

Does Employment Protection Create Its Own Political Support?

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November 2009

Abstract

This paper investigates the ability of employment protection to generate its own political support. A version of the Mortensen-Pissarides model is used for this purpose. If wages are set through Nash bargaining, workers value employment protection because it strengthens their hand in wage negotiations. Workers in high productivity matches benefit most from higher wages as they expect to stay employed for longer. By reducing turnover employment protection shifts the distribution of match-specific productivity toward lower values. Thus stringent protection in the past actually reduces support for employment protection today. Introducing involuntary separations reverses this conclusion. Now workers value employment protection because it delays involuntary dismissals. Workers in low productivity matches gain most since they face the highest risk of dismissal. The downward shift in the productivity distribution is now a shift towards supporters of employment protection. Quantitatively this mechanism is found to be weak in a standard calibration, which is traced to a counterfactually low cost of job loss in the calibrated model. The mechanism is an order of magnitude more powerful in an extension that matches empirical estimates of the cost of job loss.

Keywords: Employment Protection, Nash bargaining, Involuntary Dismissal.

JEL Classification: E24, J41, J65

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Most countries have adopted regulations that make it costly for employers to dismiss workers. It is often argued that stringent employment protection has adverse consequences for labor market performance. Economists along with organizations such as the OECD and the IMF routinely urge countries to relax such regulations. Policy makers, however, have been reluctant to follow this advice, or faced stiff political opposition when trying to do so.

A commonly invoked rationale for this failure to deregulate is the following: reform is difficult precisely because the current level of protection enjoyed by the employed is so high.¹

According to this hypothesis, the fact that employment protection was stringent in the past induces employed workers to provide strong support for maintaining stringent protection into the future. Conversely, if protection was low in the past, then the employed show little support for introducing stronger protection, enabling countries such as the US to maintain flexible labor markets. If correct, this hypothesis may play an important role in accounting for the large and persistent differences in employment protection across countries.

This explanation is incomplete, however, since it is silent on why more stringent protection in the past generates stronger support for employment protection today. Specifically, if employment protection is beneficial to employed workers, why is it that employed workers in the US do not support it as much as their peers in Europe?

This is the point of departure for the present paper, which focuses precisely on mechanisms through which high protection in the past can generate strong support of employed workers for employment protection today.

As a starting point, it is useful to consider a heuristic argument. Suppose an economy had stringent employment protection in the past. This regulation maintains some employed workers in jobs that would be destroyed otherwise. If employment protection were to be removed, they would become unemployed. Thus this group resists deregulation and may succeed in keeping stringent protection in place. In an otherwise identical country with low employment protection in the past, a group of workers whose jobs depend on stringent protection has never been generated, allowing this country to maintain flexible labor markets.

The key implicit assumption in this heuristic argument is that workers who would be left unemployed by deregulation resist the reform. The main question of this paper is then the

¹See the leader “The reason why Europe finds reform so hard is that insiders are too protected” in *The Economist The Economist (2006)* for a recent statement of this argument. Writing on European unemployment, Becker (1998) argues “If the explanation of high European unemployment rates is so clear, why are those governments reluctant to reform their labor markets toward the so-called Anglo-Saxon model? Although many excuses and explanations have been offered, politics is the most powerful reason. Strong unions, ‘insiders’ with well-paying jobs, and other groups fight to hold on to their perks and privileges.”

following: under what circumstances is this implicit assumption justified?

I approach this question using a version of the model of Mortensen and Pissarides (1994, hereafter MP) , because it readily delivers the first half of the heuristic argument: employment protection maintains workers in relatively unproductive matches, and workers in these matches are left unemployed if employment protection is deregulated.

With the first half of the argument in place, I focus on the only remaining question: are workers left unemployed by deregulation also opposed to it? In other words, are workers in good matches or workers in bad matches the primary beneficiaries of employment protection?

To answer this question, I first take a step back and ask: why would employed workers support employment protection in the first place? I distinguish two channels through which workers can benefit from employment protection. First, it is frequently argued that by making dismissal more difficult, employment protection strengthens workers' position in wage negotiations.² This I refer to as the *bargaining effect*. Second, and perhaps more in line with the etymology of the term, if separations are involuntary to workers, then employment protection benefits workers by delaying such involuntary separations. This I refer to as the *job duration effect*. Which of the two effects is present depends on how wages are determined and the interplay between wage setting and the separation decision.

I contrast two specific models of wage determination. The first, Nash bargaining, is most commonly employed in the MP model. Here it is useful analytically because it isolates one of the two channels through which workers gain from employment protection. Separations are bilaterally efficient, workers and firms agree on the timing of separations, hence separations are voluntary to workers. Thus the job duration effect is absent, leaving only the bargaining effect as a source of gains from employment protection.

With Nash bargaining, an increase in employment protection raises wages uniformly across levels of match-specific productivity. Workers in good matches benefit relatively more since they expect to stay employed for longer. Thus they are the main beneficiaries of employment protection. But high protection in the past means fewer good matches today and thus lower support for future protection. Thus the heuristic argument fails. In fact, workers left unemployed by deregulation benefit more from reform than other employed workers. They are stuck in bad matches, gaining relatively little from an enhanced bargaining position, and move into unemployment voluntarily after deregulation. This occurs because the reform stimulates hiring, making it easier to find a better match. This characterization

²See for example Lindbeck and Snower (1988) and Blanchard and Portugal (2001).

of preferences for firing costs in the MP model with Nash bargaining is interesting in its own right, as this model is widely used to study the effects of employment protection on labor market performance. Together with the finding that in this setting stringent past protection reduces the support for protection today, it constitutes the first contribution of this paper.

The second model of wage determination I consider is intentionally ad hoc, designed to have properties orthogonal to Nash bargaining: separations are involuntary to workers, activating the job duration effect; but employment protection has no direct effect on wages, shutting down the bargaining effect. While the model is deliberately ad hoc, I discuss a microfoundation offered by the literature on efficiency wages, along with a discussion of other mechanisms that give rise to involuntary dismissal.

For the heuristic argument to be correct it must be that workers in poor matches, at least on average, gain relatively more from employment protection. I argue that this is a natural outcome if dismissals are involuntary. Intuitively, workers in good matches are already protected by their high productivity. Hence involuntary dismissal is a remote concern. In contrast, workers in poor matches are closer to the dismissal margin and thus benefit more immediately from a delay in dismissal. Thereby I identify involuntary dismissal as a feature of the employment relationship which can enable employment protection to create its own political support. This is the second contribution of the paper.

The third contribution is a quantitative investigation of the strength of this mechanism, in particular whether it can sustain the coexistence of a low-firing-cost and a high-firing-cost stationary political equilibrium. I follow Prat (2006) in adopting a geometric random walk for match-specific productivity. This improves on the original specification of MP, who use a process with the counterfactual implication that the separation hazard is independent of job duration. This is critical in the present context, since it is precisely variation in this hazard that generates heterogeneity in preferences for employment protection. I calibrate the model with zero firing costs to the US labor market. Here I build on an extensive literature that has produced a fairly standard calibration approach for the parameters of the MP model. Following this approach pins down all parameters except for the volatility parameter of the random walk. I study the strength of the mechanism as a function of this parameter. While I find a small range with multiple stationary equilibria, I conclude that the mechanism is weak in the calibrated model. However, I argue that this does not reflect an inherent weakness of the mechanism, but rather that the calibrated model generates a cost of job loss far below empirical estimates, by a factor of three to four. If this cost is minuscule, then even dramatic

job losses induced by deregulation cannot keep high firing costs in place. To illustrate the role of the cost of job loss, I consider a simple extension that permits me to calibrate this cost to be consistent with empirical estimates. This strengthens the mechanism by an order of magnitude, and multiple stationary equilibria are no longer just a knife-edge outcome.

The paper is organized as follows. Section 1 discusses related literature. In Section 2 I introduce a version of the MP model. Section 3 presents the two models of wage determination, analyzes their implications for the separation decision, and discusses how they shape the preferences of workers for employment protection. Equilibrium is studied in Section 4. Section 5 describes the policy decision. The negative result for Nash bargaining is obtained in Section 6. Involuntary dismissal is analyzed in Section 7. Section 8 concludes.

1 Related Literature

Saint-Paul (2002) bears the closest relationship, since it also discusses the ability of employment protection to create its own political support. Saint-Paul does so in the context of a comprehensive analysis of the political economy of employment protection in a model of job turnover with vintage capital. Qualitatively, he argues that it is the presence of labor market rents (the utility difference between employed and unemployed workers) that makes job duration valuable to workers and thereby enables employment protection to create its own support. Based on numerical experiments, however, he concludes that quantitatively this mechanism is too weak to sustain multiple stationary political equilibria. My conclusions are substantially different in both respects. Qualitatively, the first contribution of this paper, namely the analysis of Nash bargaining, shows that rents *per se* are not key: here workers earn rents but do not value job duration. Instead, I trace the value of job duration more narrowly to involuntary dismissal. In other words, what matters is not whether the average worker earns rents, but whether there are rents *at the margin* of dismissal. This distinction is substantively important. There is little controversy that labor markets are subject to frictions which give rise to rents. In contrast, involuntary dismissal requires additional frictions that give rise to dismissal in situations where the worker would accept a wage cut. Whether this is a prevalent phenomenon is less well understood and demands further study. In this sense, my results imply that the conditions under which employment protection creates its own support are more stringent. I defer to Section 7.2 a detailed explanation why I find involuntary dismissal to be important, while it plays no role in Saint-Paul's argument. There I show that, while Saint-Paul's model features bilaterally efficient bargaining, he inadvertently

introduces involuntary dismissal in the process of solving the model.

Quantitatively, I confirm Saint-Paul's finding that multiple stationary equilibria are unlikely for a standard calibration of the MP model. However, I argue that it would be premature to conclude that the mechanism is inherently weak. The strength of the mechanism depends critically on how costly it is to lose a job. I show that the calibrated model generates a cost of job loss far below empirical estimates for the US. This empirical failure implies that the mechanism must be weak in the calibrated model. This also offers an explanation for Saint-Paul's numerical findings, since vintage models imply an even lower cost of job loss.

In an earlier paper Saint-Paul (1997) studies a simple vintage-type model with a 2-state Markov productivity process, and shows analytically that multiple stationary political equilibria arise for a range of parameters. Calibrating this model using the approach of Section 7.1, one can show that this multiplicity range is very small, again because the model can only generate a counterfactually small cost of job loss.³

Another closely related paper is Hassler et. al. (2005), which asks the same question for a different labor market policy: does generous unemployment insurance in the past increase the support for unemployment insurance today. In their model workers become more attached to their geographic location the longer they reside there. By reducing geographic mobility unemployment insurance increases attachment. In turn, attached workers vote for more generous unemployment insurance. Thus they find a positive feedback, but from a different mechanism, which is apparent from differences in the models employed. Along some dimensions their model is richer: they study a policy which benefits workers by providing insurance, hence workers are assumed to be risk averse. Along other dimensions their model is simpler: both wages and separations are exogenous, as both play no role in their mechanism. In contrast, here workers are risk neutral, so insurance consideration play no role. Workers benefit from employment protection either because it increases wages or because it delays involuntary dismissals. Thus it is essential for both wages and dismissal to be endogenous. As discussed, features of wage determination and the separation decision matter for the ability of employment protection to create its own support in this setting.

Other aspects of the political economy of employment protection have been analyzed. Vindigni (2008) studies the link between idiosyncratic uncertainty and the support for employment protection. He finds that higher uncertainty increases the support for protection if rents going to workers are large while the opposite occurs if workers' rents are low. Of particular interest here is that the sign of this effect may also depend on the past level of firing

³Details available from the author on request.

costs. Cahuc and Postel-Vinay (2002) also study the MP model with Nash bargaining, and thus a model in which workers benefit from employment protection through the bargaining effect. They introduce temporary contracts and find that workers support a combination of high protection for permanent contracts with the availability of temporary contracts.

Several papers on the political economy of employment protection examine interactions with other policies. Boeri, Conde-Ruiz, and Galasso (2007) analyze the trade-off between employment protection and unemployment benefits. In Koeniger and Vindigni (2003) more regulated product markets induce stronger support for employment protection.

Boeri and Burda (2008) take the extent of employment protection as given and argue that higher protection increases the political support for wage rigidity. Here I take the features of wage determination as given and examine how they shape the support for employment protection. A natural next step is to study the joint determination of wage setting institutions and employment protection, a point I return to in the conclusion.

Several papers trace differences in employment protection across countries to differences in fundamentals such as civic attitudes and religion (Algan and Cahuc (2009,2006)), credit market imperfections (Fogli (2004)) and costs of interregional mobility (Belot (2007)). These studies complement the focus of the present paper on the possibility that differences in employment protection may persist even for identical fundamentals.

2 The Model

Time is discrete. There is a continuum of infinitely lived ex ante identical workers of mass one. At a point in time a worker is either unemployed or employed in a match. Each match consists of one worker and one firm. Firms are owned by a continuum of entrepreneurs.

Timeline. Within a period events unfold as follows. First a fraction of workers in existing matches quits exogenously. Then surviving matches receive a new draw of match-specific productivity. Next workers unemployed at the end of last period and vacancies posted during last period are matched and each new match receives an initial draw of match-specific productivity. This is followed by separation decisions in all matches. Now production takes place in surviving matches. Finally firms decide whether to post vacancies.

Preferences. All agents have linear utility with discount factor $(1 - \rho) \in (0, 1)$: the utility of a consumption stream C_t is given by $\sum_{t=0}^{\infty} (1 - \rho)^t C_t$.

Creation. Maintaining a vacancy is associated with a cost $c > 0$ per period. The number of matches this period is given by $m(u, v)$ where u and v are the number of unemployed workers and vacancies at the end of the previous period, respectively. The matching function m has constant returns to scale, is continuous, strictly increasing in both arguments, and satisfies $m(u, v) < \min\{u, v\}$. A vacancy is matched with probability $q(\theta) \equiv m\left(\frac{1}{\theta}, 1\right)$. The matching probability of an unemployed worker is $f(\theta) \equiv m(1, \theta)$. The ratio $\theta = \frac{v}{u}$ is referred to as labor market tightness. To insure existence of equilibrium I assume that $\lim_{\theta \rightarrow \infty} q(\theta) = 0$.

Production. The initial productivity of a new match is drawn from a distribution given by the distribution function G_{new} . Subsequently a match experiences idiosyncratic productivity shocks. In particular, match-specific productivity follows a Markov process with state space $\mathcal{Y} \subseteq \mathbb{R}_+$ and transition function Q . The process is stochastically monotone: if productivity is high today, it is likely to be high tomorrow; formally $y' \geq y$ implies that $Q(y', \cdot)$ first-order stochastically dominates $Q(y, \cdot)$.⁴ I make two standard technical assumptions. First, the state space \mathcal{Y} is bounded. Second, the transition function satisfies the Feller property. The payoff of non-market activity received by unemployed workers is denoted as $z \geq 0$.

Destruction. There is both exogenous and endogenous destruction. At the beginning of each period an employed worker quits with exogenous probability $\frac{\delta}{1-\rho} \in (0, 1)$.⁵ Idiosyncratic shocks to match-specific productivity are the source of endogenous destruction.

Employment Protection. In the event of endogenous separation the firm is subject to wasteful firing costs $F \in \mathcal{F} \equiv [0, \bar{F}]$. I adopt this formulation to facilitate comparison with Saint-Paul (2002). An objection is that wasteful firing costs are likely to be dominated by severance payments as a policy instrument. Additionally, Fella (2000b) argues that typically employment protection regulations do not apply to quits; if not prevented by regulation, it is always jointly optimal for a firm-worker pair to circumvent wasteful firing costs by negotiating a severance payment and having the worker quit. Thus, throughout I discuss how results change if employment protection takes the form of severance payments.

The upper bound \bar{F} can be infinite. I also allow that legal or physical limits on the resources that can be extracted from firms impose a finite lower bound on firm values. This is equivalent to an upper bound on firing costs that can be imposed, so I allow for $\bar{F} < \infty$.

⁴Allowing for a general Markov process in discrete time — as opposed to working with specific processes in continuous time — allows me to highlight *qualitative* features of the process driving the theoretical results.

⁵I divide by the discount factor to simplify subsequent expressions.

Firms in new matches are already subject to firing costs when initial productivity is realized. Thus a firm cannot dismiss a worker at no cost if initial productivity is low. In the robustness analysis I discuss the implications of allowing firms to do so.

Changes in firing costs are modeled as in Saint-Paul (2002). It is assumed that at time $t = 0$ the economy is in the steady state induced by some past level of firing costs F_0 . Now the economy experiences an unanticipated change in the level of firing costs. Within period $t = 0$, I assume that the change occurs after separations have been made, but firms are given another opportunity to dismiss workers right after the change in policy takes effect.⁶ No further changes in firing costs are expected to occur in the future. In the exposition of Sections 3-4 the change in firing costs is treated as exogenous. Starting in Section 5 the new level of firing costs F is endogenized as the outcome of a policy decision. As discussed in Saint-Paul (2002), this once-and-for-all decision can be interpreted as an approximation to a situation in which policy decisions are infrequent.⁷

3 Wage Determination and the Separation Decision

In this section I introduce the two models of wage determination contrasted in this paper, first Nash bargaining and then a model which gives rise to involuntary dismissal.

The analysis of wage determination is greatly simplified by the simple transitional dynamics of the MP model in response to changes in parameters such as firing costs.⁸ Both labor market tightness θ and the utility of unemployed workers immediately jump to their new steady-state values. Only the level of employment and the distribution of match-specific productivity adjust slowly to the new steady state. Therefore I only need to consider the determination of wages in a match that operates in a stationary environment with constant utility from unemployment U and constant firing costs F .

A match in this environment must decide when to separate, given the process of idiosyncratic productivity shocks. For both models of wage determination stochastic monotonicity of this process insures that the optimal separation policy is a threshold rule. In general a threshold rule is a tuple $\underline{s} = (\underline{y}, \underline{\lambda})$. The first part \underline{y} is a productivity threshold. The second

⁶This implicitly assumes that firms are surprised by the policy change and cannot adjust employment before the new level of firing costs takes effect. In Brügemann (2007) firms are given this opportunity. I show that this creates a mechanism which by itself can generate multiple stationary political equilibria.

⁷Modeling repeated voting would require the use of computational methods to handle the fact that the distribution of aggregate productivity is an aggregate state variable. I leave this for future work, and provide an informal discussion of repeated voting in the conclusion.

⁸See Pissarides (2000), pp. 59–63.

part $\underline{\lambda}$ is the probability of separation if productivity is exactly equal to the threshold \underline{y} .⁹

For each model of wage determination I first study the separation decision, that is the determination of \underline{s} . Then I analyze how worker utility is affected by changes in firing costs F and the utility from unemployment U . All the intuition for the main qualitative results of the paper can be gathered from these comparative statics results. What remains to be done in later sections is to study how firing costs affect unemployed utility in equilibrium, and to combine the insights from this section in order to formally establish these main results.

3.1 Nash bargaining

With knowledge of U , F , current productivity y and the separation rule \underline{s} it is straightforward to compute the joint present discounted value of a match $V(y, \underline{s}, F, U)$. Much of the literature, including MP, appeal to the Nash bargaining solution to split the joint value between firm and worker. Millard and Mortensen (1996) adapt this approach to the model with firing costs, and obtain the sharing rule:

$$\begin{aligned} W_{NB}(y, \underline{s}, F, U) &= U + \beta [V(y, \underline{s}, F, U) - (U - F)], \\ J_{NB}(y, \underline{s}, F, U) &= -F + (1 - \beta) [V(y, \underline{s}, F, U) - (U - F)]. \end{aligned} \tag{1}$$

Here $W_{NB}(y, \underline{s}, F, U)$ is worker utility and $J_{NB}(y, \underline{s}, F, U)$ is the firm value. The term in square brackets is the surplus, which is the difference between the joint value and the sum of the two outside options. The worker's outside option is utility from unemployment U . The firm's outside option is $-F$, since the firm pays the firing costs in the event of endogenous separation. The worker receives his outside option U plus a share $\beta \in (0, 1)$ of the surplus, while the firm receives $-F$ plus the remaining share of the surplus.

The sharing rule (1) applies to matches in which the firm is subject to firing costs. This leads to the question how the joint value is split in new matches. In Millard and Mortensen firms in new matches are already subject to firing costs, so equation (1) applies. Several subsequent studies (Mortensen and Pissarides (1999), Pissarides (2000, Chapter 9.2), Cahuc and Postel-Vinay (2002)) consider the case in which the firm is not subject to firing costs in new matches, so firing costs do not yet appear in the outside option of the firm in initial wage negotiations. Here I proceed as in Millard and Mortensen, postponing the slightly more complicated second case until Section 6, where I show that none of the results are affected.

Fella (2000b) shows how (1) can be supported as the equilibrium of a strategic bargaining game, and provides a critical appraisal of the role played by firing costs in such a game.

⁹I need to allow randomization to show existence of equilibrium in the model with involuntary dismissals.

Turning to the separation decision, the first thing to notice about sharing rule (1) is that worker and firm agree about the choice of the separation rule \underline{s} : both want it to maximize the joint value $V(y, \underline{s}, F, U)$. In other words, the separation decision is bilaterally efficient.

The following lemma establishes the comparative statics properties of the threshold productivity. All proofs are collected in the appendix.

Lemma 1. *The threshold productivity $\underline{y}_{NB}(F, U)$ is strictly decreasing in F and strictly increasing in U .*

Higher firing costs make splitting up less attractive, while less painful unemployment hastens separation. Both the worker and the firm are indifferent with respect to separation when productivity equals $\underline{y}_{NB}(F, U)$, so any separation rule $\underline{s} = (\underline{y}_{NB}(F, U), \underline{\lambda})$ with $\underline{\lambda} \in [0, 1]$ is optimal. Let $\underline{s}_{NB}(F, U)$ be the set of optimal separation rules.

Let $W_{NB}^*(y, F, U) \equiv W_{NB}(y, \underline{s}_{NB}(F, U), F, U)$ be worker utility if the separation decision is optimal. In order to determine preferences of workers for employment protection, I need to analyze the comparative statics properties of W_{NB}^* .

Lemma 2. (a) *Consider $U^H > U^L$. The difference $W_{NB}^*(y, F, U^H) - W_{NB}^*(y, F, U^L)$ is positive, bounded above by $U^H - U^L$, and weakly decreasing in y .*

(b) *Consider $F^H > F^L$. The difference $W_{NB}^*(y, F^H, U) - W_{NB}^*(y, F^L, U)$ is non-negative, bounded above by $F^H - F^L$, and weakly increasing in y .*

To discuss the mechanics of this lemma, it is instructive to examine the wage implied by the sharing rule (1):

$$w_{NB}(y, F, U) = \rho U + \beta [y - \rho U + (\rho + \delta)F]. \quad (2)$$

Part (a) states that employed workers benefit from an increase in unemployed utility. This occurs for two reasons. First, they receive a higher payoff when becoming unemployed. Second, as is evident from equation (2), it enables them to obtain a higher wage in bargaining. According to part (b) the employed also benefit from an increase in firing costs. By assumption firing costs are wasted, so they do not affect workers' payoff upon separation. But equation (2) shows that higher firing costs enable workers to bargain towards higher wages. This is the *bargaining effect* discussed in the introduction.

Key for the ability of firing costs to create their own support is how these two effects vary with match-specific productivity. Part (a) states that workers in poor matches gain more from an increase in unemployed utility. This is because the increase in the flow value

of unemployment by $\rho(U^H - U^L)$ exceeds the wage increase $(1 - \beta)\rho(U^H - U^L)$. Workers in poor matches then gain more, since they are more likely to become unemployed soon.

Part (b) establishes that higher firing costs benefit workers in good matches more. The mechanism is transparent from equation (2), which reveals that the bargaining effect is uniform across levels of match-specific productivity: the wage increase associated with an increase in firing costs does not depend on whether the match is good or bad. Workers in good matches are in a better position to benefit from this wage increase, because in expectation they remain employed longer. Uniformity makes the Nash solution an attractive benchmark for studying the bargaining effect. But other bargaining models may deliver a non-uniform wage effect, a point I return to in Section 6.

The comparative statics results developed above are all that is needed to build intuition for the main result I obtain for the model with Nash bargaining. Which workers gain most from an increase in firing costs depends on the equilibrium effect of firing costs on utility from unemployment. To anticipate the equilibrium results, it is useful to work with the conjecture that utility from unemployment falls. Then the two effects work in the same direction: workers in good matches gain more from the direct effect of higher firing costs, and suffer less from the equilibrium effect of reduced utility from unemployment. Furthermore, under this conjecture Lemma 1 implies that an increase in firing costs also reduces the separation threshold, again because the decline in unemployed utility works in the same direction as the direct effect of higher firing costs. In other words, high firing costs maintain workers in bad matches. In Section 6 this yields the main result for the model with Nash bargaining: higher firing costs in the past reduce the political support for firing costs today.

In the introduction I claimed that the job duration effect is absent in the case of Nash bargaining. Notice, however, that here employment protection does extend job duration through the separation threshold. Why then do workers not benefit from this increase in job length? To make this claim precise, notice that firing costs have two effects on utility $W_{NB}(y, \underline{x}_{NB}(F, U), F, U)$. The first works through wages, the second through the separation threshold. Now conduct a thought experiment. Consider an increase in firing costs from F^L to F^H , but fix the wage schedule at $w_{NB}(y, F^L, U)$. This can be interpreted as allowing the worker to delay separation through the policy instrument of firing costs without affecting wages. Would the worker like this instrument to be used? Here the answer is no. This is because given the wage schedule $w_{NB}(y, F^L, U)$, the separation rule $\underline{x}_{NB}(F^L, U)$ is optimal for the worker. She obtains no direct benefit from manipulating the separation threshold. She wants the separation rule to drop after an increase in firing costs, but only as an afterthought

to higher wages through the bargaining effect which make staying on the job more attractive.

3.2 Involuntary Dismissal

Now I consider a class of intentionally ad hoc wage rules, designed to be orthogonal to Nash bargaining as follows. First, an increase in firing costs no longer directly enables workers to obtain a higher wage. Second, the separation rule adopted by the firm is no longer optimal from the perspective of the worker. This gives workers a reason to manipulate this rule through the policy instrument of firing costs. Specifically, I consider wage rules of the form

$$w(y, F, U) = w_{ID}(U). \quad (3)$$

There are two differences compared to the Nash bargaining wage rule (2). First, here the wage is not conditioned on match-specific productivity. In conjunction with Assumption 1 (a) below, this is sufficient for dismissal to be involuntary. Second, firing costs do not have a direct effect on wages. This shuts down the bargaining effect, allowing me to isolate the implications of involuntary dismissal. The wage rule (3) shares with Nash bargaining that labor market conditions can affect the wage through the utility of unemployed workers.

I assume that the wage rule (3) satisfies the following assumption.

Assumption 1. *The wage rule w_{ID} is continuous and has the following properties.*

(a) $w_{ID}(U) > z$ for all $U \geq \frac{z}{\rho}$.

(b) Consider $U^H > U^L \geq \frac{z}{\rho}$. Then $0 \leq w_{ID}(U^H) - w_{ID}(U^L) \leq \rho(U^H - U^L)$.

Part (a) states that the wage exceeds the value of non-market activity. Lemma 12 in Section 7 establishes that under this assumption the wage $w_{ID}(U)$ must exceed the opportunity cost of the worker ρU in equilibrium. This is intuitive, as ρU is the flow value of searching for a new job, the new job will pay the same wage $w_{ID}(U)$, and during search the worker receives the payoff z which is strictly below the wage. What this implies is that any dismissal is involuntary: in contrast to Nash bargaining, here the wage exceeds the opportunity cost at the time of separation. Thus an employed worker can benefit from firing costs even if firing costs do not directly affect the wage, because firing costs delay involuntary dismissal. It is convenient to define the involuntary dismissal region $\mathcal{U}_{ID} \equiv \{U | w_{ID}(U) > \rho U\}$, which consists of the values of unemployed utility such that the wage exceeds the opportunity cost. Due to the result mentioned above, I only need to study the properties of worker utility on \mathcal{U}_{ID} , since in equilibrium the utility of unemployed workers must lie within this region.

Notice that while independence from match-specific productivity y , together with part (a), is sufficient for involuntary dismissal, it is not necessary and can be relaxed.

Part (b) simply states that a higher flow value of unemployment increases the wage, but less than one for one. This property is shared by the Nash bargaining wage rule (2).

As discussed in the introduction, dismissal is bilaterally inefficient under wage rule (3): some separations occur although it would be mutually beneficial to renegotiate to a lower wage. Several papers have studied models of wage determination with this feature, asking how employment protection affects labor market performance in such an environment.¹⁰

Before studying how wage rule (3) shapes workers' preferences for firing costs, I briefly discuss its relationship to microfounded models of wage-setting and observed wage-setting institutions. Models of efficiency wages can give rise to involuntary dismissal. The shirking model of Shapiro and Stiglitz (1984) implies a wage rule of the form $\rho U + \bar{w}(F)$ with $\bar{w}(F) > 0$. The flow rent $\bar{w}(F)$ falls with firing costs, because inducing effort requires a fixed present discounted value of rents, determined by the cost of effort and the probability of detection. By prolonging job duration, firing costs shrink the flow rent needed to generate this present value. Consequently workers cannot gain from job prolongation due to the offsetting wage effect, and lose from firing costs if unemployed utility is adversely affected. Saint-Paul (1999, 2000) develops a version of the Shapiro-Stiglitz model which implies a wage of the form $\rho U + \bar{w}$ with $\bar{w} > 0$. The flow rent is independent of firing costs, because the severity of the moral-hazard problem in his model is proportional to expected job duration.¹¹ Since this model also satisfies Assumption 1, it provides one microfoundation for wage rule (3).

Efficiency wages can give rise to involuntary dismissal even in unregulated labor markets, yet their quantitative importance remains debated. In a field survey of US managers Bewley (1999) finds evidence for mechanisms other than efficiency wages that induce firms to limit wage renegotiation at the individual level, in particular the desire to maintain internal pay structures. A different source of involuntary dismissal is labor market regulation itself. For example, wage rule (3) encompasses a binding minimum wage, or wage floors established by collective bargaining. Of course, an explicit model of collective bargaining may imply an additional bargaining effect of employment protection, which wage rule (3) shuts down to isolate the role of involuntary dismissal.

¹⁰A non-exhaustive list includes Fella (2000b), Alvarez and Veracierto (2001), Blanchard and Portugal (2001), and Garibaldi and Violante (2005).

¹¹This describes the model of Saint-Paul (2000, Chapter 1). Saint-Paul (1999) differs slightly in that the flow rent is proportional to match-specific productivity y . The moral-hazard problem in both cases is that the worker may attempt to acquire a technology that enables stealing from the employer. If this technology permits stealing more in matches with high productivity, then the flow rent increases with y .

I now proceed to analyze the separation decision. With Nash bargaining this decision maximizes the joint value of the match. In contrast, here the worker never wants to separate, and the firm decides when to dismiss the worker taking as given the wage implied by (3). Again, this is an optimal stopping problem giving rise to a separation threshold $\underline{y}_{ID}(F, U)$.

Lemma 3. *The threshold productivity $y_{ID}(F, U)$ is weakly increasing in U and strictly decreasing in F .*

The qualitative properties of the separation threshold are similar to those of $\underline{y}_{NB}(F, U)$ established in Lemma 1. The only difference is that $\underline{y}_{ID}(F, U)$ is only weakly increasing in U . Unemployed utility affects the separation threshold only through the wage, and if an increase in U does not change the wage, then it leaves the threshold unaffected as well. The firm is indifferent about separation at $\underline{y}_{ID}(F, U)$, so the set of optimal separation rules $\underline{s}_{ID}(F, U)$ consists of all pairs $(\underline{y}_{ID}(F, U), \underline{\lambda})$ with $\underline{\lambda} \in [0, 1]$.

Now let $W_{ID}(y, \underline{s}, U)$ denote worker utility if current match productivity is y , the wage is $w_{ID}(U)$, and dismissal occurs according to the separation rule \underline{s} . Notice that firing costs do not appear as an argument of W_{ID} : conditional on the separation rule, there is no effect of firing costs on worker utility, precisely because the bargaining effect on wages is absent.

Lemma 4. *The function W_{ID} has the following properties.*

- (a) *Consider $U^H, U^L \in \mathcal{U}_{ID}$ with $U^H > U^L$. Then the difference $W_{ID}(y, \underline{s}, U^H) - W_{ID}(y, \underline{s}, U^L)$ is positive, bounded above by $U^H - U^L$, and weakly decreasing in y .*
- (b) *Fix $U \in \mathcal{U}_{ID}$. Consider $\underline{s}^L < \underline{s}^H$. Then the difference $W_{ID}(y, \underline{s}^L, U) - W_{ID}(y, \underline{s}^H, U)$ is non-negative.*

According to part (a), there is no difference vis-à-vis Nash bargaining in the comparative statics with respect to utility from unemployment. Part (b) considers a drop in the separation rule. First, a drop in the separation rule needs to be defined. The natural way to order separation rules is lexicographic: if $\underline{s}^L = (\underline{y}^L, \underline{\lambda}^L)$ and $\underline{s}^H = (\underline{y}^H, \underline{\lambda}^H)$, then

$$\underline{s}^L < \underline{s}^H \quad \Leftrightarrow \quad \underline{y}^L < \underline{y}^H \quad \text{or} \quad (\underline{y}^L = \underline{y}^H \quad \text{and} \quad \underline{\lambda}^L < \underline{\lambda}^H).$$

The lemma states that workers benefit from a drop in the separation rule. This is because dismissal is involuntary and a lower separation rule prolongs job duration.

The key question is how the benefit of an increase in firing costs varies with the productivity of the match. In the case of Nash bargaining workers in good matches benefit most

from an increase in firing costs. This is different in the model with involuntary dismissal, as now there is a mechanism that tends to make firing costs relatively more beneficial to workers in poor matches. Loosely speaking, workers in good matches are already protected from involuntary dismissal by their high productivity: since productivity is persistent, the evolution of productivity has to be very adverse in order to lead to an involuntary dismissal. Since they are already protected by their high productivity, workers in good matches tend to gain less from employment protection than workers in poor matches.

In Section 7.1 I calibrate the model to study this mechanism quantitatively. I present a calibration for two reasons. First, as I describe below, the theoretical results are somewhat weaker than in the case of Nash bargaining. Second, even if the theoretical results were as sharp as for Nash bargaining, one would still like to know whether and under what conditions this mechanism is of first-order importance quantitatively.

While the quantitative analysis is central, I also derive some qualitative results, not least because they provides insights into the mechanism underlying the quantitative findings. Recall that part (b) of Lemma 2 makes a strong statement for the case of Nash bargaining: any arbitrary increase in firing costs benefits workers in good matches more than workers in poor matches. At first glance one may seek to establish the analogous but opposite statement under involuntary dismissals, namely that the benefit

$$W_{ID}(y, \underline{s}^L, U) - W_{ID}(y, \underline{s}^H, U)$$

is weakly decreasing in productivity y for any drop in the separation rule from \underline{s}^H to $\underline{s}^L \leq \underline{s}^H$. It is easy to see, however, why this statement cannot be true in general. Consider two productivity levels y^L and y^H with $y^L < y^H$. Suppose that $y^L < \underline{y}^L < y^H < \underline{y}^H$ where \underline{y}^L and \underline{y}^H are the separation thresholds associated with \underline{s}^L and \underline{s}^H , respectively. Thus y^L is so low that even the low separation rule is not enough to save the worker's job in a match with this productivity, hence such a worker gains nothing if the separation rule is \underline{s}^L rather than \underline{s}^H . In contrast, for a worker in a match with the higher productivity level y^H the same drop in the separation rule makes the difference between dismissal and keeping the job.

While it is not generally true that workers in bad matches benefit more from *any* drop in the separation rule, I now obtain a weaker result: all workers benefit if the separation rule drops sufficiently to prohibit all dismissals, and in this case workers in poor matches do benefit most. Let $\underline{s}^P \equiv (0, 0)$ be the separation rule which prohibits dismissal entirely.

Lemma 5. *The difference $W_{ID}(y, \underline{s}^P, U) - W_{ID}(y, \underline{s}, U)$ is weakly decreasing in y on \mathcal{Y} for any \underline{s} and $U \in \mathcal{U}_{ID}$.*

As before, the intuition for the main qualitative results for this model can be developed from the comparative statics results derived above. Again, it is useful to conjecture that an increase in firing costs reduces the utility of the unemployed. Lemma 4 implies that workers in poor matches suffer more from this indirect effect of firing costs, because they are more exposed to unemployment. Thus, unlike with Nash bargaining, the two effects work in opposite directions: workers in poor matches tend to gain more from the drop in the separation rule, while suffering more from the fall in the utility of the unemployed. Notice, however, that prohibitive firing costs once again play a special role here: if dismissals are prohibited, then all workers are equally likely to become unemployed, and thus suffer equally from a drop in the utility of the unemployed. In Section 7 this leads to the following result: higher past firing costs increase the support for prohibitive firing costs today.

4 Economic Equilibrium and Steady State

4.1 Equilibrium Path

As discussed in Section 3, the transitional dynamics of the model are such that the utility of the unemployed U (and thereby the separation threshold \underline{s}) as well as labor market tightness θ are constant along the equilibrium path after the change in firing costs at time $t = 0$. I now state the conditions that determine these values in equilibrium. Statements made about the equilibrium path in this section apply to both models of wage determination $M \in \{NB, ID\}$.

An equilibrium is a triple $(U, \theta, \underline{s})$ satisfying the following conditions

$$\underline{s} \in \underline{s}_M(F, U), \tag{4}$$

$$c \geq (1 - \rho)q(\theta) \int J_M(y, \underline{s}, F, U) dG_{new}(y) \quad \text{with equality if } \theta > 0, \tag{5}$$

$$\rho U = z + (1 - \rho)f(\theta) \int [W_M(y, \underline{s}, F, U) - U] dG_{new}(y). \tag{6}$$

For notational consistency with the case of Nash bargaining, here I write $W_{ID}(y, \underline{s}, F, U)$ rather than $W_{ID}(y, \underline{s}, U)$, carrying along F as a separate argument although firing costs do not have a direct effect on worker utility in the model with involuntary dismissal.

Condition (4) requires that the separation rule \underline{s} is optimal. Condition (5) is the free-entry condition for posting vacancies. The right-hand side is the return from posting a vacancy, the value of being matched with a worker next period. In equilibrium it cannot exceed the vacancy cost c and must equal this cost if a positive mass of vacancies is posted.

Condition (6) states that the flow value of unemployment ρU is the sum of the value of non-market activity z and the capital gain from being matched with a firm next period.

Lemma 6. (a) (Existence) *For each level of firing costs $F \in \mathcal{F}$ the conditions (4)–(6) have a solution.*

(b) (Uniqueness) *The equilibrium values of U , θ , and \underline{y} , denoted as $U_M(F)$, $\theta_M(F)$ and $\underline{y}_M(F)$, are uniquely determined. Equilibrium utilities $W_M(\underline{y}, \underline{s}_M(F), F, U_M(F))$ are uniquely determined.¹²*

Part (b) states that utility levels are well determined. Thus utility of a worker at time $t = 0$ can be expressed as a function of match productivity and future firing costs:

$$\mathcal{W}_M(\underline{y}, F) \equiv W_M(\underline{y}, \underline{s}_M(F), U_M(F), F).$$

The unemployed are included by assigning them productivity $u < 0$ and setting $\mathcal{W}_M(u, F) \equiv U_M(F)$. Let $\mathcal{Y}_a \equiv \{u\} \cup \mathcal{Y}$ be the enlarged productivity space including all workers.

4.2 Steady State

First I establish that there is a unique steady-state distribution of workers over the enlarged state space \mathcal{Y}_a . Knowledge of the separation rule \underline{s} and labor market tightness θ is sufficient to pin down the steady-state distribution.

Lemma 7. *For each pair (\underline{s}, θ) a steady-state distribution exists and is unique.*

Let $G_a(\cdot | \underline{s}, \theta)$ denote the distribution function associated with the steady-state distribution as a function of the separation rule \underline{s} and labor market tightness θ . Next I turn to the productivity distribution conditional on employment, denoted as $G_e(\cdot | \underline{s})$. It does not depend on labor market tightness θ : the magnitude of flows into and out of unemployment matters for the level of employment but not for the distribution of productivity across employed workers. Now let \geq_{FSD} denote first-order stochastic dominance. The following lemma establishes that the productivity distribution shifts down with a fall in the separation rule.

Lemma 8. *Suppose $\underline{s}^H \geq \underline{s}^L$. Then $G_e(\cdot | \underline{s}^H) \geq_{FSD} G_e(\cdot | \underline{s}^L)$.*

¹²Thus everything but the separation probability is unique. Under Nash bargaining all separation probabilities $\underline{\lambda}$ are consistent with equilibrium, so $s_{NB}(F) = \{\underline{y}_{NB}(F)\} \times [0, 1]$ is the set of equilibrium separation rules. With involuntary dismissal the separation probability may be unique, this occurs if the productivity level $\underline{y}_M(F)$ occurs with positive probability during the life of a match. See the proof for details.

Next consider steady-state employment, which is given by

$$L(\underline{s}, \theta) \equiv 1 - G_a(u|\underline{s}, \theta).$$

An increase in employment protection may simultaneously reduce both the separation rate as well as labor market tightness. Thus the effect on employment is generally ambiguous. This ambiguity is a common feature of equilibrium models of employment protection.¹³

5 The Policy Decision

In the previous section the model economy experienced an unanticipated exogenous change in firing costs at time $t = 0$. In the remainder of the paper I assume that the new level of firing costs F is the outcome of a policy decision. The key question is how the political support for future firing costs F varies with the extent of past employment protection F_0 .

The heuristic argument of the introduction only states that the support of *employed* workers is increasing in the level of past protection. To evaluate this argument, I start by asking: suppose the new level of firing costs is the outcome of a policy decision among only employed workers, how does the outcome vary with past firing costs? Having analyzed this scenario, I discuss how results change if the unemployed participate in the policy decision.

Specifically, I assume that the new level of firing costs must maximize average utility of employed workers. This objective function can be derived from probabilistic voting among employed workers (Lindbeck and Weibull (1997), Persson and Tabellini (2000)).

The results for Nash bargaining obtained in Section 6 are quite robust with respect to how preferences are aggregated, and there I discuss what properties of the aggregation rule are sufficient. For involuntary dismissal, probabilistic voting insures the existence of a political equilibrium; for reasons discussed in Section 3.2 preferences satisfy neither single-crossing nor single-peakedness, and Saint-Paul (1999) shows that Condorcet cycles may occur.

Average utility of employed workers is given by

$$\Omega_{M,e}(F|F_0) \equiv \int \mathcal{W}_M(y, F) dG_e(y|\underline{s}_M(F_0)) \quad (7)$$

and thus the set of political equilibria is

$$\mathcal{P}_{M,e}(F_0) \equiv \arg \max_{F \in \mathcal{F}} \Omega_{M,e}(F|F_0). \quad (8)$$

The past level of firing costs F_0 induces a productivity distribution $G_e(\cdot|\underline{s}_M(F_0))$. The objective function depends on F_0 because it averages worker utility over this distribution. Thus

¹³Ljungqvist (2002) studies the employment effect of firing costs in a variety of equilibrium models.

the past level of firing costs affects the outcome at time $t = 0$ through its effect on the steady-state productivity distribution prevailing at that time.¹⁴ When all workers, including the unemployed, participate in the decision the set of political equilibria is denoted as $\mathcal{P}_{M,a}(F_0)$. It is obtained by replacing the productivity distribution across employed workers with the overall productivity distribution $G_a(\cdot|\underline{s}_M(F_0), \theta_M(F_0))$.

To evaluate whether an increase in past firing costs shifts up the set of political equilibria $\mathcal{P}_{M,e}(F_0)$, a way of ordering sets is required. I use the *strong set order* \leq_S , which is an extension of the usual order from points to sets.¹⁵

If a positive effect of the past level of firing costs on the current political support for protection is indeed present, then the question arises whether this mechanism can generate multiple stationary political equilibria. By stationary political equilibrium (SPE) I mean a past level of firing costs F_0 that is revalidated in the policy decision at time $t = 0$, that is $F_0 \in \mathcal{P}_{M,e}(F_0)$. As discussed in Saint-Paul (2002), this can be considered as the limit steady state of the model with repeated policy decisions as their frequency goes to zero.

Definition 1. *The model (M, e) exhibits multiple stationary political equilibria if there exist F_0^H, F_0^L such that both $F_0^H \in \mathcal{P}_{M,e}(F_0^H)$ and $F_0^L \in \mathcal{P}_{M,e}(F_0^L)$, and $F_0^H \notin \mathcal{P}_{M,e}(F_0^L)$ or $F_0^L \notin \mathcal{P}_{M,e}(F_0^H)$.*¹⁶

If $\mathcal{P}_{M,e}(F_0)$ is decreasing in the strong set order, this rules out multiple SPE.

6 Nash Bargaining

In this section I show that under Nash bargaining higher firing costs in the past imply lower political support for firing costs today. The argument has two parts. The first part is that an increase in past firing costs shifts down the productivity distribution. The second part is that this is a shift towards workers that have little to gain from firing costs.

¹⁴As a minor technical point, recall that the past level of firing costs F_0 may induce multiple stationary distributions which share the same separation threshold $\underline{y}_M(F_0)$ but differ slightly due to the probability of dismissal at this threshold. Thus equations (7)-(8) should be read as follows: $F \in \mathcal{P}_{M,e}(F_0)$ if and only if F maximizes some objective $\Omega_{M,e}(F|F_0)$ induced by a separation rule $\underline{s} \in \underline{s}_M(F_0)$.

¹⁵The set \mathcal{P}^H is *as high as* the set \mathcal{P}^L , written $\mathcal{P}^H \geq_S \mathcal{P}^L$, if for every $F^L \in \mathcal{P}^L$ and $F^H \in \mathcal{P}^H$, $F^L > F^H$ implies that both F^L and F^H are elements of the intersection $\mathcal{P}^H \cap \mathcal{P}^L$. See Milgrom and Shannon (1994).

¹⁶Since $\mathcal{P}_{M,e}(F_0)$ is a set, even if an increase in F_0 shifts down $\mathcal{P}_{M,e}(F_0)$ in the strong set order, there can still be multiple intersections with the 45-degree line. However, if F_0^H and F_0^L are two such intersections, then F_0^H must also be a political equilibrium if F_0^L prevailed in the past and vice versa. Here I am interested in a more restrictive type of multiplicity, where both low and high firing costs are SPE, but it is not the case that low firing costs would also be a political equilibrium in the high firing costs economy or vice versa.

Suppose an increase in past firing costs reduces the utility of the unemployed. In this case Lemma 1 implies that the separation threshold $\underline{y}_{NB}(F_0)$ drops, and Lemma 8 in turn implies that the productivity distribution falls as well. Thus let

$$\mathcal{F}_{NB} = \{F \in \mathcal{F} \mid \nexists F^H \in \mathcal{F} \text{ s.t. } F^H > F \text{ and } U_{NB}(F^H) > U_{NB}(F)\}$$

be the range over which an increase in firing costs reduces utility from unemployment.

Lemma 9. *Consider $F_0^H, F_0^L \in \mathcal{F}_{NB}$ with $F_0^H > F_0^L$. Let $\underline{s}_0^H \in \underline{s}_{NB}(F_0^H)$ and $\underline{s}_0^L \in \underline{s}_{NB}(F_0^L)$. Then $G_e(\cdot | \underline{s}_0^L) \geq_{FSD} G_e(\cdot | \underline{s}_0^H)$.*

If it were true that unemployed utility $U_{NB}(F)$ is monotone decreasing, this would insure $\mathcal{F}_{NB} = \mathcal{F}$ and the first part of the argument would be complete. However, this is not true in general.¹⁷ Thus I take a different approach. I show that if a level of firing costs F is not in the range \mathcal{F}_{NB} , then it is dominated: there exists a higher level of firing costs F^H which delivers higher utility to the unemployed; since employed workers can only lose from higher firing costs if unemployed utility falls, it follows that *all* workers strictly prefer F^H over F . Thus if F is a political equilibrium for some past level of firing costs F_0 , then it must lie in \mathcal{F}_{NB} . This is true no matter whether only the employed or all workers vote.

Lemma 10. *If $F \in P_{NB,e}(F_0)$ or $F \in P_{NB,a}(F_0)$ for some $F_0 \in \mathcal{F}$, then $F \in \mathcal{F}_{NB}$.*

If F does not lie in \mathcal{F}_{NB} it cannot be a past policy choice. Thus firing costs outside of \mathcal{F}_{NB} are of limited interest. In particular, they cannot be stationary SPE.

For the second part of the argument, consider an increase in firing costs in the relevant range \mathcal{F}_{NB} . Unemployed utility falls. By Lemma 2, workers in good matches suffer less from this equilibrium effect, while gaining more from the direct effect of higher wages.

Lemma 11. *Consider $F^H, F^L \in \mathcal{F}_{NB}$ with $F^H > F^L$. Then the difference $\mathcal{W}_{NB}(y, F^H) - \mathcal{W}_{NB}(y, F^L)$ is weakly increasing in y on \mathcal{Y}_a .*

With both elements in place, I now obtain the main theoretical result for the model with Nash bargaining: higher past firing costs shift down the set of political equilibria today.

Proposition 1. *Consider $F_0^H, F_0^L \in \mathcal{F}_{NB}$ with $F_0^H > F_0^L$. Then $\mathcal{P}_{NB,e}(F_0^H) \leq_S \mathcal{P}_{NB,e}(F_0^L)$.*

¹⁷If the bargaining share β is low relative to the value that satisfies the Hosios (1990) rule for efficiency, then over some range firing costs substitute for the low value of β and increase unemployed utility. Eventually the implied bargaining power of workers becomes excessive, so $U_{NB}(F)$ is hump-shaped.

The support for firing costs is non-increasing on \mathcal{F}_{NB} , and levels of firing costs outside of \mathcal{F}_{NB} cannot be a political equilibrium. Together this implies that there is at most one SPE in the set of firing costs \mathcal{F} .

Corollary 1. *The model (NB, e) does not exhibit multiple stationary political equilibria.*

It is important to point out that these results hold for $\bar{F} = +\infty$ as well as any $\bar{F} < +\infty$. As discussed in Section 2, I allow for the possibility that legal or physical limits on the resources that can be extracted from firms imply a lower bound on firm values. This is equivalent to an upper bound on the level of firing costs which can be effectively imposed. The case $\bar{F} < +\infty$ is more realistic, and also turns out to be more interesting. For $\bar{F} = +\infty$ the results above are somewhat vacuous for the following reason. Over some range employed workers face a trade-off: higher firing costs imply higher wages but also more painful unemployment. But above some level of firing costs hiring ceases and utility from unemployment remains constant at $\underline{U} = \frac{z}{\rho}$. Beyond this point there is no longer a trade-off: further increases in firing costs only increase wages, and equation (2) implies that there is no upper bound on the wage level that can be achieved. Thus employed workers prefer infinite firing costs, no matter what level of firing costs prevailed in the past. This is different if $\bar{F} < +\infty$. Importantly, in this case it does not follow that the utility of employed workers is maximized at \bar{F} . The level of firing costs at which hiring ceases can be highly undesirable. If \bar{F} is below this level or not much larger, then workers prefer an interior level of firing costs. This interior political equilibrium is then decreasing in the past level of firing costs.

Participation of the Unemployed. Unemployed workers suffer most from an increase in employment protection. Thus if more stringent regulation in the past is associated with higher unemployment today, this provides an additional force reducing support for firing costs today, strengthening the result of Proposition 1.

Corollary 2. *Consider $F_0^H, F_0^L \in \mathcal{F}_{NB}$ with $F_0^H > F_0^L$. Suppose that $\underline{s}_0^H \in \underline{s}_{NB}(F_0^H)$ and $\underline{s}_0^L \in \underline{s}_{NB}(F_0^L)$ implies $L(\underline{s}_0^H, \theta_{NB}(F_0^H)) \leq L(\underline{s}_0^L, \theta_{NB}(F_0^L))$. Then $\mathcal{P}_{NB,a}(F_0^H) \leq_S \mathcal{P}_{NB,a}(F_0^L)$.*

As discussed in Section 4, the effect of firing costs on unemployment in the model is ambiguous. Empirical evidence surveyed in Addison and Teixeira (2003) indicates that unemployment is not reduced, hence the Corollary considers the empirically relevant case.

Preference Aggregation. The argument of this section is not specific to maximization of average worker utility. What qualitative properties must the preference aggregation rule

satisfy for the argument to apply? As established in Lemma 11, worker preferences satisfy weakly increasing differences. What is needed is that the aggregation rule is monotone in the following sense: if preferences satisfy weakly increasing differences, then a downward shift in the distribution of productivity (in the sense of first-order stochastic dominance) must reduce the policy outcome. Majority voting is another example with this property.¹⁸

Bargaining in New Matches. In Section 3.1 I noted that several studies assume that firing costs do not yet apply in initial wage negotiations of a new match, and thus do not appear in the firm’s outside option. To introduce this feature here, assume the following timing of events in new matches. The worker and the firm meet and negotiate an initial split of the joint value in the absence of firing costs. As production begins initial productivity is revealed, firing costs take effect, and the split is renegotiated accordingly. This does not affect the analysis of preferences in Section 3.1, since at the time of the policy decision firing costs apply in all matches. What changes are the equilibrium conditions (5)–(6). The capital gain of a worker from being matched is now $\beta \int [V(y, \underline{s}, F, U) - U] dG_{new}(y)$ rather than $\int [W_{NB}(y, \underline{s}, F, U) - U] dG_{new}(y)$. The difference between the two βF is the transfer the worker must make at the start of the relationship to compensate the firm for subsequent upward renegotiation of the wage.¹⁹ The capital gain of the firm changes accordingly. This changes the equilibrium relationship $U_{NB}(F)$, which becomes decreasing. This implies $\mathcal{F}_{NB} = \mathcal{F}$, making Lemma 10 redundant, otherwise the main results are unchanged.

Severance Payments. Next I ask how results change if workers vote on a severance payment S rather than wasteful firing costs F . There are several reasons to consider severance payments. First, they likely dominate wasteful firing costs in terms of efficiency. Second, Fella’s argument discussed earlier implies that wasteful firing costs act similar to severance payments if firm-worker pairs circumvent them through side payments. Third, Garibaldi and Violante (2005) show that in Italy transfers upon separation are quantitatively more important than wasteful firing costs, and suggest this may hold true for other countries. Fourth, if the government collects a firing tax it could redistribute the proceeds. Blanchard and Tirole (2008) show that in models such as the present one, severance payments are equivalent to a system in which firing taxes are redistributed to workers as unemployment benefits.

¹⁸Weakly increasing differences established in Lemma 11 imply that a Condorcet winner exists. Thus the set of Condorcet winners is non-empty and decreasing in past firing costs (see Brügemann (2004)).

¹⁹In Mortensen and Pissarides (1999) this transfer is spread out over time, because by assumption wages are not renegotiated until the match experiences its first productivity change.

Sharing rule (1) must be modified in two ways. First, S does not affect the joint value since it is a transfer within the match. Second, S enhances the worker's outside option. Thus $W_{NB}(y, \underline{s}, S, U) = U + S + \beta [V(y, \underline{s}, U) - U]$. The direct effect of severance payments is independent of match-specific productivity. Therefore, in contrast to firing costs, workers in bad matches receive the same direct benefit. But they remain more exposed to equilibrium effects on U . The latter depend on assumptions about bargaining in new matches. If severance payments are not yet applicable, then by the same logic as above, the worker transfers S to the firm at the start of the relationship, and severance payments are neutral as in Lazear (1990). Incumbent workers then face no trade-off and the political equilibrium is \bar{S} (the analog of \bar{F}) irrespective of past policy. If instead S applies in initial negotiations, or the transfer of S is not possible, then U is affected. Over the region \mathcal{S}_{NB} where there is a trade-off, workers in good matches benefit more from an increase in S . An analog of Proposition 1 applies in both cases. Thus qualitatively the results are similar to firing costs. Quantitatively, the political equilibrium level of S is different, as discussed in Section 7.1.

Non-uniform Bargaining Effect. As discussed in Section 3.1, with Nash bargaining an increase in firing costs raises wages uniformly across match-specific productivity levels. I suggested that uniformity makes Nash bargaining an attractive benchmark for studying the bargaining effect. With a uniform effect, longer expected job duration in good matches implies larger gains from employment protection. To overturn this, wages of workers in poor matches would have to rise relatively more, sufficient to outweigh shorter job duration. In the limit, workers just about to be dismissed would require very large wage increases. On the other hand, in some strategic bargaining games the firm's threat to dismiss may matter more if the match is poor, making firing costs more beneficial to workers in poor matches.²⁰ It would be interesting to explore the quantitative implications of such bargaining models with non-uniform effects for the ability of employment protection to create its own support.

7 Involuntary Dismissal

In this section I ask whether employment protection can generate its own political support in the model with involuntary dismissal. First I derive qualitative results, then I turn to the main focus, which is the quantitative analysis.

I start with a preliminary result. In Section 3.2 I asserted that in equilibrium the wage

²⁰See Binmore, Rubinstein, and Wolinsky (1986).

$w_{ID}(U)$ always exceeds the worker's opportunity cost ρU , or equivalently, that unemployed utility U lies in the involuntary dismissal region \mathcal{U}_{ID} . This provided the justification for establishing the properties of worker utility W_{ID} in Lemmas 3–5 only on this region.

Lemma 12. *For all $F \in \mathcal{F}$ equilibrium utility from unemployment satisfies $U_{ID}(F) \in \mathcal{U}_{ID}$.*

The intuition for this result was already discussed in Section 3.2. Now I turn to the main analysis, which consists of the same two parts as with Nash bargaining. The first step – showing that an increase in firing costs shifts down the productivity distribution – turns out to be simpler here because an increase in firing costs always reduces the separation rule.

Lemma 13. *Consider $F^H, F^L \in \mathcal{F}$ with $F^H > F^L$. Let $\underline{s}^H \in \underline{s}_{ID}(F^H)$ and $\underline{s}^L \in \underline{s}_{ID}(F^L)$. Then $\underline{s}^H \leq \underline{s}^L$.*

In conjunction with Lemma 8 this yields a strengthened version of Lemma 9.

Lemma 14. *Consider $F_0^H, F_0^L \in \mathcal{F}$ with $F_0^H > F_0^L$. Let $\underline{s}_0^H \in \underline{s}_{ID}(F_0^H)$ and $\underline{s}_0^L \in \underline{s}_{ID}(F_0^L)$. Then $G_e(\cdot | \underline{s}_0^L) \geq_{FSD} G_e(\cdot | \underline{s}_0^H)$.*

Next I turn to the second part. For Nash bargaining Lemma 11 established that workers in good matches benefit more from *any* increase in firing costs. For reasons discussed in Section 3.2, the analogous but opposite statement is not generally true in the model with involuntary dismissal. According to Lemma 5, however, workers in poor matches benefit most if dismissal is prohibited. Lemma 5 holds utility of the unemployed constant. Now I show the same remains true if the equilibrium effect of firing costs on unemployed utility is taken into account. As discussed in Section 3.2, in general workers in poor matches suffer more if the utility of the unemployed falls, because they are more likely to become unemployed. Importantly, this difference is leveled if dismissal is prohibited. It follows that workers in poor matches benefit most from prohibiting dismissal. Formally, define the prohibitive level of firing costs F^P as the infimum of those levels that induces an equilibrium separation rule of $s_{ID}(F) = \{\underline{s}^P\}$, where $\underline{s}^P = (0, 0)$ is the prohibitive separation rule.

Lemma 15. *Consider $F^L \in \mathcal{F}$. Then the difference $\mathcal{W}(y, F^P) - \mathcal{W}(y, F^L)$ is weakly decreasing in y on \mathcal{Y} .*

In conjunction with Lemma 14, this implies that higher past firing costs increase the support for prohibitive firing costs today. Formally, if prohibitive firing costs are a political equilibrium for some level of past firing costs F_0^L , then they continue to be a political equilibrium for any higher level of past firing costs $F_0^H > F_0^L$.

Proposition 2. Consider $F_0^H, F_0^L \in \mathcal{F}$ with $F_0^H > F_0^L$. If $F^P \in \mathcal{P}_{ID,e}(F_0^L)$, then $F^P \in \mathcal{P}_{ID,e}(F_0^H)$.

This result is echoed by the quantitative results that follow: in parametrizations that exhibit multiplicity of SPE, F^P is one of the equilibria.

7.1 Quantitative Analysis

Calibration. An advantage of the MP model is that due to its frequent use for quantitative analysis, a standard calibration approach has emerged. As the US have few legal restrictions on dismissal, I use this approach to calibrate the model with zero firing costs to the US.

First, I specify functional forms. While I have taken the view that sources and prevalence of involuntary dismissal are not yet well understood, for the quantitative analysis I prefer using a version of wage rule (3) that has a microfoundation. I assume $w_{ID}(U) = \rho U + \bar{w}$, which Saint-Paul (2000) derives from a version of the Shapiro-Stiglitz model, see Section 3.2. The flow rent \bar{w} is constant, hence the wage responds one-for-one to flow utility from unemployment. I assume a standard Cobb-Douglas matching function $m(u, v) = \phi u^\alpha v^{1-\alpha}$.

The match-specific productivity process used in MP has the counterfactual implication that the separation hazard is independent of job duration. Here this is a critical limitation, as it is precisely variation in the dismissal hazard that generates heterogeneity in preferences for employment protection. Prat (2006) shows that the geometric Brownian motion is a parsimonious process which permits the model to capture the observed behavior of the dismissal hazard. Here I adopt the discrete time analog, a geometric random walk

$$Q(y, \{e^\sigma y\}) = Q(y, \{e^{-\sigma} y\}) = \frac{1}{2}$$

where $\sigma > 0$ parametrizes volatility. For the productivity distribution in new matches G_{new} I assume a uniform on $[y_{new}, e^{-\sigma} y_{new})$, choosing y_{new} to normalize the equilibrium wage w^0 under zero firing costs to one. This insures a steady-state productivity distribution with full support despite discrete shocks, without introducing additional parameters.

Turning to parameters, I adopt a model period of one week, and set $\rho = 0.001$ for an annual discount rate of 5%. Petrongolo and Pissarides (2001) identify $[0.5, 0.7]$ as a reasonable range for the matching function elasticity α , I take the midpoint 0.6. Much recent work has been devoted to improving estimates of the value of non-market activity; I adopt Hall and Milgrom's (2008) estimate $z = 0.46$. I normalize $c = 1$.²¹ This leaves

²¹Since c and ϕ affect the equilibrium allocation only through the ratio $\frac{c^{1-\alpha}}{\phi}$ one can be normalized.

four parameters: matching function scale ϕ , flow rent \bar{w} , quit rate δ , and volatility σ . I adopt three standard targets, matching stylized facts for the US. First, an unemployment rate $1 - L^0 = 0.07$ (again the superscript indicates zero firing costs). Second, a job-finding rate $f^0 = 0.083$ (12 weeks average unemployment duration). Third, a target for the average cost of hiring a worker. This is $\frac{c}{q}$ in the model, the cost of maintaining a vacancy divided by the filling probability. Following Prat (2006), I target a hiring cost of 4 weeks of wages.²²

These targets would suffice for a model without productivity shocks, and the calibration would be complete with an estimate of the weekly standard deviation σ . Since the geometric Brownian motion has not yet been used widely in quantitative applications of the MP model, however, no consensus estimate is available. A calibration proposed by Prat (2006) implies $\sigma = 0.0381$, while structural estimation in Prat (forthcoming) yields a much lower value 0.0048.²³ Moreover, both values are for the model with Nash bargaining, thus not directly applicable here. This leads me to prefer an agnostic approach, analyzing how results vary as a function of σ . To show results compactly, I present detailed findings for the three values $\sigma \in \{0.002, 0.004, 0.008\}$. For σ larger than 0.008 I find no political support for firing costs. I illustrate effects of firing costs for large values of σ by presenting results for the much higher value $\sigma = 0.04$, a 4% weekly standard deviation, and above Prat's higher estimate.

Table 1 shows parameters and targets that are invariant across all parametrizations, along with sources. Table 2(a) shows how remaining parameters vary with σ .²⁴ The total separation rate is fixed by calibration targets. Hence the primary effect of more volatility is that δ falls and endogenous dismissal accounts for a larger fraction of separations, 11%, 33%, 62%, and 94%, respectively.²⁵

Benchmark Results. Figure 1 shows how equilibrium varies with F for $\sigma \in \{0.002, 0.004, 0.008\}$. By construction separation rates d coincide at $F = 0$. Rising F suppresses endogenous dismissal and d converges to δ . This implies a larger decline for higher σ . Convergence

²²This lies at the low end of estimates reported by Hamermesh (1993), while being somewhat higher than estimates reported by Silva and Toledo (2009).

²³Prat (2006) identifies σ by adding one condition to the calibration approach used here, namely that equilibrium is socially efficient. Prat (forthcoming) estimates the model using cross-sectional data on job tenure and wages from the CPS. The weekly values reported here are converted from the annual values 0.275 and 0.035 reported in Prat (2006) and Prat (forthcoming), respectively.

²⁴ ϕ does not vary with σ as it is pinned down directly by job-finding rate and hiring cost targets.

²⁵In addition, higher σ increases flow rents \bar{w} . Due to the normalization $w^0 = 1$ this must reflect lower U . The latter reflects that the unemployed are more likely to quickly lose a job again after finding one. More volatility also induces more selection and thus higher expected output over the life of a match for given y_{new} , hence y_{new} decreases to maintain the normalization $w^0 = 1$.

is effectively complete at firing costs of 12, 34, and 100 weeks of wages, respectively.²⁶ Except for scale, the plot of job-finding rates f virtually mirrors that of d . The smaller decline for lower σ stems from higher δ : if workers quit frequently, firms are unlikely to get stuck in a poor match, mitigating adverse effects of F on hiring. Similar shapes for d and f imply that F primarily reduces turnover, with relatively small employment effects. Unemployment $1 - L$ falls slightly, more for $\sigma = 0.004$ than 0.002. A further increase to $\sigma = 0.008$ delays the decline. This effect turns positive and more dramatic for large σ : at 0.04 firing costs of 6 months increase $1 - L$ by 1.7 percentage points. Steady-state output net of hiring costs equals $L\bar{y} + (1 - L)z - v$. Here \bar{y} is average productivity, and vacancies v coincide with hiring costs due to the normalization $c = 1$. For $\sigma = 0.002$ net output is virtually unaffected by F as a decline in \bar{y} is offset by a drop in v . Notice that v declines faster than \bar{y} . For $\sigma = 0.004$ this yields a hump shape in net output. For $\sigma = 0.008$ the decline in \bar{y} becomes dominant.

Figure 2(a.1) shows preferences of workers at different productivity levels for $\sigma = 0.002$. To represent both good matches and matches that separate in response to deregulation, I plot preferences for the 5th, 50th and 95th percentile of the productivity distribution induced by prohibitive firing costs. Notice that unemployed utility U , the dotted line, is increasing in F . This is the net effect of two opposing forces: lower $1 - L$ implies that on average workers spend less time unemployed; lower f implies that unemployed workers have to wait longer for their next job. It follows that employed workers face no trade-off: higher F prolongs jobs, raises wages, and utility in the event of unemployment. While all employed gain, workers in poor matches gain more: a worker with productivity y_5 becomes unemployed if firing costs are zero, thus has more to gain than the others. Panel (a.2) shows average worker utility for this level of σ for the two extreme values of past firing costs, $F = 0$ and F^P . Throughout this section I focus on the case in which all workers vote, hence I plot $\Omega_{ID,a}$. Clearly the political equilibrium is $F^P = 105.43$ irrespective of past policy. Table 2(b) shows stationary political equilibria in row F_{SPE} . Higher past firing costs strengthen the support for firing costs today, but this effect is small here. As a measure of this effect I use

$$\Delta^2 \Omega_{ID,a} \equiv \frac{\Omega_{ID,a}(F^P|F^P) - \Omega_{ID,a}(0|F^P)}{\Omega_{ID,a}(0|0)} - \frac{\Omega_{ID,a}(F^P|0) - \Omega_{ID,a}(0|0)}{\Omega_{ID,a}(0|0)}.$$

The first term is the percentage gain from prohibitive firing costs rather than zero firing costs if prohibitive costs prevailed in the past. The second is its analog for zero past costs. If firing costs were prohibitive, then adopting $F = 0$ causes some workers to lose jobs (moving

²⁶The prohibitive level F^P is higher at 105, 175, and 280, respectively. By definition F^P protects workers with zero productivity. Convergence occurs much earlier since there is virtually no mass close to zero.

others closer to the threshold). Loosely speaking, $\Delta^2\Omega_{ID,a}$ depends both on how many workers lose jobs, and how costly job loss is. For a given parametrization $\Delta^2\Omega_{ID,a}$ provides an upper bound on the effect of past policy, as it compares zero and prohibitive firing costs. Additionally, it is a useful measure to compare the quantitative impact of past policy across parametrization. It is reported in Table 2(b). Here $\Delta^2\Omega_{ID,a} = 0.308\% - 0.265\% = 0.043\%$. Deregulation induces job loss of 6.3%, hence this is not why $\Delta^2\Omega_{ID,a}$ is small. Rather, the cost of losing a job in the zero firing cost economy is modest: average lifetime utility of an employed worker is about 0.6% higher than that of an unemployed worker.

Panels (b.1) and (b.2) repeat this for $\sigma = 0.004$. Now unemployed utility is decreasing, as a larger decline in f dominates a small drop in unemployment. Yet the net effect is relatively small: even prohibitive firing costs reduce U by only 0.26%. Now the employed face a trade-off. A worker with y_{95} is so productive that delay of involuntary dismissal yields little gain, but suffers from lower unemployed utility as she may quit. Thus she prefers zero firing costs. A worker with y_{50} is sufficiently close to dismissal that he prefers positive firing costs. A worker with y_5 does not gain from small firing costs as they do not prevent dismissal; as F rises her job is saved and she continues to benefit as job security is further improved. Panel (b.2) shows that F^P is again a SPE. But it no longer maximizes average utility for zero past firing costs. While zero itself is not a SPE, the dash-dotted line shows that $F = 3.74$ is a second SPE. Here $\Delta^2\Omega_{ID,a} = 0.070\% - (-0.065)\% = 0.134\%$ is larger than for $\sigma = 0.002$, as now deregulation from F^P to zero causes 17.4% of employed workers to lose jobs. But it remains relatively small, and sustains multiple SPE only because the effect of firing costs on unemployed utility and thus wages is small, as will become clear shortly.

Panels (c.1) and (c.2) consider $\sigma = 0.008$. The drop in U is now an order of magnitude larger, reaching 3% at firing costs of six months. This reflects an inherent nonlinearity in the impact of the job-finding rate: if f is very high, workers find jobs almost instantly, and still find them almost instantly even if f is cut in half; yet if f is low, cutting it in half implies a large absolute increase in unemployment duration. This decline in U is transmitted to wages, consequently all workers prefer $F = 0$, thus this is the political equilibrium irrespective of past policy. Notice that $\Delta^2\Omega_{ID,a} = -3.339\% - (-3.656)\% = 0.316\%$ has risen further, as deregulation now causes job loss of 34.1%. Yet due to modest cost of job loss this is dwarfed by the wage effects. The latter becomes stronger as σ increases: at 0.04 firing costs of 6 months reduce U by 12.67%. Hence there is no support for firing costs above $\sigma = 0.008$.

While multiplicity is not impossible, it is effectively a knife-edge outcome as it arises only for the small range $\sigma \in (0.00379, 0.00403)$. Outside this range the effect of firing costs on

unemployed utility and wages dwarfs the cost of job loss associated with deregulation, which prevents past policy from affecting the policy decision.

Calibrated Cost of Job Loss. The benchmark results may suggest the conclusion that the mechanism studied here is quantitatively weak. I will argue that this conclusion would be premature. The analysis indicates that the magnitude of the cost of job loss is a key determinant of the strength of the mechanism. Thus it is important to check whether the cost implied by the calibrated model is consistent with empirical estimates. A large literature on worker displacement in the US has established that earnings losses during the first unemployment spell following displacement account for only a small fraction of the total loss in lifetime earnings. The latter is mainly due to both lower wages and a higher probability of dismissal in subsequent jobs. For a representative sample, Ruhm (1991) finds that four years after displacement, wages remain depressed by 15%, and unemployment elevated by 2.6 percentage points. For a sample of high tenure workers Jacobson, LaLonde, and Sullivan (1993) find that earnings remain depressed by about 25% five years after displacement. Using Ruhm's estimates, Hall (1995) calculates that displacement reduces the present value of lifetime earnings by 1.2 years of wages, or about 6%. Based on Jacobson et. al.'s estimates, Davis (2005) concludes that this reaches 8% to 18% for high tenure workers.

Den Haan et. al. (2000) show that the original MP model is qualitatively inconsistent with this evidence. New jobs start at the highest productivity level, hence workers just hired from unemployment are paid the highest wage. As the dismissal hazard is the same for all, it is not elevated for the newly hired. Quantitatively, Davis (2005) finds that models with these features imply a cost of job loss an order of magnitude below empirical estimates.

The model studied here can generate a higher cost of job loss, as it is designed to capture a declining dismissal hazard. Yet it retains the limitation of failing to capture the persistent wage drop following job loss. In the calibrated model, dismissal of a randomly chosen worker yields an average loss in lifetime earnings of 1.2%, 1.3%, and 1.8%, for $\sigma = 0.002$, 0.004, and 0.008, respectively, far below the empirical estimates.

This suggests a simple explanation for Saint-Paul's (2002) finding that multiplicity is improbable. As in MP new jobs pay the highest wage. Additionally, his vintage model implies that newly hired workers have the longest expected job duration, contrary to empirical evidence. Both features reduce the cost of job loss vis-à-vis the model considered here.

Enhancing the MP model to be consistent with the multifaceted evidence on worker displacement is beyond the scope of this paper. Here I consider a simple extension that

permits persistently lower wages following displacement, to take a first pass at whether a higher cost of job loss strengthens the ability of employment protection to create its own support. I introduce a second component of match-specific productivity, denoted x , which differs from the first component y in that workers appropriate the returns.²⁷ I assume it follows a simple process: starting at x_L upon hiring, it rises to x_H with probability γ per period, remaining there until separation. Productivity is then $y + x_L$ before and $y + x_H$ after the γ -shock, where y follows the same process as before. The corresponding wages are $\rho U + \bar{w} + x_L$ and $\rho U + \bar{w} + x_H$. I set $\gamma = 0.00385$ so that on average it takes 5 years for wages to rise. I calibrate $x_H - x_L$ so that the present value of lifetime earnings for an average employed worker exceeds that of an unemployed worker by 6%, matching Hall's estimate.

Table 3 shows results for this exercise. The measure of the impact of past policy $\Delta^2 \Omega_{ID,a}$ increases by an order of magnitude relative to Table 2, reaching 2% of average utility for $\sigma = 0.008$.²⁸ One manifestation is that the region with multiple SPE, now $\sigma \in (0.0065, 0.0087)$, is also an order of magnitude larger. Of course, my calibration approach is silent on whether σ lies within that range. Figure 3 illustrates the source of these differences using the case $\sigma = 0.008$. Solid lines show how equilibrium varies with F , and are directly comparable to Figure 1. The behavior of the separation rate is virtually identical. The decline in the job-finding rate f is larger, for otherwise unemployed utility would decline less than under the benchmark because here firing costs enhance unemployed workers' chance of eventually obtaining a high wage job; this would imply a smaller wage decline, but this conflicts with firms' free-entry condition. Thus f drops more to induce a decline in unemployed utility U very similar to the benchmark. This implies a large increase in unemployment, which would be muted if the model is augmented with a participation margin. Figure 4(a.1) is the counterpart of Figure 2(c.1). It shows two plots for each level of y , one for each value of x . Workers with $x = x_H$ enjoy higher lifetime utility. They benefit more from firing costs, as their high wage makes involuntary dismissal more costly. The value $\sigma = 0.008$ lies in the multiplicity range, and Panel (a.2) plots average worker utility for the two SPE. Qualitatively the plot looks similar to the example of multiplicity under the benchmark in Figure 2(b.2). The key difference is the scale of the vertical axis, which shows that the impact of past firing costs on the trade-off is now an order of magnitude larger.

²⁷For this to be consistent with Saint-Paul's (1999, 2000) microfoundation, an increase in x must be a productivity change associated with a worsening of the moral-hazard problem.

²⁸Except for $\sigma = 0.04$, which already generates a cost of job loss close to 6% in the benchmark calibration.

Severance Payments. Again consider a severance payment S instead of wasteful firing costs F . I examine two cases. Case 1 maintains the benchmark wage rule $w_{ID}(U) = \rho U + \bar{w}$. This serves the analytical purpose of eliminating direct effects of employment protection on wages. Case 2 considers Saint-Paul's (2000) microfoundation. His derivation applies to a setting with wasteful firing costs, and must be modified for severance payments. The wage rule becomes $w_{ID}(S, U) = \rho(U + S) + \bar{w}$ as shirking workers obtain the payoff $U + S$.²⁹ Thus wages are affected directly, akin to the bargaining effect.

Rows S_{SPE}^1 and S_{SPE}^2 of Table 2 show SPE under the benchmark for the two cases, respectively. Multiplicity does not arise (for any σ , not just values in the table), and the level of severance payments tends to be small: at $\sigma = 0.002$ the firing cost SPE is prohibitive, while S_{SPE}^1 is a comparatively modest 6.88 weeks of wages. Case 1 is such that the effects of severance payments and wasteful firing costs coincide at the two extremes of zero and the prohibitive level. In-between severance payments avoid the waste of firing costs. This favors intermediate values, and is the reason why multiplicity disappears for $\sigma = 0.004$. Case 2 yields even lower SPE severance payments. This is due to the wage effect, which has a strong adverse equilibrium effect on hiring, and average utility is always lower than in case 1.

Table 3 shows results for the extension with a calibrated cost of job loss. Here severance payments and wasteful firing costs give rise to quantitatively similar political outcomes in Case 1. The multiplicity region for severance payments is $\sigma \in (0.0062, 0.0082)$. Again using $\sigma = 0.008$ for illustration, Figure 3 shows how equilibrium effects differ from firing costs. Case 1 exhibits a faster decline in the hiring rate f . This reflects a slower decline in unemployed utility, which is stabilized by the prospect of receiving severance payments, and which slows the wage decline. Thus unemployment $1 - L$ rises more rapidly. The additional wage effect in Case 2 implies much more dramatic declines in f and L . Figure 4(b.1) displays preferences for Case 1, only for high-wage workers to reduce clutter. The impact of severance payments is clear for a worker at y_5 , who loses his job for low severance payments, but has higher utility than the unemployed thanks to the transfer. Panel (b.2.) shows that there are two SPE, as is the case with firing costs. Notice that at 138 weeks the larger of the two SPE is actually not prohibitive. Economically the difference is minor, however, since it lies in the range where the effects of severance payments have effectively converged.

²⁹The Shapiro-Stiglitz model belongs to a class of models assuming that employee performance is not verifiable in court, see Malcomson (1999). Consistent with this, I assume that severance payments cannot be conditioned on whether dismissal is for shirking or other reasons. See Fath and Fuest (2005) for an analysis of severance payments under this assumption, and Fella (2000a) for an analysis with verifiable shirking.

Hiring Subsidies. A policy instrument which also avoids the waste of firing costs is to give firms the present discounted value of the firing tax as a hiring subsidy. Similar to severance payments it eliminates the knife-edge result of multiplicity in the benchmark calibration. With a calibrated cost of job loss it yields the multiplicity range $\sigma \in (0.0057, 0.0063)$.

Nash Bargaining. Table 4 shows quantitative results for Nash bargaining. The calibration approach is unchanged, but now identifies the bargaining share β instead of the flow rent \bar{w} . My measure of the role of past policy $\Delta^2\Omega_{NB,\alpha}$ is negative, as it must be by Corollary 2, since I find that employment is decreasing in F for all parametrizations. Laissez-faire is socially efficient if the Hosios (1990) rule $\beta = \alpha$ is satisfied. The calibrated values of β are very close to $\alpha = 0.6$ unless σ is high. While political equilibrium maximizes average worker utility rather than social welfare, SPE levels of firing costs and severance payments are very low. As was true for severance payments under Case 2, using policy to boost wages quickly becomes undesirable due to adverse effects on hiring.

7.2 Comparison with Saint-Paul (2002)

Saint-Paul (2002) points to labor market rents (the utility difference between employed and unemployed workers) as the reason why workers value job duration and thus as the source of employment protection's ability to create its own support. He discusses neither involuntary dismissal nor bilateral inefficiency. I argued that rents *per se* are not key, based on my analysis of Nash bargaining: here workers receive rents but do not gain from longer job duration. I traced the value of job duration more narrowly to involuntary dismissal, that is the presence of rents *at the margin* of dismissal. The origin of these differences in conclusions lies in the analyses of wage setting and its interaction with firing costs. This can be discussed within the MP model, without laying out the vintage structure of his model.

Saint-Paul assumes that wages are determined by bilaterally efficient bargaining, specifically the special case in which workers have all the bargaining power. Thus at first sight his results appear to be at odds with my findings for Nash bargaining. I will show that in fact dismissal is involuntary in his model, so the results are consistent. Involuntary dismissal is introduced inadvertently in the process of solving the model. First, I have to discuss how Saint-Paul introduces firing costs, which differs from my approach. He assumes that they are attached to jobs, not workers: a firm can costlessly dismiss an incumbent and hire a replacement worker for a given job, but has to pay firing costs if the job is eliminated. To give incumbent workers rents, it is assumed that replacements are less productive. As before,

let y denote the state of a job. But now y only equals productivity of the job if it is still occupied by the original incumbent. If occupied by a replacement worker, a job in state y produces $(1 - \psi)y$ with $\psi \in (0, 1)$. Let $\underline{y}_I(F, U)$ and $\underline{y}_R(F, U)$ denote the bilaterally efficient separation thresholds if the job is occupied by the original incumbent and a replacement worker, respectively. They satisfy $\underline{y}_I(F, U) < \underline{y}_R(F, U)$: as incumbents are more productive, there is a range of states y for which separation is bilaterally efficient for replacement workers but not for incumbents. A firm employing an incumbent has two outside options: replacing the worker or destroying the job. For $y \geq \underline{y}_R(F, U)$ the former is optimal, for $y < \underline{y}_R(F, U)$ the latter is preferable. The original incumbent has all the bargaining power. The following wage rule insures that he receives the entire surplus of the relationship:

$$w_I(y, F, U) = \begin{cases} \rho U + \psi y, & y \geq \underline{y}_R(F, U), \\ \rho U + [y - \rho U + (\rho + \delta)F], & y < \underline{y}_R(F, U). \end{cases} \quad (9)$$

For $y \geq \underline{y}_R(F, U)$ the incumbent extracts precisely his productivity edge over replacement workers. For $y < \underline{y}_R(F, U)$ the firm would rather destroy the job than hire a replacement. Thus the replacement option is irrelevant and the wage is given by equation (2) with $\beta = 1$. As with Nash bargaining, separation is voluntary under this wage rule. When computing his wage rule Saint-Paul does not take into account that for $y < \underline{y}_R(F, U)$ the relevant outside option of the firm is destruction rather than replacement, hence he obtains

$$w_{SP}(y, F, U) = \rho U + \psi y \quad (10)$$

for all $y \in \mathcal{Y}$. At the same time he allows firms to utilize the outside option of destruction when it is superior, with the consequence that workers are dismissed involuntarily.

8 Conclusion

To conclude, I outline two directions for future research. First, here I followed previous work in assuming that the level of firing costs set by voting today is expected to remain in place indefinitely. As argued by Saint-Paul (2002), this approximates a situation with infrequent voting. Two new considerations arise if voting occurs frequently. First, the level of employment protection enacted today will be in place only for a limited time. Second, this level affects future policy indirectly through the political support for firing costs at the time of the next vote. To illustrate potential implications, consider a worker who is in a relatively good match today, thus unlikely to be dismissed over the near term. If today's vote affects

policy only for a short time, he may prefer low protection. However, if firing costs are reduced today, this may undermine their constituency at the time of the next vote, possibly inducing permanently lower employment protection. Taken together, the worker may face a trade-off similar to once-and-for-all voting, but through a different mechanism. Additionally, there is an interesting asymmetry in that deregulation has an immediate effect on the political support for firing costs as workers lose their jobs, while raising firing costs only worsens the distribution of matches gradually. Introducing repeated voting in the present setting would be interesting, although it would likely require computational methods to handle the distribution of match-specific productivity as part of the aggregate state.

A second direction for future work is to jointly analyze the political determination of employment protection and the framework for wage determination.³⁰ In the present paper I take the features of wage determination as given and analyze their implications for the political economy of employment protection. But features of wage determination are themselves shaped by labor market policy. This is of particular interest in the present context to the extent that involuntary dismissal is mainly a consequence of collective bargaining and minimum wages. An interesting question is then whether particular bundles of wage policies and employment protection have the ability to create their own political support.

³⁰Bertola and Rogerson (1997) discuss complementarity of wage determination and employment protection.

Table 1: Parameters and Targets Invariant Across Parametrizations

Parameter	Value	Source
ρ	0.001	Shimer (2005)
α	0.6	Petrongolo and Pissarides (2001)
z	0.46	Hall and Milgrom (2008)
c	1	normalization
Target	Value	Source
u^0	0.07	Avg. US unemployment rate (BLS)
f^0	0.083	Avg. US job-finding rate (BLS)
$\frac{c}{q^0}$	4	Prat (2006)
w^0	1	normalization

Table 2: Involuntary Dismissal

σ		0.002	0.004	0.008	0.04
(a)	ϕ	0.1292	0.1292	0.1292	0.1292
	\bar{w}	0.0432	0.0437	0.0461	0.0687
	δ	0.0056	0.0042	0.0024	0.0004
	y_{new}	1.0244	1.0082	0.9550	0.2821
(b)	$\Delta^2\Omega_{ID,a}$	0.043%	0.134%	0.316%	1.223%
	F_{SPE}	$F^P = 105.43$	3.74 $F^P = 174.62$	0	0
	S_{SPE}^1	6.88	4.89	2.46	0
	S_{SPE}^2	3.75	2.96	0.12	0

Table 3: Involuntary Dismissal with Calibrated Cost of Job Loss

σ		0.002	0.004	0.008	0.04
(a)	ϕ	0.1292	0.1292	0.1292	0.1292
	\bar{w}	0.0877	0.0908	0.0828	0.0639
	δ	0.0048	0.0033	0.0024	0.0004
	y_{new}	1.0244	1.0082	0.9550	0.2821
	γ	0.0038	0.0038	0.0038	0.0038
	x_L	-0.4721	-0.3691	-0.2747	0.0177
	x_H	0.6845	0.4526	0.3286	-0.007
(b)	$\Delta^2\Omega_{ID,a}$	0.792%	1.597%	1.986%	1.03%
	F_{SPE}	$F^P = 130.60$	$F^P = 232.88$	$F^P = 253.51$	0
	S_{SPE}^1	$S^P = 130.60$	$S^P = 232.88$		0
	S_{SPE}^2	10.79	11.11	3.17	0

Table 4: Nash Bargaining

σ		0.002	0.004	0.008	0.04
(a)	ϕ	0.1292	0.1292	0.1292	0.1292
	β	0.5983	0.5980	0.5965	0.3718
	δ	0.0062	0.0059	0.0047	0.0011
	y_{new}	1.0282	1.0214	0.9903	0.2912
(b)	$\Delta^2\Omega_{NB,a}$	-0.590%	-2.217%	-6.381%	-9.889%
	F_{SPE}	0.59	0.26	0	0
	S_{SPE}	0.36	0.36	0.38	1.49

Figure 1: Equilibrium as a Function of F

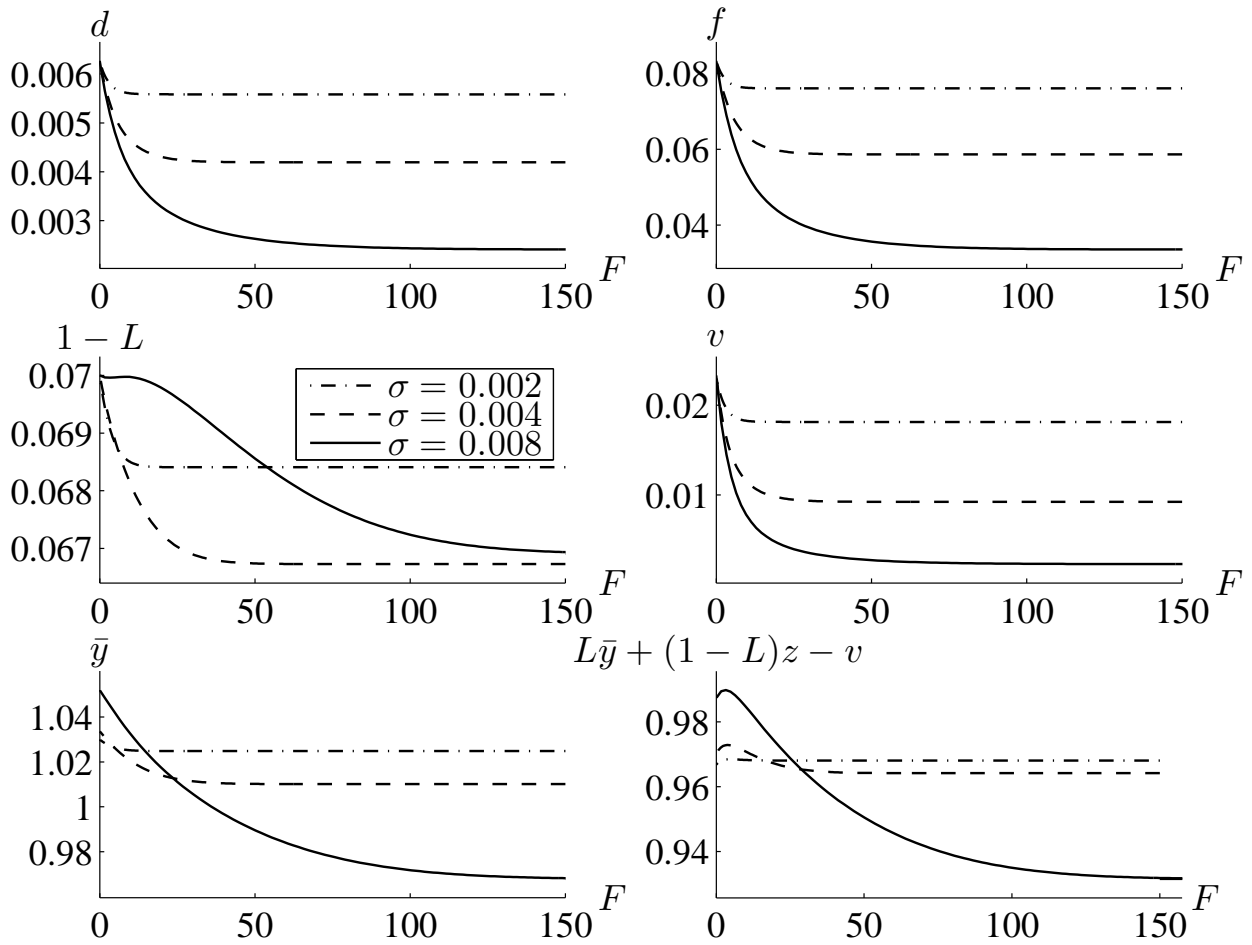
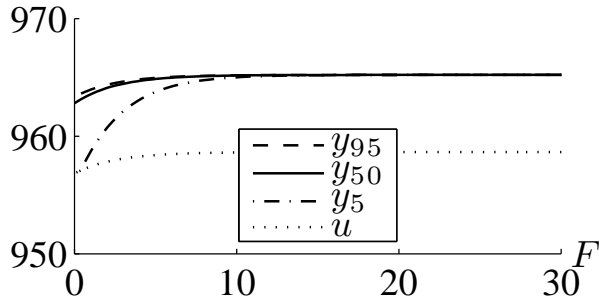
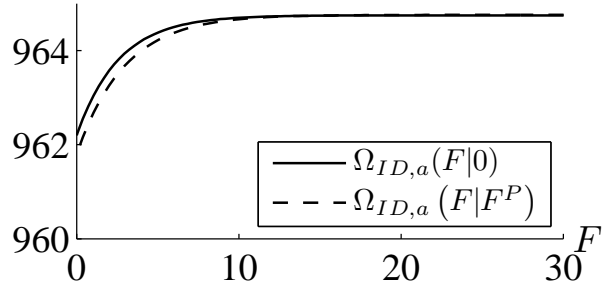


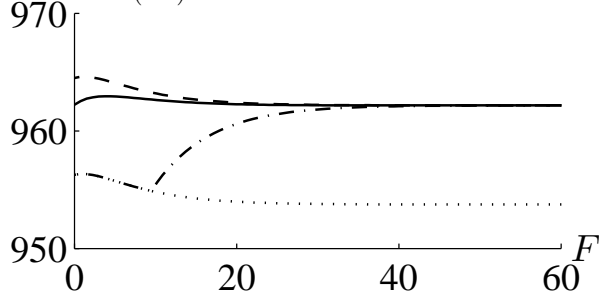
Figure 2: Utility as a Function of F



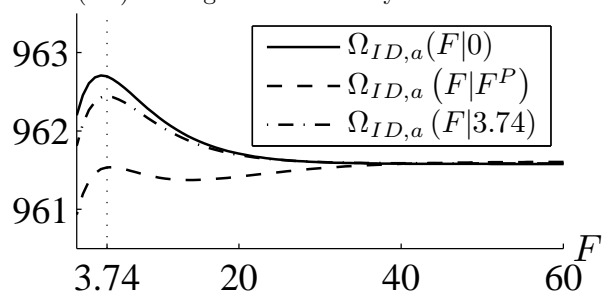
(a.1) Preferences $\sigma = 0.002$



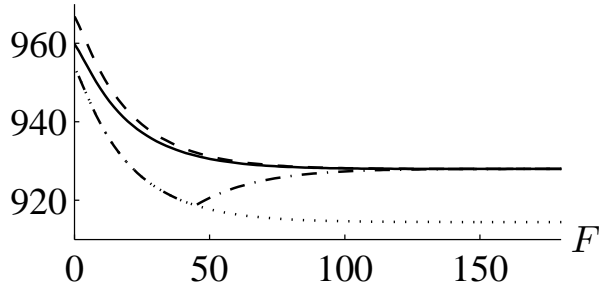
(a.2) Average Worker Utility $\sigma = 0.002$



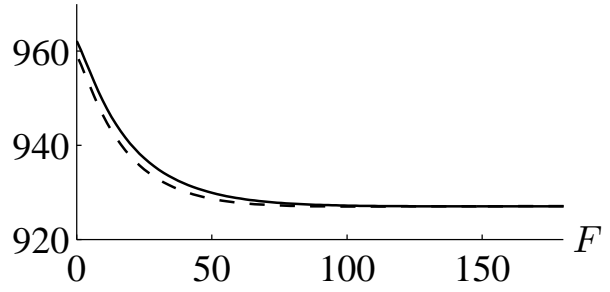
(b.1) Preferences $\sigma = 0.004$



(b.2) Average Worker Utility $\sigma = 0.004$



(c.1) Preferences $\sigma = 0.008$



(c.2) Average Worker Utility $\sigma = 0.008$

Figure 3: Calibrated Cost of Job Loss, Equilibrium

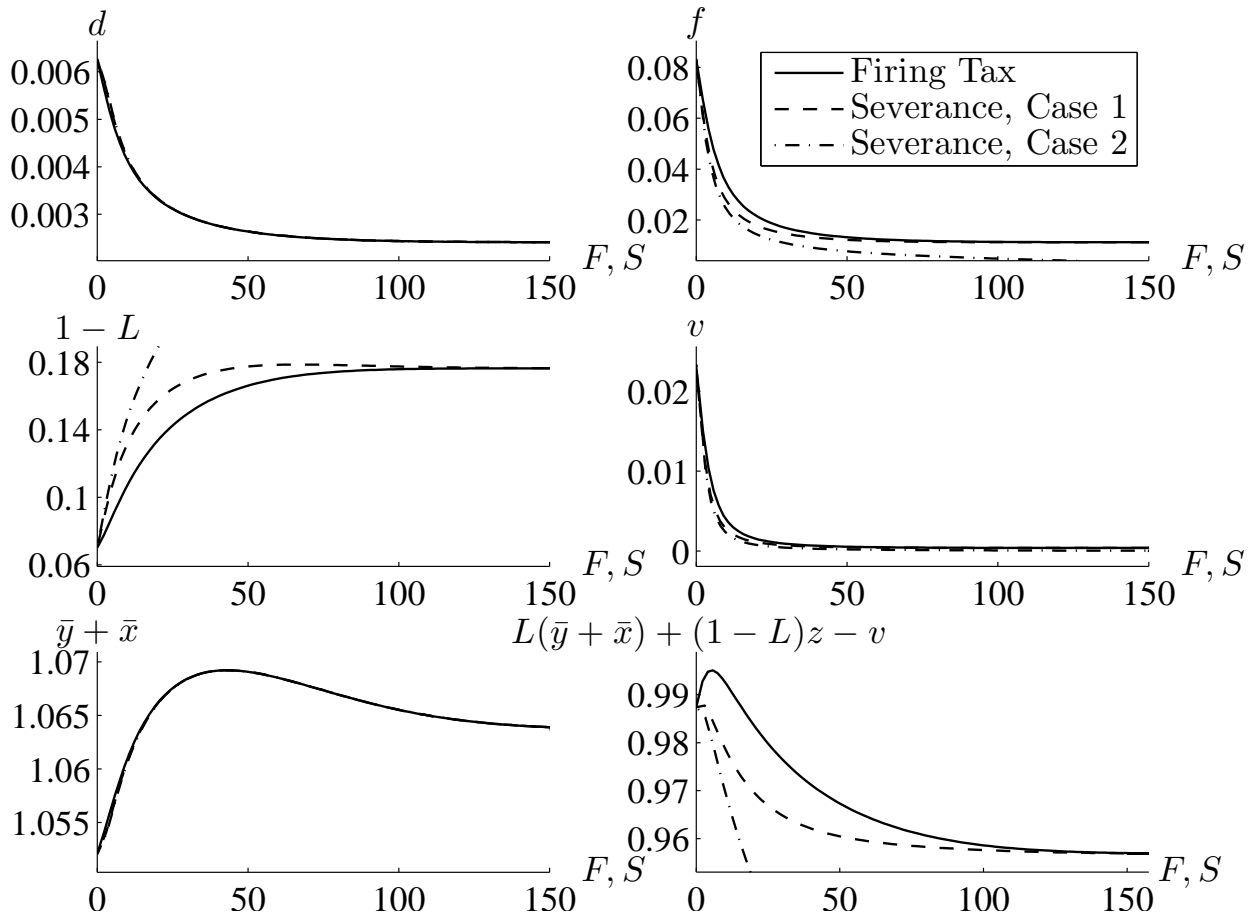
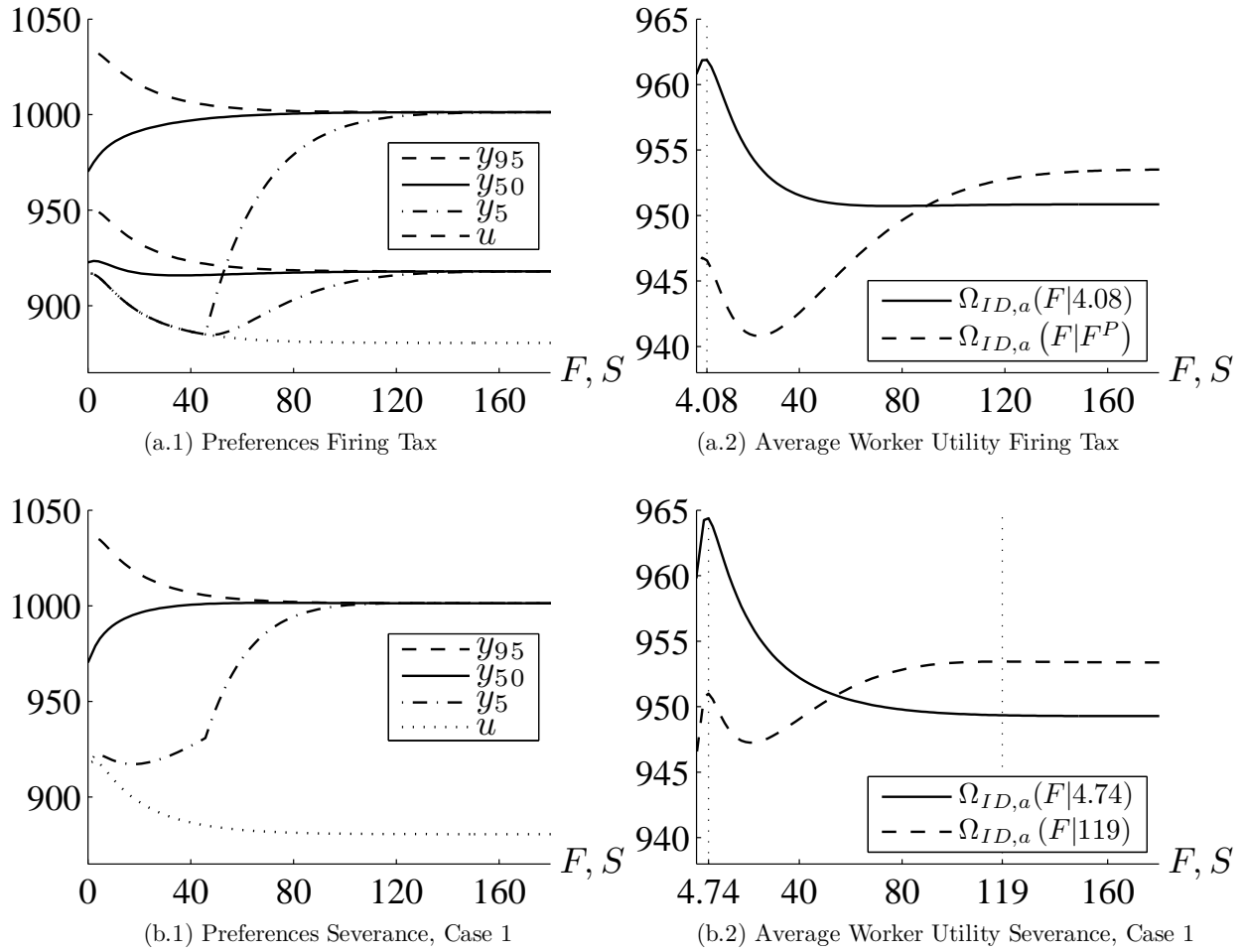


Figure 4: Calibrated Cost of Job Loss, Utility



A Proofs of Lemmas 1 and 2

In equilibrium utility from unemployment cannot be lower than the utility from perpetual unemployment $\underline{U} \equiv \frac{z}{\rho}$. Boundedness of the state space \mathcal{Y} implies that utility from unemployment cannot exceed some upper bound \bar{U} for any value of firing costs F or any of the two models of wage determination. Thus it is sufficient to analyze wage determination and the separation decision for utility from unemployment varying in the set $\mathcal{U} \equiv [\underline{U}, \bar{U}]$. Firing costs are allowed to vary in $\mathcal{F} = \mathbb{R}_+$. The optimal stopping problem for the maximization of the value of the match is

$$V^*(y, F, U) = \max \left\{ y + \delta U + (1 - \rho - \delta) \int V^*(y', F, U) Q(y, dy'), U - F \right\}.$$

The second argument of the maximum operator is the joint payoff if the match dissolves today, given by the utility of unemployment obtained by the worker minus the firing costs liability of the firm. The first argument of the maximum operator is the value of continuing the match. This yields output y this period. With probability $\frac{\delta}{1-\rho}$ the worker quits at the beginning of next period. In this case the firm obtains zero (it does not have to pay the firing costs) while the worker obtains utility $(1-\rho)U$, as he is unemployed at the beginning of next period. Taken together this yields the present discounted joint payoff δU . If the worker does not quit, then the match survives into the next period, receives a new productivity draw y' , and once again faces the same decision.

Lemma A. *The joint value function V^* is bounded, continuous, and has the following properties.*

- (a) *For each $(F, U) \in \mathcal{F} \times \mathcal{U}$ there exists a unique threshold $\underline{y}_{NB}(F, U) \in \mathbb{R}$ such that $V^*(y, F, U)$ equals $U - F$ for $y \leq \underline{y}_{NB}(F, U)$ and is strictly increasing in y for $y \geq \underline{y}_{NB}(F, U)$.*
- (b) *Fix $U \in \mathcal{U}$. Consider $F^H, F^L \in \mathcal{F}$ with $F^H > F^L$. Then $\underline{y}_{NB}(F^H, U) < \underline{y}_{NB}(F^L, U)$. The difference $V^*(y, F^H, U) - V^*(y, F^L, U)$ is non-positive, bounded below by $F^L - F^H$, and weakly increasing in y .*
- (c) *Fix $F \in \mathcal{F}$. Consider $U^H, U^L \in \mathcal{U}$ with $U^H > U^L$. Then $\underline{y}_{NB}(F, U^H) > \underline{y}_{NB}(F, U^L)$. The difference $V^*(y, F, U^H) - V^*(y, F, U^L)$ is non-negative, bounded above by $U^H - U^L$, and weakly decreasing in y .*

Proof. Let \mathcal{V} be the set of functions $V : \mathcal{Y} \times \mathcal{F} \times \mathcal{U} \rightarrow \mathbb{R}$ satisfying all the properties stated in the lemma. Let \mathcal{V} be the set of functions obtained when the strictly increasing requirement in property (a) is replaced by weakly increasing, and the strict inequalities in properties (b) and (c) are replaced by weak inequalities. Define the operator

$$(TV)(y, F, U) \equiv \max \left\{ y + \delta U + (1 - \rho - \delta) \int V(y', F, U) Q(y, dy'), U - F \right\}.$$

I will show that $T(\mathcal{V}) \subseteq \mathcal{V}'$. The desired result then follows from Corollary 1 to the Contraction Mapping Theorem in Stokey and Lucas (1989) in conjunction with the fact that \mathcal{V} is a complete metric space. To verify the claim that $T(\mathcal{V}) \subseteq \mathcal{V}'$, suppose $V \in \mathcal{V}$. Then TV is bounded and continuous by Lemma 9.5 in Stokey and Lucas. It remains to verify properties (a)–(c).

(a) Define

$$(CV)(y, F, U) \equiv y + \delta U + (1 - \rho - \delta) \int V(y', F, U) Q(y, dy').$$

As V is weakly increasing in y and Q is stochastically monotone, it follows that the integral is weakly increasing in y . Thus CV is strictly increasing in y . Set $\underline{y}(F, U)$ equal to the unique solution of the equation $(CV)(y, F, U) = U - F$. Then $(TV)(y, F, U) = U - F$ for $y \leq \underline{y}(F, U)$ and $(TV)(y, F, U)$ is strictly increasing in y for $y \geq \underline{y}(F, U)$.

(b) Consider $F^H, F^L \in \mathcal{F}$ with $F^H > F^L$. Since $0 \geq V(y', F^H, U) - V(y', F^L, U) \geq F^L - F^H$ for all $y' \in \mathcal{Y}$ it follows that $0 \geq (CV)(y, F^H, U) - (CV)(y, F^L, U) \geq (1 - \rho - \delta)(F^L - F^H)$. Since the value of separation drops by $F^H - F^L$ it follows that $0 \geq (TV)(y, F^H, U) - (TV)(y, F^L, U) \geq F^L - F^H$. Next consider the comparative statics of the separation threshold. As $(CV)(\underline{y}(F^L, U), F^L, U) = U - F^L$ it follows that $(CV)(\underline{y}(F^L, U), F^H, U) > U - F^H$, so it must be that $\underline{y}(F^H, U) < \underline{y}(F^L, U)$. It remains to show that the difference $(TV)(y, F^H, U) - (TV)(y, F^L, U)$ is weakly increasing in y . It is weakly increasing on $[0, \underline{y}(F^L, U)]$ because on this interval $(TV)(y, F^L, U) = U - F^L$ while $(TV)(y, F^H, U)$ is weakly increasing. For $y \geq \underline{y}(F^L, U)$ the difference is given by

$$\begin{aligned} & (TV)(y, F^H, U) - (TV)(y, F^L, U) \\ &= (TC)(y, F^H, U) - (TC)(y, F^L, U) \\ &= (1 - \rho - \delta) \int [V(y', F^H, U) - V(y', F^L, U)] Q(y, dy') \end{aligned}$$

and weakly increasing in y because $V(y', F^H, U) - V(y', F^L, U)$ is weakly increasing in y' and Q is stochastically monotone.

(c) The proof of property (c) proceeds in exactly the same way as the proof of property (b). ■

Proof of Lemma 1: Follows immediately from Lemma A. ■

Proof of Lemma 2:

(a) Using equation (1)

$$W_{NB}^*(y, F, U^H) - W_{NB}^*(y, F, U^L) = (1 - \beta)(U^H - U^L) + \beta [V^*(y, F, U^H) - V^*(y, F, U^L)].$$

The second term is non-negative, bounded above by $\beta(U^H - U^L)$, and weakly decreasing in y by property (c) of Lemma A. Thus the sum is positive, bounded above by $U^H - U^L$, and weakly decreasing in y .

(b) Using equation (1)

$$W_{NB}^*(y, F^H, U) - W_{NB}^*(y, F^L, U) = \beta [V^*(y, F^H, U) - V^*(y, F^L, U) + (F^H - F^L)].$$

By property (b) of Lemma A the value of the match decreases but by less than $F^H - F^L$. Thus the change in worker utility is non-negative and bounded above $F^H - F^L$. From the change in the match value it inherits the property of being weakly increasing in y . ■

B Proofs of Lemmas 3– 5

Recall from Appendix A that equilibrium utility from unemployment must lie in the bounded set \mathcal{U} . Thus I restrict the analysis of the separation decision and worker utility to the intersection $\mathcal{U}_{\cap ID} \equiv \mathcal{U} \cap \mathcal{U}_{ID}$.

The optimal stopping problem of the firm is

$$J_{ID}^*(y, F, U) = \max \left\{ y - w_{ID}(U) + (1 - \rho - \delta) \int J_{ID}^*(y', F, U) Q(y, dy'), -F \right\}.$$

and one obtains the following lemma.

Lemma B.1. *The firm value function J_{ID}^* is bounded, continuous, and has the following properties.*

- (a) *For each $(F, U) \in \mathcal{F} \times \mathcal{U}_{\cap ID}$ there exists a unique threshold $\underline{y}_{ID}(F, U) \in \mathbb{R}$ such that $J_{ID}^*(y, F, U)$ equals $-F$ for $y \leq \underline{y}_{ID}(F, U)$ and is strictly increasing in y for $y \geq \underline{y}_{ID}(F, U)$.*
- (b) *Fix $U \in \mathcal{U}_{\cap ID}$. Consider $F^H, F^L \in \mathcal{F}$ with $F^H > F^L$. Then $\underline{y}_{ID}(F^H, U) < \underline{y}_{ID}(F^L, U)$. The difference $J_{ID}^*(y, F^H, U) - J_{ID}^*(y, F^L, U)$ is non-positive, bounded below by $F^L - F^H$, and weakly increasing in y .*
- (c) *Fix $F \in \mathcal{F}$. Consider $U^H, U^L \in \mathcal{U}_{\cap ID}$ with $U^H > U^L$. Then $\underline{y}_{ID}(F, U^H) \geq \underline{y}_{ID}(F, U^L)$. The difference $J_{ID}^*(y, F, U^H) - J_{ID}^*(y, F, U^L)$ is non-positive, bounded below by $U^L - U^H$, and weakly decreasing in y .*

Proof. Analogous to the proof of Lemma A. ■

Proof of Lemma 3: Follows immediately from Lemma B.1. ■

The next lemma establishes the key properties of the worker utility function W_{ID} . Let $\underline{\mathcal{S}} \equiv \mathbb{R} \times [0, 1]$ denote the set of separation rules.

Lemma B.2. *The worker utility function W_{ID} is bounded and has the following properties.*

- (a) *For $(\underline{s}, U) \in \underline{\mathcal{S}} \times \mathcal{U}_{\cap ID}$ with $\underline{s} = (\underline{y}, \underline{\lambda})$ worker utility $W_{ID}(y, \underline{s}, U)$ equals U for $y < \underline{y}$ and is weakly increasing in y .*
- (b) *Fix $\underline{s} \in \underline{\mathcal{S}}$. Consider $U^H, U^L \in \mathcal{U}_{\cap ID}$ with $U^H > U^L$. Then $W_{ID}(y, \underline{s}, U^H) - W_{ID}(y, \underline{s}, U^L)$ is non-negative, bounded above by $U^H - U^L$, and weakly decreasing in y .*
- (c) *Fix $U \in \mathcal{U}_{\cap ID}$. Consider $\underline{s}^L, \underline{s}^H \in \underline{\mathcal{S}}$ with $\underline{s}_L < \underline{s}_H$. Then $W_{ID}(y, \underline{s}^L, U) - W_{ID}(y, \underline{s}^H, U)$ is non-negative.*

Proof. Let \mathcal{W}_{ID} be the set of functions $W : \mathcal{Y} \times \underline{\mathcal{S}} \times \mathcal{U}_{\cap ID} \rightarrow \mathbb{R}$ satisfying all the properties stated in the lemma. Define the operator

$$\begin{aligned} (TW)(y, \underline{s}, U) \\ \equiv (1 - \lambda(y, \underline{s})) \left[w_{ID}(U) + \delta U + (1 - \rho - \delta) \int W(y', \underline{s}, U) Q(y, dy') \right] + \lambda(y, \underline{s}) U. \end{aligned}$$

where

$$\lambda(y, (\underline{y}, \underline{\lambda})) = \begin{cases} 0 & \text{if } y > \underline{y}, \\ \underline{\lambda} & \text{if } y = \underline{y}, \\ 1 & \text{if } y < \underline{y}. \end{cases}$$

I will show that $T(\mathcal{W}_{ID}) \subseteq \mathcal{W}_{ID}$. The desired result then follows from the Contraction Mapping Theorem in conjunction with the fact that \mathcal{W}_{ID} is a complete metric space. To verify the claim that $T(\mathcal{W}_{ID}) \subseteq \mathcal{W}_{ID}$, suppose $W \in \mathcal{W}_{ID}$. Then TW is clearly bounded. It remains to verify properties (a)-(c).

- (a) Since $\lambda(y, \underline{s}) = 1$ for $y < \underline{y}$ it follows that $(TW)(y, \underline{s}, U) = U$. Next consider $y^H, y^L \in \mathcal{Y}$ with $y^H > y^L$. We have

$$\begin{aligned} & (TW)(y^H, \underline{s}, U) - (TW)(y^L, \underline{s}, U) \\ &= (1 - \lambda(y^H, \underline{s}))(1 - \rho - \delta) \left(\int W(y', \underline{s}, U) Q(y^H, dy') - \int W(y', \underline{s}, U) Q(y^L, dy') \right) \\ & \quad + (\lambda(y^L, \underline{s}) - \lambda(y^H, \underline{s})) \left[w_{ID}(U) - \rho U + (1 - \rho - \delta) \int (W(y', \underline{s}, U) - U) Q(y^L, dy') \right] \end{aligned}$$

The first term is non-negative since W is weakly increasing in y' , and Q is stochastically monotone. The second term is non-negative as $w_{ID}(U) > \rho U$ for $U \in \mathcal{U}_{\cap ID}$, $W(y, \underline{s}, U) \geq U$ for all $(y, \underline{s}, U) \in \mathcal{Y} \times \underline{\mathcal{S}} \times \mathcal{U}_{\cap ID}$, and $\lambda(y, \underline{s})$ is weakly decreasing in y .

(b) We have

$$\begin{aligned}
& (TW)(y, \underline{s}, U^H) - (TW)(y, \underline{s}, U^L) \\
&= (1 - \lambda(y, \underline{s})) [w_{ID}(U^H) - w_{ID}(U^L) + \delta(U^H - U^L)] \\
&+ (1 - \lambda(y, \underline{s}))(1 - \rho - \delta) \int [W(y', \underline{s}, U^H) - W(y', \underline{s}, U^L)] Q(y, dy') \\
&+ \lambda(y, \underline{s})(U^H - U^L).
\end{aligned} \tag{B.1}$$

All three terms are non-negative. Moreover, since $w_{ID}(U^H) - w_{ID}(U^L) \leq \rho(U^H - U^L)$ and $W(y', \underline{s}, U^H) - W(y', \underline{s}, U^L) \leq U^H - U^L$, it follows that $(TW)(y, \underline{s}, U^H) - (TW)(y, \underline{s}, U^L) \leq U^H - U^L$.

(c) We have

$$\begin{aligned}
& (TW)(y, \underline{s}^L, U) - (TW)(y, \underline{s}^H, U) \\
&= (1 - \lambda(y, \underline{s}^L)) \int [W(y', \underline{s}^L, U) - W(y', \underline{s}^H, U)] Q(y, dy') \\
&+ (\lambda(y, \underline{s}^H) - \lambda(y, \underline{s}^L)) \left[w_{ID}(U) - \rho U \right. \\
&\left. + (1 - \rho - \delta) \int (W(y', \underline{s}^H, U) - U) Q(y, dy') \right].
\end{aligned}$$

The first term is non-negative since W satisfies property (c). The second term is non-negative since $w_{ID}(U) > \rho U$ for $U \in \mathcal{U}_{\cap ID}$ and $W(y, \underline{s}, U) \geq U$ for all (y, \underline{s}, U) in $\mathcal{Y} \times \underline{\mathcal{S}} \times \mathcal{U}_{\cap ID}$. ■

Proof of Lemma 4. Follows immediately from Lemma B.2. ■

Proof of Lemma 5. With the separation rule \underline{s}^P all employed workers receive the same wage $w_{ID}(U)$ until they quit. Thus

$$W_{ID}(y, \underline{s}^P, U) = \frac{w_{ID}(U) + \delta U}{\rho + \delta} \tag{B.2}$$

for all $y \in \mathcal{Y}$. Thus $W_{ID}(y, \underline{s}^P, U) - W_{ID}(y, \underline{s}, U)$ is weakly decreasing in y since $W_{ID}(y, \underline{s}, U)$ is weakly increasing in y by property (a) of Lemma B.2. ■

C Proof of Lemma 6

Proof of Lemma 6. Combining condition (4) with equation (6) yields the condition

$$\rho U = z + (1 - \rho)\theta q(\theta) \int [W_M(y, (\underline{y}_M(F, U), \underline{\lambda}), F, U) - U] dG_{new}(y). \tag{C.1}$$

As a first step I look for values of $U \in \mathcal{U}$ and $\underline{\lambda} \in [0, 1]$ such that equation (C.1) is satisfied for a given value of θ . First fix $\underline{\lambda} = 0$ and consider the right-hand side of equation (C.1). It is weakly decreasing as a function of U for both models of wage determination. For $M = NB$ this follows from property (a) of Lemma 2. For $M = ID$ the capital gain $\int \left[W_{ID}(y, (\underline{y}_{ID}(F, U), 0), F, U) - U \right] dG_{new}(y)$ is weakly decreasing in U by property (a) of Lemma 4, holding constant the separation threshold $\underline{y}_{ID}(F, U)$. Moreover, the threshold $\underline{y}_{ID}(F, U)$ is weakly increasing in U by Lemma 3, which further reduces the capital gain. The left-hand side of equation (C.1) is strictly increasing in U , so it remains to show that the two must intersect. For $U = \underline{U}$ the left-hand side equals z and is thereby lower than the right-hand side. Since the left-hand side increases without bound, it eventually exceeds the right-hand side. If $M = NB$ the right-hand side is independent of $\underline{\lambda}$ and continuous in U . It follows that there is a unique $\hat{U}(\theta) \geq \underline{U}$ such that equation (C.1) is satisfied if and only if $U = \hat{U}(\theta)$ and $\underline{\lambda} \in [0, 1]$. For $M = ID$ the right-hand side need not be continuous as a function of U when the separation probability is held constant at $\underline{\lambda} = 0$. A discontinuity at U can occur if the productivity level $\underline{y}_{ID}(F, U)$ is attained with positive probability at some point during the life of a match. If a small increase in utility from unemployment increases the separation threshold, then the right-hand side jumps downward at U because staying employed is strictly better than unemployment. Nevertheless, the right-hand side is left continuous. It follows that there is a unique $\hat{U}(\theta)$ such that the right-hand side is weakly larger than the left-hand side for $U \leq \hat{U}(\theta)$ and strictly smaller for $U > \hat{U}(\theta)$. Then there are two possibilities. If $\int W_{ID}(y, (\underline{y}_{ID}(F, U), \underline{\lambda}), F, U) dG_{new}(y)$ is independent of $\underline{\lambda}$, then the right-hand side must in fact be continuous in U at $\hat{U}(\theta)$. In this case equation (C.1) is satisfied if and only if $U = \hat{U}(\theta)$ and $\underline{\lambda} \in [0, 1]$. Otherwise $\int W_{ID}(y, (\underline{y}_{ID}(F, U), \underline{\lambda}), F, U) dG_{new}(y)$ is continuous and strictly decreasing in $\underline{\lambda}$ and there is a unique $\hat{\lambda}(\theta) \in [0, 1]$ to equalize the right and left-hand sides, so $U = \hat{U}(\theta)$ and $\underline{\lambda} = \hat{\lambda}(\theta)$ is the unique solution.

The function $\hat{U}(\theta)$ is continuous (the discontinuities discussed above result in flat parts of this function) and weakly increasing. Substituting this function into the right-hand side of equation (5) yields the term $(1 - \rho)q(\theta) \int J_M(y, \underline{z}_M(F, \hat{U}(\theta)), F, \hat{U}(\theta)) dG_{new}(y)$, which is continuous and strictly decreasing in θ . If it is strictly less than c for $\theta = 0$, then the equilibrium has $\theta_M(F) = 0$ and $U_M(F) = \frac{z}{\rho}$. Otherwise the assumption that $\lim_{\theta \rightarrow \infty} q(\theta) = 0$ insures that there is a unique value $\theta_M(F)$ for which this term equals c . Equilibrium utility from unemployment is then given by $U_M(F) = \hat{U}(\theta_M(F))$. The equilibrium separation threshold is $\underline{y}_M(F) = \underline{y}_M(F, U_M(F))$. ■

D Proof of Lemmas 7 and 8

First some additional notation is introduced. Let \mathcal{B} be the σ -algebra associated with the Markov process of match-specific productivity, so the transition function is a mapping $Q : \mathcal{Y} \times \mathcal{B} \rightarrow [0, 1]$. Let \mathcal{B}_a be the σ -algebra \mathcal{B} extended in the natural way to the enlarged state space \mathcal{Y}_a defined in Section 4.1. Next I derive the transition function that includes transitions between productivity states while employed as well as between employment and

unemployment, denoted $Q_a(\cdot|\underline{s}, \theta) : \mathcal{Y}_a \times \mathcal{B}_a \rightarrow [0, 1]$. First consider transitions within employment. For $y \in \mathcal{Y}$ and a set $Y \in \mathcal{B}$ we have

$$Q_a(y, Y|(\underline{y}, \underline{\lambda}), \theta) = (1 - \tilde{\delta}) [Q(y, Y \cap (\underline{y}, +\infty)) + (1 - \underline{\lambda})Q(y, Y \cap \{\underline{y}\})].$$

A match with productivity y after separation today survives quits at the beginning of next period with probability $1 - \tilde{\delta}$ where $\tilde{\delta} \equiv \frac{\delta}{1-\rho}$. Then it receives a new productivity draw, which may lead to endogenous destruction if the draw falls short of the threshold \underline{y} . Next consider transitions from unemployment. Here

$$Q_a(u, Y|(\underline{y}, \underline{\lambda}), \theta) = f(\theta) [\mu_{new}(Y \cap (\underline{y}, +\infty)) + (1 - \underline{\lambda})\mu_{new}(Y \cap \{\underline{y}\})]$$

where μ_{new} is the probability measure associated with the distribution function G_{new} . A worker unemployed after separation decisions in the current period must wait until next period to be matched again, and productivity in the new match must exceed \underline{y} for the worker to remain employed after next period's separation decision.

For a probability measure μ_a on $(\mathcal{Y}_a, \mathcal{B}_a)$ define

$$(T_a^*(\mu_a|\underline{s}, \theta))(Y) \equiv \int Q_a(y, Y|\underline{s}, \theta)\mu_a(dy),$$

that is $T_a^*(\cdot|\underline{s}, \theta)$ is the adjoint operator associated with Q_a . Let $T_a^{*n}(\cdot|\underline{s}, \theta)$ be the operator obtained if $T_a^*(\cdot|\underline{s}, \theta)$ is iterated n times.

Lemma D. *The operator T_a^* has a unique invariant probability measure, denoted $\mu_a(\cdot|\underline{s}, \theta)$, and $T_a^{*n}(\mu_a)$ converges strongly to this invariant probability measure as $n \rightarrow \infty$ for any probability measure μ_a on $(\mathcal{Y}_a, \mathcal{B}_a)$.*

Proof. Transitions from employment satisfy $Q_a(y, \{u\}|\underline{s}, \theta) \geq \tilde{\delta}$ for all $y \in \mathcal{Y}$ while transitions from unemployment satisfy $Q_a(u, \{u\}|\underline{s}, \theta) \geq 1 - f(\theta)$. Thus $Q_a(y, \{u\}|\underline{s}, \theta) \geq \min[\tilde{\delta}, 1 - \theta q(\theta)] > 0$ for all $y \in \mathcal{Y}_a$ where the strict inequality follows from the assumptions that $\delta > 0$ and $m(u, v) < \min[u, v]$. The lemma then follows immediately from Theorem 11.12 in conjunction with Exercises 11.5(a) and 11.4(c) in Stokey and Lucas (1989). ■

Proof of Lemma 7: Follows immediately from Lemma D. Here $G_a(\cdot|\underline{s}, \theta)$ is the distribution function associated with $\mu_a(\cdot|\underline{s}, \theta)$. ■

Now I turn to the distribution of match-specific productivity across employed workers and the proof of Lemma 8. While this is of course just the distribution derived above conditional on employment, it is useful to derive it from a separate transition function. In steady state the mass of workers separating equals the mass of workers entering employment. Thus the distribution of productivity across employed workers can be computed from the transition function induced by Q when separated matches are replaced by matches with productivity drawn from μ_{new} . Of course this transition function does not exist if the separation rule is so high that all new matches separate immediately, that is if

$$h((\underline{y}, \underline{\lambda})) \equiv \mu_{new}((\underline{y}, +\infty)) + (1 - \underline{\lambda})\mu_{new}(\{\underline{y}\}) = 0.$$

If $h(\underline{s}) > 0$ then this transition function is given by

$$\begin{aligned} & Q_e(y, Y | (\underline{y}, \underline{\lambda})) \\ &= (1 - \tilde{\delta}) [Q(y, Y \cap (\underline{y}, +\infty)) + (1 - \underline{\lambda})Q(y, Y \cap \{\underline{y}\})] \\ &+ \left(\tilde{\delta} + (1 - \tilde{\delta}) [Q(y, [0, \underline{y})) + \underline{\lambda}Q(y, \{\underline{y}\})] \right) \frac{\mu_{new}(Y \cap (\underline{y}, +\infty)) + (1 - \underline{\lambda})\mu_{new}(Y \cap \{\underline{y}\})}{\mu_{new}((\underline{y}, +\infty)) + (1 - \underline{\lambda})\mu_{new}(\{\underline{y}\})}. \end{aligned}$$

The first term of the sum is the probability of transiting to a productivity level in the set Y by surviving both quits and the separation decision at the beginning of next period. The second term of the sum is the probability of transiting to the set Y via replacement through new matches with a productivity level within that set. Thus this term is the product of the destruction rate and the probability of new matches having productivity in Y . Notice that the latter probability is conditional on a new match being formed.

Let $T_e^*(\cdot | \underline{s})$ be the adjoint operator associated with $Q_e(\cdot | \underline{s})$. Lemma D insures that $T_e^*(\cdot | \underline{s})$ has a unique invariant distribution $\mu_e(\cdot | \underline{s})$ as long as $h(\underline{s}) > 0$.

Proof of Lemma 8. First consider the uninteresting case in which steady-state employment is necessarily zero under the high separation rule, that is if $h(\underline{s}_H) = 0$. Here I adopt the convention that $\mu_e(\cdot | \underline{s}_H)$ is degenerate with all mass at $+\infty$, which insures that the statement of the lemma is correct.

Now turn to the case $h(\underline{s}_H) > 0$ which implies that $h(\underline{s}_L) > 0$. As a first step I show that $T_e^*(\cdot | \underline{s}^H)$ dominates $T_e^*(\cdot | \underline{s}^L)$ according to the definition of dominance in Müller and Stoyan (MS, 2002, p. 180). Using Theorem 5.2.5 in MS dominance can be verified by showing that $Q_e(y, [0, y'] | \underline{s}^H) \leq Q_e(y, [0, y'] | \underline{s}^L)$ for all $y, y' \in \mathcal{Y}$. As usual write $\underline{s}^H = (\underline{y}^H, \underline{\lambda}^H)$ and $\underline{s}^L = (\underline{y}^L, \underline{\lambda}^L)$. For $y' < \underline{y}_H$ the desired result follows immediately as $Q_e(y, [0, y'] | \underline{s}^H) = 0$. So consider the case $y' \geq \underline{y}_H$. First it is helpful to note that

$$\frac{\mu_{new}((\underline{y}_H, y']) + (1 - \underline{\lambda}_H)\mu_{new}(\{\underline{y}_H\})}{\mu_{new}((\underline{y}_H, +\infty)) + (1 - \underline{\lambda}_H)\mu_{new}(\{\underline{y}_H\})} \leq \frac{\mu_{new}((\underline{y}_L, y']) + (1 - \underline{\lambda}_L)\mu_{new}(\{\underline{y}_L\})}{\mu_{new}((\underline{y}_L, +\infty)) + (1 - \underline{\lambda}_L)\mu_{new}(\{\underline{y}_L\})}.$$

Thus it is enough to show that

$$\begin{aligned} & (1 - \tilde{\delta}) [Q(y, (\underline{y}_H, y']) + (1 - \underline{\lambda}_H)Q(y, \{\underline{y}_H\})] \\ &+ \left(\tilde{\delta} + (1 - \tilde{\delta}) [Q(y, [0, \underline{y}_H)) + \underline{\lambda}_H Q(y, \{\underline{y}_H\})] \right) \frac{\mu_{new}((\underline{y}_H, y]) + (1 - \underline{\lambda}_H)\mu_{new}(\{\underline{y}_H\})}{\mu_{new}((\underline{y}_H, +\infty)) + (1 - \underline{\lambda}_H)\mu_{new}(\{\underline{y}_H\})} \\ &\leq (1 - \tilde{\delta}) [Q(y, (\underline{y}_L, y']) + (1 - \underline{\lambda}_L)Q(y, \{\underline{y}_L\})] \\ &+ \left(\tilde{\delta} + (1 - \tilde{\delta}) [Q(y, [0, \underline{y}_L)) + \underline{\lambda}_L Q(y, \{\underline{y}_L\})] \right) \frac{\mu_{new}((\underline{y}_H, y]) + (1 - \underline{\lambda}_H)\mu_{new}(\{\underline{y}_H\})}{\mu_{new}((\underline{y}_H, +\infty)) + (1 - \underline{\lambda}_H)\mu_{new}(\{\underline{y}_H\})}. \end{aligned}$$

Collecting terms, this condition reduces to

$$\begin{aligned} & [Q(y, [\underline{y}_L, \underline{y}_H)) + \underline{\lambda}_H Q(y, \{\underline{y}_H\}) - \underline{\lambda}_L Q(y, \{\underline{y}_L\})] \frac{\mu_{new}((\underline{y}_H, y]) + (1 - \underline{\lambda}_H)\mu_{new}(\{\underline{y}_H\})}{\mu_{new}((\underline{y}_H, +\infty)) + (1 - \underline{\lambda}_H)\mu_{new}(\{\underline{y}_H\})} \\ &\leq [Q(y, [\underline{y}_L, \underline{y}_H)) + \underline{\lambda}_H Q(y, \{\underline{y}_H\}) - \underline{\lambda}_L Q(y, \{\underline{y}_L\})] \end{aligned}$$

which is satisfied. Now let μ be a probability measure on $(\mathcal{Y}, \mathcal{B})$. By Theorem 5.2.2. in MS

$$T_e^{*n}(\mu|\underline{\mathfrak{s}}^H) \geq_{FSD} T_e^{*n}(\mu|\underline{\mathfrak{s}}^L)$$

for all $n \geq 0$. Since first-order stochastic dominance is closed with respect to strong convergence, it follows that

$$\mu_e(\cdot|\underline{\mathfrak{s}}_H) \geq_{FSD} \mu_e(\cdot|\underline{\mathfrak{s}}_L).$$

■

E Proof of Lemmas 9–11 and Proposition 1

Proof of Lemma 9. First note that $F_0^L, F_0^H \in \mathcal{F}^{NB}$ implies $U_{NB}(F_0^H) \leq U_{NB}(F_0^L)$. Then parts (b) and (c) of Lemma A imply $\underline{y}_{NB}(F_0^H) = \underline{y}_{NB}(F_0^H, U_{NB}(F_0^H)) < \underline{y}_{NB}(F_0^L, U_{NB}(F_0^L))$. This in turn implies $\underline{\mathfrak{s}}_0^H \leq \underline{\mathfrak{s}}_0^L$. The result now follows from Lemma 8. ■

Proof of Lemma 10. Suppose $F^L \notin \mathcal{F}_{NB}$. Then there exists $F^H \in \mathcal{F}$ such that $F^H > F^L$ and $U_{NB}(F^H) > U_{NB}(F^L)$. Thus

$$\begin{aligned} & \mathcal{W}_{NB}(y, F^H) - \mathcal{W}_{NB}(y, F^L) \\ &= [W_{NB}(y, F^H, U_{NB}(F^H)) - W_{NB}(y, F^H, U_{NB}(F^L))] \\ & \quad + [W_{NB}(y, F^H, U_{NB}(F^L)) - W_{NB}(y, F^L, U_{NB}(F^L))]. \end{aligned} \tag{E.1}$$

Property (a) of Lemma 2 implies that the first term is positive, while property (b) insures that the second term of the sum is non-negative. Thus all employed workers as well as unemployed workers strictly benefit from an increase of firing costs from F^L to F^H . This immediately implies $F^L \notin \mathcal{P}_{NB,e}(F_0)$ and $F^L \notin \mathcal{P}_{NB,a}(F_0)$. ■

Proof of Lemma 11. Since $F^L, F^H \in \mathcal{F}_{NB}$ it follows that $U_{NB}(F^H) \leq U_{NB}(F^L)$. Property (a) of Lemma 2 implies that the first term of equation (E.1) is weakly increasing in y , while property (b) insures that the second term is weakly increasing in y . ■

Proof of Proposition 1. Suppose $F^L \in \mathcal{P}_{NB,e}(F_0^L)$ and $F^H \in \mathcal{P}_{NB,e}(F_0^H)$ with $F^H > F^L$. Since $F^L \in \mathcal{P}_{NB,e}(F_0^L)$ it follows that there exists $\underline{\mathfrak{s}}_0^L \in \underline{\mathfrak{s}}_{NB}(F_0^L)$ such that

$$\int [\mathcal{W}_{NB}(y, F^H) - \mathcal{W}_{NB}(y, F^L)] dG_e(y|\underline{\mathfrak{s}}_0^L) \leq 0.$$

Similarly $F^H \in \mathcal{P}_{NB,e}(F_0^H)$ implies that there exists $\underline{\mathfrak{s}}_0^H \in \underline{\mathfrak{s}}_{NB}(F_0^H)$ such that

$$\int [\mathcal{W}_{NB}(y, F^H) - \mathcal{W}_{NB}(y, F^L)] dG_e(y|\underline{\mathfrak{s}}_0^H) \geq 0.$$

Lemma 9 insures that $G_e(\cdot|\underline{\mathfrak{s}}_0^H) \leq_{FSD} G_e(\cdot|\underline{\mathfrak{s}}_0^L)$. As $F^H > F^L$ the difference $\mathcal{W}_{NB}(y, F^H) - \mathcal{W}_{NB}(y, F^L)$ is weakly increasing in y by Lemma 11. This yields the inequality

$$\int [\mathcal{W}_{NB}(y, F^H) - \mathcal{W}_{NB}(y, F^L)] dG_e(y|\underline{\mathfrak{s}}_0^L) \geq \int [\mathcal{W}_{NB}(y, F^H) - \mathcal{W}_{NB}(y, F^L)] dG_e(y|\underline{\mathfrak{s}}_0^H).$$

Together these three inequalities imply

$$\begin{aligned} & \int [\mathcal{W}_{NB}(y, F^H) - \mathcal{W}_{NB}(y, F^L)] dG_e(y|\underline{s}_0^L) \\ &= \int [\mathcal{W}_{NB}(y, F^H) - \mathcal{W}_{NB}(y, F^L)] dG_e(y|\underline{s}_0^H) = 0. \end{aligned}$$

Hence $F^H \in \mathcal{P}_{NB,e}(F_0^L)$ and $F^L \in \mathcal{P}_{NB,e}(F_0^H)$.

F Proof of Lemmas 12, 13, 15, and Proposition 2

Proof of Lemma 12. Consider $F \in \mathcal{F}$ and suppose $w_{ID}(U_{ID}(F)) \leq \rho U_{ID}(F)$. Then the capital gain from finding a job is zero and equation (6) implies $U_{ID}(F) = \frac{z}{\rho}$. But this contradicts part (a) of Assumption 1 according to which $w_{ID}(U_{ID}(F)) > z$. ■

Proof of Lemma 13. Let $U^H = U_{ID}(F^H)$ and $U^L = U_{ID}(F^L)$. Suppose that the separation threshold does not decrease, so $\underline{s}^H > \underline{s}^L$. As a first step I show that this implies $U^H > U^L$. This is because $U^L \leq U^H$ would imply $\underline{y}_{ID}(F^H, U^H) < \underline{y}_{ID}(F^L, U^L)$ by Lemma 3, contradicting $\underline{s}^H > \underline{s}^L$. As a second step I show that $\underline{s}^H > \underline{s}^L$ together with $U^H > U^L$ yields a contradiction using the equilibrium conditions. Since $\int J_{ID}(y, \underline{s}_{ID}(F, U), F, U) dG_{new}(y)$ is weakly decreasing in U and F by Lemma B.1, condition (5) implies that $\theta_{ID}(F^H) \leq \theta_{ID}(F^L)$. However, given that $\underline{s}^H > \underline{s}^L$ and $\theta_{ID}(F^H) \leq \theta_{ID}(F^L)$ condition (6) implies that $U^H \leq U^L$. ■

Proof of Lemma 15. The utility difference can be written as

$$\begin{aligned} \mathcal{W}_{ID}(y, F^P) - \mathcal{W}_{ID}(y, F^L) &= [W_{ID}(y, \underline{s}^P, U_{ID}(F^P)) - W_{ID}(y, \underline{s}^P, U_{ID}(F^L))] \\ &\quad + [W_{ID}(y, \underline{s}^P, U_{ID}(F^L)) - W_{ID}(y, s_{ID}(F^L), U_{ID}(F^L))] \end{aligned}$$

Equation (B.2) implies that the first term is independent of y . The second term is weakly decreasing in y by Lemma 5 for $y \in \mathcal{Y}$. ■

Proof of Proposition 2. Suppose $F^P \in \mathcal{P}_{ID,e}(F_0^L)$. Then there exists $\underline{s}_0^L \in \underline{s}_{ID}(F_0^L)$ such that

$$\int [\mathcal{W}_{ID}(y, F^P) - \mathcal{W}_{ID}(y, F)] dG_e(y|\underline{s}_0^L) \geq 0.$$

for all $F \in \mathcal{F}$. Now pick any $\underline{s}_0^H \in \underline{s}_{ID}(F_0^H)$. By Lemma 13 one has $G_e(\cdot|\underline{s}_0^L) \geq_{FSD} G_e(\cdot|\underline{s}_0^H)$. Thus

$$\int [\mathcal{W}_{ID}(y, F^P) - \mathcal{W}_{ID}(y, F)] dG_e(y|\underline{s}_0^H) \geq 0.$$

for all $F \in \mathcal{F}$. Thus $F^P \in \mathcal{P}_{ID,e}(F_0^H)$. ■

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