

The Effect of Job Flexibility on Female Labor Market Outcomes: Estimates from a Search and Bargaining Model[‡]

Luca Flabbi[§]
Georgetown University

Andrea Moro[¶]
Vanderbilt University

October 27, 2010

Abstract

In this article we estimate the parameters of a search model of the labor market where jobs are characterized by wages and work-hours flexibility. Flexibility is valued by workers and is costly to provide by employers. We show that parameters are empirically identified because the theoretical wage distribution of flexible and non-flexible jobs is directly related to the preference for flexibility parameters. Estimation results show that more than one third of the women place positive value to flexibility. Women with a college degree value flexibility more than women with a only a high school degree. Counterfactual experiments show that flexibility has a substantial impact on the wage distribution but not on the unemployment rate. These results suggest that wage and schooling differences between males and females may be importantly related to flexibility.

1 Introduction

Anecdotal and descriptive evidence suggests that work hours' flexibility, such as the possibility of working part-time or choosing when to work during the day is a job amenity particularly favored by women when interviewed about job conditions.¹ On average women

[‡]We would like to thank the editor, two anonymous referees, conference participants at the 2010 SITE Conference on Women and the Economy (Stanford, CA), the 2009 IZA Conference on Labor Market Policy Evaluation (Washington, DC), the 2007 Conference on Auctions and Games (Blackburg, VA) and seminar participants at Bocconi University (Milan, Italy), Collegio Carlo Alberto (Turin, Italy) for many useful comments.

[§]Department of Economics, Georgetown University and IZA, lf74@georgetown.edu.

[¶]Department of Economics, Vanderbilt University, andrea@andreamoro.net

¹See for example Scandura and Lankau 1997.

spend more time in home production and child-rearing and less in the labor market.² In this paper we measure women's preference for job flexibility and its effects on labor market outcomes by estimating the parameters of a search and matching model of the labor market with wage bargaining. We show how preferences for flexibility affect labor market participation and the shape of the accepted wage distribution. Finally, we assess the desirability and welfare implications of policies favoring job flexibility.

We describe the model in Section 3. Jobs can be flexible or not, and flexible jobs are more expensive to provide.³ Workers have preferences over wages and flexibility, and meet with firms to bargain over these dimensions. Wage heterogeneity arises exogenously as a result of idiosyncratic match-specific productivity and heterogeneity in preferences for flexibility, and endogenously as a result of the bargaining process. We show that because of search frictions, the wage differential between flexible and non-flexible jobs is not a pure compensating differential.⁴

In Section 4 we discuss the identification of the model parameters with data on wages and job flexibility. The model predicts wage distributions for flexible and non-flexible jobs. The bargaining of workers and firms over wages and flexibility options generates equilibrium wage schedules that are functions of the match-specific productivity, the outside option and the flexibility regime. Given the preference for flexibility, the two wage distributions have non-overlapping support, and the size of the gap is measured by the monetary value of the preference for flexibility, which is equivalent to the compensating wage differential paid to the worker that marginally rejects a flexible job over a non-flexible job. The higher the preference for flexibility, the wider is the support of the wage distribution of flexible jobs and the larger is the discontinuity between the wage distribution at flexible and non-flexible jobs. The firms' cost of providing flexibility is also identified, because, at given preferences, a higher cost implies fewer flexible jobs in equilibrium.

We describe the data in Section 5. Working hours' flexibility includes both the possibility of working fewer hours and the option of organizing the working hours in a flexible way at same amount of total hours worked. Some papers focus on the first type of flexibility by

²For example, using recent Current Population Survey data we find that more than 20% of women with a college degree work less than 30 hours per week while only 1.6% of men in the same demographic group do so. Women also generally choose more flexible working schedule (Golden 2001). Using data from the American Time Use Survey 2008 we found that women spend approximately 60% more time in family related activity during the work day than men do.

³This cost can be justified on the grounds that flexibility makes it more difficult to coordinate workers, or may require the hiring of a higher number of workers, which implies greater search and training costs.

⁴It is a compensating differential only for the marginal worker that is indifferent between a flexible and a non-flexible job.

studying part-time work and hours-wage trade-offs.⁵ Data limitations make it difficult to study the second type of flexibility. While our model and estimation method apply to a general definition of flexibility, the data we use in the empirical application are standard and force us to approximate flexible jobs as a part-time jobs. In the empirical implementation, we define a job as flexible when the worker provides less than 35 hours of work per week.

Section 6 describes our estimation strategy. We estimate the model using a simulated method of moments to minimize a loss function that includes several moments of the wage distributions of flexible and non-flexible jobs and of unemployment durations. Our estimates, presented in Section 7, fit the data very well. Results show that flexibility is important to women. Approximately 37 percent of college-educated women have a positive preference for flexible jobs valuing them between 1 and 10 cents per hour, but only about 20 percent of them choose such jobs in equilibrium. The value of flexibility for women with at most a high school degree is estimated to be equal or lower than 2.5 cents per hour.

Estimating a structural model of the labor market on a representative sample of U.S. individuals allows us to evaluate some relevant policy interventions, which we present in Section 8. We assess the welfare effects of the simple presence of the flexibility option by comparing our estimated model with an environment where flexibility is not available. Next, we analyze policies that reduce the cost of providing flexibility. Taking into account equilibrium effects in these comparisons is crucial because the experiments imply that some individuals observed in flexible jobs might decide to work in non-flexible jobs if flexibility is not available, whereas some might decide to remain unemployed: the preferences and the productivities of these workers are relevant to assess the overall labor market impact of each policy. Search frictions and preferences over job amenities also imply that policy intervention may be welfare improving because the compensating differentials mechanism is only partially at work.⁶

The experiments suggest that there is a substantial impact of flexibility on the accepted wage distribution. However, the impact on overall welfare and unemployment is limited. This has an interesting policy implication. If the policy objective is to have an impact on the wage structure but not on welfare - for example because the policy maker wants to reduce the gender wage gap - then policies aimed at reducing the cost of the provision of flexibility could be particularly effective.

⁵See for example Altnoji and Paxson (1988) and Blank (1990).

⁶Hwang, Mortensen and Reed (1998) and Lang and Majumdar (2004) prove this argument formally.

2 The existing literature and our contribution

There is a vast literature that estimates the marginal willingness to pay for job attributes using hedonic wage regressions.⁷ Various authors have recognized the limitation of the static labor market equilibrium that provides the foundation for this approach. One alternative approach, the use of dynamic hedonic price models (see e.g. Topel 1986), maintains the static framework assumption of a unique wage at each labor market for given observables.

However, if there are any frictions that may make the market not competitive, hedonic wage regressions produce biased estimates. The bias arises for two reasons. First, flexibility is a choice, therefore a selection bias may arise if we do not observe the wage that workers choosing flexible jobs would receive had they chosen a different type of job. This bias could be identified by observing the wage pattern of workers that choose different flexibility regimes over their career. This approach is problematic because there are few workers that change their flexibility regime over their life time. Moreover, it is crucial in this approach to control appropriately for job market experience, but it is difficult to do so if experience is a choice that is affected in part by preferences for flexibility. Our approach is to model the selection so that parameters can be identified by the entire shape of the distributions of wages and unemployment durations.

The second type of bias arises because in hedonic wage models the compensating differential mechanism is working perfectly so that the conditional wage differential is a direct result of preferences. Hwang, Mortensen and Reed (1998) develop a search model of the labor market showing how frictions interfering with the perfect working of a compensating differential mechanism may bias estimates from an hedonic wage model⁸. The bias may be so severe that the estimated willingness to pay for a job amenity may have the opposite sign than the true one. The intuition is as follows. In an hedonic wage model a job amenity is estimated to convey positive utility only if the conditional mean wage of individuals at job with amenity is lower than the conditional mean of individuals without the job amenity. However, in presence of on-the-job search and wage posting, firms may gain positive profit by offering both a higher wage and the job amenity because doing so will reduce workers turnover. The presence of the job amenity affects the entire wage distribution, which also

⁷Rosen (1974) provides one of the first and most influential treatment of the issue; See Rosen (1986) for a more recent survey.

⁸Usui (2006) is an application to hours worked that confirm their results. Lang and Majumdar 2004 obtain a similar result in a nonsequential search environment. Gronberg and Reed (1994) study the marginal willingness to pay for job attributes estimating a partial equilibrium job search model on jobs durations. Differently from us, they do not use flexibility or hours worked among the job attributes and they do not attempt to fit the wage distribution.

depends on the value of the outside option. The observed wage distribution may then exhibit a positive correlation between wages and job amenity even if workers are willing to pay for it. In our model, we obtain a similar outcome without on-the-job search but as a result of bargaining: when workers and employers meet, they observe a match-specific productivity draw and then engage in bargaining over wages and job amenities. The relationship between productivity and wages depends on preferences for the job amenity in two ways: directly (the compensating differential mechanism) and indirectly through the value of the outside option (the bargaining mechanism).

Hence, despite exploiting a similar intuition as in Hwang, Mortensen and Reed (1998) for solving the hedonic models bias, our model is different with respect to the wage determination since we assume wage bargaining instead of wage posting.

The estimation of the impact of part-time or more generally of hours-wage trade-offs using hedonic wage models has been extensively studied. Moffitt (1984) is a classic example that provides estimates of a joint wage-hours labor supply model. Altonji and Paxson (1988) focus on labor market with tied hours-wage packages concluding that workers need additional compensation to accept unattractive working hours. Blank (1990) estimates large wage penalties for working part-time using Current Population Survey data but suggests that selection into part-time is significant and that the estimates are not very robust.

There exist very few attempts at estimating models with frictions capable of recovering preferences. Blau (1991) is one of the first contributions. He estimates a search model where utility depends both on earnings and on weekly hours worked. The main focus is on testing the reservation wage hypothesis and not on estimating the marginal willingness to pay for job amenities. Bloemen (2008) estimates a search model with similar preferences. He concludes that the reservation wage significantly increases for weekly hours above 50 and decreases in the 20 to 30 hours range. Both Blau and Bloemen's contributions assume that firms post joint wage-hours offers. This approach is different from ours because we allow individuals to bargain over wages and flexibility. In addition, we estimate the firms' cost in providing flexibility. The focus of their policy experiments is also different because we look at the impact of flexibility on labor market outcomes while Blau tests for the reservation wage property and Bloemen for the difference between desired and actual hours worked.

Methodologically, our paper is related to papers that estimate search and matching models with bargaining, which are a tractable version of partial equilibrium job search models allowing for a wider range of equilibrium effects once major policy or structural changes are introduced.⁹ We extend the standard model in this class by including preferences for a

⁹See Eckstein and van den Berg (2007) for a survey. Models in this class have been estimated to study

job amenity. A similar feature was implemented by Dey and Flinn (2005) who estimated preferences for health insurance. Our model differs from theirs because the provision of the job amenity is endogenously determined and can be used strategically within the bargaining process.

3 The Model

3.1 Environment

We consider a search model in continuous time with each job characterized by (w, h) where w is wage and h is an additional amenity attached to the job. In the empirical implementation, h is a job regime related to flexibility in hours worked. Workers have different preferences with respect to h and firms pay a cost to provide it.

Workers' instantaneous utility when employed is:

$$u(w, h; \alpha) = w + \alpha h, h \in \{0, 1\}; \alpha \sim H(\alpha) \tag{1}$$

where α defines the marginal willingness to pay for flexibility, the crucial preference parameter of the model, distributed in the population according to distribution H . The specification of the utility function is very restrictive but we prefer to present the specification that we can empirically identify. More general specifications are possible, but the restriction that w and h enter additively in the utility function is difficult to remove if one needs to obtain a tractable equilibrium in a search environment.

Workers' instantaneous utility when unemployed is defined by a utility (or disutility) level $b(\alpha)$. We allow for the possibility that individuals with different taste for flexibility have different preferences for being unemployed. There is no participation decision so workers can only be either employed or unemployed.

Firms' instantaneous profits from a filled job are:

$$\text{Profits}(x, w, h; k) = (1 - kh)x - w, k \in [0, 1] \tag{2}$$

where x denotes the match-specific productivity and k is the firm cost of providing flexibility.¹⁰ Cost k may arise from the need to coordinate workers in the workplace, and possibly

a variety of issues, such as: duration to first job and returns to schooling (Eckstein and Wolpin 1995); race discrimination (Eckstein and Wolpin 1999); the impact of mandatory minimum wage (Flinn 2006); gender discrimination (Flabbi 2010).

¹⁰Standard equilibrium search model assume a cost (usually homogenous) of posting a vacancy and then free-entry with endogenous meeting rates (usually determined by a matching function) to close the model.

the need to hire a higher number of workers when flexibility is provided, which generates additional search and training costs. Crucially, the total cost of flexibility kx is proportional to potential productivity x . We believe this is a natural assumption given that the potential loss of productivity that derives from lack of worker’s coordination is higher when workers are more productive, and training costs are higher when workers have higher skills.

The timing of the game is as follows: workers meet firms following a Poisson process with exogenous instantaneous arrival rate λ .¹¹ Once workers and employers meet, they observe their types¹² (defined by α) and draw the match specific productivity distributed in the population from distribution G : $x \sim G(x)$. This is an additional source of heterogeneity resulting from the match of a specific worker with a specific employer.

Matched firms and workers engage in bargaining over a job offer defined by the pair (w, h) . The timing of the game is crucial for the bargaining game and for the search process. Before an employer and a worker meet, they know their own type but not the type of who they are going to meet: this implies that they will not direct their search toward specific agents. After an employer and a worker have met, types are revealed. This avoids any problem related to the presence of asymmetric information in the bargaining game.

A match is terminated according to a Poisson process with arrival rate η . There is no on-the-job search and the instantaneous common discount rate is ρ .

3.2 Value functions and the Bargaining Game

This problem can be solved recursively, and the value functions can be written as follows.¹³ The value of employment for a worker matched to a firm is:

$$V_E(w, h; \alpha, k) = \frac{w + \alpha h + \eta V_U(\alpha)}{\rho + \eta} \quad (3)$$

Employed workers receive value from a job at the firm through two components. The first is the instantaneous flow of utility they receive by staying in the job: the wage plus the

However these costs are very difficult to identify using workers data, so as a first approximation we will assume firm have no cost of posting a vacancy.

¹¹Keeping the arrival rate exogenous introduce a major limitation in the policy experiments because it ignores that firms can react to the policy and post more or less vacancies. It would be useful to use an endogenous arrival rate but data limitations prevent the estimation of a credible “matching function” in our application since we are looking at specific labor markets where the scarce data on vacancy rates cannot be credibly applied.

¹²It is common in the literature to refer to the different values of α ’s as “types” of workers. In the same way we could define firms with different values of k ’s as ”types” of firms. In the current paper we will discuss and use in estimation the heterogeneity in workers’ types but not in firms’ types.

¹³The complete analytical derivation is presented in Appendix A.1.

benefit of flexibility ($w + \alpha h$). The second is the employment risk they face, since they know that a termination shock may hit them and send them back to unemployment. The value of this second component is the probability of receiving the shock in every instant multiplied by the value of the state in which they will end up ($\eta V_U(\alpha)$). Both these values are appropriately discounted by the intertemporal discount rate ρ and by the probability to receive the shock η .

For an unemployed worker the value is:

$$V_U(\alpha) = \frac{b(\alpha) + \lambda \int \max[V_E(w, h; \alpha, k), V_U(\alpha)] dG(x)}{\rho + \lambda} \quad (4)$$

The instantaneous flow of utility is denoted by $b(\alpha)$ and includes all the utility and disutility related to be unemployed and searching for a job. The second component of the value of unemployment is an option value: by being unemployed and searching, the agent buys the option of meeting an employer, drawing a productivity value and deciding if the resulting job will generate a flow of utility higher than her current state of unemployment. The option value will then be the probability to meet the employer (λ) multiplied by the expected gain from accepting the match ($\int \max[V_E(w, h; \alpha, k), V_U(\alpha)] dG(x)$) where the expectation is over the match-value distribution ($G(x)$). Again both components are discounted by the intertemporal discount rate ρ and by the probability to receive the shock λ .

For the firm the value of a filled position is:

$$V_F(x, w, h; \alpha, k) = \frac{(1 - kh)x - w}{\rho + \eta} \quad (5)$$

Equation (5) has an analogous interpretation to the worker's value function (3). In this case the value of the alternative state, an unfilled vacancy, is zero because we assume there are no costs of posting a vacancy.

Workers and firms bargain over the surplus. We assume the outcome of the bargaining game is the pair (w, h) described by the axiomatic Generalized Nash Bargaining Solution, using the value of unemployment and zero, respectively, as threat points, and $(\beta, 1 - \beta)$ are, respectively, the worker and the firm's bargaining power parameters. This allows us to characterize the bargaining outcome as the solution to a relatively simple problem.

To this end, we define the surplus S of the match as the weighted product of the worker's

and firm's net return from the match with weights $(\beta, 1 - \beta)$:

$$\begin{aligned} S(x, w, h; \alpha, k) &\equiv [V_E(w, h; \alpha, k) - V_U(\alpha)]^\beta [V_F(x, w, h; \alpha, k)]^{(1-\beta)} \\ &= \frac{1}{\rho + \eta} [w + \alpha h - \rho V_U(\alpha)]^\beta [(1 - kh)x - w]^{(1-\beta)}, 0 \leq \beta \leq 1 \end{aligned} \quad (6)$$

The Generalized Nash Bargaining Solution is characterized as the pair (w, h) that maximizes the surplus $S(x, w, h; \alpha, k)$. To compute this solution, we first condition on the flexibility regime and then solve for the wage schedule. When the parties agree to a flexible job, the solution is given by:

$$\tilde{w}(x, h) = \arg \max_w S(x, w, h; \alpha, k) \quad (7)$$

$$= \beta(1 - kh)x + (1 - \beta)[\rho V_U(\alpha) - \alpha h] \quad (8)$$

For a better economic intuition of this solution, we can rearrange terms as follows:

$$\tilde{w}(x, h) = (\rho V_U(\alpha) - \alpha h) + \beta(x + (\alpha - kh)h - \rho V_U(\alpha)) \quad (9)$$

Workers receive a wage which is equal to their reservation wage, which we derive below to be equal to $(\rho V_U(\alpha) - \alpha h)$, plus a fraction β of the net surplus generated by the match $(x + (\alpha - kh)h - \rho V_U(\alpha))$.

The wage schedule, together with the previous value functions, implies that the optimal decision rule has a reservation value property. Because wages are increasing in x (see (8)), the value of employment $V_E(w, h; \alpha, k)$ is increasing in wages (Equation (3)) and the value of unemployment $V_U(\alpha)$ is constant with respect to wages (equation (4)), then there exists a reservation value $x^*(h)$ such that the agent is indifferent between accepting the match or not:

$$V_E(\tilde{w}(x^*(h), h), h; \alpha, k) = V_U(\alpha) \quad (10)$$

This in turn implies that workers will accept matches with productivity higher than $x^*(h)$ and reject matches with productivity lower than $x^*(h)$. An analogous decision rule holds for firms and, because of Nash bargaining, there is agreement on the reservation values, i.e. the reservation value at which the worker is indifferent between employment and unemployment is equal to the reservation value at which the firm is indifferent between holding a vacancy or hiring the worker. Formally:

$$V_E(\tilde{w}(x^*(h), h), h; \alpha, k) = V_U(\alpha) \Leftrightarrow V_F(x^*(h), \tilde{w}(x^*(h), h), h; \alpha, k) = 0$$

We use (10) to solve for $x^*(h)$, obtaining:

$$x^*(h) = \frac{\rho V_U(\alpha) - \alpha h}{1 - kh}. \quad (11)$$

Substituting in (8), the corresponding reservation wage is:

$$w^*(h) = \rho V_U(\alpha) - \alpha h. \quad (12)$$

Notice that if flexibility were not available (i.e. $h = 0$) the reservation value would be equal to the reservation value found in the search-matching-bargaining literature:

$$w^*(0) = x^*(0) = \rho V_U(\alpha) \quad (13)$$

In this case, the reservation wage is simply the discounted value of the outside option $\rho V_U(\alpha)$. When flexibility is present, instead, the optimal decision rule changes as a function of α and k . The worker is receiving an amenity that she values and she values it more as α increases. Equation (12) then states that providing flexibility has a direct impact in lowering the wage at which the worker is willing to accept a job (the $-\alpha h$ term). Equation (11) shows the relation between the flexibility provision and the productivity reservation value. It states that providing flexibility has two opposite effects on the reservation productivity value at which workers and firms will deem the match acceptable: flexibility lowers the reservation value because the worker is receiving a valuable job amenity but it also increases the reservation value because the firm pays a cost to provide the amenity.

Workers and firms do not only decide if the match is acceptable or not, they also decide the flexibility regime at which they want the job to be realized. Given a match productivity value x , workers and firms solve this decision by comparing the value of the job with flexibility and the value without flexibility. They are indifferent when productivity is equal to threshold x^{**} such that the two values are equal. Nash bargaining guarantees that this is the case for both agents at the same productivity value. Formally, x^{**} satisfies:

$$\begin{aligned} V_E(\tilde{w}(x^{**}, 1), 1; \alpha, k) &= V_E(\tilde{w}(x^{**}, 0), 0; \alpha, k) \\ &\Downarrow \\ V_F(x^{**}, \tilde{w}(x^{**}, 1), 1; \alpha, k) &= V_F(x^{**}, \tilde{w}(x^{**}, 0), 0; \alpha, k) \end{aligned} \quad (14)$$

In the optimal decision rule an accepted job will be flexible if productivity is less than the

threshold x^{**} , otherwise it will be non-flexible. Solving equation (14) we obtain:

$$x^{**} = \frac{\alpha}{k} \tag{15}$$

Because a higher utility from flexibility α increases the threshold x^{**} then individuals with higher α accept a job with flexibility over a larger support of x . On the other hand, for a firm with a high cost of providing flexibility it will be optimal to offer job with flexibility over a smaller support of x .

Depending on parameters, it is possible that no jobs with flexibility are created. The cost of providing flexibility and the preferences for flexibility have an opposite impact on the reservation value x^{**} and this threshold represents the point in the support of the productivity distribution where agents switch from the flexible regime to the non-flexible regime. Therefore, if x^{**} is lower than $x^*(1)$ there is no region over the space of x where flexible jobs are accepted. In the next subsection, we characterize the threshold productivities in terms of the values of the fundamental parameters. This characterization will then be exploited for purpose of the model's empirical identification.

3.3 Equilibrium

We can characterize the optimal decision rule by comparing the values of the three reservation productivities defined in (11) and (15): $\{x^*(0), x^*(1), x^{**}\}$. Recall that $x^*(0)$ is the reservation productivity value at which agents are indifferent between unemployment and employment at a non-flexible job, $x^*(1)$ is the value at which agents are indifferent between unemployment and employment at a flexible job and x^{**} is the value at which agents are indifferent between employment at a flexible and at a non-flexible job. The following proposition characterizes the reservation values in terms of the model parameters:¹⁴

Proposition 1 *For a given k , there exists a unique α^* , defined as the solution to $\alpha^* = k\rho V_U(\alpha^*)$, such that:*

$$\begin{aligned} \alpha > \alpha^* &\iff x^*(1) < x^*(0) < x^{**} \\ \alpha = \alpha^* &\iff x^*(1) = x^*(0) = x^{**} \\ \alpha < \alpha^* &\iff x^*(1) > x^*(0) > x^{**} \end{aligned}$$

This proposition essentially defines two qualitatively different equilibria over two regions of the support of the distribution $H(\alpha)$.

¹⁴The proof is in Appendix A.2.

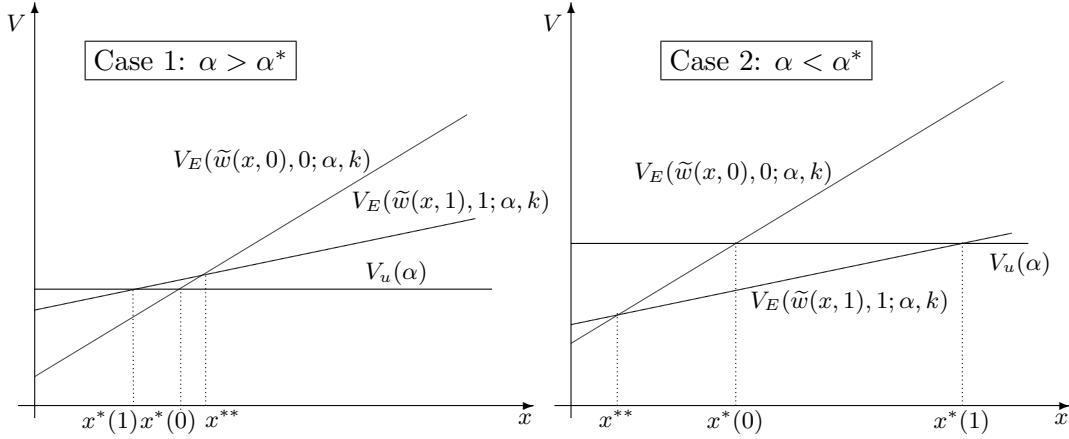


Figure 1: Different equilibrium outcomes

Case 1: $\alpha > \alpha^* = k\rho V_U(\alpha^*)$.

By Proposition 1 in this case we have that $x^*(1) < x^*(0) < x^{**}$. Therefore, the optimal decision rule in this region of the α -parameter support is:

$$\begin{aligned} x < x^*(1) & \text{ reject the match} \\ x^*(1) < x < x^{**} & \text{ accept the match } \{\tilde{w}(x,1),1\} \\ x^{**} < x & \text{ accept the match } \{\tilde{w}(x,0),0\} \end{aligned}$$

Figure 1 illustrates the value functions for the employment and unemployment states (equations (3) and (4)), as a function of the match-specific productivity x . Utility maximization implies that the optimal behavior is choosing the value function delivering the highest value for each x . The value of being unemployed, $V_U(\alpha)$, is the horizontal line which does not depend on wages and is therefore constant with respect to x . The value of being employed both at flexible and not flexible jobs is increasing in wages and therefore, by Equation (8), it is increasing in x . However, again by (8), workers in a non-flexible job receive more surplus from additional productivity than workers in a flexible job and therefore the slope of equation $V_E(\tilde{w}(x,0),0;\alpha,k)$ is steeper than the slope of equation $V_E(\tilde{w}(x,1),1;\alpha,k)$. For the same reason when the productivity is extremely low, workers at flexible jobs are better off because they receive the benefit of flexibility: therefore equation $V_E(\tilde{w}(x,1),1;\alpha,k)$ has a higher intercept than equation $V_E(\tilde{w}(x,0),0;\alpha,k)$. This configuration is common to both Case 1 and Case 2 equilibria. The difference between Case 1 and Case 2 is the location of the intersection points.

Case 1 is described in the left panel of Figure 1. For low values of the match-specific productivity x , agents prefer to reject the match because the value of unemployment is higher. The point of indifference for switching state is reached at $x = x^*(1)$ where both agents are indifferent between leaving the match or entering a match with a flexible regime and a wage determined by the match schedule (8). Between $x^*(1)$ and $x^*(0)$ only jobs with a flexible regime are acceptable since the value of a job without flexibility is lower than both the value of job with flexibility and unemployment. Notice then that without the job amenity jobs would be rejected in this range of productivity values. At $x = x^*(0)$ non-flexible jobs start to become acceptable. However up to $x = x^{**}$ the surplus generated by a flexible job is higher than the surplus generated by a non-flexible job, as shown by equation (14). Only for values of match-specific productivity higher than x^{**} the optimal decision rule is to accept a non-flexible job with wage determined by (8). Finally, by monotonicity of the difference (14), it is guaranteed that this will remain the optimal decision rule for the rest of the support of x .

Given the optimal decision rules and conditioning on α , the value of unemployment can be rewritten as:

$$\begin{aligned} \rho V_U(\alpha) &= b(\alpha) + \lambda \int_{x^*(1)}^{x^{**}} [V_E(\tilde{w}(x, 1), 1; \alpha, k) - V_U(\alpha)] dG(x) \\ &\quad + \lambda \int_{x^{**}} [V_E(\tilde{w}(x, 0), 0; \alpha, k) - V_U(\alpha)] dG(x) \end{aligned} \quad (16)$$

which, after substituting the optimal wages schedules and value functions, becomes:

$$\begin{aligned} \rho V_U(\alpha) &= b(\alpha) + \frac{\lambda\beta}{\rho + \eta} \int_{\frac{\rho V_U(\alpha) - \alpha}{1-k}}^{\frac{\alpha}{k}} \left[x - \frac{\rho V_U(\alpha) - \alpha}{1-k} \right] dG(x) \\ &\quad + \frac{\lambda\beta}{\rho + \eta} \int_{\frac{\alpha}{k}} [x - \rho V_U(\alpha)] dG(x) \end{aligned} \quad (17)$$

This equation (implicitly) defines the value of unemployment $V_U(\alpha)$ as a function of the primitive parameters of the model. Given that $G(x)$ is a cumulative distribution function, this equation has a unique solution for $V_U(\alpha)$.

Case 2: $\alpha < \alpha^* = k\rho V_U(\alpha^*)$.

By Proposition 1, in this case $x^{**} < x^*(0) < x^*(1)$. Therefore, the optimal decision rule in this region of the α -parameter support is:

$$\begin{aligned} x < x^*(0) & \text{ reject the match} \\ x^*(0) < x & \text{ accept the match } \{\tilde{w}(x, 0), 0\} \end{aligned}$$

In Case 2 the added utility of flexibility relative to the cost of providing it is not enough to generate acceptable flexible jobs: only non-flexible jobs with high enough match-specific productivity are acceptable to both agents. This case is illustrated on the right panel of Figure 1. The indifference between the two employment regime, x^{**} , occurs in a region where matches are not accepted. Agents prefer employment to unemployment (or a filled job to a vacancy) only when the match-specific productivity is higher. But this is the region above $x^*(0)$ where the optimal choice is accepting jobs without flexibility.

To summarize, if the benefit from flexibility is too low, $\alpha < k\rho V_U(\alpha^*)$, workers and firm will only accept non-flexible jobs. Given the optimal decision rules and conditioning on α , the value of unemployment can be rewritten as:

$$\rho V_U(\alpha) = b(\alpha) + \lambda \int_{\rho V_U(\alpha)} [V_E(\tilde{w}(x, 0), 0; \alpha, k) - V_U(\alpha)] dG(x) \quad (18)$$

which, after substituting the optimal wages schedules and value functions, is equivalent to:

$$\rho V_U(\alpha) = b(\alpha) + \frac{\lambda\beta}{\rho + \eta} \int_{\rho V_U(0)} [x - \rho V_U(\alpha)] dG(x) \quad (19)$$

This equation (implicitly) defines the value of unemployment $V_U(\alpha)$ as a function of the primitive parameters of the model. Given that $G(x)$ is a cumulative distribution function, this equation has a unique solution for $V_U(\alpha)$.

The optimal behavior in Case 1 and Case 2 can be summarized as follows:

Definition 2 *Given $\{\lambda, \eta, \rho, \beta, b(\alpha), k, G(x), H(\alpha)\}$ an equilibrium is a set of values $V_U(\alpha)$ that solves equation (17) for any $\alpha \leq \alpha^*$ and a set of $V_U(\alpha)$ that solve equation (19) for any $\alpha > \alpha^*$ in the support of $H(\alpha)$.*

This definition states that, given the exogenous parameters of the model, we can solve for the value functions which uniquely identify the reservation values: the reservation values are the only piece of information we need to identify the optimal behavior. This definition is also very convenient from an empirical point of view because - as we will see in more

detail in the identification section - we can directly estimate the reservation values and from them recover information about the value functions and the primitive parameters.

The economic interpretation of the equilibrium is that only for relatively high productivity matches the higher wage compensates the worker for not having a flexible job. This is a result of the bargaining process: since workers share a proportion of the rents generated by the match, there will always be a value of the rent high enough that more than compensate the utility gain of working in a flexible job.¹⁵ On the other hand, if a worker has a significant utility from flexibility and the productivity is low enough, it will be optimal to give up some of the relative small share of surplus to gain job flexibility. The range of productivities over which flexible jobs are accepted is directly related to preferences since a higher α means that the distance between the two reservation values x^{**} and $x^*(1)$ is larger. In the Section 4 we will show how a similar implication holds for wages generating a useful mapping from the data to the parameters.

Finally, observe the interval $[x^*(1), x^*(0)]$ in the left panel of Figure 1. This interval is proportional to the region of matches that would have not been created without the flexible job option. In a sense this region illustrates an efficiency gain of having the option to offer flexible jobs: if the flexibility option were not available, fewer matches would be created leaving more unfilled jobs and unemployed workers.

The equilibrium exists and it is unique because equations (17) and (19) admit a unique solution. The proof involve showing that both equations generate a contraction mapping: it is relatively straightforward in this case since we are integrating positive quantities on a continuous probability density function.

Given that the arrival rate of matches follows a Poisson process with parameter λ , it can be shown that the distribution of completed spells of unemployment for a worker with given α is:¹⁶ $q(t_u) = \lambda(1 - F(rV_U(\alpha)))e^{-\lambda t_u(1 - F(rV_U(\alpha)))}$. The hazard rate out of unemployment h is defined as the probability of leaving unemployment conditional on having been unemployment for a given length of time. In an infinite horizon model, it is constant over time:

$$h = \frac{\lambda(1 - F(rV_U(\alpha)))e^{\lambda t_u(1 - F(rV_U(\alpha)))}}{e^{-\lambda t_u(1 - F(rV_U(\alpha)))}} = \lambda(1 - F(rV_U(\alpha))) \quad (20)$$

It can also be shown that the average duration can be computed as $1/(\lambda(1 - F(rV_U(\alpha))))$, the inverse of the hazard rate, a result that will be exploited in the estimation.

¹⁵To be precise, this is true if the sampling productivity distribution is not bounded above. If there is an upper bound to productivity and the share at this upper bound is small enough, it is possible that some high α -types will never work in a non-flexible job.

¹⁶See, for example, Flinn and Heckman (1982).

Finally, in steady state the flows of workers into employment status should be equal to the flow out of it. Hence, defining U_r as the unemployment rate it must be the case that $hU_r = \eta(1 - U_r)$, or, equivalently,

$$U_r = \frac{\eta}{h + \eta} \quad (21)$$

4 Identification

The set of parameters to be identified is: the bargaining power parameter β , the parameters of the distribution over the match-specific productivities $G(x)$, the match arrival rate λ and termination rate η , the discount rate ρ , the utility flow during unemployment b , the cost of providing flexibility k , and the distribution over preferences for flexibility $H(\alpha)$.

Identification is discussed based on data containing the following information: accepted wages, unemployment durations and an indicator of flexibility. We denote it with the set:

$$\Delta \equiv \{w_i, t_i, h_i\}_{i=1}^N$$

This is a relatively limited amount of information but it allows for the estimation of all the relevant parameters of the model. If the drawback of our approach is the reliance on some functional form assumptions for identification, one advantage is the relatively minor data requirement needed for the estimation.

The bargaining power parameter. The separate identification of this coefficient is difficult without demand side information¹⁷ and therefore we resort to a common assumption in the literature, which is to assume *symmetric* bargaining, or $\beta = 1/2$.

The “classic” search-matching model parameters. We now focus on the identification of the set

$$\Theta(\alpha) \equiv \{\lambda, \eta, \rho, b(\alpha), G(x)\}$$

conditioning on a given type α . Once identification of this set of parameters is proved for a given type α , it can be replicated for each type as long as the types are identified. T

The basic proof of identification for the set $\Theta(\alpha)$ from the vector of data Δ was first proposed by Flinn and Heckman (1982). It is possible to show that the inverse of the hazard rate characterized in (20) is equal to the mean unemployment duration. Hence, the hazard rate is identified by the mean unemployment duration, which can be used to identify the termination rate of a job η using (21) and the observed unemployment rate. The arrival rate of offers λ can be recovered from (20) once we have estimates of the wage distribution

¹⁷See Flinn (2006) and Eckstein and Wolpin (1995).

F and of the value of unemployment (see below for its identification). In a basic model without flexibility, this value is equal to the reservation wage, and is therefore identified nonparametrically by the minimum observed wage in the sample. This is also true in our model: the minimum observed wage identifies the lowest acceptable wage for some type of worker α_j , which must be equal to the value of unemployment for that type, from which we can recover λ after we have estimates of F .

Flinn and Heckman (1982) also show that the accepted wage distribution identify the parameters of the match distribution $G(x)$ only if an appropriate parametric assumption is made. The parametric assumption must be on the primitive sampling distribution $G(x)$ and requires the distribution to be *recoverable*. A recoverable distribution is a distribution that can be uniquely determined by observing its own truncation at a known point. This condition applies to all problems in which accepted wage distribution is a truncation of the offered wage distribution. In our case, we want to identify the sampling distribution of match-specific productivity using the accepted wage distribution. Therefore, our model requires the same parametric assumption since the sampling distribution maps into wage offers through the optimal Nash bargaining solution. We can therefore identify the wage offers distribution from the accepted wage distribution thanks to the recoverability condition and then we can identify the productivity distribution $G(x)$ by inverting the mapping wage-productivity implied by Nash bargaining.

The parameters ρ and $b(\alpha)$ can only be jointly identified. This is the case because they contribute to the mapping from the data to the parameters only through the discounted value of unemployment $\rho V_U(\alpha)$. This value is not a primitive parameter, but an implicit function of various parameters (see equations (17) and (19)).¹⁸ If $\rho V_U(\alpha)$ is identified, then ρ and $b(\alpha)$ can be jointly recovered using the equilibrium equation that implicitly defines $\rho V_U(\alpha)$.

Cost to provide and preferences for flexibility. Flinn and Heckman (1982) is an homogenous model in terms of workers preferences, i.e. there are no α -types therefore $b(\alpha)$ and $\rho V_U(\alpha)$ are unique and this step concludes the identification of their model. We discuss here identification of the set of parameters which is not commonly found in the literature: the distribution of preferences for flexibility α and the cost of providing flexibility k .

Heterogeneity in preferences for flexibility helps us fit the data we observe. For example, if there were only one type of worker with $0 \leq \alpha < k\rho V_U(0)$, then in equilibrium we observe

¹⁸Postel-Vinay and Robin (2002) is one of the few articles providing direct estimates of the discount rate within a search framework. Their model is however not comparable to ours because the discount rate includes both “impatience” (as in our model) and risk aversion. They generate high estimates for this parameter: about 12% for the skilled group and up to 65% for some unskilled groups in some specific industries.

only non-flexible jobs. If instead there were only one type with $k\rho V_U(\alpha) \leq \alpha$ then we could observe workers in both types of jobs, but the wage distributions of the two jobs would have non-overlapping support, something we do not observe in the data.

A larger number of types generates an accepted wage distribution as a mixture of distributions (one for each type) that is capable of better fitting the data we observed for flexible and non-flexible jobs.

More formally, we follow what is now a standard approach in the literature¹⁹ and assume a discrete distribution $H(\alpha)$ implying a finite number of values α_j , $J = 0 \dots T$ and call p_j , $j = 0 \dots T$ the proportion of individuals with preference for flexibility α_j (or, more concisely, the frequency of individuals of type j). The set of parameters left to be identified will then be:

$$\Upsilon \equiv \{\alpha, \mathbf{p}, T, k\}$$

where α and \mathbf{p} are vectors of dimension $T + 1$.

We first focus on the identification of α , \mathbf{p} and k given the number of types and assuming we know how to group individuals by preference. In other words, we discuss the identification of the $H(\alpha)$ distribution and the cost of providing flexibility assuming we know the total number of types and to which type each individual belongs. Since we assume we know how to group individuals by preference, the identification of \mathbf{p} is trivial and it is given by the proportion of observations in each type.

For any α_j such that $\alpha_j > k\rho V_U(\alpha_j)$ the equilibrium described in Definition 2 generates a distribution of wages over both flexible and non-flexible regimes and the accepted wage distribution does not have a connected support.²⁰ This is because accepted wages are obtained from the productivity distribution by the equilibrium wage schedule (8). The lower bound of the accepted wage distribution is given by the wage of the worker that marginally accepts a flexible job, $\tilde{w}(x^*(1), 1; \alpha_j)$; the maximum accepted wage in a flexible job is $\tilde{w}(x^{**}, 1)$. Between these two bounds the wage distribution is governed by $\tilde{w}(x, 1)$. For $x > x^{**}$ the wage distribution is instead governed by $\tilde{w}(x, 0)$ so that on the region $(\tilde{w}(x^{**}, 1; \alpha_j), \tilde{w}(x^{**}, 0; \alpha_j))$ the accepted wage distribution does not place any probability mass. This means that for a given type there is a gap in the support of the accepted wage distribution. The three bounds (i.e. the three truncation points that correspond to the two

¹⁹See, e.g., Wolpin (1990), Eckstein and Wolpin (1995) or Eckstein and van den Berg (2007)

²⁰Throughout the identification discussion and in the empirical application we assume the support of $G(x)$ is equal to the positive real line. This seems a fairly reasonable assumption since x represents the productivity of a job match.

flexibility regimes) are, by equations (8), (11) and (15), equal to:

$$\tilde{w}(x^*(1), 1; \alpha_j) = \rho V_U(\alpha_j) - \alpha_j \quad (22)$$

$$\tilde{w}(x^{**}, 1; \alpha_j) = \beta(1-k)\frac{\alpha_j}{k} + (1-\beta)[\rho V_U(\alpha_j) - \alpha_j] \quad (23)$$

$$\tilde{w}(x^{**}, 0; \alpha_j) = \beta\frac{\alpha_j}{k} + (1-\beta)\rho V_U(\alpha_j) \quad (24)$$

We solve this system of equations to obtain:

$$\widehat{\alpha}_j = \tilde{w}(x^{**}, 1; \alpha_j) - \tilde{w}(x^{**}, 0; \alpha_j) \quad (25)$$

$$\rho\widehat{V}_U(\alpha_j) = \widehat{\alpha}_j + \tilde{w}(x^*(1), 1; \alpha_j) \quad (26)$$

$$\widehat{k} = \beta\widehat{\alpha}_j \left[\tilde{w}(x^{**}, 0; \alpha_j) - (1-\beta)\rho\widehat{V}_U(\alpha_j) \right]^{-1} \quad (27)$$

These three equations state that the size of the discontinuity in the wage support identifies the preference for flexibility; the minimum wage in the sample of observations belonging to type α_j identifies the discounted value of unemployment; and the location of the discontinuity identifies k . The same identification procedure holds for any α_j such $\alpha_j > k\rho V_U(\alpha_j)$.

For any α_j such $\alpha_j < k\rho V_U(\alpha_j)$, instead, we do not have identification because in this case all the accepted jobs are non-flexible and flexibility has no impact on the variables that we can observe. We denote the types α'_j such that this is the case with α_0 . In the estimation we obtain values of α_j such $\alpha_j > k\rho V_U(\alpha_j)$ that are quite low (between 0.1 and 0.01). Since we know that α_0 must be smaller than the smallest estimated α_j , we normalize α_0 to zero.

We now focus on the identification of α , \mathbf{p} and k given T but without assuming we know the type to which each individual belong. In this case we observe a mixture of wage distributions over the T types and we want to identify the proportions in the mixture (\mathbf{p}) together with the parameters that define the types (α). Since the discontinuity in the accepted wage support for one type may overlap with a region without discontinuity for another type, the mixture may not exhibit the discontinuity we used for identification in the previous case. However, the mixture will still exhibit a drop in probability mass in correspondence with the discontinuity in the accepted wage distribution for a given type. This is due to the fact that in such region that type does not place any probability mass. As a result, the presence of a drop in the accepted wage distribution signals the presence of an α_j -type such that $\alpha_j > k\rho V_U(\alpha_j)$. By equation (25), we also know that the width of the support over which the drop occurs identifies the size of the α_j . The height of the drop identifies the proportion p_j : the stronger the drop the higher the proportion of that specific

type in the population. The location of the drops with respect to the lowest accepted wage identifies k since k is proportional to the distance $[\tilde{w}(x^{**}, 0; \alpha_j) - \tilde{w}(x^*(1), 1; \alpha_j)]$, as shown in equation (27). All the results are again derived from the equations (8), (11) and (15) used before but now using the drops in the mixture instead of the truncation points in the support as crucial information. This means that support information is not enough for identification but that knowledge of the the shape of the density of the accepted wage distribution is needed. This density should exhibit drop and kinks "smoothed out" by the presence of different types with different α'_j s. The degree of smoothness depends both on the total number of types present and on the relative proportion of the types in the population.

Finally, we focus on the identification of the number of types T , completing the identification of the set Υ . Given the previous discussion, the number of types with α_j such that $\alpha_j > k\rho V_U(\alpha_j)$ is identified by the number of discontinuities in the support of the accepted wage distribution and/or by the number of drops in the density of the accepted wage distribution.

We found that the minimum number of types necessary to match the data reasonably well is three. In our data, we observe: (i) overlapping of the accepted wage supports of flexible and non-flexible jobs; and (ii) a relatively smooth empirical wage distribution. If only one type were present, then the accepted wages of flexible and non-flexible jobs would be ordered (lower wages for flexible jobs and higher wages for non-flexible jobs) with a discontinuity in the wage supports of flexible and non-flexible jobs. If only two types were present, wage supports would overlap but the wage distribution would be very peculiar, contradictions with the relatively smooth empirical wage distribution we observe. In one case one type has very low utility from flexibility and never accepts flexible jobs ($\alpha < k\rho V_U(\alpha)$) while the other has utility from flexibility high enough ($\alpha > k\rho V_U(\alpha)$) to accept flexible jobs at least in some range of productivity values. If this were the case, the empirical wage distribution would not be smooth, exhibiting a drop in its density at the point where workers that value flexibility switch from the flexible regime to the non-flexible regime. The drop is generated by the gap in the accepted wage distribution due to the change in wage schedule that we discussed in the identification section (see equation 25). In the second possible²¹ case both types have utility from flexibility high enough (both types have $\alpha > k\rho V_U(\alpha)$) to work flexible on some productivity range. For the same reason discussed above, we should observe two drops in the empirical wage distribution where workers belonging to the two types switch from flexible to non-flexible jobs. Since the

²¹A third case is possible but trivially rejected by the data: the case in which both types receive very low utility from flexibility and never work flexible.

empirical wage distribution we observe in the data does not exhibit so clear drops but has a smoother shape, we reject the two types model and we start our estimation assuming at least three types. A model with three types is better equipped to “smooth out” the drops and therefore to better resemble the data. This added flexibility also allows us to not assign in advance the drops to a given type but to let the optimization procedure choose which assignment fit the data better.

5 Data

For identification purposes, we need a data set reporting accepted wages, unemployment durations, a flexibility regime indicator and some additional controls to insure a degree of homogeneity to the estimation sample.

Finding a good flexibility indicator is a difficult task: ideally we would like to have a variable indicating if the worker can freely choose how to allocate her working hours. In principle this type of information is observable (for example, some labor contracts have a *flexitime* option allowing workers to enter and exit the job at her chosen time, or allowing workers to bundle extra working hours to gain some days off). However, there is lack of an homogenous definition across firms and industries of these types of contract. Moreover, we prefer to provide estimates based on a representative sample of the population than on specific firms or occupations. For this reason we use a very limited but at least transparent and comparable definition of flexibility that allows us to use a standard and representative sample of the U.S. labor market. The definition of flexibility we use is based on hours worked under the assumption that working fewer hours per week is a way to obtain the type of flexibility we are interested in. For comparability across workers with different flexibility choices, wages are measured in dollars per hour.

The data is extracted from the *Annual Social and Economic Supplement* (ASES or March supplement) of the Current Population Survey (CPS) for the year 2005. We consider only women that declare themselves as white, in the age range 30-55 years old, and that belong to two educational levels: high school completed (high school sample) and at least college completed (college sample). To avoid outliers and top-coding issues we trim hourly earnings excluding the top and the bottom 1% of the raw data.

The variables that we extract are: on-going unemployment durations observed for individuals currently unemployed (t_i); accepted wages observed for individuals currently employed (w_i) and the flexibility regime (h_i) where the worker is assumed to be in a flexible job if working less than 35 hours per week. We obtain a sample whose descriptive statis-

Females	College	High School
N. flexible	264	240
N. non-flexible	1058	854
Average wage, flexible	22.5 (14.2)	10.3 (4.3)
Average wage, non-flexible	23.4 (10.3)	13.9 (5.9)
Wage range, flexible	2.4-70	2.13-26.7
Wage range, non-flexible	7-57.7	3.65-38.5
Avg. hours worked, flexible	21.3 (7.7)	23.4 (7.6)
Avg. hours worked, non-flexible	42.7 (6.4)	40.5 (3.8)
N. unemployed	34	72
Avg. unemployment duration	4.4 (5.2)	4.6 (5.9)

Table 1: Descriptive statistics (standard deviations in parenthesis)

tics are presented in Table 1. Accepted earnings are measured in dollars per hour and unemployment durations in months.

6 Estimation

The minimum observed wage is a strongly consistent estimator of the reservation wage²². In our model we can exploit this property of observed minimum wages both at flexible and at non-flexible jobs because they refer to the reservation wage of two different types of individuals: the lowest accepted wage at non-flexible jobs is a strongly consistent estimator for the reservation wage of workers' type such that $\alpha < k\rho V_U(\alpha)$ while the lowest accepted wage at flexible jobs is a strongly consistent estimator for the reservation wage of workers' that belong to one of the types satisfying $\alpha > k\rho V_U(\alpha)$. Without loss of generality, we assume this the lowest accepted wage of a flexible job pertains to type T.

Therefore, the first step of our estimation procedure uses equation (12) to obtain the following strongly consistent estimators:

$$\begin{aligned} \widehat{\rho V_U(0)} &= \min_i \{w_i : h_i = 0\} \\ \widehat{\rho V_U(\alpha_T)} - \alpha_T &= \min_i \{w_i : h_i = 1\} \end{aligned} \tag{28}$$

The remaining parameters are estimated in a second step using a Simulated Method of Moments (SMM) procedure where, for a given parameters vector, we simulate moments that we then compare with the corresponding moments obtained from the data sample.²³

²²See Flinn and Heckman (1982)

²³In principle, one could attempt a maximum likelihood approach. This is difficult in our model because

We estimate λ and η by matching two moments exactly: the mean duration of unemployment spells is equal to the hazard rate (see (20)), which, together with the unemployment rate (21) defines a system of two linear equations in two unknowns (λ and η). Assuming $G(x)$ is lognormal with parameters (μ, σ) ,²⁴ the remaining vector of parameters is defined by $\theta \equiv \{\mu, \sigma, k, \alpha, \mathbf{p}, \rho V_U(\alpha_{-j})\}$ and is estimated as:

$$\hat{\theta} = \arg \min_{\theta} \Psi(\theta, \mathbf{t}, \mathbf{w}, \mathbf{h})' W \Psi(\theta, \mathbf{t}, \mathbf{w}, \mathbf{h}) \quad (29)$$

such that $\Psi(\theta, \mathbf{t}, \mathbf{w}, \mathbf{h}) = \left[\Gamma_R \left(\theta | \widehat{\rho V_U(0)}; \widehat{\rho V_U(\alpha_j)} - \alpha_j \right) - \gamma_N(\mathbf{t}, \mathbf{w}, \mathbf{h}) \right]$

where γ_N is the vector of the sample moments obtained by our sample of dimension N while $\Gamma_R \left(\theta | \widehat{\rho V_U(0)}; \widehat{\rho V_U(\alpha_j)} - \alpha_j \right)$ is the vector of the corresponding moments obtained from a simulated sample of size R. Bold types represent vectors of variables: for example \mathbf{t} is the vector of the unemployment durations t_i . The weighting matrix W is a diagonal matrix with elements equal to the inverse of the bootstrapped variances of the sample moments.

The moments we match are extracted from the unemployment durations and from the accepted wages distributions at flexible and non-flexible jobs. For the unemployment durations, we simply compute the mean and the proportion of individuals in unemployment. For the wage distributions, we need to exploit the fact that the identification of the types relies on the fractions of flexible and non-flexible job workers with overlapping wage support. We attain that by computing means and standard deviations of wages at flexible and non-flexible jobs over various percentile ranges defined on accepted wages at non-flexible jobs. In particular, we use percentile 0, 20, 40, 60, 80 and 100 of the non-flexible workers' accepted wage distribution to define 5 intervals. Within these 5 intervals, we compute the proportion of workers holding flexible jobs and the mean and standard deviations of wages at flexible and non-flexible jobs.²⁵ Matching wage moments and the proportions of flexible and non-flexible jobs over the same wage supports should capture the “smoothed out” discontinuities generated by a model with multiple types, as illustrated in the Section 4.

each type α such that $\alpha > k\rho V_U(\alpha)$ defines a parameter-dependent support over flexible and non-flexible jobs and the first step allows the estimation of only one such type α . The support of the variables over which the likelihood is defined depends on parameters and therefore a standard regularity condition is violated.

²⁴This is the most commonly assumed distribution in this literature because it satisfies conditions for the identification of its parameters and it provides a good fit for observed wages distributions.

²⁵The complete list of the simulated moments is in Appendix A.3.

Parameter	College	High School
μ	3.5343 (0.0066)	3.0107 (0.0116)
σ	0.5378 (0.0056)	0.4841 (0.0075)
η	0.0057 (0.0016)	0.0136 (0.0026)
λ	0.2288 (0.0504)	0.2196 (0.0355)
α_1	0.1035 (0.0609)	0.0100 (0.00004)
p_1	0.1256 (0.0103)	0.2084 (0.0337)
α_2	0.0100 (0.00003)	0.0255 (0.0120)
p_2	0.2437 (0.0119)	0.1641 (0.0202)
k	0.0004 (0.00004)	0.0006 (0.00005)
$\rho V_U(0)$	7.0000 (0.0211)	3.6500 (0.2449)
$\rho V_U(\alpha_1)$	15.3092 (5.1034)	3.9059 (0.8017)
$\rho V_U(\alpha_2)$	2.4100 (1.1328)	2.1555 (0.1250)
Loss function	46.561	3.671
N	1,356	1,166

Table 2: Estimation results (bootstrapped standard errors from 140 samples in parenthesis)

7 Results

The model is estimated separately with data from women with a high school degree, and women with at least a college degree. The implicit assumption is that the labor market is segmented along observable workers' characteristics so that the two education groups do not compete for the same jobs. This assumption is consistent with the ex-ante homogeneity condition imposed in the theoretical model and with previous literature on the estimation of search models.²⁶

The specification of the unobserved heterogeneity in preferences for flexibility includes three types. Due to the non-identification result discussed in Section 4, we set $\alpha_0 = 0$ for the type that only accepts non-flexible jobs. We estimated the model with four types but the specification did not generate a significant improvement of the model fit.²⁷

Estimated parameters are reported in Table 2. The parameter estimates fit the data very well (see the table in the Appendix A.3). Observe first that arrival rates, termination rates, and the two parameters of the lognormal distribution of match-specific productivity are comparable to the corresponding values obtained in the literature.²⁸ The arrival rates

²⁶See for example Bowlus (1997) and Eckstein and Wolpin (1995).

²⁷The additional type estimate of α converged in value to the α of one of the existing types and its proportion in the population was negligible.

²⁸See for example Flabbi (2010) and Bowlus (1997) who estimated comparable search models on samples of women. Flabbi used CPS 1995 data on white college graduates finding a very similar arrival rate and slightly lower average productivity in the presence of employers' discrimination. Bowlus used a NLSY 1979

imply that agents receive an offer, which they may accept or reject, about every 4 months on average. The sampling productivity distribution parameters (μ, σ) imply that the average productivity of college graduates is almost 40 dollars per hour while the average productivity of high school graduates is about 23 dollars per hour. The reservation wages should be interpreted as measured in dollars per hour, and they appear to be within a reasonable range.

The flexibility-related parameters have plausible values: about 37% of college educated women are willing to pay between 1 and 10 cents per hour to work in flexible jobs. Firms' cost of providing flexibility is 0.04% of the hourly potential productivity. A similar proportion of women with high school education value flexibility but they are willing to pay a lower dollar amount (between 1 and 2.5 cents per hour) while firms face a higher cost of providing it, about 0.06% of the hourly potential productivity.

We have a very limited model of the firms side of the market so it is difficult to find an explanation about why firms employing low skilled workers may have higher cost of flexibility. While lower skills makes it easier to substitute workers, secretarial and manual jobs are often performed in teams and require a higher need for coordinating work-hours among workers than professional jobs.

The difference between the parameter estimates on high school and college graduates suggests that women might choose schooling in part to accommodate a preference for job flexibility. Schooling is costly but provides access to jobs where the relative cost of flexibility is lower. This might provide a partial explanation to the puzzle of why women have lower wages than men, but acquire more schooling.²⁹

The simulations performed in the next section illustrate the important role of flexibility on labor market outcomes that these estimates imply.

8 Policy Experiments

We present three types of experiments. For each experiment we compute the new equilibrium and use it to generate a sample of wages and unemployment durations which we compare to a sample derived from the parameter estimates reported in Table 2 of Section 7 (the benchmark model). In each experiment we generate a sample of 100,000 observations to compute various statistics.

sample of college and high school women finding a slightly lower hazard rate from unemployment in the presence of a non-participation state.

²⁹The main explanations proposed so far have focused on the positive returns in the marriage market (Chiappori, Iyigun and Weiss 2006 and Ge 2008).

In the first experiment we keep all model parameters μ , σ , k , α , \mathbf{p} , $\rho V_U(0)$, $\rho V_U(\alpha_1)$, $\rho V_U(\alpha_2)$ to their estimated values for each educational level; in experiments 2 and 3 we only change parameter k to one half of its estimated value. To compute the equilibrium, we need the value of unemployment $b(\alpha_j)$ for each type, and because ρ and $b(\alpha_j)$ are only jointly identified, we fix the discount rate ρ to 0.05 and recover $b(\alpha_j)$ using the equilibrium equations (17) (for $j = 1, 2$) and (19) (for $j = 0$).³⁰

We present statistics computed from each experiment as ratios with respect to the same statistics computed using the parameter estimates, which we refer to as the “benchmark model”. Statistics from the benchmark model are presented in Table 3 for reference. The first row shows the discounted value of unemployment $\rho V_U(\alpha)$, which can be interpreted as a measure of welfare because $V_U(\alpha)$ is the value of participating in the labor market for a potential worker of type α . The next six rows report statistics about workers in flexible and non-flexible jobs: the average and standard deviation of accepted wages, and the proportion of employed individuals working in each flexibility regime. The next two rows present statistics for unemployed workers: the average unemployment duration and the unemployment rate. The last two rows show firm profits. The columns present values for each of worker type and for the whole sample, by educational achievement.³¹

8.1 Counterfactual 1: no flexibility

To understand the impact of flexibility, we ask how much the labor market outcomes of women would change if flexibility were not available. To answer this question, the first policy experiments imposes that all jobs must be non-flexible.

We fix all model parameters their estimated values for each educational level. To generate durations and wage distributions, we need to compute the equilibrium corresponding to the environment without flexibility. We impose the same behavioral model we have used so far, therefore the equilibrium wage schedule is characterized by a reservation value rule. The only decision workers have to make is between accepting or rejecting a wage offer at a non-flexible job. Therefore there will be only one reservation value, obtained by equating the value of unemployment and the value of employment at a given wage. The equivalent of Equation (11) is:

$$x^*(0) = \rho V_U(\alpha_j) \tag{30}$$

³⁰Flinn and Heckman (1982) use a value of 5% and 10% and Flinn (2006) uses 5%. We performed sensitivity analysis and found that doubling discount rate to 10% does not make an appreciable difference on the results.

³¹The values in the “All” column are not simple averages of each group’s mean but averages computed on the overall relevant sample.

	College				High School			
	α_0	α_1	α_2	All	α_0	α_1	α_2	All
$\rho V_U(\alpha)$	7.000	15.309	2.410	6.925	3.650	3.906	2.156	3.458
Workers in non-flexible jobs								
Mean wage	23.335	172.338	25.433	23.803	13.242	16.008	27.685	13.932
St. dev. wages	11.367	29.763	10.998	11.462	5.833	5.499	6.273	6.097
Prop. of empl. (%)	100.00	0.007	69.971	80.125	100.00	66.236	6.432	77.608
Workers in flexible jobs								
Mean wage	.	28.392	10.730	21.880	.	8.118	11.448	10.401
St. dev. wages	.	11.246	2.279	12.424	.	1.412	4.190	3.880
Prop. of empl. (%)	.	99.993	30.029	19.875	.	33.764	93.568	22.392
Unemployed workers								
Avg. unempl. dur.	4.378	4.677	4.371	4.414	4.556	4.556	4.555	4.556
Unempl. rate	0.024	0.026	0.024	0.024	0.058	0.058	0.058	0.058
Firms' average profits								
Non-flex Jobs	16.335	157.028	23.023	17.778	9.592	12.102	25.530	10.257
Flex Jobs	.	13.187	8.330	11.395	.	4.222	9.318	7.716

Table 3: Benchmark model: statistics computed using the parameter estimates

which can be computed by solving the fixed point equation:

$$\rho V_U(\alpha_j) = b(\alpha_j) + \frac{\lambda\beta}{\rho + \eta} \int_{\rho V_U(\alpha_j)} [x - \rho V_U(\alpha_j)] dG(x|\mu, \sigma) \quad (31)$$

which corresponds to equation (19) in the benchmark model.

This experiment has two unambiguous implications in terms of labor market outcomes. First, the range of productivities mapping into acceptable job matches is smaller than in the benchmark model. This can be intuitively understood by looking at the left panel in Figure 1. The range between $x^*(1)$ and $x^*(0)$ defines productivities where only jobs with a flexible regime are accepted: if we remove this job option a portion of jobs in this range will remain unfilled. Second, agents with preferences for flexibility have a lower value of participating in the labor market because a job amenity that they value is not available. We can measure this impact by comparing the present discounted value of unemployment $V_U(\alpha_j)$ with or without the policy.

Both of these impacts are very modest: Table 4 shows that the unemployment rate is only 0.05 per cent higher for the type with the highest value of flexibility (α_1 in the college sample) and essentially unchanged for the other types.³² The decrease in $V_U(\alpha_j)$ is

³²On the other types, the differences in unemployment rates before and after the policy are so small that the ratio between them approximate 100 at the fifth decimal.

	College				High School			
	α_0	α_1	α_2	All	α_0	α_1	α_2	All
$\rho V_U(\alpha)$	100.00	99.58	99.92	99.88	100.00	99.96	99.33	99.92
Workers in non-flex jobs								
Mean wage	100.00	16.43	82.39	98.22	100.00	83.79	44.99	94.38
St. dev. wages	100.00	38.05	104.54	101.10	100.00	107.16	93.07	96.03
Prop. of empl. (%)	100.00	1412473.1	142.91	124.80	100.00	150.97	1554.80	128.85
Unemployed workers								
Avg. unempl. dur.	100.00	100.06	100.00	100.01	100.00	100.00	100.00	100.00
Unempl. rate	100.00	100.05	100.00	100.01	100.00	100.00	100.00	100.00
Firms' profits								
Avg. profit	100.00	8.32	80.55	92.60	100.00	78.58	40.40	94.50
Tot. profit	100.00	9258.14	115.10	115.54	100.00	118.60	622.49	121.76

Table 4: No flexibility (benchmark model=100)

present for all the types that value flexibility but the amount of the decrease is very modest (between 0.04 and 0.42 per cent). The impact is so small because individuals react to the new environment by significantly decreasing the reservation wages to accept non-flexible jobs. In other words, they would like flexible jobs but lacking them they prefer non-flexible jobs to unemployment. This allows them to offset the impact on total welfare.

The implications for the distribution of accepted wages are ambiguous. First, accepted wages of agents with positive α change in two opposite directions. There is a positive effect since all the jobs are non-flexible so there is no wage cut due to the provision of flexibility. There is a negative effect since the workers' outside option in bargaining with the firms, $V_U(\alpha_j)$, is lower. The outside option is lower because the labor market does not provide an amenity that the workers value. Second, the composition of the productivity distribution of the accepted non-flexible jobs is different: the accepted non-flexible jobs are on average less productive than the accepted non-flexible jobs in the pre-policy regime because in the pre-policy regime low productivity matches were associated with flexible jobs.

The results show that the negative effects dominate. The average wages for types that value flexibility is considerably smaller, ranging from 16.4% of the average wage in the benchmark model for the α_1 -type in the college sample to 83.8% for the α_1 -type in the high school sample.

The impact on the proportion of employed individual working flexible and non-flexible is huge for types working mostly flexible in the pre-policy regime. Only 0.007% of the α_1 -type in the college sample is working in flexible jobs in the pre-policy regime while now 100% of them is forced to work in non-flexible jobs; accordingly, the proportion of workers

working non-flexible increases by about fourteen thousands times.

The impact on profits on types with a high value of flexibility is large due to composition effects. For example, the average profit firms make on the α_1 -type in the college sample is a small fraction of the pre-policy profit but this is because more α_1 -types work in flexible jobs generating a large increase in total profits.

To summarize, the impact of the presence of flexibility is large on some labor market outcomes (wages and hazard rates, redistribution of employment from flexible to non-flexible jobs) but small in other dimensions (unemployment).

8.2 Counterfactual 2: reduction of the cost of flexibility financed with costless technological innovation

The second and third experiments consider policies that ease the provision of flexible jobs by reducing their cost. We first consider a reduction of k to one half of the estimated value at zero cost to both employers or firms, due, for example, to spillovers from technological changes.³³ In the next subsection we will consider the effect of financing this cost reduction with taxation. All other parameters are set at their estimated values. The equilibrium has the same characterization as in the benchmark model (Section 3).

The implications for the realized distributions of accepted wages and durations are reported in Table 5. We expect an increase in welfare for workers' types that value flexibility. The increase in welfare is due to the provision of flexibility at a lower cost: since workers partially bear this cost due to bargaining, any cost reduction is beneficial to them. Results show that this effect is very small. The increase in welfare (first row of the table) is only between 0.01 and 0.13 percentage points. The reason is that the flexibility cost was very low in the benchmark model and therefore the cost reduction implied by the experiment is relatively modest.

Given this result, we also expect a larger range of productivities associated with acceptable jobs. In principle, the impact on the reservation productivity value at which jobs start to become acceptable ($x^*(h|\alpha)$) is ambiguous. Looking at the equation that defines reservation productivity, Equation (11), the numerator increases due to the increase in $\rho V_U(\alpha)$ and the denominator increases due to the decrease in k . However, we know from the first row of Table 5 that the increase in $\rho V_U(\alpha)$ is very small and therefore we expect the second effect to dominate leading to a decrease in $x^*(h|\alpha)$. A lower reservation values means that

³³That is, technological innovation motivated by other reasons may have as a spillover effect the reduction of the flexibility cost. For example, IT innovations may not be motivated by concerns on flexibility but makes telecommuting possible, effectively reducing the cost of providing flexibility.

	College				High School			
	α_0	α_1	α_2	All	α_0	α_1	α_2	All
$\rho V_U(\alpha)$	100.00	100.01	100.13	100.01	100.00	100.08	100.06	100.03
	Workers employed in non-flexible jobs							
Mean wage	100.00	179.00	148.01	102.97	100.00	149.12	182.18	98.94
St. dev. wages	100.00	118.70	99.37	108.81	100.00	101.19	164.19	103.64
Prop. of empl. (%)	100.00	0.24	31.73	85.47	100.00	23.47	2.46	85.06
	Workers in flexible jobs							
Mean wage	.	99.68	150.94	96.05	.	140.68	108.00	114.17
St. dev. wages	.	99.31	237.94	81.47	.	235.57	133.11	117.96
Prop. of empl. (%)	.	100.01	259.07	158.57	.	250.14	106.70	151.77
	Unemployed workers							
Avg. unemp dur	100.00	99.998	100.00	99.9998	100.00	100.00	100.00	100.00
Unempl. rate	100.00	99.998	100.00	99.9998	100.00	100.00	100.00	100.00
	Firms profits							
Avg (non flex)	100.00	186.70	153.02	100.52	100.00	164.95	189.11	98.69
Total (non flex)	100.00	169.73	48.63	85.93	100.00	38.80	6.40	83.96
Avg. (flex)	.	99.29	165.58	118.59	.	178.14	109.81	114.42
Total (flex)	.	99.30	428.62	188.06	.	445.21	117.17	173.60

Table 5: Half flexibility cost at zero cost to workers (benchmark model = 100)

some productivity ranges that were not acceptable before are now acceptable leading to decrease in unemployment. In the simulation, this decrease turns out to be negligible, with an order of magnitude of one thousandth of a percentage point on the type with the highest utility from flexibility.³⁴

Since flexibility is cheaper and preferences are unchanged, we expect a transfer of employed workers from non-flexible to flexible jobs. We also expect a greater inflow to employment in flexible jobs from unemployment since the reservation productivity value at which workers will accept a flexible job is lower. As a result, the proportion of employed working in flexible jobs increases. The eight row of Table 5 shows that the increase is large (about 2 and half times) for the α_2 -type in the College sample and the α_1 -type in the High school sample. These are types that value flexibility but still had more than half of the workers employed in non-flexible jobs in the benchmark model. The increase is small on the the other two types valuing flexibility because almost all the workers were already employed in flexible jobs in the benchmark model.

The equilibrium impact on average wages is complex and takes place through four different channels. The first three channels lead to an increase in average wages in both flexible

³⁴On the other types valuing flexibility the change is so small as to approximate 100 up to the fifth decimal.

and non-flexible jobs. First, the lower cost of flexibility has a positive impact on wages because the higher rents generated by the lower cost are split between workers and firms. Second, the equilibrium effect on the reservation wage is positive because the reservation wage is directly proportional to $\rho V_U(\alpha)$ which is increasing. Third, the composition in terms of productivity of workers working in flexible and non-flexible jobs is changing. The transition from non-flexible to flexible jobs involves productivity ranges that are low with respect to non-flexible jobs in the benchmark model but high with respect to flexible jobs in the benchmark model. Therefore, average wage will increase in flexible jobs because of the inflow of high productivity workers and will also increase in non-flexible jobs because only the most productive workers will remain there. The fourth channel works through the lower reservation productivity value at which workers accept a flexible job. Since the reservation productivity value is lower, there is an inflow of relative low productivity workers into flexible jobs leading to a negative impact on the average wage of workers in flexible jobs.

The results show that the first three channels dominate on all types with the exception of type α_1 in the College sample. Average wages increase by about 50 per cent or more in non-flexible jobs for both α_1 and α_2 types on both the College and High School sample. Wages also increase in flexible jobs: by about 50 per cent on type α_2 in the College sample and by about 40 per cent on type α_1 in the High School sample. For the College sample type α_1 they decrease slightly (see fifth row and second column of Table 5). Almost all workers of this type were employed in flexible jobs in the pre-policy regime, therefore they are most sensible to the wage compression due to the lower reservation productivity value (the fourth channel described above).

There are also economically significant impacts on profits. Starting with α_2 -type workers with college education, we observe that average profits in non-flexible jobs increase. The increase is due to the redistribution of workers from non-flexible to flexible jobs: with respect to the pre-policy environment fewer but more productive matches are realized without flexibility, therefore overall profits will decrease and average profit will increase. Over this type of workers, average profits at flexible jobs also increase. This is because the additional surplus generated by the lower cost of flexibility is not fully appropriated by the worker but it is partially distributed to the firm. The only type over which profits do not increase is type α_1 in the College sample. Similarly to what happens on wages, the reservation productivity value at which jobs become acceptable decreases, leading to lower average and total profits.

	College				High School			
	α_0	α_1	α_2	All	α_0	α_1	α_2	All
$\rho V_U(\alpha)$	100.00	100.01	100.13	100.01	100.00	100.08	100.06	100.03
Workers in non-flexible jobs								
Mean wage	99.72	179.00	148.01	102.72	100.02	148.56	181.01	98.93
St. dev. wages	100.91	118.70	99.37	109.62	100.83	102.69	143.28	104.25
Prop. of empl. (%)	100.00	0.24	31.73	85.47	100.00	23.47	2.46	85.06
Workers in flexible jobs								
Mean wage	.	99.68	150.95	96.05	.	140.53	108.09	114.17
St. dev. wages	.	99.31	237.94	81.47	.	234.98	134.74	118.95
Prop. of empl. (%)	.	100.01	259.07	158.57	.	250.14	106.70	151.77
Unemployed workers								
Avg. unemp dur	100.0001	99.9985	100.00	99.9998	100.0002	100.0001	100.00	100.0004
Unempl. rate	100.0001	99.9986	100.00	99.9998	100.0001	100.0001	100.00	100.0003
Firms' profits								
Avg. (non-flex)	99.60	186.70	153.02	100.19	100.03	164.20	187.84	98.67
Total (non-flex)	99.60	169.73	48.63	85.64	100.03	38.62	6.36	83.94
Avg. (flex)	.	99.29	165.58	118.59	.	177.86	109.93	114.41
Total (flex)	.	99.30	428.62	188.06	.	444.51	117.30	173.58

Table 6: Half flexibility cost financed by lump-sum tax (benchmark model = 100)

8.3 Counterfactual 3: reduction to the cost of flexibility financed by lump-sum tax

In the third experiment we consider a reduction in the cost of flexibility financed by a lump-sum tax on all workers. The main difference with the second experiment is that the types that do not value flexibility are now directly affected by the policy since they are subject to the lump-sum tax.

The model is characterized by the same structural parameters of the previous case. The lump-sum tax is computed endogenously as the tax rate necessary to support in equilibrium a cost reduction of k to one half of its estimated value. The new equilibrium is analogous to the one obtained in the Section 3, with the addition of the derivation of the tax rate. Details of such derivation are in Appendix A.4.

The results are reported in Table 6. The impact on types α_1 and α_2 is very similar to the one in the second experiment: the tax generates a modest difference in labor market outcomes with respect to the second experiment because the cost of flexibility is very low and therefore the tax required to finance it is very low. Individuals belonging to the α_0 -type

pay a tax for something that does not benefit them, therefore their welfare should decrease in the post-policy environment. However, the tax is extremely small and the cost of the tax is shared with the firms through bargaining. As a result, their welfare loss is so small that the welfare value of the α_0 -type is less than a thousandth of a percentage point smaller in the post-policy environment than in the pre-policy environment. This welfare loss is more than compensated by the gains on the other two types which ranges from 0.01 per cent to 0.13 per cent. The overall average welfare gain is a tenth of a percentage point on the College sample and about 0.03 per cent on the High School sample.

One general conclusion from the policy experiments is that, despite the small magnitude of the change in policies we are proposing, there is a large effect on wages. If the policy objective is to impact the wage structure, then policies aimed at reducing the cost of providing flexibility could be particularly effective. Moreover, if it actually exists a strong asymmetry in preference for flexibility between men and women - as some anecdotal evidence seems to indicate - then these policies have the potential to reduce the wage gap because they increase female wages proportionally more than male wages.

9 Conclusion

In this paper, we estimate the parameters of a dynamic search model of the labor market where workers and firms bargain over wages and the provision of flexibility. We maintain the narrow definition of flexibility most frequently found in the literature - flexibility as the availability of part-time work - and show that women value this amenity significantly.

In our estimates we also find that college graduates and high school graduates value flexibility differently. College graduates place higher value to having a flexible jobs. Moreover, we find that jobs requiring a college education can provide flexibility at lower cost. Because women might choose schooling also to accommodate their preference for job flexibility, we speculate this might explain some of the observed differences in schooling achievements between men and women.

The counterfactual experiments reveal that the impact of flexibility is quite substantial on some labor market outcomes (wages and hazard rates, the distribution of employment between flexible and non-flexible jobs) but not on others (unemployment). For example, without flexibility, for college-educated women that value flexibility the most, the average wage would be 74% lower, while the unemployment rate would be at most 0.06% higher than in the benchmark environment with flexibility. We infer from our experiments that policies reducing the cost of flexibility provision could be very effective in changing the

realized wage distribution at little cost in terms of employment.

Our approach presents four main limitations. First, in the empirical application of our model we define flexible jobs using part-time jobs. A more appropriate definition should also capture the option of organizing work time in a flexible way.

Second, we estimate the model by schooling groups and we find significant differences between them but we did not integrate a schooling decision in the model and in the estimation procedure. We think devoting future work to fill this gap is particularly promising to test our conjecture that expectations on future job amenities, such as flexibility, are important components of the schooling choices of women.

Third, employers and workers in our model are very stylized. In particular we assume a homogenous cost of providing flexibility, and workers are heterogeneous only in education and preference for flexibility. Estimating heterogeneous costs and correlations between costs and industries could help explain why we observe different preference across different skill levels and could deepen our understanding of the feedback of the labor market on schooling choice. Just as we find that different levels of schooling are correlated with preferences for flexibility, we could find that different types of jobs or schooling at same level (for example college majors) are correlated with preferences for flexibility because they increase the likelihood of working in jobs and industries that provide flexibility at low cost.

Fourth, we have found a strong impact of flexibility on wages and a significant correlation between preference for flexibility and level of schooling. There is a large literature on gender differentials on both variables which is currently facing a puzzle: recent U.S. workers data shows women earning lower wages, despite having a positive schooling differential with respect to men. Results from the counterfactuals show that changes in the provision of flexibility (for example through a subsidization of its cost) have a large differential impact for people that value flexibility differently. Therefore, a higher preference for flexibility for women with respect to men (if proved), could potentially explain a large portion of the gender wage differential. Moreover, if we can conclude that women choose college at least in part to obtain flexibility in their future jobs, we could also explain part of the gender college differential.

The lack of males working in flexible jobs in our data prevented us to provide estimates for men. We hope that a more complete data set providing a better definition of flexibility (and possibly more detailed schooling and firms information) will also generate enough data variation to estimate the model on a sample of men.

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A Appendix

A.1 Derivation of Value Functions

The value of employment at wage w and flexibility regime h for an agent with preference α working at a firm with flexibility cost k is given by the following discrete time approximation:

$$\begin{aligned} V_E(w, h; \alpha, k) &= (w + \alpha h) \Delta t + \\ &+ \rho(\Delta t)[(1 - \eta\Delta t)V_E(w, h; \alpha, k) + \eta\Delta tV_U(\alpha) + o(\Delta t)] \end{aligned} \quad (32)$$

where Δt denotes a time span. This expression states that the value of employment is given by the utility received in the entire period plus the discounted expected value of remaining at the job or of falling in the unemployment state. Other possible events are happening with a negligible probability $o(\Delta t)$. Assuming $\rho(\Delta t) = (1 + \rho\Delta t)^{-1}$, rearranging terms and dividing both sides by Δt , we obtain:

$$\begin{aligned} \frac{(1 + \rho\Delta t)}{\Delta t} V_E(w, h; \alpha, k) &= (w + \alpha h) \Delta t \frac{(1 + \rho\Delta t)}{\Delta t} + \\ &+ \frac{(1 - \eta\Delta t)}{\Delta t} V_E(w, h; \alpha, k) + \frac{\eta\Delta t}{\Delta t} V_U(\alpha) + \frac{o(\Delta t)}{\Delta t} \end{aligned} \quad (33)$$

Since the Poisson process assumption implies that $\lim_{\Delta t \rightarrow 0} \frac{o(\Delta t)}{\Delta t} = 0$, when $\Delta t \rightarrow 0$ the previous expression converges to:

$$\rho V_E(w, h; \alpha, k) = w + \alpha h - \eta V_E(w, h; \alpha, k) + \eta V_U(\alpha) \quad (34)$$

After collecting terms, this equation is equivalent to (3).

The value of unemployment for an agent with preference α is given by the following discrete time approximation:

$$\begin{aligned} V_U(\alpha) &= b(\alpha)\Delta t + \\ &+ \rho(\Delta t) \left\{ (1 - \lambda\Delta t)V_U(\alpha) + \lambda\Delta t \int \max[V_E(w, h; \alpha, k), V_U(\alpha)] dG(x) + o(\Delta t) \right\} \end{aligned} \quad (35)$$

This expression states that the value of unemployment is given by the total (dis)utility from unemployment over the period, equal to $b(\alpha) \Delta t$, and by the the fact that after a period Δt

two main events may happen: not meeting any firm and remain unemployed or meeting a firm, extract a match-specific productivity value x and decide if accept the job offer or not. We can proceed as with the derivation of V_E , obtaining:

$$\begin{aligned} \frac{(1 + \rho\Delta t)}{\Delta t} V_U(\alpha) &= b(\alpha)\Delta t \frac{(1 + \rho\Delta t)}{\Delta t} + \frac{(1 - \lambda\Delta t)}{\Delta t} V_U(\alpha) + \\ &+ \frac{\lambda\Delta t}{\Delta t} \int \max[V_E(w, h; \alpha, k), V_U(\alpha)] dG(x) + \frac{o(\Delta t)}{\Delta t} \end{aligned} \quad (36)$$

Takin the limit to continuous time this expression becomes:

$$\rho V_U(\alpha) = b(\alpha) - \lambda V_U(\alpha) + \lambda \int \max[V_E(w, h; \alpha, k), V_U(\alpha)] dG(x) \quad (37)$$

leading to equation (4) when we collect terms.

Finally, the value of a filled job for a firm with technology k paying a wage w , offering a flexibility regime h to an agent with preference α is:

$$\begin{aligned} V_F(pr, h; \alpha, k) &= [(1 - kh)x - w] \Delta t + \\ &+ \rho(\Delta t)[(1 - \eta\Delta t)0 + \eta\Delta t V_F(pr, h; \alpha, k) + o(\Delta t)] \end{aligned} \quad (38)$$

Notice that the dependence on the worker's preference is through the wage schedule, which depends on α after the bargaining game is solved. Applying the assumption on the discount function $\rho(\Delta t)$ and rearranging we get:

$$\frac{(1 + \rho\Delta t)}{\Delta t} V_F(pr, h; \alpha, k) = [(1 - kh)x - w] \frac{(1 + \rho\Delta t)}{\Delta t} + \frac{\eta\Delta t}{\Delta t} V_F(pr, h; \alpha, k) + \frac{o(\Delta t)}{\Delta t} \quad (39)$$

and taking limits to continuous time:

$$\rho V_F(pr, h; \alpha, k) = [(1 - kh)x - w] + \eta V_F(pr, h; \alpha, k) \quad (40)$$

leading to equation (5) when we collect terms.

A.2 Proof of Proposition 1

Proof. By definition of the reservation values:

$$x^{**} \leq x^*(0) \iff \frac{\alpha}{k} \leq \rho V_U(\alpha) \iff \alpha \leq k\rho V_U(\alpha)$$

Also by definition of the reservation values we obtain:

$$x^*(0) \leq x^*(1) \iff \rho V_U(\alpha) \leq \frac{\rho V_U(\alpha) - \alpha}{1 - k} \iff \alpha \leq k\rho V_U(\alpha)$$

proving the claim. ■

A.3 Matched Moments

We match mean unemployment duration and the proportion of individuals in unemployment exactly to compute the hazard rate and ρ . To estimate the other parameters, we match various moments of portions of five interquartiles of the flexible and non-flexible workers' wage distributions delimited by percentiles 0, 20, 40, 60, 80, and 100 of the non-flexible workers' wage distribution. The moments we match are: the mean and standard deviation of wages of workers in non-flexible jobs, the fraction of workers in flexible jobs, and the mean and standard deviation of wages of workers in flexible jobs. The following table illustrates the moments in the data and simulated moments at the estimated parameter values.

Sample	Non-flexible jobs				Flexible jobs					
	Mean wages		St. dev. wages		Prop. workers		Mean wages*		St. dev. wages*	
	Estim.	Data	Estim.	Data	Estim.	Data	Estim.	Data	Estim.	Data
All College	23.715	23.410	11.302	10.360	0.191	0.200	21.836	22.490	12.784	14.152
Quintile 1	12.297	12.032	1.976	2.273	0.311	0.311	3.495	3.447	2.491	2.470
Quintile 2	16.858	17.085	1.124	1.106	0.118	0.122	2.020	2.131	1.798	1.911
Quintile 3	21.141	21.134	1.270	1.352	0.128	0.071	2.701	1.528	2.374	1.469
Quintile 4	26.587	26.574	1.857	2.080	0.163	0.190	4.368	5.037	3.683	4.144
Quintile 5	39.222	39.910	7.783	8.196	0.197	0.195	7.819	8.021	6.483	6.714
All High Sc.	13.933	13.879	6.097	5.923	0.218	0.219	10.512	10.294	3.918	4.279
Quintile 1	7.321	7.532	1.179	1.253	0.379	0.369	2.744	2.765	1.768	1.798
Quintile 2	10.301	10.091	0.718	0.731	0.276	0.277	2.757	2.769	2.008	2.026
Quintile 3	12.718	12.735	0.736	0.770	0.145	0.144	1.846	1.843	1.590	1.609
Quintile 4	15.640	15.559	1.004	1.139	0.146	0.144	2.273	2.223	1.956	1.945
Quintile 5	22.452	22.392	3.974	4.137	0.089	0.084	1.760	1.780	1.622	1.703

*Because some quintiles may not display any worker in flexible jobs for some parameter values and because identification relies on the fractions of flexible and non-flexible job workers with overlapping wage support, means and standard deviations of wages in flexible

jobs were multiplied by the corresponding fraction of workers in flexible job (except for the row displaying moments for all workers).

A.4 Derivation of Lump-sum Tax in Counterfactual Experiment 3

The equilibrium characterization of this model is analogous to that obtained in Section 3, but we also need to compute the tax rate t . Wages and profits result from bargaining over the surplus. The surplus - represented in the pre-policy environment by equation (6) - now becomes:

$$S(x, w, h; \alpha, k) = \frac{1}{\rho + \eta} [w - t + \alpha h - \rho V_U(\alpha)]^\beta [(1 - k'h)x - w]^{(1-\beta)} \quad (41)$$

leading to the following wage schedule:

$$\tilde{w}(x, h) = \beta (1 - k'h)x + (1 - \beta) [\rho V_U(\alpha) + t - \alpha h] \quad (42)$$

This is the wage schedule that corresponds to equation (7) in the pre-policy environment. As in the benchmark case, the model can be written recursively. The value of unemployment equations used to compute the reservation values are, for α_0 :

$$\rho V_U(\alpha_0) = b(\alpha_0) + \frac{\lambda\beta}{\rho + \eta} \int_{\rho V_U(\alpha_0) + t}^{\alpha_j} [x - \rho V_U(\alpha_0) - t] dG(x|\mu, \sigma) \quad (43)$$

and for α_1, α_2 :

$$\begin{aligned} \rho V_U(\alpha_j) &= b(\alpha_j) + \frac{\lambda\beta}{\rho + \eta} \int_{\frac{\rho V_U(\alpha_j) + t - \alpha_j}{1 - k'}}^{\frac{\alpha_j}{k'}} \left[x - \frac{\rho V_U(\alpha_j) + t - \alpha_j}{1 - k'} \right] dG(x|\mu, \sigma) \\ &+ \frac{\lambda\beta}{\rho + \eta} \int_{\frac{\alpha_j}{k'}}^{\alpha_j} [x - \rho V_U(\alpha_j) + t] dG(x|\mu, \sigma) \end{aligned} \quad (44)$$

where we have already imposed the optimal wage schedule and the optimal decision rule based on the reservation values:

$$x^*(h|\alpha_j) = \frac{\rho V_U(\alpha_j) + t - \alpha_j h}{1 - k'h}$$

Given these equations the equilibrium is defined as in the benchmark model.

To compute the endogenous tax rate we need to know in equilibrium the proportion of workers who are employed and unemployed. To obtain these values, it is useful to define the hazard rate from unemployment to employment in flexible and non-flexible jobs. Given the

stationarity of the model and the Poisson process assumption, the hazard rates are constant and equal to the probability of receiving an offer multiplied by the probability to accept it. For types α_1 and α_2 , the hazard rate from unemployment to employment in flexible jobs is:

$$r(h = 1|\alpha_j) = \lambda \left[G\left(\frac{\alpha_j}{k'}|\mu, \sigma\right) - G\left(\frac{\rho V_U(\alpha_j) + t - \alpha_j}{1 - k'}|\mu, \sigma\right) \right] \quad (45)$$

For types α_0 , α_1 and α_2 , the hazard rate from unemployment to employment in non-flexible jobs is:

$$r(h = 0|\alpha_j) = \lambda(1 - G[\rho V_U(\alpha_0) + t|\mu, \sigma]) \quad (46)$$

By equating flow in and out unemployment, we obtain the steady state equilibrium rates of unemployment:

$$\begin{aligned} u(\alpha_0) &= \frac{\eta}{r(h = 0, \alpha_0) + \eta} \\ u(\alpha_j) &= \frac{\eta}{[r(h = 0, \alpha_j) + r(h = 1, \alpha_j)] + \eta}; \alpha_j = \alpha_1, \alpha_2 \end{aligned} \quad (47)$$

We can then compute the total expense (TE) to reduce the cost of providing flexibility by multiplying the per unit cost ($k - k'$) for the total mass of workers employed in flexible jobs:

$$TE = (k - k') \left[\frac{r(h = 1|\alpha_1)}{\eta} u(\alpha_1) p_1 + \frac{r(h = 1|\alpha_2)}{\eta} u(\alpha_2) p_2 \right] \quad (48)$$

The total lump-sum tax TT is paid by all employed workers, so it will be equal to:

$$TT = t[(1 - u(\alpha_0)) p_0 + (1 - u(\alpha_1)) p_1 + (1 - u(\alpha_2)) p_2] \quad (49)$$

Notice that both TE and TT are a function of the tax rate because the equilibrium unemployment rate depends on t . By equating tax revenue with expenses, $TT=TE$, we obtain an implicit function of the tax rate t that we can solve for t .