The European Unemployment Puzzle: The Importance of Bargaining and Endogenous Job Destruction in a Dynamic Matching Model

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Abstract

This paper explores the roles of wage bargaining and endogenous job destruction in accounting for the effect of unemployment insurance on the level of unemployment when unemployed workers may be subject to loss of specific skills. Under generalized Nash wage bargaining, high unemployment benefits imply greater worker bargaining power, but not necessarily higher unemployment. Further, when separations are endogenous, a higher rate of skill loss tends to reduce the flow into unemployment, even when unemployment benefits are high. These factors are shown to reverse the findings of Ljungqvist and Sargent (1998) that tie the divergence of European and U.S. unemployment rates to the interaction of high unemployment compensation with increased economic turbulence.

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1 Introduction

After the oil shocks in the 1970s, unemployment increased in both the U.S. and Europe. While the unemployment rate decreased in America during the 1980s and is now at a record low, it remained high (see Figure 1) in most European countries[1].

Lindbeck and Snower (1988) and Blanchard and Summers (1986) blame strong unions bargaining for high wages, which leads to fewer new jobs. High employment protection and with it low job separation rates have been singled out by Blanchard and Portugal (1998) as well as many others (Bentolila and Bertola, 1990, Bertola and Rogerson, 1997, Garibaldi, 1998, Lazear, 1990, Millard, 1995). They argue that employment protection discourages job creation because firms cannot easily fire the workers again. Alvarez and Veracierto (1999), Ljungqvist and Sargent (1995), Pissarides (1998), and many others argue that high unemployment insurance makes workers more reluctant to accept low paying jobs.

More recently, research efforts have shifted from explaining the status quo to accounting for both the similar behavior of the U.S. and European economies until the mid-Seventies and their subsequently diverging unemployment rates. The importance of unions and employment protection has decreased since the Seventies, and hence neither can be the sole culprit for Europe's high unemployment rates. The growth of hourly wages and unemployment benefits in Europe has slowed substantially in the mid-Eighties, but this is precisely when unemployment rates started to soar. As a result, a new line of research which studies the interactions among shocks and institutions has emerged (Coe and Snower, 1996, Blanchard, 1998b). Mortensen and Pissarides (1999) use a standard matching framework to demonstrate how an increased spread in idiosyncratic productivities can lead to higher mean unemployment in Europe than in the U.S., even if initial unemployment is the same.

Ljungqvist and Sargent (1998) focus on the labor supply decision and its relation to the generosity of unemployment benefits. Their analysis highlights the strong effect of match and industry specific skills when workers are forced to switch industries and unemployment benefits are linked to past earnings. Unemployed workers who previously had a high-paying job are faced with new wage offers that cannot compete with the unemployment benefits they

[1] See Nickell (1997) for a detailed analysis of individual European countries.

Figure 1: Unemployment rates for the U.S. and Europe. Source: 1959–1970 Handbook of Labor Statistics (1974), Tables 1 and 164; 1970–1999 OECD Economic Outlook. For 1959–1970 Europe is represented by France, West Germany, Great Britain, Italy, and Sweden and after 1970 includes all current members of the European Union.

receive, so they decide to remain unemployed. In the "tranquil" Fifties when only few workers switched industries, this effect is not very strong. In the "turbulent" Nineties, however, when a large fraction of workers is forced to switch, the unemployment rate shoots up. This model is consistent with the observation that long-term unemployment has increased across Europe (Blank, 1997, Ljungqvist and Sargent, 1998).

While Ljungqvist and Sargent focus exclusively on the labor supply decision, I explore the implications for the unemployment rate when firms' labor demand decisions are added by carefully modeling both parties to an employment contract, i.e. workers *and firms*. I argue that Ljungqvist and Sargent's ad-hoc wage determination process is biased toward too many rejections of job offers because it neglects a firm's incentive to negotiate as long as an additional job yields an increase in the firm's expected discounted future profits. By generalizing the framework of Ljungqvist and Sargent to allow for negotiation of wage payments, I show that unemployment insurance improves the bargaining position of a worker, but typically does not imply the higher job rejection rates predicted by Ljungqvist and Sargent.

In addition, Ljungqvist and Sargent assume that separation rates are exogenously fixed and thus do not change in response to the increased possibility of skill obsolescence. By studying endogenous separations in a Mortensen-Pissarides type framework, however, I show that if workers take the increased risk of losing their skills into account properly, they become more reluctant to quit, and the model would actually predict *lower* unemployment for Europe in the Nineties than in the Fifties. In summary, my paper shows that the results of Ljungqvist and Sargent rely on neglecting a firm's role in the wage bargaining process and ignoring a worker's caution when quitting a job.

Section 2 presents my adaptation of Ljungqvist and Sargent's (1998) model of an economy with ad-hoc bargaining, which differs from the original in the details but captures the main features. Section 3 then introduces firms and allows negotiations between workers and firms to determine the wage rate. The outcomes of both economies are compared for different levels of economic turbulence and highlight the effect of bargaining on unemployment and wages. Section 4 extends the model to allow for endogenous separations and demonstrates their interactions with economic turbulence. Section 5 checks the results for robustness. Finally, section 6 discusses an extension and concludes.

2 A Search Economy with Ad-hoc Wage Determination

The model developed in this section is intended to replicate the main ideas of Ljungqvist and Sargent (1998) while being embedded in a general equilibrium framework. From there, the model can then be easily extended to allow for more general wage setting institutions and endogenous separations[2].

The economy is inhabited by a continuum of risk neutral workers with stochastic lifetimes. In each period a fraction δ of the population dies and the same number of newborns enters

[2]The present ad-hoc bargaining model differs from Ljungqvist and Sargent (1998) insofar as they assume nonstochastic productivities at every skill level, and workers draw their wage rate from a fixed distribution. Here the split of output, ϖ, is constant, and the productivities are stochastic. Both setups lead to stochastic wages.

the economy. Agents do not care about future generations, so bequests are not an issue. There is no disutility of labor, so agents maximize expected after-tax lifetime income by deciding whether to accept a job or not. This is the only decision that agents can make. A newborn or unemployed worker is matched to a firm with probability λ^w. We can interpret the match as the worker getting a job interview. At the interview, the worker determines how adept he is at performing the job at hand by drawing a productivity θ, which is equivalent to the output of the match, according to the probability law ν_k. The worker decides whether or not to accept the job based on his productivity and wage, which is just a share ϖ of the match output.

The two skill levels in the economy, $k = h$ and $k = l$, are associated with high and low skills. Correspondingly there are two productivity distributions, ν_h and ν_l, with $\nu_h(\theta) < \nu_l(\theta)$. With probability π^h an employed low-skilled worker becomes high-skilled, which gives him an increase in productivity by exactly the amount necessary to put him at the same quantile on the productivity distribution ν_h as he was on ν_l. This setup guarantees that once a worker has accepted a job, he will never initiate a separation. Matches are randomly destroyed with probability χ^x, so every worker is equally likely to lose his job regardless of skill and tenure[3].

Upon separation, a worker switches from being high- to low-skilled with probability π^l. While unemployed, an agent receives unemployment compensation as a fraction β of the average wage for his skill level when he was last employed.

Unemployment benefits are financed through income taxation at a rate τ on payments to both workers and firms, and can hence be interpreted as taxation of both labor and entrepreneurial income. The income tax rate is set so that in steady state tax revenues cover unemployment compensation expenses.

2.1 The Job Acceptance Decision

In this economy workers and firms do not bargain over the surplus generated by the match; the worker just receives a fixed fraction ϖ of output instead. There are no endogenous

[3]The latter two assumptions are made in Ljungqvist and Sargent (1998) and will be relaxed later.

separations; once workers decide to enter a match, nothing in the future can make the worker and firm willing to separate, so they will stay together until exogenously separated. Let k denote the current skill level of an unemployed worker. When deciding whether to accept a job, a worker compares the after-tax wage offer plus the expected discounted future benefits $V_m^w(\theta, k)$ of entering into the match to his current unemployment benefits plus the expected discounted value of waiting for a better match. The expected benefits of entering into the currently proposed match depend on a worker's skill level, k, and the productivity, θ, of the match. Unemployment benefits are linked to the past earnings of a worker through his past skill level, k^o. For simplicity, unemployment benefits are a proportion of the mean wage for each skill level, so that all workers of a given past skill level receive the same unemployment compensation, $b(k^o)$. The value of staying in the unemployment pool, $V_u^w(k^o, k)$, depends on the past skill level, which determines the level of the unemployment benefits, and on the current skill level, which determines the type of match a worker can find. The lowest productivity $\underline{\theta}\,(k^o, k)$ necessary for accepting a job offer makes the worker indifferent between accepting the job or remaining unemployed. Therefore $\underline{\theta}\,(k^o, k)$ is the solution to

$$(1-\tau)\varpi\underline{\theta}\,(k^o, k) + V_m^w(\theta, k) = b(k^o) + V_u^w(k^o, k), \tag{1}$$

where ϖ is the worker's share of output. For simplicity, assume that rejecting a job offer does not alter a worker's eligibility for unemployment insurance. Note, however, that when an offer is accepted and the first wage is paid out, future unemployment benefits would no longer depend on k^o. The firm plays no role in the decision process in this version of the model.

The worker's benefit from ending this period in the matching pool can be formulated recursively as being matched with probability λ^w or staying in the matching pool with probability $(1-\lambda^w)$. It depends on the skill level in the last active job through unemployment compensation. Let ϱ denote a worker's total discount factor, $\varrho = (1-\delta)(1-\rho)$, that accounts for both dying (δ) and discounting (ρ). We can then write

$$V_u^w(k^o, k) \quad = \quad \lambda^w V_I^w(k^o, k) + \varrho(1-\lambda^w)\left(V_u^w(k^o, k) + b(k^o)\right). \tag{2}$$

$V_I^w(k^o, k)$ denotes the worker's expected discounted value of obtaining a job interview, which involves averaging the expected value of the future benefits of being in a match, $V_m^w(\theta, k)$, over θ. To be more precise, upon being matched, a firm-worker pair receives a productivity draw. Because the productivity draw is not known before the job interview, the worker's expected discounted value of a job interview is given by

$$\begin{aligned} V_I^w(k^o, k) &= \varrho \int_0^{\underline{\theta}(k^o,k)} \left(b(k^o) + V_u^w(k^o, k)\right) \mathrm{d}\nu_k(\tilde{\theta}) \\ &+ \varrho \int_{\underline{\theta}(k^o,k)}^{\infty} \Big((1-\tau)p^w(\tilde{\theta}) + V_m^w(\tilde{\theta}, k)\Big) \mathrm{d}\nu_k(\tilde{\theta}), \end{aligned} \quad (3)$$

where $p^w(\theta)$ denotes the wage payments to the worker, which in this simple setting are given by $p^w(\theta) = \varpi\theta$.

Low-skilled workers cannot lose skills upon separation, but while they are in a match they can get promoted with probability π^h. When a matched worker gets promoted to being a high-skilled worker, he does *not* receive a new productivity draw. Instead he just moves to the same quantile on the higher distribution. A low-skilled worker's value of ending this period in a match is hence given by

$$\begin{aligned} V_m^w(\theta, l) &= \varrho(1-\chi^x)\pi^h \left((1-\tau)p^w(\theta') + V_m^w(\theta', h)\right) \quad (4) \\ &+ \varrho(1-\chi^x)(1-\pi^h) \left((1-\tau)p^w(\theta) + V_m^w(\theta, l)\right) \\ &+ \varrho\chi^x \left(V_u^w(l, l) + b(l)\right), \end{aligned}$$

where θ' denotes the appropriately changed productivity after the worker switched to the high skill level, and χ^x denotes the exogenous separation probability. The value of ending this period in a match as a high-skilled worker takes the possible skill loss upon separation into account and can be written as

$$\begin{aligned} V_m^w(\theta, h) &= \varrho(1-\chi^x) \left((1-\tau)p^w(\theta) + V_m^w(\theta, h)\right) \quad (5) \\ &+ \varrho\chi^x \left(\pi^l V_u^w(h, l) + (1-\pi^l) V_u^w(h, h) + b(h)\right). \end{aligned}$$

2.2 Aggregate Flows and Equilibrium

In steady state, flows into and out of unemployment must be the same. It is useful to disaggregate both the employment and the unemployment pools based on agents' past and current skill levels. With two skill levels we obtain a total of nine possible states. The

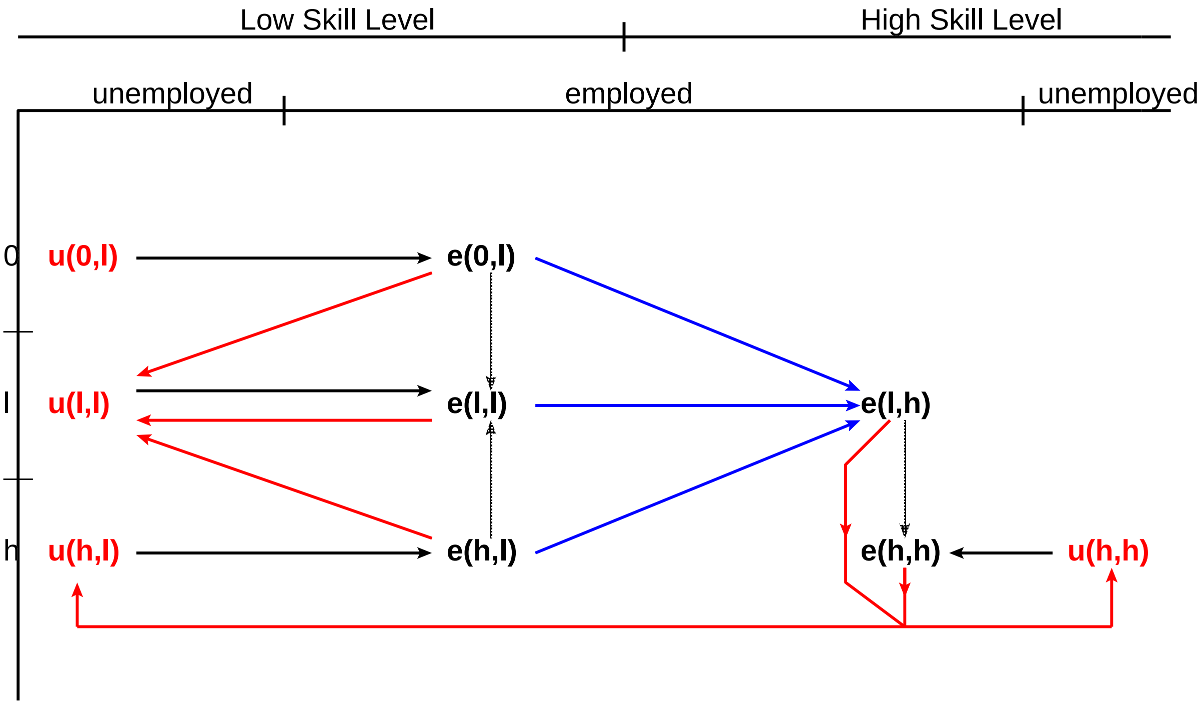

Figure 2: Transition between (un)employment states.

flows between these states[4] are illustrated in Figure 2. A newborn worker starts out in state $u(0,l)$. He is ineligible for unemployment benefits and endowed with low skills. After finding a job and working for one period as a low-skilled $e(0,l)$ worker, he becomes eligible for unemployment benefits and moves to state $e(l,l)$. Should the match be separated now, the worker has established eligibility for unemployment compensation and moves to the unemployment state $u(l,l)$. If the match is not separated, the worker switches to the high-skill level state $e(l,h)$ with probability π^h. After receiving his first paycheck as a high-skilled worker, he establishes eligibility for high unemployment benefits and moves to state $e(h,h)$. Upon separation, a high-skilled worker can keep his skills and move to $u(h,h)$, from where he will return to the pool of high-skilled workers for his next match. With probability π^l a skilled worker loses his skills upon separation and joins unemployment pool $u(h,l)$. This group of low-skilled workers with high unemployment benefits drives the results of Ljungqvist and Sargent. Given both the probabilities of accepting a job offer and the matching probabilities, we can solve a linear system of nine equations to obtain the steady state probabilities for

[4]The corresponding flow equations are available from the author upon request.

each state.

Equilibrium determination involves a discounted lifetime utility maximizing choice of $\underline{\theta}(k^o, k)$ and the resulting expected future utility. To obtain a steady state solution solve equations (1) – (3) together with the flow equations. Existence of equilibrium can be shown analogously to Ramey and Watson (1997).

2.3 Steady State Results

The goal of Ljungqvist and Sargent (1998) is to explain how the unemployment rate in the U.S. and Europe could be low in both regions during the Fifties and Sixties, but so markedly different in the Eighties and Nineties; with unemployment low in the U.S. and high in Europe. Economies differ across continents and over time as depicted in Figure 3. The distinguishing feature across continents is that the U.S. generally has far less generous unemployment benefits than Europe[5]. Ljungqvist and Sargent consider the increasing speed of advances in technology to be the main difference over time both in the U.S. and Europe. Such an increase in technological advances leads to faster changes in the industry mix of a country. Ljungqvist and Sargent argue that workers in the Fifties had better chances of finding another job in their industry and as a result, could easily transfer skills acquired on their job to another job. In the rapidly changing economy of the Nineties, workers have a hard time staying in their industry and therefore will have to start accumulating new and different skills when switching[6]. Ljungqvist and Sargent call the Nineties "turbulent" because of the fast changing environment, and the Fifties "tranquil". They find that high unemployment compensation alone does not necessarily imply high unemployment, but that the combination of high unemployment compensation and high turbulence will generate the unemployment rates observed in Europe today. Similarly, Blanchard (1998b) argues that high European unemployment could have arisen from the interaction of an established labor market institution with a change in the economic environment.

The ad-hoc bargaining model presented in this section replicates the main ideas and

[5]The present analysis considers the current members of the European Union.

[6]See Neal (1995) for empirical evidence on industry specific human capital. The OECD Employment Outlook (OECD, 1992) provides evidence on structural adjustment in manufacturing.

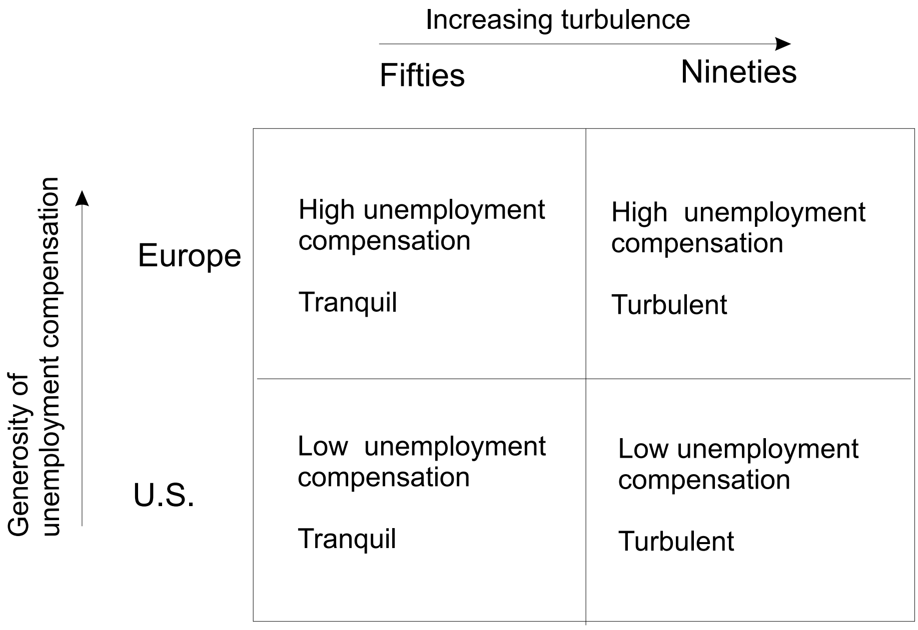

Figure 3: Stylized features for U.S. and Europe across time.

findings of Ljungqvist and Sargent (1998). The time period for the model is months. Workers have an average work life of 40 years which translates into a probability of dying of $\delta = 0.002$. As in Ljungqvist and Sargent (1998) labor share, ϖ, is set at 0.5. The choice of $\lambda^w = 0.39$ is based on computations similar to those of Den Haan, Ramey and Watson (1997) and adjusted to reflect monthly data. The 2% exogenous separation rate χ^x and the standard deviation 0.01 of the productivity for high-skilled workers $\sigma(\theta_h|k = h)$ are chosen to yield 5% unemployment and an unemployment duration of 2.5 months in tranquil times, which is motivated by the results of Perry (1972) and Katz and Krueger (1999). Productivities are assumed to be distributed according to a lognormal distribution, which avoids the truncations and rescaling that are typical when assuming normal distributions. The mean skill levels for low- and high-skilled workers are set at $\mathrm{E}(\theta|k = l) = 0.5$ and $\mathrm{E}(\theta|k = h) = 1$, respectively, generating post-displacement wage losses of the magnitude observed by Jacobson, LaLonde and Sullivan (1993). These mean skill levels are also consistent with Ljungqvist and Sargent, who assumed that the highest skill level is twice as productive as the lowest skill level. The probability of becoming a high-skilled worker, π^h, is set at 4%, implying that workers remain

	'Tranquil' $\pi^l = 0$	'Turbulent' $\pi^l = 1$
Unemployment Rate (%):		
Welfare State:	5.54	11.08
Laissez Faire:	5.36	5.66
Unemployment Duration (Months):		
Welfare State:	2.65	6.29
Laissez Faire:	2.57	2.67
Labor Share (%):		
Welfare State:	50	50
Laissez Faire:	50	50
Tax Rate (%):		
Welfare State:	1.90	4.50

Table 1: Steady state values for the economy with ad-hoc bargaining.

low-skilled for two years on average before switching to the high-skilled distribution.

The tranquil Fifties are modeled as a period when each worker is able to find another job in his own industry, i.e., there is no skill loss upon separation ($\pi^l = 0$). In the turbulent Nineties, however, no worker can transfer skills from one job to another, i.e., there is complete skill loss upon separation ($\pi^l = 1$). Now consider the responses of the unemployment rate to increases in turbulence for the U.S. and Europe. The main results are reported in Table 1. For simplicity, describe the U.S. economy as an economy without any unemployment benefits (laissez faire). We see from Table 1 that the steady-state unemployment rate in the laissez-faire economy remains virtually constant at 5.36% in the tranquil Fifties and 5.66% in the turbulent Nineties, demonstrating that an increase in turbulence alone need not imply higher unemployment rates.

Next, consider what happened in Europe. Since WWII unemployment benefits have been rather generous, and unemployment compensation as high as 70% of the previous wage is not uncommon (Martin, 1996). In the model of the welfare state with a replacement ratio of

$\beta = .7$, the unemployment rate is approximately 5.5% in the tranquil Fifties. In the turbulent Nineties the welfare economy exhibits Ljungqvist and Sargent's 'time-bomb' effect as the unemployment rate doubles. Seventy percent of the unemployed were formerly high-skilled workers who do not obtain job offers commensurate with their previous skills. Reservation wages for this specific group of workers are very high, and hence, on average they reject three offers before accepting a new job. Job offers, however, arrive with a probability of roughly 0.4, so that the average unemployment spell for this group lasts around 9 months. The combination of high unemployment compensation and high turbulence leads to a high rate of job rejection and, consequently, to long durations of unemployment and high unemployment rates.

3 Bargaining and Unemployment Insurance

In the previous section, wages were determined by first arbitrarily splitting the match output and then checking whether the worker's participation constraint was met. Such a procedure can result in matches not being formed, although they would have been profitable for both parties.

To illustrate this point, consider a one-period example. When matched, a worker and firm generate profits of 100. Say $\varpi = .5$, i.e., the sharing rule is to split output evenly. Then the worker and the firm would each receive 50. If the worker's unemployment benefits are higher than 50, say, 70, then he will not accept the job. Now consider a Nash bargaining solution where firms have a zero outside option. The surplus generated by the match is given by output less the worker's outside option, in this case, 30, which can be split in any way between the worker and the firm. Because parties receive payoffs higher than their respective outside options, they will be willing to enter the match. The match would not have been formed only if the worker's outside option had actually exceeded total output. Note, however, that the outside option improves the worker's bargaining position. For concreteness, assume a Nash bargaining weight ω of 0.5 to obtain an (85,15) split of output. Note the 85% labor share even though the worker's bargaining weight ω is set to .5.

In this section I generalize the model of the previous section by simultaneously determining job acceptance and wages in a Mortensen-Pissarides type model. Wages are determined by generalized Nash bargaining as suggested by Mortensen and Pissarides (1994) following Mortensen (1982) and Nash (1950). An increase in the replacement ratio, β, will, above all, increase a worker's bargaining power by increasing his outside option. It will not necessarily raise the unemployment rate as it did in the previous model; instead workers simply get a bigger share of total output because each party is always paid at least its outside option.

3.1 The Job Acceptance Decision

The key difference between the model in this section and the framework in Ljungqvist and Sargent (1998) is that here workers and firms *mutually* decide whether to enter a new relationship by comparing the *joint* benefits of accepting a job with the *joint* benefits of prolonging the search. If we let V_v^f and V_m^f denote the firm's expected discounted value of posting a vacancy and being matched, respectively, a new relationship will be formed as long as

$$(1-\tau)\theta + V_m^w(\theta, k) + V_m^f(\theta, k) \geq b(k^o) + V_u^w(k^o, k) + V_v^f - \Pi, \tag{6}$$

where Π denotes the vacancy posting cost that the firm incurs each period it is in the matching pool. The surplus $s(\theta, k^o, k)$ of a match is defined as the difference of the left hand side and the right hand side, i.e., what remains of the mutual present and future benefits of entering a match after deducting total outside options:

$$s(\theta, k^o, k) = (1-\tau)\theta + V_m^w(\theta, k) + V_m^f(\theta, k) - \left(b(k^o) + V_u^w(k^o, k) + V_v^f - \Pi\right). \tag{7}$$

The lowest acceptable productivity $\underline{\theta}(k^o, k)$ yields a surplus of zero, i.e., equation (6) holds with equality. A match will be rejected only if there is no possible split of output that is weakly preferred by each agent over his respective outside option.

For ongoing matches, surplus is given by $s(\theta, k, k)$, where k is the worker's current skill level. The worker's discounted future benefits of ending the period in the matching and unemployment pools are again given by equations (2) – (4). Under generalized Nash bargaining with weights ω for the worker and $(1-\omega)$ for the firm, the payments and future benefits of keeping the match for a worker should equal the worker's share ω of the surplus plus his outside option. Thus, a low skilled worker in an ongoing relationship can negotiate a wage of

$$p^w(\theta, l, l) \;\; = \;\; \omega s(\theta, l, l) - V_m^w(\theta, l, l) + b(l) + V_u^w(l, l). \tag{8}$$

A high-skill worker in an ongoing relationship can lose skills upon separation, which makes his outside option depend on the degree of turbulence, as defined in terms of π^l. Accordingly, a high-skilled worker in an ongoing relationship can negotiate a wage of

$$p^w(\theta, h, h) \;\; = \;\; \omega s(\theta, h, h) - V_m^w(\theta, h) + b(h) + \pi^l V_u^w(h, l) + (1 - \pi^l) V_u^w(h, h). \tag{9}$$

For the firm the value of posting a vacancy is given by

$$V_v^f = \lambda^f V_I^f + (1 - \lambda^f)\varrho(V_v^f - \Pi),$$

where λ^f denotes the probability that a vacancy is matched with a worker. Before a firm is matched, it does not know the skills of the worker it will be matched with, which stems from the assumption that there is no segmentation in the labor market. The firm's expected discounted benefit V_I^f of interviewing a worker (i.e., being matched) is then formed as an expectation over all possible types of workers in the unemployment pool:

$$\begin{aligned} V_I^f = \sum_{(k^o,k)\in\{(0,l),(l,l),(h,l),(h,h)\}} \quad & \varrho \quad \mu(k^o, k) \left(\int_0^{\underline{\theta}(k^o,k)} V_v^f \mathrm{d}\nu_k(\tilde{\theta}) \right. \\ & + \left. \int_{\underline{\theta}(k^o,k)}^{\infty} \left((1-\tau) p^f(\tilde{\theta}, k^o, k) + V_m^f(\tilde{\theta}, k) \right) \mathrm{d}\nu_k(\tilde{\theta}) \right), \end{aligned} \tag{10}$$

where $\mu(k^o, k)$ denotes the fraction of unemployed workers with characteristics (k^o, k). The assumption of free entry ensures that firms will post vacancies as long as $V_v^f > \Pi$. Hence in equilibrium $V_v^f = \Pi$, and we have that the firm's expected outside option, which consists of the expected income streams from future matches minus the vacancy posting cost, is zero. Therefore

$$\Pi = V_v^f = \lambda^f V_I^f. \tag{11}$$

Once matched, the firm's value of ending this period in a match with a low-skilled worker is the probability weighted sum of the value of that worker becoming high-skilled and the value of that worker if he remains low-skilled.

$$\begin{aligned} V_m^f(\theta, l) \;\; = & \;\; \varrho(1 - \chi^x)\pi^h \left((1-\tau) p^f(\theta', l, h) + V_m^f(\theta', h) \right) \\ + & \;\; \varrho(1 - \chi^x)(1 - \pi^h) \left((1-\tau) p^f(\theta, l, l) + V_m^f(\theta, l) \right). \end{aligned} \tag{12}$$

Similarly, for a match with a high-skilled worker:

$$V_m^f(\theta, h) \quad = \quad \varrho(1-\chi^x)\left((1-\tau)p^f(\theta, k, k) + V_m^f(\theta, h)\right). \tag{13}$$

The payment to the firm is what remains after the worker is paid:

$$\begin{aligned} p^f(\theta, k^o, k) &= (1-\omega)s(\theta, k^o, k) - V_m^f(\theta, k) \\ &= \theta - p^w(\theta, k^o, k). \end{aligned} \tag{14}$$

To be able to solve the model we also need to specify how firms and job seekers find each other. Firms and workers are matched based on the matching technology suggested by Den Haan et al. (1997) (DRW) which guarantees that matching probabilities are always in the interval $[0, 1]$ without having to rely on truncation and the introduction of nondifferentiabilities. The DRW matching function is given by

$$m(u, v) = \frac{uv}{(u^\ell + v^\ell)^{\frac{1}{\ell}}}, \tag{15}$$

where u stands for the number of unemployed workers, v for the number of vacancies, and ℓ for the efficiency of the matching process[7]. Matching probabilities for firms and workers are defined as

$$\lambda^f \quad = \quad \frac{m(u, v)}{v} \tag{16}$$

$$\lambda^w \quad = \quad \frac{m(u, v)}{u}. \tag{17}$$

To obtain a steady state solution equations (2) – (17) are solved together with the flow equations. The first key result of this paper is that the lowest acceptable productivity level $\underline{\theta}(k^o, k)$ determined according to Ljungqvist and Sargent (equation 1) will be greater than the lowest acceptable productivity level based on the Nash bargaining solution of (6). It will be strictly greater if $(1-\tau)\theta > b(k^o) + V_u^w(k^o, k)$. As long as a match generates nonnegative expected discounted surplus, there is an allocation of output which is preferred

[7]Higher ℓ can be interpreted as more efficient matching institutions. For the case of perfect efficiency we have $\lim_{\ell\to\infty} m_\ell(u, v) = \min(u, v)$ which confirms the claim that matching probabilities defined in (16) and (17) will always be less than or equal to one. Cobb-Douglas matching functions, which have dominated the literature so far, do not guarantee this and have to be truncated.

by both workers and firms over their respective outside options. As we can see by comparing equations (1) and (6), the inflexible wage determination approach of section 2 neglects to account for the benefits that a match yields to a firm. We see that unemployment benefits do not necessarily imply a higher unemployment rate but can lead instead to higher wage payments by increasing a worker's relative bargaining position, provided that the worker does not already receive total output.

3.2 Steady State Results

In order to assess the effect of including a firm's labor demand decision and Nash bargaining, this section replicates the steady state comparisons of section 2.3. All parameters remain the same, and matching probabilities for firms are set at $\lambda^f = .79$. Wages are determined according to Nash bargaining with the worker's bargaining weight $\omega = 0.5$. Table 2 reports steady state results for the model with Nash bargaining. The experiment compares how economies without unemployment compensation and economies with high (European) levels of unemployment compensation react to an increase in economic turbulence. A tranquil economic environment is again defined in terms of zero probability of skill loss upon separation in the Fifties and a turbulent environment by certain skill loss in the Nineties.

As in Ljungqvist and Sargent (1998) and section 2.3, neither high unemployment insurance nor high turbulence alone necessarily increases unemployment. Nevertheless, while the combination of high unemployment compensation and turbulence leads to a 100% increase in the unemployment rate with ad-hoc wage determination, the same two effects cause unemployment to go up by only 50% when job acceptance becomes a mutual decision of workers and firms. Fewer matches are rejected, when compared to ad-hoc wage determination, because firms would rather pay a higher wage than let a worker walk away from a profitable relationship.

Workers who lost their skills upon separation but maintain high unemployment benefits are still the group that drives these results. They are reluctant to accept a new job at a lower wage. When allowing for bargaining, however, high unemployment benefits improve their bargaining position, and, instead of walking, away they receive higher wages as long as some share in profits from the match remains for the firm. Under ad-hoc wage determination

	'Tranquil' $\pi^l = 0$	'Turbulent' $\pi^l = 1$
Unemployment Rate (%):		
Welfare State:	5.34	8.18
Laissez Faire:	5.34	5.34
Unemployment Duration (Months):		
Welfare State:	2.56	4.22
Laissez Faire:	2.56	2.56
Labor Share (%):		
Welfare State:	97	96
Laissez Faire:	94	93
Tax Rate (%):		
Welfare State:	3.46	5.80

Table 2: Steady state values for the economy with Nash bargaining.

labor share is 50% by construction, but bargaining pushes the labor share, defined as the ratio of total wages over total output, beyond 90%! We will see in section 5 that the effect of turbulence disappears when values for ω are assumed that imply more reasonable values for the labor share. The large labor share can, above all, be attributed to the asymmetric characteristics of firms and workers. Firms are assumed to come from an infinite mass and can freely enter the market after paying the vacancy posting cost. Therefore their outside option is zero. The total number of workers, on the other hand, is constant and a worker's outside option consists of possible unemployment benefits and expected discounted future wage payments. The different threat points provide for a strong bargaining position for the worker before negotiations about the division of the surplus even begin. The effect of bargaining weights and labor shares, as well as the robustness of the results in Tables 1 and 2, will be assessed further in section 5.

4 Endogenous Separations and Turbulence

This section extends the Nash bargaining model of section 3 by introducing endogenous breakups. The assumption of constant productivities at each skill level of a match is relaxed by introducing infrequent redraws of a new productivity level θ from the distribution ν_k of the current skill level, analogous to Mortensen and Pissarides (1994) or Den Haan, Ramey and Watson (1999). After observing the new productivity level, firms and workers mutually decide whether to continue the match and renegotiate wages. A very low draw, where output is less than the sum of the outside options, will prompt both parties to terminate the relationship and search for better matches.

4.1 The Breakup Decision

When deciding whether to continue a job, high-skilled workers take the possibility of becoming a low-skilled worker upon separation into account. They may be willing to stay in a match during a period of low productivity, even if they receive a new, lower draw of θ, in order to prevent separation and the skill loss it may entail. A high-skilled worker with new productivity θ will *remain in a match* as long as

$$(1-\tau)\theta + V_m^w(\theta,h) + V_m^f(\theta,h) \geq b(h) + \pi^l V_u^w(h,l) + (1-\pi^l)V_u^w(h,h). \tag{18}$$

Compare (18) to the *job acceptance* decision of an unemployed high-skilled worker, who will enter a new match with productivity θ as long as

$$(1-\tau)\theta + V_m^w(\theta,h) + V_m^f(\theta,h) \geq b(h) + V_u^w(h,h). \tag{19}$$

We clearly see from (18) and (19) that for $\pi^l > 0$ there exist productivity levels $\theta < \underline{\theta}(h,h)$ at which a high-skilled worker is willing to maintain an existing match, even though he would not have accepted a new job with that same productivity θ.

Low skilled workers decide to maintain an existing match after a new productivity draw of θ as long as

$$(1-\tau)\theta + V_m^w(\theta,l) + V_m^f(\theta,l) \geq b(l) + V_u^w(l,l). \tag{20}$$

The lowest productivity necessary for maintaining an existing match, $\underset{\sim}{\theta}(h,h)$ and $\underset{\sim}{\theta}(l,l)$, solve equations (18) and (20) with equality. Using $\underset{\sim}{\theta}\,(k,k)$, we can define the endogenous separation probability, χ^e to be

$$\chi^e(k,k) = \int_0^{\underset{\sim}{\theta}\,(k,k)} \mathrm{d}\nu_k(\tilde{\theta}). \tag{21}$$

The values for being in the matching pool do not change and are given by equations (2) and (11). Continuation values for workers and firms, V_m^w and V_m^f, need to be adjusted to reflect the additional source of separations and are presented in the appendix.

4.2 Steady State Results

The probability of a new productivity draw at the same skill level is given by $\pi^n = 0.1$, which corresponds to an average duration for each productivity draw of roughly one year. The means of the low-skilled and high-skilled productivity distributions are again $\mathrm{E}(\theta|k = l) = 0.5$ and $\mathrm{E}(\theta|k = h) = 1$. In order to maintain comparability with the previous sections, $\sigma(\theta|k = l) = 0.07$ and $\sigma(\theta|k = h) = 0.1$ are chosen so that the total separation rate in the tranquil welfare economy is still at the 2% level, even though the rate of exogenous separations is reduced to $\chi^x = 0.01$. The parameter values for all experiments are summarized in Table 4.

As in the previous sections, I again examine how the two economies with different levels of unemployment compensation (none for the laissez faire and 70% of previous wage level for the welfare state) react to changes in economic turbulence. Again, turbulence is defined as the probability of skill loss upon separation, π^l. In the tranquil Fifties, $\pi^l = 0$, and the turbulent Nineties are modeled by setting $\pi^l = 1$.

Table 3 shows the steady states for the welfare state and the laissez faire economy for tranquil and turbulent times. The effect of an increase in turbulence on the welfare economy is strikingly different from the previous section where an increase in turbulence brought about a 50% increase in the unemployment rate. In contrast, the same increase in turbulence now leads to a reduction in the unemployment rate of approximately 15%! The primary explanation for this is that high-skilled workers are willing to maintain matches that they would have discarded had their skills not been at stake.

	'Tranquil' $\pi^l = 0$	'Turbulent' $\pi^l = 1$
Unemployment Rate (%):		
Welfare State:	6.26	5.26
Laissez Faire:	3.00	3.00
Unemployment Duration (Months):		
Welfare State:	2.88	5.13
Laissez Faire:	2.56	2.56
Labor Share (%):		
Welfare State:	96	93
Laissez Faire:	95	92
Tax Rate (%):		
Welfare State:	4.26	3.46

Table 3: Steady state values for the economy with Nash bargaining and endogenous separations.

Table 3 also reports that the lower unemployment rate in the turbulent economic environment is accompanied by a significantly higher average duration of unemployment spells for the welfare state. The breakdown of the unemployment rate into flows into the unemployment pool and flows out of the unemployment pool reveals both a considerable reduction in the separation rate and a strong increase in the job rejection rate[8]. The dominant first effect can be attributed to high-skilled workers toughing out periods of low productivity, instead of breaking up and starting anew. The latter effect comes from the group of high-skilled workers who do break up and find themselves with large skill losses while being entitled to generous unemployment compensation. That is, the incentive problem identified by Ljungqvist and Sargent as causing the high unemployment in their model is still present, but it is dominated by a motive of caution that makes workers more reluctant to break up. As a result,

[8] A similar mechanism is at work in Blanchard and Portugal (1998) where employment protection measures reduce both the separation rate as well as the job acceptance rate.

the overall unemployment rate decreases because the endogenous separation decision neutralizes or even reverses the effect of economic turbulence, defined in terms of skill loss upon separation.

5 Robustness of Results

The previous sections identify two effects. The introduction of a firm's labor demand decision together with Nash bargaining implies better bargaining positions for workers in welfare economies as compared to laissez-faire states. Compared to an economy like Ljungqvist and Sargent's, bargaining leads to a higher rate of job acceptance. Additionally, allowing for endogenous breakups also reduces the separation rate in a turbulent economy as compared to a tranquil economy. As a result, the flows into unemployment are drastically diminished and dominated by the increased job rejection rate that is implied by higher turbulence. The purpose of this section is to examine the robustness of these findings.

When considering the group of workers driving the results, the crucial factor becomes the size of the skill drop upon separation. To check the robustness of my results, I will vary the mean of the low-skill productivity distribution from 0.3 (i.e. a 70% drop in average skills) to 0.8 and compensate by adjusting the standard deviation of θ_l such that unemployment rates in the ad-hoc bargaining model exhibit the properties of Ljungqvist and Sargent while keeping all other parameters constant at their respective values of sections 2 and 3. Table 5 reports the unemployment rates for each of these choices for the ad-hoc model and the model with Nash bargaining. For every skill drop, the possibility of wage negotiations is sufficient to accommodate the higher wage demands of displaced high-skilled workers. Unemployment rates in the welfare economy increase by roughly 50% with bargaining (instead of 100% without bargaining) as we move from a tranquil to a turbulent environment.

Does turbulence necessarily lead to higher unemployment in the welfare economy with Nash bargaining? The free entry condition typically assumed in the literature (Blanchard, 1998a, Mortensen and Pissarides, 1999) provides the firm with a negligible outside option as compared to a worker's 70% of the previous wage provided by unemployment benefits. Splitting the remaining surplus evenly leaves the firm with a very small share of output, indeed. Table 2 reports that a bargaining weight of 0.5 implies a labor share of over 90%. Lowering the bargaining weight to obtain more reasonable values for the labor share completely removes the effect of turbulence in welfare economies. In fact, for a bargaining weight of $\omega = 0.3$ the effect of turbulence disappears, even though $\omega = 0.3$ still implies a labor share of at least 85% as reported in Table 5.

Consider next the effect of endogenous job destruction. The bigger the drop in skills, the more cautious a worker becomes once he takes the risk of losing his skills into account. Again, the difference in expected productivities for low- and high-skilled workers becomes the dimension of choice. Keeping everything else constant, vary $\mathrm{E}(\theta_l)$ from 0.3 to 0.8. Table 6 reports that separation rates drop consistently when turbulence increases and that the unemployment rate in turbulent times is always lower than in tranquil times. For any size skill drop a reduction in separation rates due to an increase in turbulence always dominates the increase in job rejection rates, leading, thus, to lower unemployment rates.

6 Conclusions

In this paper I establish the importance of bargaining and endogenous job destruction in dynamic matching models. In a Nash-bargaining framework, an increase in unemployment benefits shifts bargaining power to the worker by increasing his outside option. As long as the worker does not already receive total match output, an increase in unemployment compensation will lead to higher wage rates, but not necessarily to fewer accepted job offers. Furthermore, in more turbulent times, i.e., periods with a higher probability of skill loss, wages actually go down for skilled workers because the value of their outside options decreases. This implies a reduction in unemployment benefits and, therefore, beneficial "self correcting" feedback.

Endogenizing the separation decision makes the analysis of both the flows into and out of unemployment, and their reactions to changes in the economic environment possible. Ljungqvist and Sargent (1998) focus on the job acceptance decision, but neglect break-ups by making them exogenous. I establish that for an increase in turbulence defined as the probability of skill loss upon separation, the decrease in job destruction, caused by a worker's motive of caution, is larger than the reduction in job creation implied by unemployed workers' incentive problems. Thus, even though generous unemployment benefits reduce job acceptance rates for high-skilled workers in times of restructuring, these high-skilled workers also drastically reduce their propensity to quit. The overall effect is a reduction in the unemployment rate in times of high restructuring, contrary to empirical observations of the present high unemployment rates across Europe. The increase in economic turbulence as suggested by Ljungqvist and Sargent hence succeeds in explaining the high durations of European unemployment, but it cannot explain the high European unemployment rates when embedded in a Mortensen-Pissarides type matching model with Nash bargaining and endogenous job destruction.

I am currently exploring alternative explanations for the observed divergence in unemployment rates in a model that allows for endogenous destruction and incorporates bargaining theory to endogenize wage setting. The interaction between labor market policies and the reduction in TFP growth is a promising candidate. In periods of high growth, the future values of maintaining a match dominate even generous unemployment benefits. However, a persistent reduction in growth rates brings about a decline in expected future values of maintaining a job, thereby shifting more importance to unemployment compensation. In an economy with low unemployment benefits, such a shift need not have a big effect, but for a welfare state with typical European generosity, the consequences could be striking.

	Parameter	Ad-hoc Exo Sep	Nash Exo Sep	Nash Endo Sep
Discount Rate	ρ	0.00426	0.00426	0.00426
Probability of Dying	δ	0.0020	0.0020	0.0020
Labor Share	ϖ	0.5	—	—
Bargaining Weight	ω	—	0.5	0.5
Exogenous Separations	χ^x	0.02	0.02	0.1
Matching Probability for Workers	λ^w	0.39	0.39	0.39
Matching Probability for Firms	λ^f	—	0.78	0.78
Replacement Ratios	β	0 / 0.7	0 / 0.7	0 / 0.7
Probability of Skill Loss	π^l	0 / 1	0 / 1	0 / 1
Probability of Skill Improvement	π^h	0.04	0.04	0.04
Probability of New Productivity Draw	π^n	0	0	0.1
Mean Unskilled Productivity	$E(\theta\|k = l)$	0.5	0.5	0.5
Standard Deviation Unskilled Productivity	$\sigma(\theta\|k = l)$	0.07	0.07	0.07
Mean Skilled Productivity	$E(\theta\|k = h)$	1	1	1
Standard Deviation Skilled Productivity	$\sigma(\theta\|k = h)$	0.01	0.01	0.1

Table 4: Parameters for the models.

		Ad-hoc Wage Determination		Nash Bargaining		Nash Bargaining	
		$\varpi = 0.5$		$\omega = 0.5$		$\omega = 0.3$	
		Low Turb.	High Turb.	Low Turb.	High Turb.	Low Turb.	High Tur
		$\pi^l = 0$	$\pi^l = 1$	$\pi^l = 0$	$\pi^l = 1$	$\pi^l = 0$	$\pi^l = 1$
$\mathrm{E}(\theta_l) = 0.3$	WF:	5.48	10.12	5.34	8.00	5.34	5.35
$\sigma(\theta_l) = 0.01$	LF:	5.34	5.34	5.34	5.34	5.34	5.34
$\mathrm{E}(\theta_l) = 0.4$	WF:	5.51	10.33	5.34	8.29	5.34	5.56
$\sigma(\theta_l) = 0.04$	LF:	5.35	5.39	5.34	5.34	5.34	5.34
$\mathrm{E}(\theta_l) = 0.5$	WF:	5.57	10.76	5.35	8.62	5.34	5.80
$\sigma(\theta_l) = 0.07$	LF:	5.39	5.65	5.34	5.34	5.34	5.34
$\mathrm{E}(\theta_l) = 0.6$	WF:	5.65	10.59	5.36	8.61	5.34	5.98
$\sigma(\theta_l) = 0.085$	LF:	5.42	5.81	5.34	5.38	5.34	5.34
$\mathrm{E}(\theta_l) = 0.7$	WF:	5.78	10.57	5.37	7.98	5.36	6.08
$\sigma(\theta_l) = 0.1$	LF:	5.48	5.97	5.34	5.38	5.34	5.36
$\mathrm{E}(\theta_l) = 0.8$	WF:	5.72	10.48	5.41	7.70	5.37	6.12
$\sigma(\theta_l) = 0.11$	LF:	5.43	6.04	5.34	5.38	5.34	5.36

Table 5: Unemployment rates in % for different values of $\mathrm{E}(\theta_l)$, $\mathrm{E}(\theta_h) = 1$, $\sigma(\theta_h) = 0.01$, when separations are exogenous.

		Unemployment Rate		Separation Rate	
		Low Turb.	High Turb.	Low Turb.	High Turb.
		$\pi^l = 0$	$\pi^l = 1$	$\pi^l = 0$	$\pi^l = 1$
$\mathrm{E}(\theta_l) = 0.3$	WF:	6.01	3.00	2.00	1.00
	LF:	3.00	3.00	1.00	1.00
$\mathrm{E}(\theta_l) = 0.4$	WF:	5.91	3.00	2.00	1.00
	LF:	3.00	3.00	1.00	1.00
$\mathrm{E}(\theta_l) = 0.5$	WF:	6.1	3.01	2.00	1.00
	LF:	3.00	3.00	1.00	1.00
$\mathrm{E}(\theta_l) = 0.6$	WF:	6.15	3.03	2.00	1.00
	LF:	3.00	3.00	1.00	1.00
$\mathrm{E}(\theta_l) = 0.7$	WF:	6.17	3.07	2.00	1.00
	LF:	3.00	3.00	1.00	1.00
$\mathrm{E}(\theta_l) = 0.8$	WF:	6.18	3.13	2.00	1.00
	LF:	3.00	3.00	1.00	1.00

Table 6: Unemployment and separation rates in % for different values of $\mathrm{E}(\theta_l)$, $\sigma(\theta_l) = 0.05$, Nash Bargaining: $\omega = 0.5$, with endogenous separations.

Appendix: Value functions with endogenous breakups

In the absence of exogenous breakups, the values of being in a match for workers and firms are given by

$$
\begin{aligned}
V_m^w(\theta,l) &= \varrho\chi^e(l,l)\left(V_u^w(l,l)+b(l)\right) && (22)\\
&+ \varrho(1-\chi^e(l,l))\pi^h\left((1-\tau)p^w(\theta')+V_m^w(\theta',h)\right)\\
&+ \varrho(1-\chi^e(l,l))(1-\pi^h)\left((1-\tau)p^w(\theta)+V_m^w(\theta,l)\right)\\
V_m^w(\theta,h) &= \varrho\chi^e(h,h)\left(\pi^l V_u^w(h,l)+(1-\pi^l)V_u^w(h,h)+b(h)\right) && (23)\\
&+ \varrho(1-\chi^e(h,h))\left((1-\tau)p^w(\theta)+V_m^w(\theta,h)\right)\\
V_m^f(\theta,l) &= \varrho(1-\chi^e(l,l))\pi^h\left((1-\tau)p^f(\theta',l,h)+V_m^f(\theta',h)\right) && (24)\\
&+ \varrho(1-\chi^e(l,l))(1-\pi^h)\left((1-\tau)p^f(\theta,l,l)+V_m^f(\theta,l)\right).\\
V_m^f(\theta,h) &= \varrho(1-\chi^e(h,h))\left((1-\tau)p^f(\theta,k,k)+V_m^f(\theta,h)\right) && (25)
\end{aligned}
$$

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