.3 percent. This value provides a reasonable compromise between treating nonemployment as the sum of unemployment and nonparticipation together vs. identifying nonemployment as unemployment only.

9. The employment share of multiple jobholders. We calculate the average over the years 1994 to 2018 of the multiple jobholding time series displayed in Figure 3.

[16] Elsby and Michaels [2013] use empirical evidence based on Silva and Toledo [2009] to calculate this number.

Table 1: Parameter values

	Parameters set externally					
1	discount factor β			0.9951		
2	threshold for full-time work $\bar{h}$			0.4		
3	match prod., persistence ρ_y			0.975		
4	match prod., unconditional mean μ_y			1.0		
5	tightness elasticity of job filling α			0.5		
6	bargaining power of workers ϕ			0.5		
7	matching efficiency χ			0.50		
		Men			**Women**	
	Parameters set internally	L	H		L	H
1	**home prod., persistence ρ_z**	**0.797**	**0.848**		**0.995**	**0.995**
2	**home prod., unconditional mean μ_z**	**0.152**	**0.464**		**0.097**	**0.418**
3	**home prod., standard dev. σ_z**	**0.078**	**0.168**		**0.009**	**0.042**
4	prod. gap at $\bar{h}$ hours ψ	0.046	0.072		0.010	0.024
5	vacancy posting cost κ	0.093	0.101		0.087	0.092
6	match prod. shock, standard dev. σ_ε	0.145	0.166		0.161	0.189
7	on-the-job search efficiency s_e	0.392	0.399		0.391	0.395
8	**cost of working job 1 ω_1**	**0.244**	**0.151**		**0.243**	**0.129**
9	**cost of working job 2 ω_2**	**0.099**	**0.119**		**0.098**	**0.116**

Notes: The model period is set to be one month. L and H indicate that the curvature parameter γ is set to match, respectively, low (0.30) and high (0.60) values of the Frisch elasticity of labor supply.

Observe that since the model-generated are determined jointly, the calibrated parameter values of ρ_z, μ_z, σ_z, ψ, κ, σ_ε, s_e, ω_1, ω_2 are also jointly set. Yet each parameter turns out to be closely related to a specific data moment targeted by our calibration exercise. To highlight this mapping, we use the same number to list each of these parameters in the first column of Table 1 and the data moment that best identifies it in Table 2. For instance, the persistence of home productivity ρ_z is most directly related to transitions from full-time to part-time work among single jobholders (rows labeled 1 in Tables 1 and 2). In all tables of the paper, the columns labeled L and H denote calibrations based, respectively, on low and high Frisch elasticities. For men, the corresponding values of the curvature parameter γ are 0.229 and 0.458. For women, the values of γ are 0.181 and 0.362.

Validation of the model. The upper panel of Table 2 compares targeted data moments to their model-generated counterparts. As can be seen, the model matches the data well. The fit is very satisfactory with respect to transitions to and from employment, and the model captures well the gender difference in the incidence of part-time employment. For women, the model slightly overestimates the probability of moving from full-time to part-time work among single

Table 2: Targeted and untargeted moments

		Men			Women		
	Targeted moments	Data	L	H	Data	L	H
1	F_S to P_S trans. prob.	2.14	2.09	2.28	4.50	6.44	6.58
2	share under full-time hours	5.94	5.91	5.94	20.7	20.8	21.1
3	average hours per worker	187	187	186	161	170	165
4	share bunching at full-time hours	45.4	45.4	45.3	44.5	45.5	44.5
5	job creation cost*	14.0	14.0	14.0	14.0	14.0	13.9
6	E to N trans. prob.*	2.50	2.50	2.50	2.50	2.49	2.48
7	E to E trans. prob.	2.00	1.99	2.00	1.93	1.92	1.92
8	N to E trans. prob.*	31.3	31.3	31.4	31.3	31.3	31.3
9	MJH share	5.59	5.61	5.59	5.92	5.99	6.05
	Untargeted moments	Data	L	H	Data	L	H
1	**F_S to M trans. prob.**	**1.89**	**1.52**	**1.56**	**1.78**	**1.37**	**1.35**
2	**P_S to M trans. prob.**	**4.58**	**3.22**	**3.26**	**3.45**	**3.10**	**3.04**
3	**N to M trans. prob.**	**0.31**	**0.00**	**0.00**	**0.15**	**0.00**	**0.00**
4	**F_M to S trans. prob.**	**29.3**	**25.9**	**25.0**	**28.9**	**23.1**	**22.2**
5	**F_M to N trans. prob.**	**0.57**	**0.41**	**0.31**	**0.56**	**0.05**	**0.02**
6	**P_M to S trans. prob.**	**31.6**	**31.9**	**33.2**	**30.6**	**30.5**	**30.2**
7	**P_M to N trans. prob.**	**2.42**	**1.71**	**1.69**	**1.29**	**1.13**	**0.97**

Notes: Data moments not marked by an asterisk are computed from the monthly files of the Current Population Survey over the years 1994 to 2018; see Appendix B for details. Data moments marked by an asterisk (*) are taken from the literature. E: employment; N: nonemployment; F_S: single jobholding with a full-time primary job; P_S: single jobholding with a part-time primary job; $S = F_S + P_S$: single jobholding; F_M: multiple jobholding working full-time on the primary job; P_M: multiple jobholding working part-time on the primary job; $M = F_M + P_M$: multiple jobholding. The job creation cost is the ratio between the vacancy posting cost and average quarterly earnings. L and H indicate that the curvature parameter γ is set to match, respectively, low (0.30) and high (0.60) values of the Frisch elasticity of labor supply. All table entries are expressed in percent.

jobholders.[17] For both gender groups, it predicts job-to-job transitions and multiple jobholding very precisely. What is more, the model performs well at capturing all the inflows and outflows of multiple jobholding (lower panel of Table 2). First, it consistently predicts that multiple jobholding is more prevalent among individuals who are working part-time as opposed to full-time on their primary job. That is, the inflow transition probability is about twice as high for part-time workers as for full-time workers. The model slightly underpredicts the transition probability of moving from multiple jobholding to single jobholding with a full-time primary job. Yet it captures the fact that this transition probability is lower than the probability of moving to single jobholding among multiple jobholders with a part-time primary job. Second, the assumption that workers in the model cannot move directly from nonemployment to multiple jobholding is in line with the data. In the reverse direction, the model generates some transitions

[17] In the calibration, we cap the persistence parameter at ρ_z at 0.995. As Table 1 shows, we hit this upper bound for women regardless of the value of the Frisch elasticity. This leaves the model with no margin of maneuver to make hours worked more persistent for women.

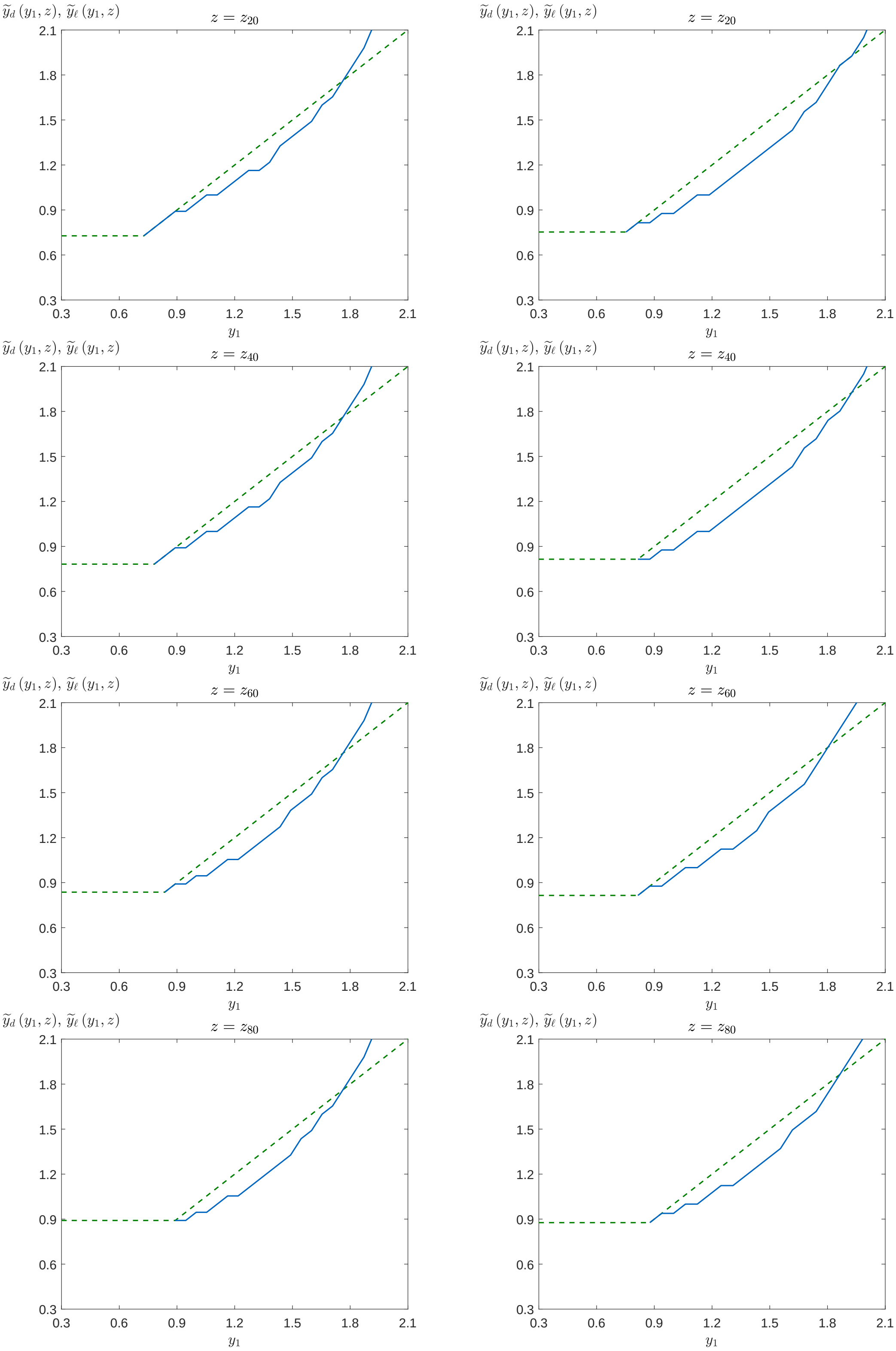
directly from multiple jobholding to nonemployment, and the fit with respect to this data moment is satisfactory.

To illustrate further the workings of the model, in Figure 1 we plot two thresholds that play an important role in the model's equilibrium.[18] The first one, $\tilde{y}_d(y_1, z)$, is defined by: $E(y_1, \tilde{y}_d(y_1, z), z) = E(y_1, z)$. That is, $\tilde{y}_d(y_1, z)$ gives the lowest match productivity of the second job y_2 such that the worker chooses to become a multiple jobholder. The other threshold, $\tilde{y}_\ell(y_1, z)$, is the value of match productivity such that the worker moves to the new employer upon receiving an on-the-job offer.[19] From top to bottom, the plots correspond to different values of idiosyncratic home productivity, z: z_{20} denotes the first quintile, z_{40} the second quintile, etc. Recall that the timing is such that, on receiving an outside job offer, the worker first chooses whether or not to move to the new employer, then decides whether or not she becomes a multiple jobholder. This means that the area in between $\tilde{y}_d(y_1, z)$ and $\tilde{y}_\ell(y_1, z)$ in Figure 1 (or the area above $\tilde{y}_d(y_1, z)$ in regions where $\tilde{y}_d(y_1, z) > \tilde{y}_\ell(y_1, z)$) corresponds to values of y_2 so that the worker chooses to piece together two jobs. We map these areas into probabilities to complement the information provided by the plots. In Figure 2, the solid lines show the probability that the worker becomes a multiple jobholder conditional on drawing y_2, and the dashed lines the probability that she makes a job-to-job transition conditional on drawing y_2. Both sets of probability are computed using $F_0(y_2)$. When match productivity on the first job y_1 is low, the worker is very likely to switch to the outside employer. The conditional probability of multiple jobholding becomes similar to, and eventually larger than, the conditional job-to-job transition probability if y_1 is in the middle range of values. Last, when match productivity on the first job y_1 is high, the worker discards both the option of switching to the outside employer and the option of holding two jobs at a time.

Returning to Figure 1, another implication of the area between $\tilde{y}_d(y_1, z)$ and $\tilde{y}_\ell(y_1, z)$ being so tight is that, in most instances, a multiple jobholder quickly returns to single jobholding. In line with this observation, we calculate that the average duration of a second job is around

[18] To avoid reporting the outcomes for different values of the curvature parameter γ, we calibrate two auxiliary models (one for each gender group) that correspond to an intermediate value of the Frisch elasticity of 0.45. The underlying values of γ are 0.344 for men and 0.271 for women. We use these models for the plots in Figures 1 and 2 in this section, and Figures 3 and 4 in Section 6.

[19] In all plots, it is clear that $\tilde{y}_\ell(y_1, z)$ has two segments. The horizontal part corresponds to the job destruction threshold. Although hard to discern, this threshold is slightly increasing with respect to z. The other segment of $\tilde{y}_\ell(y_1, z)$ overlaps the 45 degree line, indicating that the worker chooses to move to the outside job if it has a value of match productivity that is higher than that of her current job.



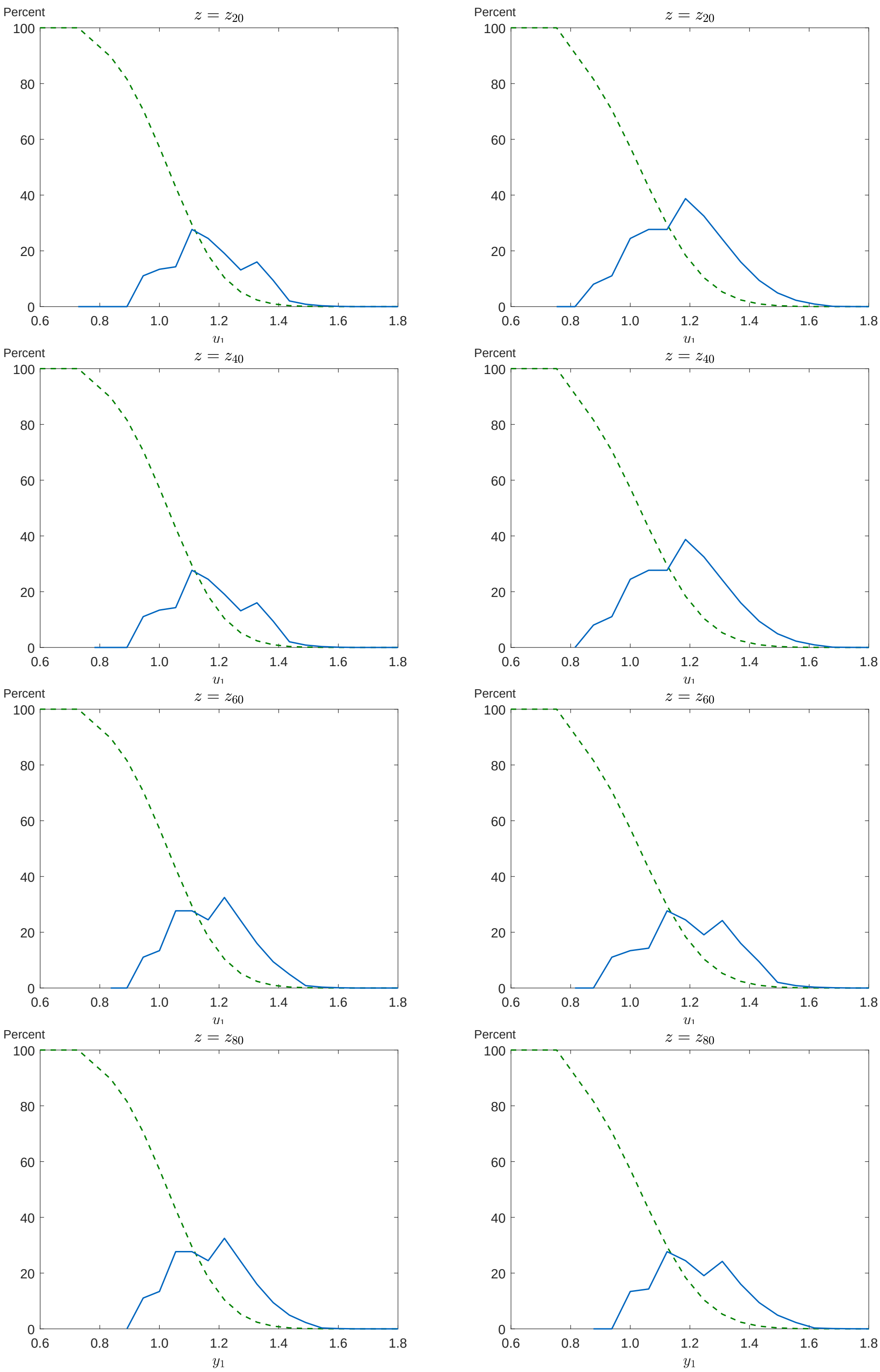
(a) Men

(b) Women

$\widetilde{y}_d(y_1,z)$ — $\widetilde{y}_\ell(y_1,z)$ - - -

Figure 1: Reservation thresholds for multiple jobholding and job-to-job transitions

Notes: Both for men and women, the plots are based on the calibration using an intermediate value for the curvature parameter γ. The solid lines in each plot denote the reservation thresholds for multiple jobholding, $\widetilde{y}_d(y_1,z)$. The dashed lines in each plot denote the reservation thresholds for job-to-job transitions, $\widetilde{y}_\ell(y_1,z)$.



(a) Men **(b)** Women

become MJHer E to E transition

Figure 2: Conditional probability of multiple jobholding and job-to-job transitions

Notes: Both for men and women, the plots are based on the calibration using an intermediate value for the curvature parameter γ. The solid lines in each plot denote the probability of becoming a multiple jobholder (MJHer). The dashed lines in each plot denote the probability of making a job-to-job transition (E to E).

3.5 months, with a large share of second jobs that actually end after only 1 month.[20] From the employers' perspective, these numbers imply that there is substantial variance in expected job duration on meeting an employed worker.

Model outcomes. We continue our examination of the model's outcomes in Table 3. The first panel of the table compares the flow costs of working ω_1 and ω_2 to a worker's average earnings. Two results stand out. The first one is that ω_1, which we calibrated to match a specific data moment on the job-finding rate, is at most 40 percent of earnings. Thus, if we compare it to the standard search model, this amounts to interpreting the flow value of nonemployment as unemployment benefits. Second, on average ω_2 is worth 16 to 18 percent of workers' earnings. Unlike ω_1, ω_2 is not very sensitive to the value of the Frisch elasticity. In our view, this suggests that the cost of working a second job can be substantial. For instance, in Bils et al. [2012]'s calculations, the expenditure necessitated by work is 10 percent of average earnings for high-wage workers and 27 percent of earnings for low-wage workers. Aguiar and Hurst [2013] document that work-related expenses (clothing, food away from home, commute to work, etc.) account for only a small fraction of total consumer spending. In our model on the other hand, ω_2 comes in addition to ω_1 and so should represent a small portion of the expenditure necessitated by work. Another way to put it is that our model suggests there is a large nonmonetary cost of working a second job.

In the middle panel of Table 3, we study 'hours constraints' through the lens of the model. This examination is motivated by the focus of much of the literature on whether workers take on second jobs to alleviate hours constraints that affect their primary job. Some labor force surveys provide 'direct' evidence on hours constraints: they ask, "If you had a choice, would you prefer to work the same number of hours and earn the same money, fewer hours at the same rate of pay and earn less money, or more hours at the same rate of pay and earn more money?" (see Kahn and Lang [2001] for an overview).[21] We can use our model to relate to this question. The hours of market work that a single jobholder would prefer at her current pay

[20] The figures reported in Table 2 allow to compute the expected duration of spells of multiple jobholding. To calculate the duration using *actual completed spells* of multiple jobholding, we draw a panel of 50,000 workers from the equilibrium cross-sectional distribution of multiple jobholders and we simulate their individual labor market trajectory over 36 months.

[21] This question is extracted from the supplements of the Current Population Survey. Kahn and Lang [2001] point out the importance of question wording: one can get very different estimates if the question does not spell out clearly that a change in hours would be accompanied by a proportional change in earnings.

rate solve

$$\max_{h}\left\{\frac{w\left(y_1,z\right)}{h\left(y_1,z\right)}h+zg\left(1-h\right)\right\},\tag{30}$$

and the first-order condition gives:

$$h^*\left(y_1,z\right)=1-\left(\frac{zh\left(y_1,z\right)}{w\left(y_1,z\right)}\right)^{\gamma}.\tag{31}$$

Likewise, we can ask a multiple jobholder how many hours she would prefer to work on each job given her current pay rates. To answer this question, this worker would solve

$$\max_{h_1,h_2}\left\{\frac{w\left(y_1,z\right)}{h\left(y_1,z\right)}h_1+\frac{w\left(y_1,y_2,z\right)}{h\left(y_1,y_2,z\right)}h_2+zg\left(1-h_1-h_2\right)\right\}.\tag{32}$$

We compare these preferred hours to agents' actual hours worked. We deem a worker dissatisfied with her hours if preferred hours differ from actual hours by at least 5 percent.[22] The middle panel of Table 3 presents results from these calculations. A very large share (between 40 and 60 percent) of workers are dissatisfied with their hours. This dovetails well with the evidence surveyed by Kahn and Lang [2001].[23] Although most dissatisfied workers would like to work fewer hours, there is some variation here depending on the underlying distribution of z and Frisch elasticity of labor supply. Multiple jobholders bring in additional pieces of information. First, they are much less likely to want more hours than single jobholders do. Second, multiple jobholders who would like to work more would typically choose to increase hours on the second job. This is because the *hourly* wage of the second job is high, since workers are often unable to work many hours on this job (see equation (15)). Third, and related, conditional on wanting to reduce hours, multiple jobholders would prefer to work less on the first job.

As was just mentioned, the hourly wage of the second job is often higher than that of the primary job. This is *not* inconsistent with the data. For example, Paxson and Sicherman [1996] show that this pattern prevails among college and university teachers (presumably because

[22] Increasing the threshold to 10 or 15 percent has little effect on the shares of multiple jobholders who are dissatisfied with their hours. For single jobholders, the extent of dissatisfaction is more sensitive to the threshold. Raising the threshold from 5 to 10 percent reduces by half the shares of single jobholders who want more hours or fewer hours. These numbers change little when the threshold is raised from 10 to 15 percent.

[23] Kahn and Lang [2001] find a roughly similar estimate across five different surveys for the U.S.: more than 40 percent of individuals would like to change their hours. Also, with exception of one survey, they find that most dissatisfied workers in the U.S. would like to work more, not fewer, hours. They report that 60 percent of workers in Canada would like to change their hours and are evenly split between working more and working less. In data for Europe, it appears that most dissatisfied workers would prefer to reduce hours.

Table 3: Additional model outcomes

		Men		Women	
	Costs of working	L	H	L	H
1	cost of working job 1 ω_1 rel. to earnings	38.5	21.9	42.2	20.9
2	cost of working job 2 ω_2 rel. to earnings	15.7	17.3	16.9	18.8
	Hours constraints	L	H	L	H
1	SJHer wanting more hours	8.02	26.0	10.4	19.9
2	MJHer wanting more hours on job 1	0.62	1.65	0.42	1.55
3	MJHer wanting more hours on job 2	5.94	5.87	6.38	6.33
4	SJHer wanting fewer hours	24.6	19.3	19.7	47.5
5	MJHer wanting fewer hours on job 1	2.45	2.54	2.96	3.99
6	MJHer wanting fewer hours on job 2	0.04	0.03	0.00	0.02
	Moving from MJH to SJH	L	H	L	H
1	job 1 ends	24.1	23.9	24.8	24.4
2	job 2 ends, not viable if held by a SJHer	11.3	10.8	12.1	11.0
3	job 2 ends, while viable if held by a SJHer	64.7	65.4	63.1	64.7

Notes: SJHer: single jobholder; MJHer: multiple jobholder; MJH: multiple jobholding. L and H indicate that the curvature parameter γ is set to match, respectively, low (0.30) and high (0.60) values of the Frisch elasticity of labor supply. All table entries are expressed in percent.

contracted consultancy work pays well per hour). Also, let us note that the *total* wage (hourly wage times hours worked) of the second job is on average much lower than that of the primary job. Due to the constraint coming from the primary job, multiple jobholders spend few hours working on the second job and, as a result, they produce little output at the secondary employer.

At the bottom of Table 3, we study the motives for returning from multiple to single jobholding.[24] Almost 25 percent of these transitions occur because the first job is no longer viable, meaning that the worker moves to the outside employer. Notice that this actually is a job-to-job transition – and is counted as such when computing the job-to-job transition rate of the model.[25] The remaining three-quarters of these transitions are made up of two numbers. In some instances (about 15 percent of the remaining cases), the worker gives up a second job that, at that point, would not be viable even if it were matched to a single jobholder. That is, $J_2(y_1, y_2, z)$ (which is proportional to $E(y_1, y_2, z) - E(y_1, z)$) and $J(y_2, z)$ are both negative. This is likely to occur when y_2 suffers a large negative shock. But in most instances, the worker gives up a second job that would actually generate a positive surplus if operated by a single

[24] As Table 2 indicates, in some rare instances the worker moves directly to nonemployment at the end of the spell of multiple jobholding (viz. $J(y_1, z)$ and $J(y_2, z)$ are both negative). The bottom panel of Table 3 looks at worker transitions that are conditional on staying employed.

[25] Unlike in the standard search model (e.g. Mortensen and Pissarides [1994]), the job destruction rate in this model is different from, and higher than, the probability of moving from employment to nonemployment. One job gets destroyed when a single jobholder moves to nonemployment or moves to a new employer, or when a multiple jobholder returns to holding a single job, and two jobs are destroyed when a multiple jobholder moves to nonemployment.

jobholder; the 'counterfactual' value $J(y_2, z)$ is positive. To understand these figures, recall that workers take on a second job when y_2 is in between $\tilde{y}_d(y_1, z)$ and $\tilde{y}_\ell(y_1, z)$ in Figure 1 (as match productivity is initially drawn from the distribution F_0 that is centered at μ_y). Therefore in most spells of multiple jobholding, we have $J(y_2, z) > J_2(y_1, y_2, z) \geq 0$.[26]

6 Numerical experiments

We now turn to the main applications of the model. We use it to address two broad questions: how search frictions affect the decision to become a multiple jobholder, and in turn how multiple jobholding contributes to aggregate search frictions.

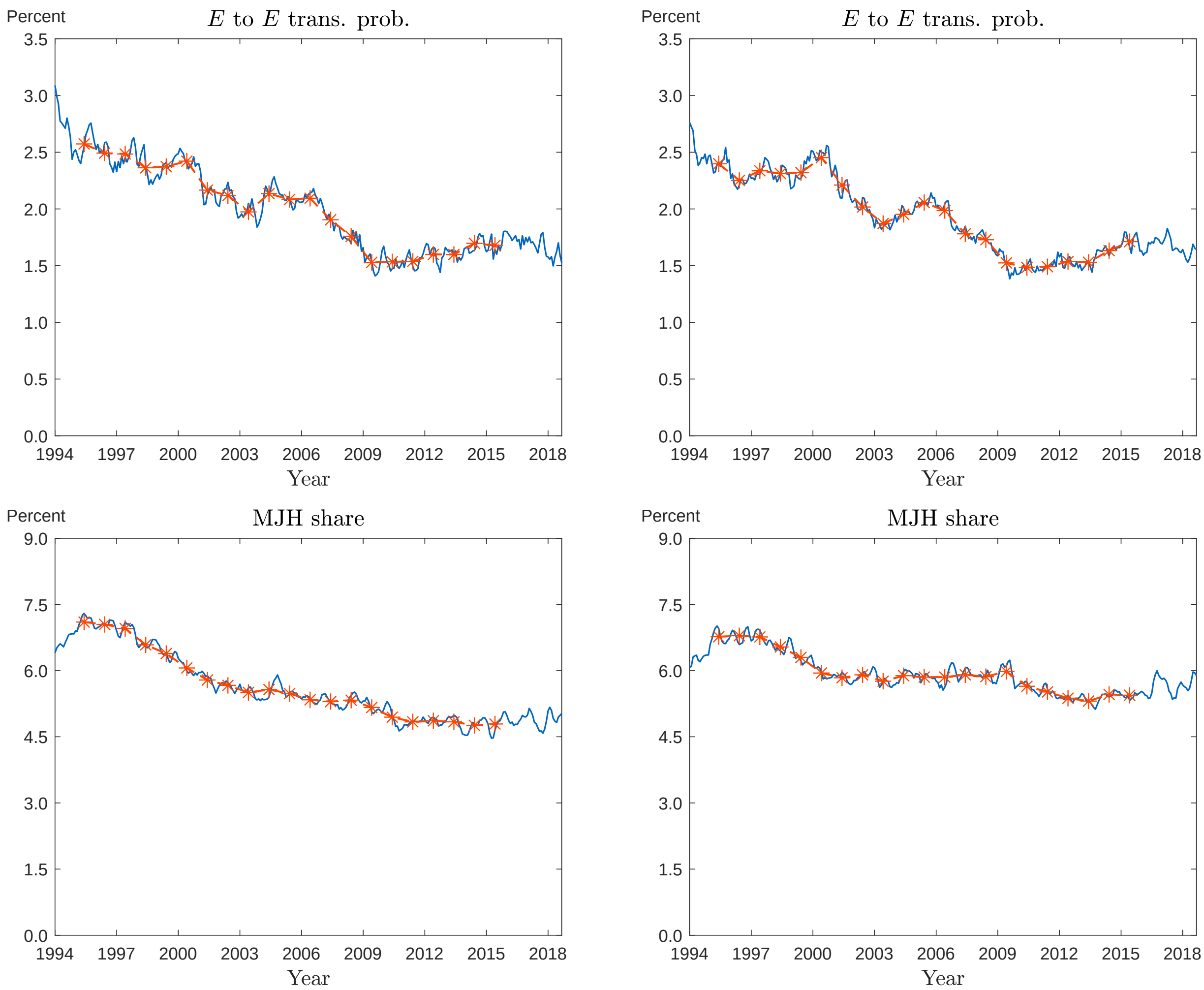
We answer these questions in the context of the joint dynamics of job-to-job transitions and multiple jobholding over the period from the mid-1990s until today. The solid lines in Figure 3 show that they have both decreased substantially over time. The dotted lines denote the model counterparts. These are obtained by calibrating s_e and ω_2 to match the average of the time series for every year in between 1995 and 2015.[27,28] We will use these calibrated value to analyze the relationships between search frictions and multiple jobholding. Before doing so, we must explain why we choose to focus on changes in 'only' s_e and ω_2.

Consider the set of internally-calibrated parameters of the model: ρ_z, μ_z, σ_z, ψ, κ, σ_ε, s_e, ω_1, ω_2 (see Table 1). The data support changes in only a subset of these parameters. The parameters ρ_z, μ_z, σ_z, which govern the stochastic process of home productivity z, would generate changes in transitions to part-time work, the part-time employment share and average hours per worker. In the data, however, these are constant on average over time. Changes in the vacancy-posting cost κ or in the flow cost of working one job ω_1 would imply changes in the job-finding rate, which would again be counterfactual. As for the standard deviation of match productivity shocks, σ_ε, recall that it is most directly related to the job separation rate.

[26] Thus, in most instances the secondary employer would be willing to pay a fee to the worker to induce her to quit her primary job, but our assumptions effectively rule out these types of arrangements.

[27] The purpose of Figure 3 is to demonstrate the model's ability to account for the outcomes that interest us in this section. On the other hand, in the numerical experiments, we focus on comparing the years 1995 and 2015. The period from the mid-2010s until today is characterized by stable behavior of the time series. Thus, assuming that the economy is at a steady state at the end of the sample period is perhaps not unreasonable. The assumption is more debatable for the initial subperiod, although multiple jobholding seems to be roughly constant over the years 1994 through 1996.

[28] As in Figures 1 and 2, to preserve legibility we report the outcomes of only one model for each gender group; we use models with an intermediate value of 0.45 for the Frisch elasticity. The plots in Figures 3 and 4 are very similar for the economies calibrated with low and high values of the Frisch elasticity of labor supply.



(a) Men **(b)** Women

Data ✳ Model

Figure 3: Targeted data and model-generated moments

Notes: Data moments are computed from the monthly files of the Current Population Survey over the years 1994 to 2018. Both for men and women, the model-generated moments are based on the calibration using an intermediate value for the curvature parameter γ. E: employment; MJH: multiple jobholding.

Flows from employment to unemployment have decreased secularly in the data. Thus, if σ_ε were allowed to change over time, then its value would become lower, not higher. This is inconsistent with the fact that cross-sectional wage dispersion is not decreasing over time. The remaining parameter of the list above, in addition to s_e and ω_2, is the technology parameter ψ driving the productivity gap at full-time hours. We show in Appendix C that our conclusions remain unchanged when ψ is allowed to vary jointly with s_e and ω_2. Thus, we focus here on the simpler experiments with s_e and ω_2 only. We note, moreover, that the experiments are consistent with the *untargeted* behavior of multiple jobholding inflows and outflows observed in the data: see

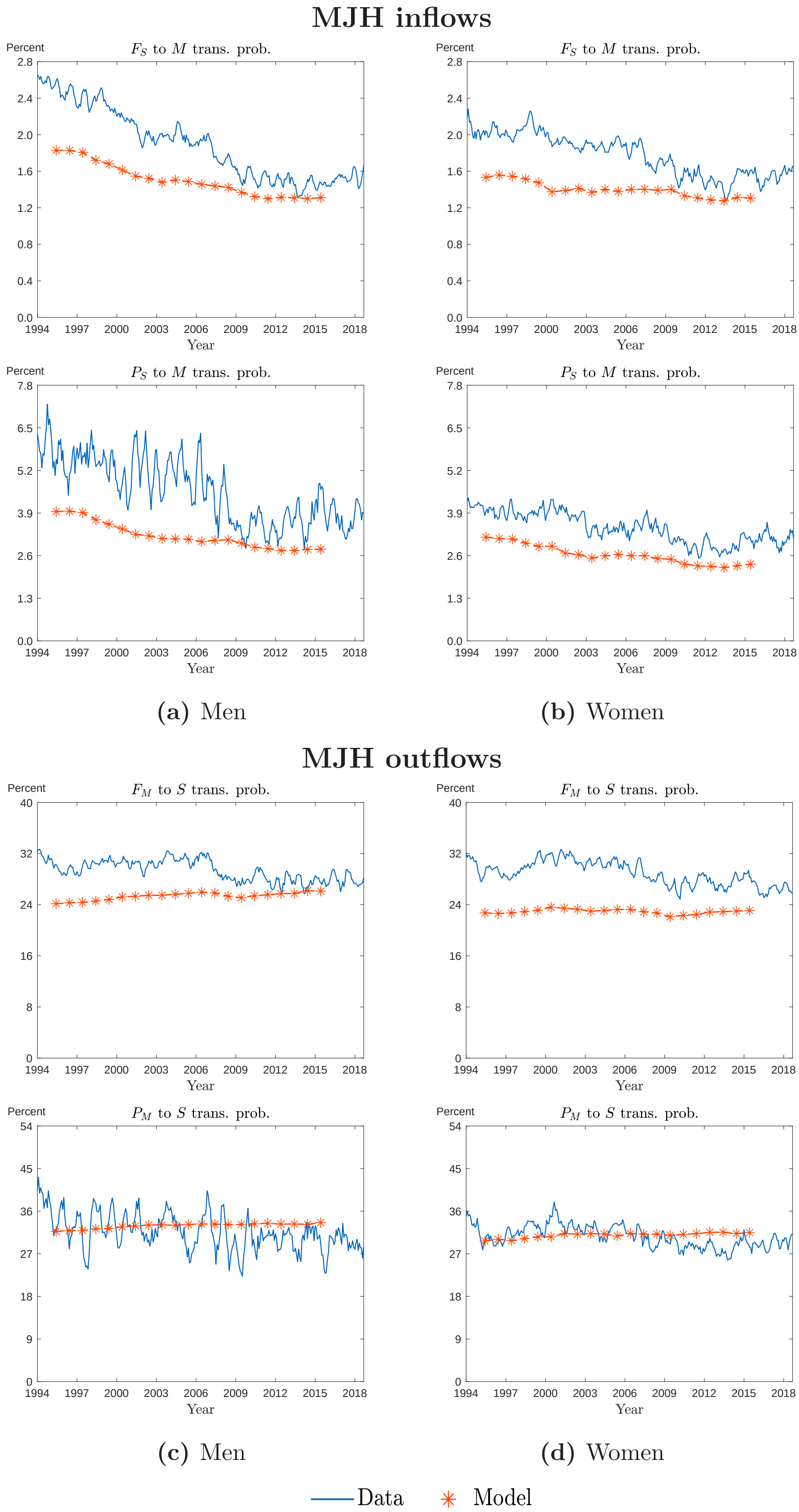


Figure 4: Untargeted data and model-generated moments

Notes: Data moments are computed from the monthly files of the Current Population Survey over the years 1994 to 2018; see Appendix B for details. Both for men and women, the model-generated moments are based on the calibration using an intermediate value for the curvature parameter γ. F_S: single jobholding with a full-time primary job; P_S: single jobholding with a part-time primary job; $S = F_S + P_S$: single jobholding; F_M: multiple jobholding working full-time on the primary job; P_M: multiple jobholding working part-time on the primary job; $M = F_M + P_M$: multiple jobholding. MJH: multiple jobholding.

Figure 4. While the discrepancy in terms of the levels of these transition probabilities (not targeted by the calibration) remains the same, the model is able to capture certain dynamic aspects of the decline of multiple jobholding, namely that (i) it is driven mostly by lower worker inflows while (ii) the outflows remain approximately constant over time (Fact 10 in Section 2).

6.1 Sources of changes in multiple jobholding

The top panel of Table 4 complements Figure 3 in two ways. First, it provides figures quantifying the joint decline of job-to-job transitions and multiple jobholding. Between 1995 and 2015, the job-to-job transition probability fell by 35.3 percent among men and by 28.5 percent among women, and the corresponding numbers for the multiple jobholding share are respectively 32.6 percent and 19.6 percent. To explain these changes, the model requires substantial changes in the search effort of employed workers, s_e. It predicts a decrease by 47 percent for men and by 37-39 percent for women. At the same time, according to the model, the flow cost of working a second job, ω_2, increased by 11-13 percent for men and by 5-6 percent for women (half the increase of the parameter for men).

In the middle panel of Table 4, we run the following experiment: We hold ω_2 constant to its 1995 level and calculate counterfactual changes in the job-to-job transition probability and multiple jobholding share implied solely by the dynamics of s_e. Perhaps surprisingly, we find that the large decrease in s_e contributed to *raising* the multiple jobholding share. On the one hand, a lower s_e implies lower inflows into multiple jobholding as single jobholders become less likely to meet an outside employer. On the other hand, conditional on holding a second job, multiple jobholders become reluctant to give it up as they anticipate that holding a second job in the future is unlikely. From 1995 to 2015, the decrease of s_e is so large that the longer duration of spells of multiple jobholding offsets the negative effect of lower worker inflows. These mechanisms are important to draw an inference about changes in the cost of working a second job. That is, ignoring the change in s_e revealed by the dynamics of the job-to-job transition probability would lead to an underestimation of the increase in ω_2.

The lower panel of Table 4 reports results from another experiment, in which s_e is held constant to its 1995 level while only ω_2 changes over time. First, conditional on holding two job opportunities, a higher ω_2 induces workers to switch employers instead of choosing multiple

Table 4: Source of changes in multiple jobholding

		Men			Women		
	Changes in s_e and ω_2	Data	L	H	Data	L	H
1	**% change in s_e**		**-46.9**	**-47.2**		**-39.1**	**-37.0**
2	**% change in ω_2**		**13.1**	**11.5**		**5.03**	**6.10**
3	E to E trans. prob.	-35.3	-34.7	-34.7	-28.5	-29.0	-28.6
4	MJH share	-32.6	-32.7	-32.7	-19.6	-19.5	-19.6
	Changes in s_e		L	H		L	H
1	E to E trans. prob.	–	-38.2	-38.1	–	-31.1	-31.1
2	MJH share	–	9.21	5.91	–	3.30	1.62
	Changes in ω_2		L	H		L	H
1	E to E trans. prob.	–	1.61	2.19	–	0.30	0.58
2	MJH share	–	-41.7	-38.7	–	-21.8	-20.4

Notes: Data moments are computed from the monthly files of the Current Population Survey and refer to differences in averages between years 1995 and 2015. s_e: on-the-job search efficiency; ω_2: cost of working job 2; E: employment; MJH: multiple jobholding. L and H indicate that the curvature parameter γ is set to match, respectively, low (0.30) and high (0.60) values of the Frisch elasticity of labor supply. All table entries are expressed in percent.

jobholding. This is because a higher ω_2 moves the thresholds $\tilde{y}_d(y_1, z)$ upward in Figure 1, thus leaving more mass in values of y_1 where a job-to-job transition is likely to occur in the near future. As a result, the increase in ω_2 contributed to dampening the decrease of job-to-job transitions. We find that this effect is quantitatively limited: the counterfactual increases of the job-to-job transition probability are never higher than 2.5 percent. Second, if s_e remains unchanged from its 1995 value, then the change in ω_2 overpredicts the decline of the multiple jobholding share. This is in line with our previous discussion of the role of changes in s_e. The effect is especially large among male workers. Indeed, we find that the predicted change exceeds the change driven by the joint dynamics of s_e and ω_2 by more than 20 percent (the predicted decrease for male workers is between -39 and -41 percent vs. -33 percent for the decrease resulting from the joint behavior of s_e and ω_2).

We reach two main conclusions through this set of experiments. First, multiple jobholding is very elastic to the flow cost incurred by working a second job. Therefore the dynamics of the parameter ω_2 are of first-order importance to understanding the dynamics of the multiple jobholding share. Second, while the role of the search effort s_e is secondary, it cannot be ignored in understanding the decision to give up the second job. By extension, search frictions as measured by s_e matter for quantifying the role and change over time of ω_2. In the last paragraphs of this section, we provide several observations to help interpret the dynamics of s_e and ω_2 as revealed by the experiments.

6.2 Implications for search frictions

Next, we evaluate the contribution of multiple jobholding to search frictions. The questions we ask are as follows: Moving on from 1995 to 2015, what is the effect of the increase in ω_2 on job creation efforts? Does it improve incentives for firms to open more vacancies, or instead reduce vacancy postings? What are the channels through which ω_2 affects the vacancy-posting decisions of firms? How important are these channels?

To answer these questions, we examine the job creation condition through the lens of a simple decomposition. Let us define $\boldsymbol{\Omega} = \{p(y_1, z), d(y_1, y_2, z), \ell(y_1, y_2, z), \varphi_0(z), \varphi_1(y_1, z)\}$ and $\boldsymbol{S} = \{S(y_1, z), S(y_1, y_2, z)\}$. We use these notations to define the expected surplus conditional on meeting, $\mathbb{E}(\boldsymbol{S}|\boldsymbol{\Omega})$, given by

$$\begin{aligned}\mathbb{E}(\boldsymbol{S}|\boldsymbol{\Omega}) = &\int\int p(y_1', z') S(y_1', z') \, dF_0(y_1') \, dG(z'|z) \frac{\varphi_0(z)}{\bar{\varphi}_0 + s_e\bar{\varphi}_1} dz \\ &+ \int\int\int (\ell(y_1', y_2', z') p(y_2', z') S(y_2', z') + (1 - \ell(y_1', y_2', z')) p(y_1', z') \\ &\times d(y_1', y_2', z') S(y_1', y_2', z')) \, dF_0(y_2') \, dF(y_1'|y_1) \, dG(z'|z) \frac{s_e\varphi_1(y_1, z)}{\bar{\varphi}_0 + s_e\bar{\varphi}_1} dy_1 dz. \end{aligned} \tag{33}$$

Next, we let v denote vacancies, and denote variables from the final steady-state equilibrium, viz. the equilibrium in 2015, with an upper tilde $(\tilde{.})$. We can decompose the change in vacancies from initial to final steady states using the following relation:

$$\begin{aligned}\tilde{v} - v = &\underbrace{((\tilde{\bar{\varphi}}_0 + s_e\tilde{\bar{\varphi}}_1) - (\bar{\varphi}_0 + s_e\bar{\varphi}_1))\theta}_{\substack{\text{meeting probability} \\ \text{(extensive search margin)}}} \\ &+ \underbrace{\left(\frac{\chi}{\kappa}\beta(1-\phi)\right)^{\frac{1}{\alpha}} \left(\mathbb{E}\left(\boldsymbol{S}|\tilde{\boldsymbol{\Omega}}\right)^{\frac{1}{\alpha}} - \mathbb{E}(\boldsymbol{S}|\boldsymbol{\Omega})^{\frac{1}{\alpha}}\right)(\tilde{\bar{\varphi}}_0 + s_e\tilde{\bar{\varphi}}_1)}_{\substack{\text{matching} \mid \text{meeting} \\ \text{(intensive search margin)}}} \\ &+ \underbrace{\left(\frac{\chi}{\kappa}\beta(1-\phi)\right)^{\frac{1}{\alpha}} \left(\mathbb{E}\left(\tilde{\boldsymbol{S}}|\tilde{\boldsymbol{\Omega}}\right)^{\frac{1}{\alpha}} - \mathbb{E}\left(\boldsymbol{S}|\tilde{\boldsymbol{\Omega}}\right)^{\frac{1}{\alpha}}\right)(\tilde{\bar{\varphi}}_0 + s_e\tilde{\bar{\varphi}}_1)}_{\substack{\text{surplus} \mid \text{matching} \\ \text{(changing job stability)}}}. \end{aligned} \tag{34}$$

The first term is the effect of ω_2 on the extensive margin of search. As ω_2 increases and deters workers from taking on second jobs, the number of single jobholders, and therefore the number of job seekers increases. Through the matching function, this generates a positive externality on the decision of firms to open more vacancies (as the probability of meeting a job seeker increases). The second term measures the effect of the intensive margin of search. Conditional on meeting a worker, there is a higher probability that this worker will give up her current job and accept the outside job offer if ω_2 is higher. Again, this margin is expected to contribute positively to vacancy creation. Third, the surplus of employment is lower when ω_2 increases. This is because any increase in a cost of employment relative to nonemployment lowers the match surplus. It is also straightforward to interpret this effect from the perspective of a firm that has been able to fill its vacant position. A higher ω_2 increases the probability that the worker accepts the outside job offers she will receive in the future, meaning that the duration of the filled position is shortened. We call this a reduction in job stability.

In Table 5, we quantify the impact of the rising costs of holding a second job on job creation. We evaluate the effects of increasing ω_2 both in 1995, when s_e was higher, and in 2015, when s_e had suffered a large decline. The last row in each panel of Table 5 reports the percent change in vacancies between the initial and final steady state. The other rows report the relative contribution of each of the three channels identified by Equation (34) to changes in vacancies.[29]

Three results stand out. First, the decline of multiple jobholding contributed to improving job creation efforts: the number of posted vacancies increases in all instances. The largest effect concerns male workers in the experiment based on the 2015 value of s_e, in which the number of vacancies increases by more than 6 percent in response to the change in the flow cost of working a second job. Second, the effect is positive because the extensive and intensive margins of search contribute positively and, combined, their impact is larger than the negative effect of reduced job stability. Third, a robust finding is that the intensive margin of search is the most important contributor to changes in job creation efforts. In fact, when we evaluate the role of increasing ω_2 at the 2015 value of s_e, the effects of the extensive search margin and reduced job stability cancel each other out, so that the improvement in vacancies is entirely driven by the intensive margin of search frictions. At any rate, the experiments indicate that

[29] In principle, the magnitude of the effects is not independent of the order in which the adjustments moving the economy from initial to final steady states are implemented. Meanwhile, in practice we find that the results are quantitatively similar when we change the order of the adjustments.

Table 5: Implications for search frictions

		Men		Women	
	Effects evaluated at s_e^{1995}	L	H	L	H
1	effect of meeting prob.	67.1	65.8	66.5	57.6
2	effect of matching | meeting	73.5	77.4	84.7	75.2
3	effect of surplus | matching	-40.6	-43.1	-51.2	-32.8
4	**% change in vacancies**	**4.58**	**4.33**	**2.62**	**2.72**
	Effects evaluated at s_e^{2015}	L	H	L	L
1	effect of meeting prob.	56.1	52.0	44.7	43.9
2	effect of matching | meeting	108.7	102.1	108.5	110.7
3	effect of surplus | matching	-64.8	-54.1	-53.3	-54.6
4	**% change in vacancies**	**6.12**	**6.73**	**3.43**	**3.22**

Notes: s_e^{1995}: on-the-job search efficiency in 1995; s_e^{2015}: on-the-job search efficiency in 2015. L and H indicate that the curvature parameter γ is set to match, respectively, low (0.30) and high (0.60) values of the Frisch elasticity of labor supply. All table entries are expressed in percent.

the increase in ω_2, driving the decline of multiple jobholding, contributed to reducing search frictions for workers.

6.3 Robustness and discussion

The results of this section are very robust to calibration choices. In calculations not reported here, we re-calibrate all parameter values to match data moments in 1995, re-run the experiments, and obtain results that are similar quantitatively to those presented in Tables 4 and 5. The same conclusion holds when data moments in 2015 are used to inform the calibration. More importantly, in our view, we find quantitatively similar results if we target a richer dynamics than that depicted in Figure 3. In Appendix C, we run the experiments of changing s_e and ω_2, as well as the technology parameter ψ, to match the joint changes of the job-to-job transition probability, the multiple jobholding share, and the share of workers bunching at full-time hours. That share has increased substantially over time – by more than 25 percent for both gender groups. According to our model, this implies a major shift in technology, as ψ must be increased by at least 70 percent in order to explain this evolution. Meanwhile, the orders of magnitude of changes in s_e and ω_2 remain in the same ballpark relative to Table 4. The implications of changes in ω_2 for search frictions remain positive, too. Vacancies increase by 6 to 8 percent among men and by 2 to 4 percent among women.

Dispersion over time vs. across space. In the experiments, we focus on the time variation of the multiple jobholding share. Section 2 points out two other sources of dispersion in multiple jobholding. One, multiple jobholding varies significantly by education and primary occupation of employment (Fact 6). Two, multiple jobholding decreases markedly with market size (Fact 7): the multiple jobholding share is typically higher by 1.5 percentage points in nonmetropolitan areas compared to metropolitan areas. We used our model to understand these differences. We re-calibrated its parameters by targeting data moments separately by area type. The model consistently attributes the bulk of the dispersion in multiple jobholding to the flow cost of working a second job ω_2. That is, a 12 percent higher ω_2 in metropolitan areas explains why these areas' multiple jobholding shares are lower than in nonmetropolitan areas. This lines up well with the results of Hirsch et al. [2017], who focused specifically on understanding the dispersion of multiple jobholding shares across cities. They write, "*Differences in industry and occupation structure, commute times, job churn rates, and ancestry patterns explain a significant share of the MJH variation across MSAs*" [Hirsch et al., 2017, p.27].

Interpreting changes in s_e and ω_2. To summarize, we uncover an internally coherent picture of changes of certain aggregate variables. Over the past two decades, the propensity of single jobholders to gain additional work opportunities has decreased, and the cost of working a second job has increased. The change in search effort is substantial: s_e dropped by almost one-half among men and by more than one-third among women. It seems more difficult to determine whether the change in the cost parameter ω_2 is large or not. In the next paragraphs, we draw on external information to provide observations that substantiate these findings.

There is a voluminous literature devoted to the decline in U.S. labor market dynamism. The Brookings paper by Molloy et al. [2016] provides a useful entry into that literature.[30] On the explanation side, the authors attribute much of the decline (measured by lower worker mobility) to a worsening of the distribution of outside job offers.[31] Our model agrees with this explanation. That is, s_e is exogenous in the model, but it is likely that with endogenous on-the-job search efforts, the increase in ω_2 over time would contribute to reducing s_e. Regarding the implications, Molloy et al. [2016] point out that the decline in U.S. labor market dynamism may have negative

[30]Relevant references that focus on the dynamics of job-to-job transitions in the U.S. labor market include Bjelland et al. [2011], Hyatt and McEntarfer [2012] and Hyatt and Spletzer [2013]. Decker et al. [2016] provide a useful overview that is indicative of several potential explanations.

[31]Davis and Haltiwanger [2014] analyze that an increasing share of employment is concentrated in occupations that require licensing, and that this could contribute to increasing the cost of occupational mobility. Molloy et al. [2016] find little support for this type of explanations.

consequences, such as a less efficient allocation of resources, but also positive effects coming from reduced uncertainty over one's labor market trajectory. Against this backdrop, our analysis makes a point that has so far been overlooked. Conditional on meeting an employed worker, there is a nonnegligible probability that this worker will opt for the multiple jobholding option. This has a negative impact on vacancy posting, as the worker manages to extract a higher wage from the outside employer. Thus, seen from this perspective, the reduction in s_e and increase in ω_2 may actually portend good news for labor market dynamism.

The finding that ω_2 has increased over time is challenging to interpret and explain, but it seems to dovetail with several empirical observations. A plausible interpretation is that this reflects a shift in the structure of employment (e.g. occupations or industries) toward primary jobs that provide *less* flexibility to workers. This observation is consistent with the increase in the share of workers at full-time hours that we described in the previous paragraphs; see Figure C1 in the appendix. This lower flexibility could be due to the increasing bargaining power of employers and/or changes in the organization of the work schedules within firms. We note, however, that this interpretation is not easy to reconcile with a major trend in the structure of U.S. employment – namely, the decline of the manufacturing sector. Jobs in this sector provide little flexibility in terms of hours, so the falling share of manufacturing employment implies that the average job in the final steady state must be associated with a lower ω_2.[32] Lower flexibility in terms of work scheduling could also be due to a spatial distribution of workers and jobs that has increased the costs of traveling between jobs. U.S. evidence shows that travel time for workers of both genders increased during the 1990s and 2000s; see Figure 3 in McKenzie and Rapino [2011]. Also, mean travel times to work are considerably longer in the largest metropolitan areas, where a large share of total employment is concentrated.

Another possible interpretation of the increase in ω_2 is that it captures changes in preferences over leisure, changes in leisure goods, or changes in the technology used to transform nonmarket time into goods (see Greenwood and Vandenbroucke [2008]). Aguiar and Hurst [2007] and Ramey and Francis [2009] have documented that time spent on market work has fallen secularly and that leisure time has increased over time.[33] The decrease in hours of market work is

[32] Lalé [2015] documents that workers whose primary industry of employment is in mining, construction, manufacturing, or transportation, are significantly less likely to hold a second job. However, the decline in multiple jobholding occurs within industries, so that composition effects coming from the changing structure of employment cannot explain the trend in aggregate data.

[33] The trends in leisure time in Aguiar and Hurst [2007] are different from those in Ramey and Francis [2009].

concentrated on men, but the increase in leisure time concerns both men and women. The numerical experiments seem to be consistent with this gender difference in that the increase in ω_2 is higher for male than for female workers. All in all, we think interpretations based on the changing structure of employment and changes in leisure-work preferences are likely to complement each other. For instance, some occupations are more stressful than others, some occupations are associated with positive nonpecuniary benefits, and so on. Fitting the model to match disaggregated data could provide additional insights into the interpretation of the cost parameter ω_2 and the source of its changes over time.

7 Conclusion

We developed a general equilibrium theory of multiple jobholding. This theory is quantitative, and so we used it to draw inferences about a number of key aggregate variables. We reached the following conclusions. First, in addition to the hours schedule of individuals (notably the distinction between full-time and part-time employment), accounting for the flow cost of working a second job is key to properly understand multiple jobholding. This cost is sizable by several metrics, and in all likelihood nonmonetary factors (e.g., disutility from work, preferences over amenities, etc.) are among the important underlying contributors. Second, search frictions explain little of the differences in multiple jobholding over time and across space. Search frictions are nevertheless important to draw inferences about the levels and changes in the costs of working a second job. Viewed through the lens of the model, the past two decades have witnessed a massive decline in on-the-job search effort and a significant increase in the costs of working a second job. Third, while some worry that these dynamics herald a less-flexible labor market, our model indicates that the increase in the cost of working a second job contributed to reducing search frictions. The improvements in job creation incentives are brought about by a positive impact on the aggregate meeting probability (due to a larger pool of job seekers) as well as the probability of job acceptance conditional on meeting.

The proposed theory opens up new opportunities for research. First, hours constraints are often identified by comparing the outcomes of specific regressions of total hours worked

It seems that this difference is mostly driven by the categorization of certain activities (for example: eating while in the workplace) into market versus nonmarket time.

on wages among single vs. multiple jobholders. This reduced-form approach is valid only under certain assumptions on both workers' preferences and the wage-hour setting protocol. It would be useful to revisit this approach through the lens of our structural model. Second, empirical research that looks at the effects of income taxation on hours worked finds very large differences in labor supply elasticities when measured using the primary or secondary job. The underlying reasons, which often remain unclear, hold different implications for tax policies, and in particular for whether secondary jobs should be tax exempted. The framework proposed here is suitable for investigating these effects in detail and deriving policy implications. We leave these and other applications for future research.

Appendices

A Model appendix

Appendix A.1 contains the proof of Proposition 1. Appendix A.2 presents the Bellman equations associated to $N(z)$, $E(y_1, z)$, $E(y_1, y_2, z)$, $J(y_1, z)$, $J_1(y_1, y_2, z)$, $J_2(y_1, y_2, z)$. It shows how to combine them with the policy functions from Proposition 1 and the surplus-sharing Equations (8) and (9) in order to arrive at Equations (20), (23) and (25). Appendix A.3 discusses a simple modification of the model that introduces a lower mass point in the distribution of hours worked.

A.1 Proof of Proposition 1

The first two policy functions, $p(y_1, z)$ and $d(y_1, y_2, z)$, are trivially related to joint match surpluses. We have

$$p(y_1, z) = \mathbb{1}\{J(y_1, z) \geq 0\} = \mathbb{1}\{(1-\phi) S(y_1, z) \geq 0\} = \mathbb{1}\{S(y_1, z) \geq 0\}$$

and

$$d(y_1, y_2, z) = \mathbb{1}\{E(y_1, y_2, z) \geq E(y_1, z)\} = \mathbb{1}\{\phi S(y_1, y_2, z) \geq 0\} = \mathbb{1}\{S(y_1, y_2, z) \geq 0\}.$$

Next, we look at

$$\begin{aligned}\ell(y_1, y_2, z) = \mathbb{1}\{\max\{E(y_2, z), N(z)\} \geq \max\{&E(y_1, z), E(y_1, z)\\ &+p(y_1, z)(E(y_1, y_2, z) - E(y_1, z)), N(z)\}\}.\end{aligned}$$

Subtracting $N(z)$ on both side of the inequality yields

$$\begin{aligned}\ell(y_1, y_2, z) = \mathbb{1}\{\max\{E(y_2, z) - N(z), 0\} \geq \max\{&E(y_1, z) - N(z), E(y_1, z)\\ &+p(y_1, z)(E(y_1, y_2, z) - E(y_1, z)) - N(z), 0\}\}.\end{aligned}$$

On the one hand, we have

$$\max\{E(y_2, z) - N(z), 0\} = \max\{\phi S(y_2, z), 0\} = p(y_2, z)\phi S(y_2, z).$$

On the other, $E(y_1, z) - N(z) = \phi S(y_1, z)$ and $E(y_1, y_2, z) - E(y_1, z) = \phi S(y_1, y_2, z)$, and thus we have

$$\begin{aligned}&\max\{E(y_1, z) - N(z), E(y_1, z) + p(y_1, z)(E(y_1, y_2, z) - E(y_1, z)) - N(z), 0\}\\ &\quad = \max\{\phi S(y_1, z), \phi(S(y_1, z) + p(y_1, z) S(y_1, y_2, z)), 0\}\\ &\quad = \max\{\max\{\phi S(y_1, z), \phi(S(y_1, z) + p(y_1, z) S(y_1, y_2, z))\}, 0\}\\ &\quad = \max\{\phi S(y_1, z) + \max\{0, p(y_1, z)\phi S(y_1, y_2, z)\}, 0\}\\ &\quad = \max\{\phi S(y_1, z) + p(y_1, z) d(y_1, y_2, z)\phi S(y_1, y_2, z), 0\}.\end{aligned}$$

If $S(y_1, z) \geq 0$ then $S(y_1, z) + p(y_1, z) d(y_1, y_2, z) S(y_1, y_2, z) \geq 0$, so that we also have

$$\begin{aligned}\max\{\phi S(y_1, z) + p(y_1, z) d(y_1, y_2, z)\phi S(y_1, y_2, z), 0\} = p(y_1, z)\phi(&S(y_1, z)\\ &+ d(y_1, y_2, z) S(y_1, y_2, z))\end{aligned}$$

and we arrive at

$$\ell\left(y_1, y_2, z\right) = \mathbb{1}\left\{p\left(y_2, z\right) S\left(y_2, z\right) \geq p\left(y_1, z\right)\left(S\left(y_1, z\right) + d\left(y_1, y_2, z\right) S\left(y_1, y_2, z\right)\right)\right\}.$$

A.2 Bellman equations

The asset value of a non-employed worker is

$$\begin{aligned} N\left(z\right) &= \beta \int \left(\left(1-\lambda_0\right) N\left(z'\right) + \lambda_0 \int \max\left\{E\left(y_1', z'\right), N\left(z'\right)\right\} dF_0\left(y_1'\right)\right) dG\left(z'|z\right) \\ &= \beta \int \left(N\left(z'\right) + \lambda_0 \int \max\left\{E\left(y_1', z'\right) - N\left(z'\right), 0\right\} dF_0\left(y_1'\right)\right) dG\left(z'|z\right) \end{aligned}$$

and since $E\left(y_1, z\right) - N\left(z\right) = \phi S\left(y_1, z\right)$, we have

$$\begin{aligned} N\left(z\right) &= \beta \int \left(N\left(z'\right) + \lambda_0 \int \max\left\{\phi S\left(y_1', z'\right), 0\right\} dF_0\left(y_1'\right)\right) dG\left(z'|z\right) \\ &= \beta \int \left(N\left(z'\right) + \lambda_0 \phi \int p\left(y_1', z'\right) S\left(y_1', z'\right) dF_0\left(y_1'\right)\right) dG\left(z'|z\right) \end{aligned}$$

using the policy function $p\left(y_1, z\right) = \mathbb{1}\left\{S\left(y_1, z\right) \geq 0\right\}$.

The asset value of a single jobholder is

$$\begin{aligned} E\left(y_1, z\right) &= w\left(y_1, z\right) - \omega_1 + zg\left(1 - h\left(y_1, z\right)\right) + \beta \int \Bigg(\left(1-\lambda_1\right) \int \max\Big\{E\left(y_1', z'\right), \\ &\quad N\left(z'\right)\Big\} dF\left(y_1'|y_1\right) + \lambda_1 \int\int \max\Big\{E\left(y_1', z'\right) + p\left(y_1', z'\right)\left(E\left(y_1', y_2', z'\right) - E\left(y_1', z'\right)\right), \\ &\quad E\left(y_1', z'\right), E\left(y_2', z'\right), N\left(z'\right)\Big\} dF_0\left(y_2'\right) dF\left(y_1'|y_1\right)\Bigg) dG\left(z'|z\right) \\ &= w\left(y_1, z\right) - \omega_1 + zg\left(1 - h\left(y_1, z\right)\right) + \beta \int \Bigg(N\left(z'\right) + \left(1-\lambda_1\right) \int \max\Big\{E\left(y_1', z'\right) \\ &\quad - N\left(z'\right), 0\Big\} dF\left(y_1'|y_1\right) + \lambda_1 \int\int \max\Big\{E\left(y_1', z'\right) + p\left(y_1', z'\right)\left(E\left(y_1', y_2', z'\right) - E\left(y_1', z'\right)\right) \\ &\quad - N\left(z'\right), E\left(y_1', z'\right) - N\left(z'\right), E\left(y_2', z'\right) - N\left(z'\right), 0\Big\} dF_0\left(y_2'\right) dF\left(y_1'|y_1\right)\Bigg) dG\left(z'|z\right). \end{aligned}$$

Since $E\left(y_1, z\right) - N\left(z\right) = \phi S\left(y_1, z\right)$ and $E\left(y_1, y_2, z\right) - E\left(y_1, z\right) = \phi S\left(y_1, y_2, z\right)$ via the surplus-sharing Equations (8) and (9), it follows that

$$\begin{aligned} E\left(y_1, z\right) &= w\left(y_1, z\right) - \omega_1 + zg\left(1 - h\left(y_1, z\right)\right) + \beta \int \Bigg(N\left(z'\right) + \left(1-\lambda_1\right) \\ &\quad \times \int \max\left\{\phi S\left(y_1', z'\right), 0\right\} dF\left(y_1'|y_1\right) + \lambda_1 \int\int \max\Big\{\phi\left(S\left(y_1, z\right) + p\left(y_1, z\right) S\left(y_1, y_2, z\right)\right), \\ &\quad \phi S\left(y_1', z'\right), \phi S\left(y_2', z'\right), 0\Big\} dF_0\left(y_2'\right) dF\left(y_1'|y_1\right)\Bigg) dG\left(z'|z\right). \end{aligned}$$

Last, using the policy functions and results from Appendix A.1 we obtain

$$E(y_1,z) = w(y_1,z) - \omega_1 + zg(1-h(y_1,z)) + \beta \int \Bigg(N(z') + (1-\lambda_1) \int \phi p(y_1',z')$$
$$\times S(y_1',z')\, dF(y_1'|y_1) + \lambda_1 \int \int \phi\left(\ell(y_1',y_2',z')\, p(y_2',z')\, S(y_2',z') + (1-\ell(y_1',y_2',z'))\right.$$
$$\left. \times p(y_1',z')\left(S(y_1',z') + d(y_1',y_2',z')\, S(y_1',y_2',z')\right)\right) dF_0(y_2')\, dF(y_1'|y_1) \Bigg)\, dG(z'|z)$$

given that: if $\ell(y_1,y_2,z) = 1$, then the worker receives $\phi S(y_2,z)$ if $p(y_2,z) = 1$; and if $\ell(y_1,y_2,z) = 0$ and $p(y_1,z) = 1$, the worker receives $\phi S(y_1,z)$ and in addition she receives $\phi S(y_1,y_2,z)$ if $d(y_1,y_2,z) = 1$.

The asset value of a multiple jobholder is

$$\begin{aligned}
E(y_1,y_2,z) &= w(y_1,z) - \omega_1 + w(y_1,y_2,z) - \omega_2 + zg(1-h(y_1,z) - h(y_1,y_2,z)) \\
&+ \beta \int \Bigg(\left(\left(\int (1-p(y_1',z'))\, dF(y_1'|y_1)\right) \int \max\{E(y_2',z'), N(z')\}\, dF(y_2'|y_2)\right. \\
&+ \int\int \left(p(y_1',z')\left(E(y_1',z') + d(y_1',y_2',z')\left(E(y_1',y_2',z')\right.\right.\right. \\
&\left.\left.\left. - E(y_1',z')\right)\right)\right) dF(y_2'|y_2)\, dF(y_1'|y_1) \Bigg)\, dG(z'|z) \\
&= w(y_1,z) - \omega_1 + w(y_1,y_2,z) - \omega_2 + zg(1-h(y_1,z) - h(y_1,y_2,z)) \\
&+ \beta \int \Bigg(N(z') + \left(\int (1-p(y_1',z'))\, dF(y_1'|y_1)\right) \int \max\{E(y_2',z') - N(z') \\
&, 0\}\, dF(y_2'|y_2) + \int\int \left(p(y_1',z')\left(E(y_1',z') - N(z') + d(y_1',y_2',z')\left(E(y_1',y_2',z')\right.\right.\right. \\
&\left.\left.\left. - E(y_1',z')\right)\right)\right) dF(y_2'|y_2)\, dF(y_1'|y_1) \Bigg)\, dG(z'|z)
\end{aligned}$$

where we have made use directly of the policy functions $p(y_1,z)$ and $d(y_1,y_2,z)$. Surplus sharing and making use of $p(y_2,z)$ for the second job yields

$$\begin{aligned}
E(y_1,y_2,z) &= w(y_1,z) - \omega_1 + w(y_1,y_2,z) - \omega_2 + zg(1-h(y_1,z) - h(y_1,y_2,z)) \\
&+ \beta \int \Bigg(N(z') + \left(\int (1-p(y_1',z'))\, dF(y_1'|y_1)\right) \int \max\{\phi S(y_2',z'), 0\}\, dF(y_2'|y_2) \\
&\qquad + \int\int \left(p(y_1',z')\left(\phi S(y_1',z') + d(y_1',y_2',z')\right.\right. \\
&\qquad \left.\left. \times \phi S(y_1',y_2',z')\right)\right) dF(y_2'|y_2)\, dF(y_1'|y_1) \Bigg)\, dG(z'|z) \\
&= w(y_1,z) - \omega_1 + w(y_1,y_2,z) - \omega_2 + zg(1-h(y_1,z) - h(y_1,y_2,z)) \\
&+ \beta \int \Bigg(N(z') + \left(\int (1-p(y_1',z'))\, dF(y_1'|y_1)\right) \int \phi p(y_2',z')\, S(y_2',z')\, dF(y_2'|y_2) \\
&+ \int\int \left(\phi p(y_1',z')\left(S(y_1',z') + d(y_1',y_2',z')\, S(y_1',y_2',z')\right)\right) dF(y_2'|y_2)\, dF(y_1'|y_1) \Bigg)\, dG(z'|z)\,.
\end{aligned}$$

Next, the asset value of employing a single jobholder is

$$
\begin{aligned}
J(y_1,z) = {} & y_1 f(h(y_1,z)) - w(y_1,z) + \beta \int \Bigg(\lambda_1 \int\int ((1-\ell(y_1',y_2',z'))\, p(y_1',z') \\
& \times ((1-d(y_1',y_2',z'))\, J(y_1',z') + d(y_1',y_2',z')\, J_1(y_1',y_2',z')))\, dF_0(y_2')\, dF(y_1'|y_1) \\
& + (1-\lambda_1) \int \max\{J(y_1',z'),0\}\, dF(y_1'|y_1) \Bigg) dG(z'|z) \\
= {} & y_1 f(h(y_1,z)) - w(y_1,z) + \beta \int \Bigg(\lambda_1 \int\int ((1-\ell(y_1',y_2',z'))\, p(y_1',z') \\
& \times (J(y_1',z') + d(y_1',y_2',z')(J_1(y_1',y_2',z') - J(y_1',z'))))\, dF_0(y_2')\, dF(y_1'|y_1) \\
& + (1-\lambda_1) \int \max\{J(y_1',z'),0\}\, dF(y_1'|y_1) \Bigg) dG(z'|z)
\end{aligned}
$$

where, again, we have made direct use of the policy functions $p(y_1,z)$ and $d(y_1,y_2,z)$ to simplify notations. Notice that $p(y_1,z)$ multiplies $J_1(y_1,y_2,z)$ in the above as the participation of the primary employer must be ensured. With the surplus sharing rule, we arrive at

$$
\begin{aligned}
J(y_1,z) = {} & y_1 f(h(y_1,z)) - w(y_1,z) + \beta \int \Bigg(\lambda_1 \int\int ((1-\ell(y_1',y_2',z'))\, p(y_1',z') \\
& \times ((1-\phi)\, S(y_1',z') + d(y_1',y_2',z')(J_1(y_1',y_2',z') - (1-\phi)\, S(y_1',z'))))\, dF_0(y_2')\, dF(y_1'|y_1) \\
& + (1-\lambda_1) \int (1-\phi)\, p(y_1',z')\, S(y_1',z')\, dF(y_1'|y_1) \Bigg) dG(z'|z).
\end{aligned}
$$

In order to write the asset value of the primary employer, recall that the value in the continuation period depends on $d(y_1,y_2,z)$, the worker's decision to keep the second job, and on the constraint that the job remains viable captured by $p(y_1,z)$. Thus, the asset value of the primary employer is

$$
\begin{aligned}
J_1(y_1,y_2,z) = {} & y_1 f(h(y_1,z)) - w(y_1,z) + \beta \int\int\int (d(y_1',y_2',z')\, p(y_1',z')\, J_1(y_1,y_2,z) \\
& + (1-d(y_1',y_2',z')) \max\{J(y_1',z'),0\})\, dF(y_2'|y_2)\, dF(y_1'|y_1)\, dG(z'|z) \\
= {} & y_1 f(h(y_1,z)) - w(y_1,z) + \beta \int\int p(y_1',z') \Bigg((1-\phi)\, S(y_1',z') + \int (d(y_1',y_2',z') \\
& \times (J_1(y_1',y_2',z') - (1-\phi)\, S(y_1',z'))\, dF(y_2'|y_2) \Bigg) dF(y_1'|y_1)\, dG(z'|z).
\end{aligned}
$$

The last equation uses the surplus sharing rule, and so we arrive at equation (25).

Last, the asset value of being the secondary employer of a multiple jobholder is

$$
\begin{aligned}
J_2(y_1,y_2,z) = {} & y_2 f(h(y_1,y_2,z)) - w(y_1,y_2,z) + \beta \int \Bigg(\int\int (d(y_1',y_2',z')\, p(y_1',z') \\
& \times \max\{J_2(y_1',y_2',z'),0\})\, dF(y_2'|y_2)\, dF(y_1'|y_1) + \left(\int (1-p(y_1',z'))\, dF(y_1'|y_1) \right) \\
& \times \left(\int \max\{J(y_2',z'),0\}\, dF(y_2'|y_2) \right) \Bigg) dG(z'|z),
\end{aligned}
$$

taking account of the workers' commitment $p(y_1,z) = \mathbb{1}\{J(y_1',z') \geq 0\}$ towards her primary employer. Therefore we have

$$
\begin{aligned}
J_2(y_1,y_2,z) = {} & y_2 f(h(y_1,y_2,z)) - w(y_1,y_2,z) + \beta \int \left(\int \int (d(y_1',y_2',z')\, p(y_1',z') \right. \\
& \times \max\{(1-\phi) S(y_1',y_2',z'),0\})\, dF(y_2'|y_2)\, dF(y_1'|y_1) + \left(\int (1-p(y_1',z'))\, dF(y_1'|y_1) \right) \\
& \left. \times \left(\int \max\{(1-\phi) S(y_2',z'),0\}\, dF(y_2'|y_2) \right) \right) dG(z'|z) \\
= {} & y_2 f(h(y_1,y_2,z)) - w(y_1,y_2,z) + \beta \int \left(\int \int (d(y_1',y_2',z')\, p(y_1',z') \right. \\
& \times (1-\phi) S(y_1',y_2',z')\, dF(y_2'|y_2)\, dF(y_1'|y_1) + \left(\int (1-p(y_1',z'))\, dF(y_1'|y_1) \right) \\
& \left. \times \left(\int p(y_1',z') (1-\phi) S(y_2',z')\, dF(y_2'|y_2) \right) \right) dG(z'|z).
\end{aligned}
$$

Here, we have used the policy functions from Proposition 1 and the surplus sharing equations. In particular, observe that $d(y_1',y_2',z') \max\{J_2(y_1',y_2',z'),0\} = d(y_1',y_2',z') J_2(y_1',y_2',z')$ since $d(y_1',y_2',z') = \mathbb{1}\{S(y_1',y_2',z') \geq 0\} = \mathbb{1}\{J_2(y_1',y_2',z') \geq 0\}$.

To complete the derivation, add up the last equations we have obtained for $E(y_1,z)$ and $J(y_1,z)$ and subtract $N(z)$ in order to arrive at Equation (20) ($S(y_1,z)$). Similarly, add up the last equations we have obtained for $E(y_1,y_2,z)$ and $J_2(y_1,y_2,z)$ and subtract $E(y_1,z) = \phi S(y_1,z) + N(z)$ to arrive at Equation (23) ($S(y_1,y_2,z)$). Finally, to recover the wage functions, rearrange the last equation we have obtained for $J(y_1,z)$ and $J_2(y_1,y_2,z)$ to compute $w(y_1,z)$ and $w(y_1,y_2,z)$. In these calculations, use $J(y_1,z) = (1-\phi) S(y_1,z)$ and $J_2(y_1,y_2,z) = (1-\phi) S(y_1,y_2,z)$ on the left-hand side of each equation.

A.3 Lower hours threshold

In the model, the discontinuous mapping from hours worked onto labor services is motivated by the empirical observation that a very large share of individuals report the same number of hours worked amounting to 172 hours per month. A closer look at the data reveals that there are also some significant mass points at lower hours (see, for instance, the online appendix of Borowczyk-Martins and Lalé [2019]). It is straightforward to amend the model to explain this additional feature of the distribution of hours worked, by introducing a lower (or minimum) hours requirement in the labor service function. Instead of functional form (4), we postulate the following piecewise linear function with three bends:

$$
f(h_t) = \begin{cases} 0 & \text{if } h_t < \underline{h} \\ (1-\psi) h_t & \text{if } \underline{h} \leq h_t < \bar{h} \\ (1-\psi) h_t + \psi & \text{if } h_t \geq \bar{h} \end{cases}.
$$

$\underline{h}$ denotes the exogenous lower amount of hours required to obtain positive labor services. Under this specification, we obtain two thresholds on match productivity conditional on z. The first threshold, which is trivial to work out, is the level of match productivity $y_{\underline{h}}(z)$ such that $y_{\underline{h}}(z) f(\underline{h}) + zg(1-\underline{h}) = y_{\underline{h}}(z) f(0) + zg(1) = 0$. Solving this equation, we obtain

$$
y_{\underline{h}}(z) = \frac{1}{(1-\psi)\underline{h}} \frac{(1-\underline{h})^{1-\frac{1}{\gamma}} - 1}{\frac{1}{\gamma} - 1} z.
$$

The other threshold, $y_{\bar{h}}(z)$, is equal to the threshold $y_{\bar{h}}(z)$ defined by Equation (10). The hours schedule we obtain is

$$h(y_1, z) = \begin{cases} 0 & \text{if } y < y_{\underline{h}}(z) \\ \overline{h} & \text{if } y_{\underline{h}}(z) \leq y < y_{\bar{h}}(z) \\ 1 - \left(\frac{z}{(1-\psi) y_1}\right)^{\gamma} & \text{if } y_{\underline{h}}(z) \leq y < y_{\underline{h}}(z) \text{ or } y \geq y_{\bar{h}}(z) \end{cases}.$$

A threshold $y_{\underline{h}}(y_1, z)$ can be calculated in a similar fashion to amend the hours schedule of multiple jobholders, $h(y_1, y_2, z)$.

B Data appendix

Data. The data used to inform the calibration and experiments come from the monthly files of the Current Population Survey (CPS). The CPS is a survey of households administered by the U.S. Census Bureau under the auspices of the U.S. Bureau of Labor Statistics. Since January 1994, the CPS has been collecting information which allow to identify multiple jobholders. The survey asks respondents about the number of jobs held during the reference week, whether they usually receive a wage or salary from the primary job, and collects information on hours worked for up to two jobs. Starting in January 1994, the CPS also measures whether individuals change employers from one month to the next.

CPS respondents are interviewed for four consecutive months, are rotated out of the survey for eight months, and are included in the survey again for four consecutive months. As a result, in each monthly file of the CPS, about three-quarters of respondents were already in the sample in the previous month. We use this feature to match individuals from the non-outgoing groups so as to measure gross labor market flows and construct transition probabilities. Throughout the analysis, we focus on workers aged 25 to 54 years old.

Framework. We use a stock-flow framework to compute transitions in and out of multiple jobholding. In each period t, individuals are classified into one of the following states: multiple jobholding with a full-time primary job (F_M), multiple jobholding with a part-time primary job (P_M), single jobholding with a full-time job (F_S), single jobholding with a part-time job (P_S), and nonemployment (N). We let the vector $\boldsymbol{s}_t$ contain the number of individuals (stocks) in each of these states:

$$\boldsymbol{s}_t = [\underbrace{F_M \quad P_M}_{M} \underbrace{F_S \quad P_S}_{S} \quad N]'_t,$$

where $M = F_M + P_M$ (resp. $S = F_S + P_S$) is the number of multiple jobholders (resp. single jobholders) in period t. As is standard, the evolution of $\boldsymbol{s}_t$ is described by means of a discrete-time, first-order Markov chain:

$$\boldsymbol{s}_t = \boldsymbol{\Pi}_t \boldsymbol{s}_{t-1}.$$

In this equation, $\boldsymbol{\Pi}_t$ is the stochastic matrix of transition probabilities across labor market states i and j. Each of these transition probabilities is measured by the gross flow of workers from state i to state j at time t divided by the stock of workers in state i at time $t-1$. We clear transition probabilities from several measurement issues: we adjust them to control for systematic seasonal variations, margin error discrepancies and time-aggregation bias (see Lalé [2016] for details about these adjustments).

C Additional results

In this appendix, we provide additional results summarized in Subsection 6.3 of the text. We inform the model using a richer dynamic, by allowing the *triplet* (s_e, ψ, ω_2) to vary over time. To calibrate s_e, ψ, ω_2, we target the joint behavior of the following time series: the job-to-job transition probability, the mass point in the hours distribution of workers bunching at full-time hours, and the multiple jobholding share. The solid lines in Figure C1 present the dynamics of these time series, and the dotted lines show their model counterparts. Table C1 is the analogue of Table 4 of the main text. The table reports the joint changes in s_e, ψ, ω_2 implied by Figure C1. It also reports results from three counterfactual calculations illustrating the role of each parameter. In Table C2, we re-run the experiments measuring the implications of the increase of ω_2 for vacancy posting. For simplicity, we evaluate the effects at the 1995 value of the bundle (s_e, ψ) and at the 2015 value of (s_e, ψ). The results shown in Tables C1 and C2 are much in line with the baseline results.

Table C1: Source of changes in multiple jobholding: Additional results

		Men			Women		
	Changes in s_e, ψ and ω_2	Data	*L*	*H*	Data	*L*	*H*
1	**% change in s_e**		**-51.4**	**-52.7**		**-39.5**	**-38.8**
2	**% change in ψ**		**119.0**	**98.6**		**76.0**	**70.2**
3	**% change in ω_2**		**18.5**	**17.9**		**6.24**	**7.81**
4	*E* to *E* trans. prob.	-35.3	-35.4	-35.2	-28.5	-28.4	-28.8
5	share at full-time hours	28.4	28.6	28.5	25.1	25.0	25.0
6	MJH share	-32.6	-32.6	-32.6	-19.6	-20.4	-19.8
	Changes in s_e		*L*	*H*		*L*	*H*
1	*E* to *E* trans. prob.	–	-42.3	-43.4	–	-31.4	-32.6
2	share at full-time hours	–	0.59	0.40	–	-0.36	0.29
3	MJH share	–	5.11	3.58	–	-1.12	1.25
	Changes in ψ		*L*	*H*		*L*	*H*
1	*E* to *E* trans. prob.	–	3.96	5.93	–	0.55	1.39
2	share at full-time hours	–	27.6	24.9	–	24.5	23.7
3	MJH share	–	12.9	15.1	–	4.95	5.77
	Changes in ω_2		*L*	*H*		*L*	*H*
1	*E* to *E* trans. prob.	–	1.40	2.23	–	1.08	0.71
2	share at full-time hours	–	1.24	1.11	–	0.25	0.51
3	MJH share	–	-53.8	-53.8	–	-20.2	-24.8

Notes: Data moments are computed from the monthly files of the Current Population Survey and refer to differences in averages between years 1995 and 2015. s_e: on-the-job search efficiency; ψ: productivity gap at $\bar{h}$ hours; ω_2: cost of working job 2; E: employment; MJH: multiple jobholding. L and H indicate that the curvature parameter γ is set to match, respectively, low (0.30) and high (0.60) values of the Frisch elasticity of labor supply. All table entries are expressed in percent.

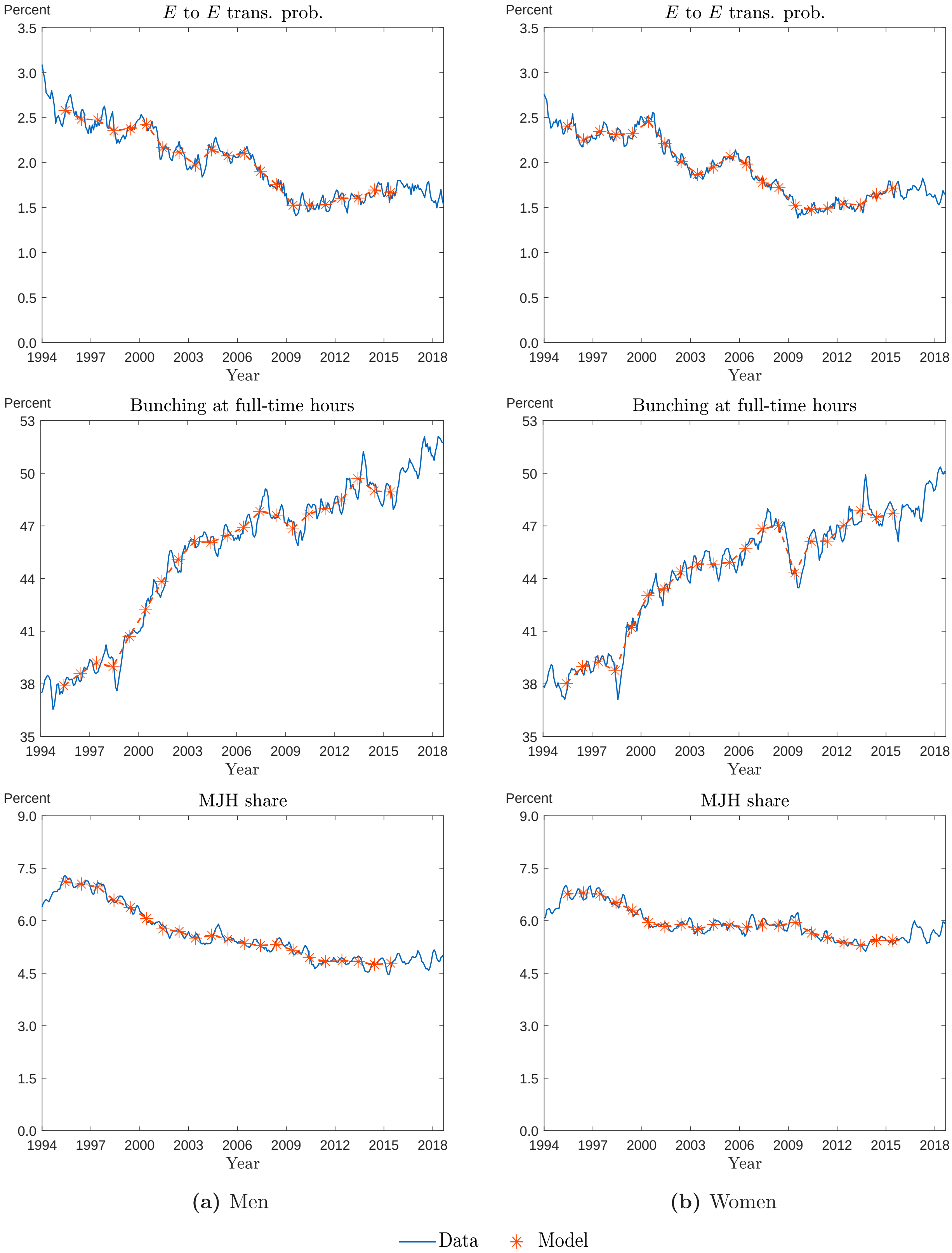


Figure C1: Targeted data and model-generated moments

Notes: Data moments are computed from the monthly files of the Current Population Survey over the years 1994 to 2018. Both for men and women, the model-generated moments are based on the calibration using an intermediate value for the curvature parameter γ. E: employment; MJH: multiple jobholding.

Table C2: Implications for search frictions: Additional results

		Men		Women	
	Effects evaluated at s_e^{1995} and ψ^{1995}	L	H	L	H
1	effect of meeting prob.	63.2	61.9	65.4	71.8
2	effect of matching | meeting	76.6	80.3	77.2	72.9
3	effect of surplus | matching	-39.8	-42.3	-42.6	-44.8
4	**% change in vacancies**	**6.35**	**6.48**	**2.21**	**2.49**
	Effects evaluated at s_e^{2015} and ψ^{2015}	L	H	L	L
1	effect of meeting prob.	52.4	54.4	47.2	44.6
2	effect of matching | meeting	103.1	106.6	113.7	104.1
3	effect of surplus | matching	-55.6	-61.0	-61.0	-48.7
4	**% change in vacancies**	**8.07**	**7.50**	**3.35**	**4.85**

Notes: s_e^{1995}: on-the-job search efficiency in 1995; ψ^{1995}: productivity gap at full-time hours in 1995; s_e^{2015}: on-the-job search efficiency in 2015; ψ^{2015}: productivity gap at full-time hours in 2015. L and H indicate that the curvature parameter γ is set to match, respectively, low (0.30) and high (0.60) values of the Frisch elasticity of labor supply. All table entries are expressed in percent.

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