

Manzini, Paola; Snower, Dennis J.

**Working Paper — Digitized Version**

## On the foundations of wage bargaining

CEPR Discussion Paper Series, Centre for Economic Policy Research (CEPR), London, No. 1514

**Provided in Cooperation with:**

Kiel Institute for the World Economy – Leibniz Center for Research on Global Economic Challenges

*Suggested Citation:* Manzini, Paola; Snower, Dennis J. (1996) : On the foundations of wage bargaining, CEPR Discussion Paper Series, Centre for Economic Policy Research (CEPR), London, No. 1514, Centre for Economic Policy Research (CEPR), London

This Version is available at:

<https://hdl.handle.net/10419/925>

**Standard-Nutzungsbedingungen:**

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

**Terms of use:**

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*

## DISCUSSION PAPER SERIES

No. 1514

### ON THE FOUNDATIONS OF WAGE BARGAINING

Paola Manzini and Dennis J Snower

*HUMAN RESOURCES*

W 32 (1514)



719527

12. DEZ. 1996 Weltwirtschaft

W 32-

Kiel 11-74

Phil Del

**Centre for Economic Policy Research**

# ON THE FOUNDATIONS OF WAGE BARGAINING

**Paola Manzini and Dennis J Snower**

Discussion Paper No. 1514  
November 1996

Centre for Economic Policy Research  
25–28 Old Burlington Street  
London W1X 1LB  
Tel: (44 171) 878 2900  
Fax: (44 171) 878 2999  
Email: [cepr@cepr.org](mailto:cepr@cepr.org)

This Discussion Paper is issued under the auspices of the Centre's research programme in **Human Resources**. Any opinions expressed here are those of the authors and not those of the Centre for Economic Policy Research. Research disseminated by CEPR may include views on policy, but the Centre itself takes no institutional policy positions.

The Centre for Economic Policy Research was established in 1983 as a private educational charity, to promote independent analysis and public discussion of open economies and the relations among them. It is pluralist and non-partisan, bringing economic research to bear on the analysis of medium- and long-run policy questions. Institutional (core) finance for the Centre has been provided through major grants from the Economic and Social Research Council, under which an ESRC Resource Centre operates within CEPR; the Esmée Fairbairn Charitable Trust; and the Bank of England. These organizations do not give prior review to the Centre's publications, nor do they necessarily endorse the views expressed therein.

These Discussion Papers often represent preliminary or incomplete work, circulated to encourage discussion and comment. Citation and use of such a paper should take account of its provisional character.

November 1996

## ABSTRACT

### On the Foundations of Wage Bargaining\*

This paper provides strategic foundations for the insight that the bargaining power of employees depends on the firm's labour turnover costs. The analysis shows how these costs determine the firm's degree of substitutability between two sets of wage negotiations: (i) those the firm conducts with its incumbent employees; and (ii) the alternative negotiations it could conduct with new job seekers. In this context, labour turnover costs not only influence the negotiators' alternatives to bargaining (i.e. the negotiators' fall-back positions and outside options); they affect the nature of the bargaining process itself. This approach leads to a new theory of wage determination.

JEL Classification: C78, J31, J32

Keywords: bargaining, outside option, insider-outsider, labour turnover costs

Paola Manzini  
Department of Economics  
University of Exeter  
Rennes Drive  
Exeter EX4 4RJ  
UK  
Tel: (44 1392) 263 212  
Fax: (44 1392) 263 242  
Email: p.manzini@exeter.ac.uk

Dennis J Snower  
Department of Economics  
Birkbeck College  
7-15 Gresse Street  
London W1P 1PA  
UK  
Tel: (44 171) 631 6408/1  
Fax: (44 171) 631 6416  
Email: dsnower@econ.bbk.ac.uk

\*This paper is produced as part of a CEPR research programme on *Product Market Integration, Labour Market Imperfections and European Competitiveness*, supported by a grant from the Commission of the European Communities under its Human Capital and Mobility Programme (no. ERBCHRXCT930235). The authors would like to acknowledge the financial support of the Leverhulme Trust for the CEPR project on 'Unemployment Dynamics and Matching Workers with Jobs' (grant No. F/558/D). The views expressed are those of the authors and do not necessarily reflect those of the Leverhulme Foundation or CEPR. We wish to thank, with the usual disclaimers, seminar participants at ESEM 1996 in Istanbul, the XI World

Congress of the IIA in Tunis, the Labour Market Imperfections Group, and the University of Bristol. We are particularly grateful to Marco Mariotti and Abhinay Muthoo for very helpful discussions and comments on an earlier version of the paper. Paola Manzini gratefully acknowledges financial support from a Royal Economic Society Junior Fellowship.

Submitted 4 October 1996

## NON-TECHNICAL SUMMARY

Existing wage bargaining theories have paid scant attention to labour turnover costs, focusing predominantly on how wages are set when the firm and its employees bargain without interference from other job searchers. In conventional theories, employees' bargaining power is portrayed as either exogenously given (as in the Nash bargaining theories, where the bargaining power is depicted by a constant exponent of the Nash product) or determined by the preferences of the negotiators (as in strategic bargaining theories where the bargaining power depends on the negotiators' relative rates of time preference or their relative degrees of risk aversion). It is common in the labour economics literature to summarize the bargaining outcome by a 'wage-setting function', in which the wage depends on such variables as the aggregate level of employment (or unemployment) and unemployment benefits. Labour turnover costs generally remain out of this picture. In this regard, these theories fail to provide a full account of where employees' bargaining power comes from, i.e. they fail to explain why employees can achieve more than the minimum wage at which other job seekers are willing to work.

In so far as labour turnover costs have any role to play at all in the conventional wage bargaining literature, they are usually relegated to influencing the 'external environment' of the bargaining process, characterized by the negotiators' fall-back positions and outside options. We argue, however, that this approach fails to capture a centrally important phenomenon: *Labour turnover costs determine the firm's degree of substitutability between two alternative sets of wage negotiations – (i) those the firm conducts with its incumbent employees ('insiders') and (ii) those it could conduct with other job seekers ('outsiders').* In other words, labour turnover costs affect the outcome of wage negotiations between the firm and its incumbent employees, not just because these costs influence the external environment of these negotiations, but because they influence the way the negotiators interact with one another. These costs do so by determining the degree to which the two alternative sets of bargains – the firm-insider bargains and the firm-outsider bargains – are interdependent.

The aim of this paper is to provide game-theoretic foundations for this insight. This means taking leave of the standard wage setting equations in the labour economics literature. Our analysis suggests that the prevailing Nash bargaining paradigm needs to be relinquished in favour of a new wage determination mechanism, which we examine here.

In addition to providing an account of where employees' market power comes from and examining the role of labour turnover costs in the bargaining process, this paper provides a game-theoretic foundation for the analysis of two further phenomena: (i) why some firms 'bond' with their employees (i.e. enter into long-term relationships with them) whereas other firms are 'revolving doors' (characterized by short-term employment relationships); and (ii) how wage bargaining can lead to unemployment that is 'involuntary' in the sense that outsiders remain jobless even though they would prefer employment to unemployment.

In examining the fundamental role of labour turnover costs in structuring the wage bargaining process, our analysis delivers a new theory of wage determination. Our contention is that most wage bargaining theories thus far have been significantly incomplete, in that they provide no account of employees' bargaining power in terms of the firm's labour turnover costs. We argue that labour turnover costs are a fundamental source of this bargaining power and our analysis shows how these costs determine the degree of competition between insiders and outsiders.

# 1 Introduction

It is a commonplace that firms' labor turnover costs are a fundamental source of employees' bargaining power. In the absence of such costs (e.g. hiring, training, and firing costs, or productivity differentials between incumbent employees and new recruits), employees would generally receive their reservation wage; for if they would claim any wage in excess of this reservation wage, their employers would costlessly replace them by other job seekers. On this account, labor turnover costs may be expected to play a critical role in the wage bargaining process. Surprisingly, though, these costs have been largely ignored in the wage bargaining literature. We will show that once their role in determining the nature of labor market competition and in shaping the strategic bargaining process is explicitly taken into account, the conventional wage bargaining outcomes no longer apply, and we are led to a new theory of wage determination.

Specifically, consider a firm with a given number of incumbent employees, facing a large number of unemployed job seekers, who behave atomistically (viz. they do not collude with each other, with the firm's employees, or the firm), and suppose that the firm makes its employment decisions unilaterally. Then, if the firm faced no labor turnover costs, the incumbent employees and the job seekers would be perfect substitutes for the firm, and it is on this account that the incumbents would lack market power. But in the presence of labor turnover costs, the two sets of workers would be imperfect substitutes, and then the incumbents may be able to negotiate wages in excess of their reservation wage.

While this may sound obvious to the layperson, existing wage bargaining theories have paid scant attention to labor turnover costs, focusing predominantly on how wages are set when the firm and its employees bargain without interference from other job searchers. In the conventional theories, the employees' bargaining power is portrayed as either exogenously given (as in the Nash bargaining theories, where the bargaining power is depicted by a constant exponent of the Nash product) or determined by the preferences of the negotiators (as in strategic bargaining theories where the bargaining power depends on the negotiators' relative rates of time preference or their relative degrees of risk aversion). It is common in the labor economics literature to summarize the bargaining outcome by a "wage setting function", in which the wage depends on such variables as the aggregate level of employment (or unemployment) and unemployment benefits. Labor turnover costs generally remain out of this picture<sup>1</sup>. In this regard, these theories fail to provide a full account of where the employees' bargaining power comes from, i.e. they fail to explain

---

<sup>1</sup>See, for example, McDonald and Solow (1981), Layard et al (1991, ch.2), and Pissarides (1990, ch.1).



why the employees can achieve more than the minimum wage at which other job seekers are willing to work.

Insofar as labor turnover costs have any role to play at all in the conventional wage bargaining literature, they are usually relegated to influencing the “external environment” of the bargaining process, characterized by the negotiators’ fall-back positions and outside options. We will argue, however, that this approach fails to capture a centrally important phenomenon: *Labor turnover costs determine the firm’s degree of substitutability between two alternative sets of wage negotiations: (i) those the firm conducts with its incumbent employees (“insiders”) and (ii) those it could conduct with other job seekers (“outsiders”).* In other words, labor turnover costs affect the outcome of wage negotiations between the firm and its incumbent employees, not just because these costs influence the external environment of these negotiations,<sup>2</sup> but because they influence the way the negotiators interact with one another. These costs do so by determining the degree to which the two alternative sets of bargains - the firm-insider bargains and the firm-outsider bargains - are interdependent.

The greater are a firm’s labor turnover costs, *ceteris paribus*, the less profitable the firm finds the second set of negotiations relative to the first, and consequently the less dependent are the insiders on the bargain the firm could have made with the outsiders. There are only two circumstances in which labor turnover costs do not affect the level of the negotiated wages: At one extreme, when labor turnover costs are zero, the two sets of negotiations are perfect substitutes for the firm, and thus the insider wage is driven down to the reservation wage. At the other extreme, when labor turnover costs are prohibitively high, the firm-insider bargains are independent of the firm-outsider bargains, thereby creating a bilateral monopoly between the firm and its insiders.

Between these extremes, the negotiations between the firm and its insiders are conducted with a view to the negotiations that could take place between the firm and the outsiders; and the firm-outsider negotiations, in turn, proceed with a view to the negotiations that occur if the outsiders eventually turn into insiders. In this interaction between the two sets of negotiations, labor turnover costs may be interpreted as a fee for switching the employer’s negotiating partners. It is here, we argue, that the central role of labor turnover costs in wage bargaining is to be found.

The aim of this paper is to provide game-theoretic foundations for this insight. This

---

<sup>2</sup>In other words, these costs do not just influence the magnitude of the negotiators’ bargaining surpluses, by affecting their payoffs in the absence of bargaining agreement (fall-back positions); nor do they just influence the feasible range within which the negotiated wage must fall, by affecting the negotiators’ opportunities outside the bargaining process (outside options).

means taking leave of the standard wage setting equations in the labor economic literature. In our analysis, the well-known result of Binmore (1987) and Binmore, Rubinstein, and Wolinsky (1986) - that the strategic bargaining outcome converges to the Nash outcome as the time between alternating wage offers becomes infinitesimally small - no longer applies. By implication, our analysis suggests that the prevailing Nash bargaining paradigm needs to be relinquished in favor of a new wage determination mechanism, which we examine here.

In addition to providing an account of where employees' market power comes from and examining the role of labor turnover costs in the bargaining process, this paper provides a game-theoretic foundation for the analysis of two further phenomena: (i) why some firms "bond" with their employees (i.e. enter into long-term relationships with them) whereas other firms are "revolving doors" (characterized by short-term employment relationships), and (ii) how wage bargaining can lead to unemployment that is "involuntary" in the sense that outsiders remain jobless even though they would prefer employment to unemployment.

For this purpose we require a model in which outsiders do not turn into insiders as soon as the firm starts bargaining with them. For otherwise the firm's negotiations with its insiders would be indistinguishable from its negotiations with its new recruits, and the issue of substitutability between the two sets of negotiations (and the related issue of bonding versus revolving doors) could not be addressed. Thus we will assume that the position of a new recruit is not protected with labor turnover costs, and that it takes time for this recruit to turn into an insider, whose position is thus protected. As shown below, the labor turnover costs give the insiders bargaining power and thereby permit them to achieve wages greater than those received by the entrants. The outsiders, by contrast, are perfect competitors for jobs; thus they exercise no market power when negotiating the entrant wage.

In this context, the outsiders may be called "involuntarily unemployed" when the entrant wage exceeds the outsiders' reservation wage, so that the workers who remain jobless would prefer to be entrants. Our analysis indicates that, when labor turnover costs fall within a particular range, unemployment is involuntary in this sense, despite the outsiders' lack of market power.

The paper is organized as follows. Section 2 relates our analysis to the existing literature. Section 3 presents our basic model and derives the bargaining outcome. Section 4 extends our results to include unemployment benefits and training costs. Section 5 concludes.

## 2 Relation to the literature

To see how our approach differs from axiomatic theories of bargaining as conventionally applied to wage negotiations, consider the following variant of the Nash bargaining model (Nash (1950), (1953)). Suppose that the wage is the outcome of negotiations between an employee-employer pair. Let the wage  $w$  and  $w^-$  be the employee's payoff in the presence and absence of agreement, respectively; let profits  $\pi(w)$  and  $\pi^-$  be the employer's payoff under these contingencies; and  $w^O$  and  $\pi^O$  be the employee's and employer's outside options<sup>3</sup>, respectively. Then the negotiated wage can be found as the solution to the following maximization problem:

$$\begin{aligned} \max_w & (w - w^-)^\mu (\pi(w) - \pi^-)^{1-\mu} \\ \text{subject to} & \quad w \geq w^O, \pi \geq \pi^O \end{aligned}$$

where  $\mu$  ( $0 < \mu < 1$ ) is a constant describing the employee's bargaining strength relative to that of the employer, and  $w^-$ ,  $\pi^-$ ,  $w^O$ , and  $\pi^O$  are constants. When there is an interior solution to this problem, the available economic rent is divided among the employee and employer in the proportions  $\mu$  and  $(1 - \mu)$ ; otherwise, either the employee or the employer exploit their respective outside options, so that  $w = w^O$  or<sup>4</sup>  $\pi = \pi^O$ . In most wage bargaining models of this type in the literature (e.g. Layard et al. (1991, ch.2)), labor turnover costs play no role at all. More importantly, even when such models are extended to include these costs as determinants of the negotiators' fall-back positions ( $w^-$  and  $\pi^-$ ) or the outside options ( $w^O$  and  $\pi^O$ )<sup>5</sup>, they still fail to capture the phenomenon discussed in the previous section, namely, that labor turnover costs determine the employer's degree of substitutability between the negotiations with insiders and outsiders.

Turning to strategic models of wage bargaining, we begin by observing that the basic Rubinstein (1982) model, interpreted in terms of a negotiation between a worker and a firm over a given amount of revenue, describes a bilateral monopoly problem, and thus does not deal with the issue of substitutability between alternative wage bargains. The first attempt to consider this issue was made by Shaked and Sutton (1984). In

---

<sup>3</sup>See Binmore, Shaked and Sutton (1989).

<sup>4</sup>If both outside option constraints were binding, then there would be no gains from bargaining in the first place.

<sup>5</sup>For example, when the employers' alternative to wage negotiations with the insiders is replacing the insiders by outsiders, then the employers' outside option is the outsiders' wage plus the relevant labor turnover costs. Furthermore, labor turnover costs affect the probabilities of locating vacancies and jobs and thereby influence the fall-back positions of the employers and employees.

their path-breaking model, labor turnover costs take the form of a fixed number of time periods over which the employer and the insider are obliged to bargain with one another. Here the substitutability between the employer's negotiations with an insider and those with an outsider depends on the length of this "negotiation period"<sup>6</sup>. While this is an important insight, it is clear that in practice labor turnover costs frequently take other forms. Monetary costs of replacing insiders by entrants and insider-entrant productivity differentials are particularly common. Our analysis focuses on these labor turnover costs.

Furthermore, Shaked and Sutton (1984) do not distinguish between negotiations with insiders and those with outsiders: they assume that when the firm switches to an outsider, that outsider instantaneously turns into an insider, entitled to the same negotiation period as the previous insider. In practice, of course, established incumbent employees commonly have greater job security than new recruits, implying that the labor turnover costs associated with the incumbents generally exceed those of the entrants. Our analysis takes this asymmetry into account.

Finally, both the Rubinstein and Shaked-Sutton models are concerned with the division of an existing pie (revenue) between two parties, but not with a temporal production process in which revenue can be generated during each time period. In their models, the only cost of delaying agreement is a temporal discounting cost (i.e. the pie shrinks with the passage of time). By contrast, when there is a temporal production process running alongside the temporal bargaining process, delaying agreement generates an additional cost in the form of foregone output. This is generally the case in practice, since production usually yields a flow of output through time, rather than being a one-shot event. Implications of this latter approach has been explored by Fernandez and Glazer (1991), Haller and Holden (1991), Holden (1994), who however do not take account of the possibility that an employer may have several alternative bargaining partners. This paper attempts to do both.

### 3 The model

In this section we build a model which formalizes the idea that labor turnover costs influence the wage negotiation process by determining the firm's degree of substitutability between its bargains with insiders and outsiders. As noted, both sets of bargains are viewed as temporal processes, taking time that could have been spent on production.

---

<sup>6</sup>In their model the insider has a privileged position *vis à vis* the outsider because the former has the right to bargain with the firm for the duration of the negotiation span, but the insider does not become an employee - entitled to a wage and producing output - until the negotiations are over.

Thus, bargains are not about the division of a single “pie”, but rather about splitting a succession of pies through time, corresponding to the stream of revenues that the workers produce. Moreover, agents’s utility over time is discounted by the factor  $\delta \in (0, 1)$ .

We assume that labor turnover costs take the form of a firing cost (constant per insider) and an insider-entrant productivity differential. Along the lines of the insider-outsider theory,<sup>7</sup> these labor turnover costs allow us to distinguish among three types of workers:

1. an *insider*: an incumbent employee whose position is associated with a firing cost ( $\varphi$ , a positive constant), and who produces an output of 1 per period when there is bargaining agreement;
2. an *entrant*: a previously jobless worker who has just been hired, whose position is not associated with a firing cost, and who produces an output of  $1 - \alpha$  under bargaining agreement (where  $\alpha$  is a constant,  $0 \leq \alpha \leq 1$ ); and
3. an *outsider*: belonging to the pool of jobless workers, who are perfect competitors for the available jobs.

When an outsider is hired, he turns into an entrant for a limited “initiation period”. The entrant is employed on a temporary contract, and at the end of the initiation period the firm decides whether to retain him or replace him by another entrant. If he is retained, he turns into an insider which means that (a) his productivity rises from  $1 - \alpha$  to 1, (b) his position becomes associated with the firing cost  $\varphi$ , to be paid by the firm upon dismissal, and (c) the wage is renegotiated on this basis. The insider is employed on a permanent contract in the sense that once the insider’s wage has been agreed, it is not renegotiated, for neither the firing cost nor the insider’s productivity changes from one period to the next over his infinite lifetime.

### 3.a Structure of the game

The structure of the game is depicted in Figure 1. It comprises three types of subgames<sup>8</sup>:

- (a) *subgame  $G^O$* , in which the firm bargains with an outsider ( $O$ ). After agreement is reached, the outsider turns into an entrant ( $E$ );

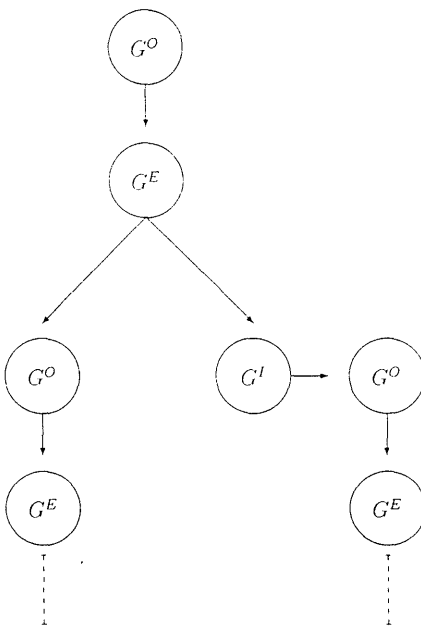
---

<sup>7</sup>See, for example, Lindbeck and Snower (1988). For a game theoretic interpretation, see Sabourian (1988).

<sup>8</sup>Notice that within each type of subgame one should distinguish between subgames starting with an offer by the firm and subgames starting with an offer by the worker. However, in what follows we always refer to subgames starting with an offer by the firm, so that no confusion should arise.

- (b) *subgame*  $G^E$ , in which the firm decides whether to retain or replace the entrant:  
and
- (c) *subgame*  $G^I$ , in which the firm bargains with an insider ( $I$ ).

As shown in Figure 1, a subgame  $G^O$ , between the firm and an outsider, is followed by a subgame  $G^E$ , between the firm and an entrant. If the firm fires the entrant, the firm moves to another subgame  $G^O$ , but if it retains the entrant, it moves to the subgame  $G^I$ , between the firm and its insider. If the firm fires the insider, it then moves to another subgame  $G^O$ , and so on.



**Figure 1: Structure of the game**

Consider the structure of each of these subgames in turn. Figure 2a illustrates the firm-outsider subgame<sup>9</sup>  $G^O$ . As noted, the size of the “pie” (the revenue to be split

---

<sup>9</sup>Since the game begins with negotiations between the firm and an outsider, the subgame  $G^O$  comprises the entire game.

between the two parties) is  $1 - \alpha$ . At time  $t$  the firm (denoted by  $F$  in the triangle) makes a wage offer to an outsider. If the offer is accepted ( $a$  in the figure), the game proceeds to a subgame of type  $G^E$ ; if the offer is rejected ( $r$  in the figure), the outsider ( $O$  in the triangle) makes a counter-offer in period  $t + 1$ . If the counter-offer is accepted, play moves to a subgame  $G^E$ . If the counter-offer is rejected, the firm decides whether to start bargaining with another outsider ( $O'$ ) in period  $t + 1$  (and thereby move to another subgame  $G^O$ ), or whether to make a counter-offer to the original outsider in period  $t + 2$ , and so on.

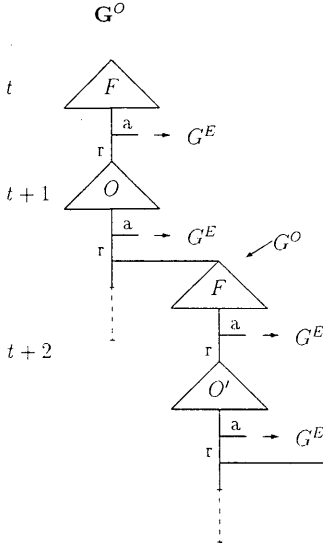


Figure 2a



Figure 2b

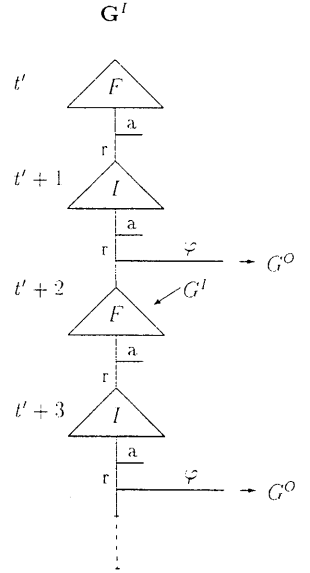


Figure 2c

Figure 2: Structure of the three types of subgames

Figure 2b depicts the firm-entrant subgame  $G^E$ . If the firm decides to retain the entrant and allow him to renegotiate his wage as an insider, the game proceeds to a subgame  $G^I$ , whereas the firm decides to bargain with another outsider, it moves back to

a subgame  $G^O$ .

Finally, Figure 2c depicts the firm-insider subgame  $G^I$ . At time  $t'$  the firm makes an offer to the insider. If it is accepted, the game ends, and from then on the worker receives the negotiated wage in each subsequent time period. If the offer is rejected, the insider ( $I$  in the triangle) makes a counter-offer in period  $t' + 1$ . Once again, if the offer is accepted, the game ends; but if it is rejected, the firm decides whether to pay the firing cost  $\varphi$  and replace the insider by an outsider (thereby moving to a subgame  $G^O$ ), or whether to make a counter-offer itself in the next period, and so on.

### 3.b Overview of the outcomes

We will show that the outcome of this game depends on the two exogenous parameters of our model - the productivity differential ( $\alpha$ ) and the firing cost ( $\varphi$ ) - since they determine the relative profitability of entrants and insiders.

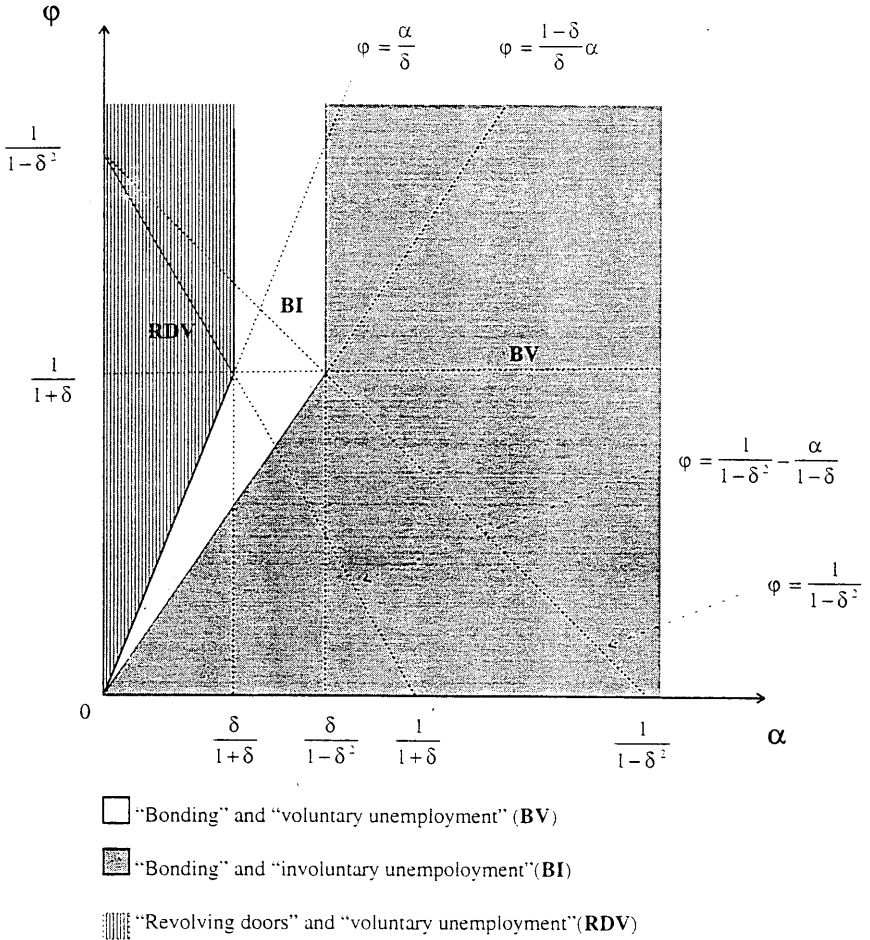
The influence of the productivity differential is straightforward. When deciding whether to retain or fire an entrant, the firm faces a tradeoff: (a) if the entrant is retained and subsequently turns into an insider - the case of “bonding” - the firm loses bargaining power to the insider, since the insider’s position is protected by the firing cost, but (b) if the entrant is fired and replaced by another entrant - so that the firm becomes a “revolving door” - the firm sacrifices productivity, since an entrant’s productivity is less than that of an insider. We will show that when the insider-entrant productivity differential is sufficiently high (as defined below), there will be bonding; and when this differential is sufficiently low, the firm may be a revolving door.

The influence of the firing cost is different. If the firing cost is sufficiently high relative to the insider-entrant productivity differential, the firm’s negotiations with an insider are a bilateral monopoly problem, for the firm does not find it worthwhile to fire the insider when the wage is at the bilateral monopoly outcome. Here entry to the firm is “blockaded”. On the other hand, if the firing costs is sufficiently low relative to the insider-entrant productivity differential, the firm has an incentive to fire its insider unless the latter accepts a wage below the bilateral monopoly outcome. The insider, knowing this, sets his wage as high as possible without inducing firing. Here entry is “restricted”.

On this account, the insider-entrant productivity differential and the firing cost jointly determine the profitability of entrants relative to insiders, and consequently the degree of substitutability between alternative bargains for the firm. On this basis, the analysis below will show that we can distinguish among three regimes of equilibrium wage negotiations, depending on whether the employer and employee have a long or short term relationship and whether or not the entrant receives more than his reservation wage. Fig-



Figure 3 depicts the combination of the parameter values which identify these three scenarios, which we label as **BV** (for “bonding” and “voluntary unemployment”), **RDV** (for “revolving door” and “voluntary unemployment”) and **BI** (for “bonding” and “involuntary unemployment”):



**Figure 3:** The three scenarios.

**BV** “Bonding” and “Voluntary unemployment”: A long term relationship is established between the employer-employee pair (“bonding”), and the entrant receives his reservation wage. This situation prevails when labor turnover costs are such that the profitability of entrants does not exceed the profitability of insiders. In this case the firm has always an incentive to retain an entrant and let him turn into an insider. The entrant is hired at the “bonding reservation wage”,  $W^b$ , which is the wage that makes the entrant indifferent between long-term employment and unemployment. If an entrant were to claim a higher wage, the firm would have an incentive to start a new set of negotiations with another job seeker. In this sense, then, jobless workers are “voluntarily unemployed”.

**RDV** “Revolving doors” and “Voluntary unemployment”: There is a short-term relationship between the employee-employer pair, and the entrant receives his reservation wage. This scenario prevails when the combination of the insider-entrant productivity differential and the firing cost is such that entrants are more profitable than insiders. In this case the firm is a “revolving door”, replacing one entrant by another before they achieve insider status. Each entrant receives his “revolving door reservation wage”,  $W^{rd}$ , which is the wage that makes the entrant indifferent between being employed for just one period and being unemployed. This is the sense in which jobless workers are “voluntarily unemployed”. The entrant cannot obtain a wage in excess of  $W^{rd}$ , since otherwise the firm would have an incentive to start a new bargain with another job seeker.

**BI** “Bonding” and “Involuntary unemployment”: There is a long-term relationship between the employer-employee pair, and the entrant receives more than his reservation wage. This scenario prevails when the insider and an entrant are equally profitable. The entrant receives a wage above his “bonding reservation wage”  $W^b$ . If the firm offered the entrant  $W^b$ , the entrant would be more profitable than an insider, so that the firm would have no incentive to retain him. But if the entrant were not retained, his reservation wage would rise to  $W^{rd}$ , since he would expect to be employed for just one period. Consequently, the outsiders are “involuntarily” unemployed in the sense that they would prefer being entrants than remaining jobless.

Our results are summarized in Table 1.

The following three propositions fully characterize the solution to this game. We assume that the workers’ objective is to maximize the present discounted value of their wages over time, and the firm’s objective is to maximize the present discounted value of its

Entry to insiders' jobs				
	B		R	
BV	$\Pi^I = \frac{1}{1+\delta}$	$W^I = \frac{\delta}{1+\delta}$	$\Pi^I = 1 - \delta(1-\delta)(\varphi + \alpha)$	$W^I = \delta(1-\delta)(\varphi + \alpha)$
	$\Pi^O = \frac{1}{1-\delta^2} - \alpha$	$W^O = -\frac{\delta^2}{1-\delta^2}$	$\Pi^O = 1 + \delta^2\varphi - (1-\delta^2)\alpha$	$W^O = -\delta^2(\varphi + \alpha)$
BI	$\Pi^I = \frac{1}{1+\delta}$	$W^I = \frac{\delta}{1+\delta}$	$\Pi^I = 1 - \delta\varphi$	$W^I = \delta\varphi$
	$\Pi^O = \frac{1}{1+\delta}$	$W^O = \frac{\delta}{1+\delta} - \alpha$	$\Pi^O = 1 - \delta\varphi$	$W^O = \delta\varphi - \alpha$
RDV	$\Pi^I = \frac{1}{1+\delta}$	$W^I = \frac{\delta}{1+\delta}$	$\Pi^I = 1 - \delta[\alpha + (1-\delta)\varphi]$	$W^I = \delta[\alpha + (1-\delta)\varphi]$
	$\Pi^O = 1 - \alpha$	$W^O = 0$	$\Pi^O = 1 - \alpha$	$W^O = 0$

The equilibrium payoffs to the firm ( $\Pi$ ) and the worker ( $W$ ) in negotiations between the firm and the insider  $I$ , and between the firm and the outsider  $O$ : Labor turnover costs determine the negotiation scenario: “bonding” an “voluntary unemployment” ( $BV$ ), “bonding” and “involuntary unemployment” ( $BI$ ), or “revolving doors” and “voluntary unemployment” ( $RD$ ). The firing cost  $\varphi$  relative to the insider-entrant productivity differential determines whether entry is “blockaded” ( $B$ ) or “restricted” ( $R$ ).

Table 1: Payoffs achieved by the firm and the workers in equilibrium.

profits. We concentrate on stationary strategies, and assume that the workers' strategies are symmetric, in the sense that all workers belonging to a specific group adopt the same strategy. We make the tie-breaking assumption that whenever the insider's wage is such that the firm is indifferent between retaining and replacing the insider, the firm retains him.

### 3.c “Bonding” and “Voluntary unemployment”

The bargaining outcome when the insider-entrant productivity differential is high may be described as follows:

**Proposition 1** *There is a unique subgame perfect equilibrium in which the firm retains an entrant hired at the reservation wage, such that:*

1. If  $\alpha \geq \frac{\delta}{1-\delta^2}$  and  $\varphi \geq \frac{1}{1-\delta^2} - \alpha$  (blockaded entry)<sup>10</sup>:

(a) the firm and the outsider immediately agree to share the revenue  $1 - \alpha$  such that the firm's profit and the entrant's wage are:

$$\left( \frac{1}{1-\delta^2} - \alpha; -\frac{\delta^2}{1-\delta^2} \right)$$

respectively; and

(b) after one period the firm retains the entrant, who thus turns into an insider and immediately agrees to share the revenue 1 such that the firm's profit and the insider's wage are:

$$\left( \frac{1}{1+\delta}; \frac{\delta}{1+\delta} \right)$$

respectively.

2. If  $\alpha \geq \frac{\delta}{1-\delta}\varphi$  and  $\varphi < \frac{1}{1-\delta^2} - \alpha$  (restricted entry):

(a) the firm and the outsider immediately agree to share the revenue  $1 - \alpha$  such that the firm's profit and the entrant's wage are:

$$(1 + \delta^2\varphi - (1 - \delta^2)\alpha; \delta^2(\varphi + \alpha))$$

respectively; and

(b) after one period the firm retains the entrant, who thus turns into an insider and immediately agrees to share the revenue 1 such that the firm's profit and the insider's wage are:

$$(1 - \delta(1 - \delta)(\varphi + \alpha); \delta(1 - \delta)(\varphi + \alpha))$$

respectively.

**Proof:** See Appendix.

**Supporting strategies.** To describe the equilibrium strategies which support Proposition 1, it is useful to introduce the following definitions. Let the index  $i$  describe the

---

<sup>10</sup>Note that since  $\alpha \leq 1$ , the discount factor must satisfy  $\delta \leq \frac{-1+\sqrt{5}}{2}$ .

productivity differential scenarios:  $i = H, M, L$  (“high”, “intermediate” and “low” insider-entrant productivity differential); and the index  $j$  describe the degree to which firing cost restricts entry:  $j = B, R$  (“blockaded” and “restricted” entry). Furthermore, let  $x^h$ ,  $h = I, O$  (“insider” and “outsider”) be the firm’s proposed partition of the available revenue when negotiating with player  $h$ , and let  $x_k^h$ ,  $k = F, I, O$  (“firm”, “insider” and “outsider”) be what player  $k$  receives in the proposed partition  $x^h$ . Then  $x_k^h(i, j)$  is player  $k$ ’s payoff from the firm’s proposed partition  $x_k^h$  under productivity differential  $i$  and firing cost  $j$ . Similarly, let  $y^h$  be the worker’s proposed partition of the available revenue (where the worker may be either an insider or an outsider) and let  $y_k^h$ ,  $k = F, I, O$  be what player  $k$  receives in the proposed agreement  $y^h$ . Then  $y_k^h(i, j)$  is player  $k$ ’s payoff from the worker’s proposed partition  $y_k^h$  under productivity differential  $i$  and firing cost  $j$ . Let  $x_k^{h*}(i, j)$  and  $y_k^{h*}(i, j)$  be the corresponding subgame perfect equilibrium partitions (see Table 2).

Then the strategies that support the equilibrium outcome of Proposition 1 may be described as follows. Under blockaded entry ( $\alpha \geq \frac{\delta}{1-\delta^2}$  and  $\varphi \geq \frac{1}{1-\delta^2} - \alpha$ ), the firm (a) offers the worker  $i$ ,  $i = I, O$ , a partition  $(x_F^{h*}(H, B), x_i^{h*}(H, B))$  of the available revenue, (b) accepts any proposed partition that yields at least  $y_F^{h*}(H, B)$  and rejects any proposal which yields less than  $y_F^{h*}(H, B)$ , (c) never fires the insider after rejecting his offer, (d) always turns to another outsider when rejecting one outsider’s offer and (e) always retains its entrant. Worker  $i$  (a) always proposes to the firm a partition  $(y_F^{h*}(H, B), y_i^{h*}(H, B))$ , (b) accepts any proposed partition that yields at least  $x_i^{h*}(H, B)$  and rejects any proposal which yields less than  $x_i^{h*}(H, B)$ . Under restricted entry ( $\alpha \geq \frac{\delta}{1-\delta}\varphi$  and  $\varphi < \frac{1}{1-\delta^2} - \alpha$ ) the firm (a) proposes to worker  $i$  a partition  $(x_F^{h*}(H, R), x_i^{h*}(H, R))$  of the available revenue, (b) accepts any proposed partition that yields at least  $y_F^{h*}(H, R)$  and rejects any proposal which yields less than  $y_F^{h*}(H, R)$ , (c) always turns to an outsider after rejecting an offer by the insider, (d) always turns to another outsider when rejecting one outsider’s offer and (e) retains its entrant. Worker  $i$  (a) always proposes to the firm a partition  $(y_F^{h*}(H, R), y_i^{h*}(H, R))$ , (b) accepts any proposed partition that yields at least  $x_i^{h*}(H, R)$  and rejects any proposal which yields less than  $x_i^{h*}(H, R)$ .

The intuition underlying Proposition 1 is straightforward. If the firing cost ( $\varphi$ ) is sufficiently high relative to the productivity differential ( $\alpha$ ), entry to insider jobs is blockaded, and the insider and the firm are in a bilateral monopoly position. In this case even if the insider fully exploits his bargaining power, obtaining the bilateral monopoly wage ( $\frac{\delta}{1+\delta}$ ), labor turnover costs are high enough so that the insider is still more profitable to the firm than an entrant.

$(x_F^{I^*}(H, B), x_W^{I^*}(H, B)) = \left(\frac{1}{1+\delta}, \frac{\delta}{1+\delta}\right)$	$(y_F^{I^*}(H, B), y_W^{I^*}(H, B)) = \left(\frac{\delta}{1+\delta}, \frac{1}{1+\delta}\right)$
$(x_F^{I^*}(H, R), x_W^{I^*}(H, R)) =$	$(y_F^{I^*}(H, R), y_W^{I^*}(H, R)) =$
$= (1 - \delta(1 - \delta)(\varphi + \alpha); \delta(1 - \delta)(\varphi + \alpha))$	$= (1 - (1 - \delta)(\varphi + \alpha); (1 - \delta)(\varphi + \alpha))$
$(x_F^{O^*}(H, B), x_W^{O^*}(H, B)) = \left(\frac{1}{1-\delta^2} - \alpha; -\frac{\delta^2}{1-\delta^2}\right)$	$(y_F^{O^*}(H, B), y_W^{O^*}(H, B)) = \left(\frac{1}{1-\delta^2} - \alpha; -\frac{\delta^2}{1-\delta^2}\right)$
$(x_F^{O^*}(H, R), x_W^{O^*}(H, R)) =$	$(y_F^{O^*}(H, R), y_W^{O^*}(H, R)) =$
$= (1 + \delta^2\varphi - (1 - \delta^2)\alpha; -\delta^2(\varphi + \alpha))$	$= (1 + \delta^2\varphi - (1 - \delta^2)\alpha; -\delta^2(\varphi + \alpha))$
$(x_F^{I^*}(M, B), x_W^{I^*}(M, B)) = \left(\frac{1}{1+\delta}, \frac{\delta}{1+\delta}\right)$	$(y_F^{I^*}(M, B), y_W^{I^*}(M, B)) = \left(\frac{\delta}{1+\delta}, \frac{1}{1+\delta}\right)$
$(x_F^{I^*}(M, R), x_W^{I^*}(M, R)) = (1 - \delta\varphi; \delta\varphi)$	$(y_F^{I^*}(M, R), y_W^{I^*}(M, R)) = (1 - \varphi; \varphi)$
$(x_F^{O^*}(M, B), x_W^{O^*}(M, B)) = \left(\frac{1}{1+\delta}, \frac{\delta}{1+\delta} - \alpha\right)$	$(y_F^{O^*}(M, B), y_W^{O^*}(M, B)) = \left(\frac{1}{1+\delta}, \frac{\delta}{1+\delta} - \alpha\right)$
$(x_F^{O^*}(M, R), x_W^{O^*}(M, R)) = (1 - \delta\varphi; \delta\varphi - \alpha)$	$(y_F^{O^*}(M, R), y_W^{O^*}(M, R)) = (1 - \delta\varphi; \delta\varphi - \alpha)$
$(x_F^{I^*}(L, B), x_W^{I^*}(L, B)) = \left(\frac{1}{1+\delta}, \frac{\delta}{1+\delta}\right)$	$(y_F^{I^*}(L, B), y_W^{I^*}(L, B)) = \left(\frac{\delta}{1+\delta}, \frac{1}{1+\delta}\right)$
$(x_F^{I^*}(L, R), x_W^{I^*}(L, R)) =$	$(y_F^{I^*}(L, R), y_W^{I^*}(L, R)) =$
$= (1 - \delta[\alpha + (1 - \delta)\varphi]; \delta[\alpha + (1 - \delta)\varphi])$	$= (1 - [\alpha + (1 - \delta)\varphi]; \alpha + (1 - \delta)\varphi)$
$(x_F^{O^*}(L, B), x_W^{O^*}(L, B)) = (1 - \alpha; 0)$	$(y_F^{O^*}(L, B), y_W^{O^*}(L, B)) = (1 - \alpha; 0)$
$(x_F^{O^*}(L, R), x_W^{O^*}(L, R)) = (1 - \alpha; 0)$	$(y_F^{O^*}(L, R), y_W^{O^*}(L, R)) = (1 - \alpha; 0)$

Table 2: Subgame perfect equilibrium proposals

Furthermore, the entrant receives his reservation wage<sup>11</sup>  $(-\frac{\delta^2}{1-\delta^2})$ , which makes him indifferent between remaining unemployed (receiving a zero payoff) and gaining employment in the current period, followed by insider employment thereafter. The reason the firm can drive the entrant's wage down to his reservation wage is that if an outsider were to claim a higher wage in the negotiations leading to an entrant job, then the firm would have an incentive to switch (costlessly) to another outsider as bargaining partner<sup>12</sup>.

When the firing cost is sufficiently low relative to the insider-entrant productivity differential, there is restricted entry to insiders' jobs. Then an insider who claimed the bilateral monopoly wage would be less profitable than an entrant; consequently the firm would have an incentive to replace that insider. The insider, knowing this, will claim a wage beneath the bilateral monopoly wage, but just high enough to make the firm indifferent between retaining and replacing him. This wage is  $\delta(1-\delta)(\varphi+\alpha)$ .

As above, the entrant receives his reservation wage. But since the insider receives less than the bilateral monopoly wage, this reservation wage will be higher than in the case of blockaded entry  $(-\delta^2(\varphi+\alpha))$ .

The parameter values which generate this scenario are depicted in Figure 3a, and can be derived from the equilibrium payoffs in Table 1 as follows. Since there is bonding, the profits generated by an insider,  $\Pi^I$ , are at least as great as the profits generated by an entrant,  $\Pi^O$ . By substituting the corresponding values from Table 1, under blockaded entry this requires  $\Pi^I = \frac{1}{1+\delta} \geq \frac{1}{1-\delta^2} - \alpha = \Pi^O$ , leading to  $\alpha \geq \frac{\delta}{1-\delta^2}$ . Moreover, notice that entry is blockaded when the profitability of the entrant,  $\Pi^O$ , does not exceed the cost that the firm has to bear to replace its insider for an entrant,  $\varphi$ . This requires<sup>13</sup>

<sup>11</sup>Since the insider receives a positive payoff, this reservation wage must be negative. This implausible result is merely an artifact of our assumption that outsiders receive a zero payoff. If for example we had instead assumed that an outsider received a sufficiently large positive unemployment benefit, the entrant's reservation wage would be positive. See Table 3 below.

<sup>12</sup>It is easy to show that if the firm had to pay a hiring cost each time it switched from one outsider to another, then any outsider negotiating with the firm would have some bargaining power, and consequently receive more than his reservation wage.

<sup>13</sup>The condition on the parameter values which determines whether entry is blockaded or restricted derives from the subgame perfection of the equilibrium strategies described in Proposition 1. According to its equilibrium strategy, under blockaded entry the firm never replaces its current insider with a new recruit when it has the opportunity to do so. Consider now a node off the equilibrium path, in which the firm has just rejected an offer by its insider: is it optimal for the firm to opt out? If the firm does not replace its insider, the game moves to the next period, in which - given their equilibrium strategies - the firm and its insider will reach an agreement which yields the firm a payoff of  $\Pi^I$ , and will keep sharing all future "pies" in the same fashion forever after. Thus, by not opting out the firm can receive a stream of payoffs whose sum in present discounted value is  $\frac{\delta\Pi^I}{1-\delta}$ . On the other hand, if the firm were to deviate from its equilibrium strategy, then by hiring another outsider the future stream of the firm's payoff would be  $\Pi^O - \varphi + \frac{\delta\Pi^I}{1-\delta}$ , which corresponds to the sum of the firm's share when hiring an outsider

$\Pi^O = \frac{1}{1-\delta^2} - \alpha \leq \varphi$ . The two inequalities yield the parameter values for the BV scenario under blockaded entry, and correspond to the area  $BV_B$  depicted in Figure 3.a.

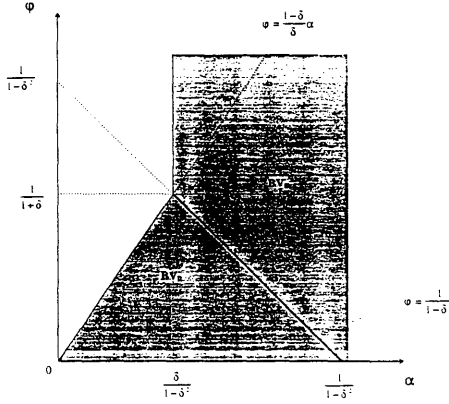


Figure 3a: "Bonding" and "voluntary unemployment"

By the same token, when entry is restricted the firm's insider is at least as profitable as an entrant as long as  $\Pi^I = 1 - \delta(1 - \delta)(\varphi + \alpha) \geq 1 + \delta^2\varphi - (1 - \delta^2)\alpha = \Pi^O$  (see Table 1), which can be rearranged to yield  $\alpha \geq \frac{\delta}{1-\delta}\varphi$ . Furthermore, under restricted entry  $\Pi^O > \varphi$ . This requires  $\Pi^O = 1 + \delta^2\varphi - (1 - \delta^2)\alpha > \varphi$ , which can be rearranged as  $\varphi < \frac{1}{1-\delta^2} - \alpha$ . This set of inequalities establishes the parameter values for the BV scenario with restricted entry, depicted as the  $BV.R$  in Figure 3.a.

Observe that labor turnover costs are sufficiently high so that entrants are never more profitable than insiders even though they are hired at the reservation wage, so that paying the entrants this reservation wage, which is well below the insider wage, does not undermine their opportunity of achieving insider status in the future.

In short, regardless of whether entry is blockaded or restricted, a high insider-entrant productivity differential, relative to the firing cost, leads to an insider-entrant wage differential that is less than this productivity differential, and thus the firm has an incentive to retain its entrant.

---

- net of the firing cost - and its stream of payoffs from the following period onwards, when this entrant turns into an insider and is allowed to renegotiate his wage. Thus, such deviation will not be profitable if  $\frac{\delta\Pi^I}{1-\delta} \geq \Pi^O - \varphi + \frac{\delta\Pi^I}{1-\delta}$ , which can be rearranged as  $\Pi^O - \varphi \leq 0$ .



### 3.d “Bonding” and “Involuntary unemployment”

Now consider the interplay between the firm’s negotiations with insiders and outsiders when the insider-entrant productivity differential falls in the “intermediate” range.<sup>14</sup>

**Proposition 2** *There is a unique subgame perfect equilibrium in which the firm retains an entrant hired at a wage above the reservation wage, such that:*

1. *If  $\alpha < \frac{\delta}{1-\delta^2}$  and  $\varphi \geq \frac{1}{1+\delta}$  (blockaded entry):*

(a) *the firm and the outsider immediately agree to share the revenue  $1 - \alpha$  such that the firm’s profit and the entrant’s wage are:*

$$\left( \frac{1}{1+\delta}; \frac{\delta}{1+\delta} - \alpha \right)$$

*respectively; and*

(b) *after one period the firm retains the entrant, who thus turns into an insider and immediately agrees to share the revenue 1 such that the firm’s profit and the insider’s wage are:*

$$\left( \frac{1}{1+\delta}; \frac{\delta}{1+\delta} \right)$$

*respectively.*

2. *If  $\alpha < \frac{\delta}{1-\delta}\varphi$  and  $\varphi < \frac{1}{1+\delta}$  (restricted entry):*

(a) *the firm and the outsider agree immediately to share the revenue  $1 - \alpha$  such that the firm’s profit and the entrant’s wage are:*

$$(1 - \delta\varphi; \delta\varphi - \alpha)$$

*respectively; and*

(b) *after one period the firm retains the entrant, who thus turns into an insider and immediately agrees to share the revenue 1 such that the firm’s profit and the insider’s wage are:*

$$(1 - \delta\varphi; \delta\varphi)$$

*respectively.*

---

<sup>14</sup>Strictly speaking, this is a misnomer since, as we shall see below, this area includes the range of “low” insider-entrant productivity differential.

**Proof:** See Appendix.

**Supporting strategies.** The strategies that support this equilibrium are as follows. Under blockaded entry ( $\alpha < \frac{\delta}{1-\delta^2}$  and  $\varphi \geq \frac{1}{1+\delta}$ ), the firm (a) offers the worker  $i$ ,  $i = I, O$ , a partition  $(x_F^{h*}(M, B), x_i^{h*}(M, B))$  of the available revenue, (b) accepts any proposed partition that yields at least  $y_F^{h*}(M, B)$  and rejects any proposal which yields less than  $y_F^{h*}(M, B)$ , (c) never fires the insider after rejecting his offer, (d) always turns to another outsider when rejecting one outsider's offer and (e) retains its entrant. Worker  $i$  (a) always proposes to the firm a partition  $(y_F^{h*}(M, B), y_i^{h*}(M, B))$ , (b) accepts any proposed partition that yields at least  $x_i^{h*}(M, B)$  and rejects any proposal which yields less than  $x_i^{h*}(M, B)$ . Under restricted entry ( $\alpha < \frac{\delta}{1-\delta}\varphi$  and  $\varphi < \frac{1}{1+\delta}$ ) the firm (a) proposes to worker  $i$  a partition  $(x_F^{h*}(M, B), x_i^{h*}(M, B))$  of the available revenue, (b) accepts any proposed partition that yields at least  $y_F^{h*}(M, R)$  and rejects any proposal which yields less than  $y_F^{h*}(M, R)$ , (c) always turns to an outsider after rejecting an offer by the insider, (d) always turns to another outsider when rejecting one outsider's offer and (e) retains its entrant. Worker  $i$  (a) always propose to the firm a partition  $(y_F^{h*}(M, R), y_i^{h*}(M, R))$ . (b) accepts any proposed partition that yields at least  $x_i^{h*}(M, R)$  and rejects any proposal which yields less than  $x_i^{h*}(M, R)$ .

The intuition underlying Proposition 2 is of particular interest, since it contains the basis for a microeconomic rationale for "involuntary" unemployment in the sense that, at the equilibrium insider and entrant wages, the outsiders would prefer to gain employment as entrants rather than remain unemployed. As in Proposition 1, if the firing cost ( $\varphi$ ) is sufficiently high, then the insider receives the bilateral monopoly wage ( $\frac{\delta}{1+\delta}$ ). But unlike Proposition 1, the entrant receives more than his reservation wage.

To understand why, observe that the entrant has a higher reservation wage when the firm is a "revolving door" than when it retains its entrant ("bonding"), or  $W^{rd} > W^b$ . The reason, clearly, is that when the firm is a revolving door, the entrant anticipates only one period of entrant employment, whereas when there is bonding, the entrant anticipates one period of entrant employment followed by insider employment in perpetuity. In Proposition 2, the insider-entrant productivity differential is sufficiently low ( $\alpha \leq \min[\frac{\delta}{1-\delta^2}, \frac{\delta}{1-\delta}\varphi]$ ) so that if the firm were to offer the entrant  $W^b$ , then the entrant would become more profitable than the insider, and consequently the firm would have an incentive to become a revolving door. But if the firm were a revolving door, it would have to offer the entrant the higher reservation wage  $W^{rd}$ . The only way for the firm to keep the reservation wage at  $W^b$  is to offer the entrant the minimum wage necessary to prevent the insider from

becoming less profitable than the entrant. But this minimum wage is greater than the reservation wage  $W^b$ . This implies that outsiders are “involuntarily unemployed”, in the sense that they prefer employment to being unemployed.

Furthermore, observe that in this case the insider-entrant productivity differential is absorbed by the entrant's wage; thus, the profitability to the firm from replacing one entrant with another is the same as the profitability from turning the entrant into an insider, so that the firm has no incentive to be a “revolving door”. In other words, the entrant is prepared to bear the cost  $\alpha$  in order to be retained in employment: by so doing, he ensures that he receives a wage above his reservation wage.

If the firing cost is low relative to  $\alpha$  then, as in Proposition 1, the insider claims less than the bilateral monopoly wage, so as not to induce the firm to replace him. This wage is  $\delta\varphi$ . Given this wage, the equilibrium entrant wage ( $\delta\varphi - \alpha$ ) is once again the one that makes the entrant just as profitable as the insider. Since the insider wage is now less than the one under blockaded entry, the entrant wage must be less than the one under blockaded entry as well.

The parameter values which bring about this scenario are graphed in Figure 3.b and can be easily retrieved proceeding as follows.

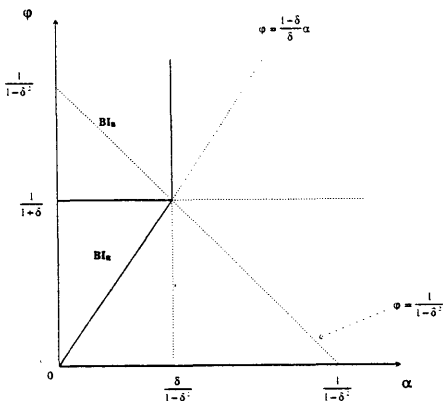


Figure 3b: “Bonding” and “involuntary unemployment”

First of all, recall from the discussion of Proposition 1 that blockaded entry occurs if  $\varphi \geq \Pi^O$ , whereas if  $\varphi < \Pi^O$  entry to insiders' jobs is only restricted. In order to retrieve the second condition on the parameter values<sup>15</sup>, notice that the entrant wage is adversely

<sup>15</sup>In this case it is not meaningful to confront  $\Pi^O$  and  $\Pi'$  in order to retrieve threshold values for the parameters, since in the equilibrium described by Proposition 2 insiders are always as profitable as outsiders, regardless of the values of  $\alpha$  and  $\varphi$ .

affected by the productivity differential, so that there might be values of  $\alpha$  which make it not worthy for an entrant to accept a job. Thus, an entrant will be persuaded to accept employment only if the present discounted value of his future wages (the entrant wage plus the insider wage from the following period onwards) is greater than what he could obtain if unemployed - which is just the null payoff. Consequently, what is required is that  $W^O + \delta \frac{W^I}{1-\delta} > 0$ <sup>16</sup>. Under blockaded entry, the two conditions become  $\varphi \geq \Pi^O = \frac{1}{1+\delta}$  and  $W^O + \delta \frac{W^I}{1-\delta} = \frac{\delta}{1+\delta} - \alpha + \frac{\delta^2}{1-\delta^2} > 0$ , which we can rearrange as  $\alpha < \frac{\delta}{1-\delta^2}$ . These two inequalities are represented as the area  $BI_B$  in Figure 3.b.

When entry is only restricted, then the above conditions become  $\varphi < \Pi^O = 1 - \delta\varphi$ , or  $\varphi < \frac{1}{1+\delta}$ ; and  $W^O + \delta \frac{W^I}{1-\delta} = \delta\varphi - \alpha + \frac{\delta^2\varphi}{1-\delta} > 0$ , which can be rearranged to yield  $\alpha < \frac{\delta}{1-\delta}\varphi$ . Fulfilment of these inequalities is represented as the area  $BI_R$  in Figure 3.b.

Observe that in moving from the case of blockaded entry to that of restricted entry, the equilibrium insider wages fall in both Propositions 1 and 2, but the equilibrium entrant wages move in opposite directions. The reason that when the insider wage falls in Proposition 1, the entrant wage rises, is that the entrant wage is equal to the reservation wage. However when the insider wage falls in Proposition 2, the entrant wage falls as well, since this wage is meant to preserve the equality between the insider's and entrant's profitability.

### 3.e “Revolving doors” and “voluntary unemployment”

The final proposition describes the bargaining outcomes when the firm has an incentive to be a revolving door.

**Proposition 3** *There is a unique subgame perfect equilibrium in which the firm never retains an entrant hired at the reservation wage, such that when either:*

1.  $\alpha < \frac{\delta}{1+\delta}$  and  $\varphi \geq \frac{1}{1-\delta^2} - \frac{\alpha}{1-\delta}$ , or:
2.  $\alpha < \delta\varphi$  and  $\varphi < \frac{1}{1-\delta^2} - \frac{\alpha}{1-\delta}$ ,

*regardless of whether entry to insider's jobs is blockaded or restricted, the firm and the outsider agree immediately on sharing the revenue  $1 - \alpha$  such that the firm's profit and the entrant's wage are:*

$$(1 - \alpha; 0)$$

---

<sup>16</sup>Proposition 2 focuses on the case where the entrant's lifetime earnings are strictly positive; the case where the outsider is indifferent between employment and unemployment is taken care of by Proposition 1.

*In the following round, the firm always fires the entrant.*

**Proof:** See Appendix.

**Supporting strategies.** Although the agreement that is struck with the outsider in the “revolving door” equilibrium is independent on whether entry to insider’s jobs is blockaded or restricted, the strategies that support such equilibrium have to specify the outcomes off the equilibrium path, and therefore depend on the size of  $\varphi$  relative to  $\alpha$ . In fact the firing cost would influence the outcome of negotiations between the firm and an insider, if the firm ever were to retain an entrant and allow him to recontract his wage. Hence under blockaded entry ( $\varphi \geq \frac{1}{1-\delta^2} - \frac{\alpha}{1-\delta}$  when  $\alpha < \frac{\delta}{1+\delta}$ ), the firm (a) offers the worker  $i$ ,  $i = I, O$ , a partition  $(x_F^{h*}(L, B), x_i^{h*}(L, B))$  of the available revenue, (b) accepts any proposed partition that yields at least  $y_F^{h*}(L, B)$  and rejects any proposal which yields less than  $y_F^{h*}(L, B)$ , (c) never fires the insider after rejecting his offer. (d) always turns to another outsider when rejecting one outsider’s offer and (e) always fires its entrant. Worker  $i$  (a) always proposes to the firm a partition  $(y_F^{h*}(L, B), y_i^{h*}(L, B))$ , (b) accepts any proposed partition that yields at least  $x_i^{h*}(L, B)$  and rejects any proposal which yields less than  $x_i^{h*}(L, B)$ . Under restricted entry ( $\varphi < \frac{1}{1-\delta^2} - \frac{\alpha}{1-\delta}$  when  $\alpha < \delta\varphi$ ) the firm (a) proposes to worker  $i$  a partition  $(x_F^{h*}(L, R), x_i^{h*}(L, R))$  of the available revenue, (b) accepts any proposed partition that yields at least  $y_F^{h*}(L, R)$  and rejects any proposal which yields less than  $y_F^{h*}(L, R)$ , (c) always turns to an outsider after rejecting an offer by the insider, (d) always turns to another outsider when rejecting one outsider’s offer and (e) always fires its entrant. Worker  $i$  (a) always propose to the firm a partition  $(y_F^{h*}(L, R), y_i^{h*}(L, R))$ , (b) accepts any proposed partition that yields at least  $x_i^{h*}(L, R)$  and rejects any proposal which yields less than  $x_i^{h*}(L, R)$ .

Intuitively this proposition is a straightforward counterpart of Proposition 1. In contrast to Proposition 1, where the profitability of an insider is greater than the profitability of an entrant (even though the entrants receive the “low” reservation wage  $W^b$ ), the “revolving door” equilibrium described in Proposition 3 deals with the case where entrants are more profitable than the insiders (even though the entrants receive the “high” reservation wage  $W^{rd}$ ). It is on this account that the firm becomes a revolving door, hiring only entrants, who each generate the revenue  $1 - \alpha$ . Here the firm can capture all the available economic rent, because if the outsider claimed a wage in excess of his reservation wage in the negotiations leading to an entrant job, the firm would find it worthwhile to switch costlessly to another outsider. Consequently, the entrant’s wage is zero, and the firm profit per entrant is  $1 - \alpha$ .

The values of  $\alpha$  and  $\varphi$  which generate this scenario are depicted in Figure 3.c. The fact that the firm is of the revolving door type requires  $\Pi^I < \Pi^O$ , which allows us to retrieve the values of the insider-entrant productivity differential which trigger this scenario. Next, observe that subgame perfection of the equilibrium strategies requires that entry is blockaded if the stream of payoffs which accrue to the firm when negotiating with its insider exceeds those from replacing its insider with a new recruit. Consider a stage of the bargaining game in which the firm has to decide whether or not to replace its incumbent employee. If the firm decides to pay the firing cost and substitute the insider with an outsider, the sum of its future payoffs in present discounted value is given by  $\Pi^O - \varphi + \frac{\delta\Pi^O}{1-\delta} = \frac{\Pi^O}{1-\delta} - \varphi$ . On the other hand, if the firm decides not to replace its insider, the game moves to the following stage, where the firm and the insider - given their equilibrium strategies - settle on an agreement which yields the firm  $\Pi^I$  forever after, or  $\frac{\delta\Pi^I}{1-\delta}$ . Consequently, entry is blockaded if  $\frac{\delta\Pi^I}{1-\delta} \geq \frac{\Pi^O}{1-\delta} - \varphi$ , which can be rearranged as  $\varphi \geq \frac{\Pi^O - \delta\Pi^I}{1-\delta}$ . By substituting the equilibrium payoffs from Table 1 it is straightforward to verify that the RDV scenario under blockaded entry arises if  $\Pi^I = \frac{1}{1+\delta} < 1 - \alpha = \Pi^O$ , or  $\alpha < \frac{\delta}{1+\delta}$ ; and  $\varphi \geq \frac{1}{1-\delta}(\Pi^O - \delta\Pi^I) = \frac{1}{1-\delta}(1 - \alpha - \frac{\delta}{1+\delta})$ , or  $\varphi \geq \frac{1}{1-\delta^2} - \frac{\alpha}{1-\delta}$ . These inequalities define the area  $RDV_B$  depicted in Figure 3.c.

Alternatively, restricted entry requires  $\Pi^I = 1 - \delta[\alpha + (1 - \delta)\varphi] < 1 - \alpha = \Pi^O$ , or  $\alpha < \delta\varphi$ ; and  $\varphi < \frac{1}{1-\delta}(\Pi^O - \delta\Pi^I) = \frac{1}{1-\delta}\{1 - \alpha - \delta + \delta^2[\alpha + (1 - \delta)\varphi]\}$ , or  $\varphi < \frac{1}{1-\delta^2} - \frac{\alpha}{1-\delta}$ . This situation is depicted as the area  $RDV_R$  in Figure 3.c.

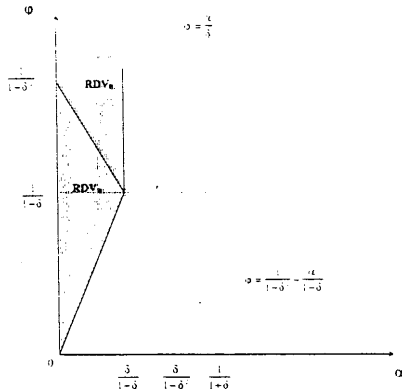


Figure 3c: "Revolving doors" and "voluntary unemployment"

Notice that the parameter values which define Proposition 3 are compatible also with the equilibrium described in Proposition 2: thus, for this range of the labor turnover costs,

there are two patterns of behavior. In one - the case of “bonding norms” (which we will call “Japanese case” for short) - the entrant compensates the firm for the insider-entrant productivity differential by accepting a correspondingly lower wage. The entrant is willing to do this because he knows that he will be retained by the firm; thus, in spite of the fact that their wage is reduced by an amount  $\alpha$ , entrants manage to be hired at a wage which lies above their reservation wage. In the other equilibrium - where there are no “bonding norms” (which we will call the “US case”) - the strategies of the firm and the workers are such that it is optimal for the firm to fire its entrants before they turn into insiders. The employees are consequently not prepared to absorb  $\alpha$  in the form of lower wages; instead, they are hired at their “revolving door” reservation wage, and the firm captures all the rent.

### 3.f Summary

The results are brought together in Figure 3 and may be summarized as follows:

- When the firing cost is “high” relative to the insider-entrant productivity differential, entry is blockaded and the insider wage is the outcome of a bilateral monopoly problem; whereas when the firing cost is “low”, entry is restricted and thus the insider wage depends on the entrant wage and vice versa.
- When the insider-entrant productivity differential is “high” there is bonding, since this differential makes the insider at least as profitable as an entrant even though the entrant receives the (low) bonding reservation wage  $W^b$ .
- By contrast, when the insider-entrant productivity differential is “low”, the firm is a revolving door, since this differential makes the entrant at least as profitable as an insider even though the entrant receives the (high) revolving-door reservation wage  $W^{rd}$ .
- But when the insider-entrant productivity differential lies in the “intermediate” range, insiders are just as profitable as entrants. Although there is bonding, the entrant receives more than the bonding reservation wage  $W^b$ . The reason is that at the entrant wage  $W^b$ , the entrant would be more profitable than the insider; thus the firm would become a revolving door and as result the entrant’s reservation wage would rise to the revolving-door reservation wage  $W^{rd}$ . By implication, the outsiders are “involuntarily unemployed”.

## 4 Extensions of the results

We now extend the model above in a few simple ways to examine the effect of productivity, unemployment benefits, and training costs on equilibrium wages. Specifically, we consider a model in which (a) each insider's productivity is a positive constant  $\gamma$  and each entrant's productivity is  $\gamma - \alpha$  (with  $\gamma \geq \alpha$ ), (b) each unemployed worker receives an unemployment benefit  $\beta$  per period when he is out of work, and (c) each entrant is trained by the firm at a cost  $\tau$  (a constant), with  $\alpha, \beta, \tau \in [0, \gamma]$ .

In this extended model the labor turnover costs can be shown to generate three wage determination scenarios analogous to those identified above, which we now denote as **BV'** ("bonding" and "voluntary unemployment"), **BI'** ("bonding" and "involuntary unemployment") and **RDV'** ("revolving door" and "voluntary unemployment"). The equilibrium wages in the three scenarios<sup>1</sup> are given in Table 3. The parameter values which define the three scenarios now depend on the insider's productivity ( $\gamma$ ), the unemployment benefit ( $\beta$ ), and the training cost ( $\tau$ ), in addition to the firing cost ( $\varphi$ ) and the productivity differential ( $\alpha$ ):

**BV'**: "Bonding" and "Voluntary unemployment": Here incumbent workers are at least as profitable as new recruits, and consequently the firm retains the entrants hired in the previous period. It can be shown that:

- when  $\alpha \geq \frac{\delta}{1-\delta^2}\gamma - \tau - \frac{\beta}{1-\delta}$  and  $\varphi \geq \frac{1}{1-\delta^2}\gamma - \alpha - \tau - \frac{\beta}{1-\delta}$ , entry to insiders' jobs is blockaded;
- when  $\alpha \geq \frac{\delta}{1-\delta}\varphi - \tau - \frac{\beta}{1-\delta}$  and  $\varphi < \frac{1}{1-\delta^2}\gamma - \alpha - \tau - \frac{\beta}{1-\delta}$ , entry to insiders' jobs is restricted;

As in the **BV** scenario, entrants receive their reservation wage, for if they were to claim a higher wage, the firm would switch to other job seekers. However, the reservation wage is now positively related to unemployment benefits, and when  $\beta$  is sufficiently high, the entrant wage is positive.

**BI'**: "Bonding" and "Involuntary unemployment": Here entrants are retained and are as profitable as insiders. It can be shown that:

- when  $\alpha < \frac{\delta}{1-\delta^2}\gamma - \tau - \frac{\beta}{1-\delta}$  and  $\varphi \geq \frac{\gamma}{1+\delta}$ , entry to insiders' jobs is blockaded;

---

<sup>1</sup>We do not derive the full solution of the game in this modified setting. However, it is straightforward to extend the proof of propositions 1 to 3 to amend the subgame perfect equilibrium partitions presented in Table 2. Notice that if we let  $\gamma = 1$  and  $\tau = \beta = 0$ , this model reduces to the original model.



		Entry to insiders' jobs			
		B		R	
BV'	$\Pi^I = \frac{1}{1+\delta}\gamma$	$W^I = \frac{\delta}{1+\delta}\gamma$	$\Pi^I = \gamma - \delta[\beta + (1 - \delta)(\varphi + \alpha + \tau)]$	$W^I = \delta[\beta + (1 - \delta)(\varphi + \alpha + \tau)]$	
	$\Pi^O = \frac{1}{1-\delta^2}\gamma - \alpha - \tau - \frac{\beta}{1-\delta}$	$W^O = -\frac{\delta^2}{1-\delta^2}\gamma + \frac{\beta}{1-\delta}$	$\Pi^O = \gamma + \delta^2\varphi - (1 - \delta^2)(\alpha + \tau) - (1 + \delta)\beta$	$W^O = -\delta^2(\varphi + \alpha + \tau)\gamma + (1 + \delta)\beta$	
BI'	$\Pi^I = \frac{1}{1+\delta}\gamma$	$W^I = \frac{\delta}{1+\delta}\gamma$	$\Pi^I = \gamma - \delta\varphi$	$W^I = \delta\varphi$	
	$\Pi^O = \frac{1}{1+\delta}\gamma$	$W^O = \frac{\delta}{1+\delta}\gamma - \alpha - \tau$	$\Pi^O = \gamma - \delta\varphi$	$W^O = \delta\varphi - \alpha - \tau$	
RDV'	$\Pi^I = \frac{1}{1+\delta}\gamma$	$W^I = \frac{\delta}{1+\delta}\gamma$	$\Pi^I = \gamma - \delta[\alpha + \tau + (1 - \delta)\varphi + \beta]$	$W^I = \delta[\alpha + \tau + (1 - \delta)\varphi + \beta]$	
	$\Pi^O = \gamma - \alpha - \tau - \beta$	$W^O = \beta$	$\Pi^O = \gamma - \alpha - \tau - \beta$	$W^O = \beta$	

The above table reports the equilibrium payoffs to the firm ( $\Pi$ ) and the worker ( $W$ ) in both negotiations between the firm and the insider  $I$  (over a “pie” of size  $\gamma$ ), and between the firm and the outsider,  $O$  (over a “pie” of size  $\gamma - \alpha$ ). Labor turnover costs determine the “regime” of wage negotiations, either “bonding” an “voluntary unemployment” ( $BV'$ ), “bonding” and “involuntary unemployment” ( $BI'$ ) or “revolving doors” and “voluntary unemployment” ( $RDV'$ ); the firing cost  $\varphi$  relative to the insider-entrant productivity differential “blocks” entry to insider’s jobs ( $B$ ) or “restricts” it ( $R$ ).

Table 3: Equilibrium payoffs for the firm and the workers in the modified game.

- when  $\alpha < \frac{\delta}{1-\delta}\varphi - \tau - \frac{\beta}{1-\delta}$  and  $\varphi < \frac{1}{1-\delta}\gamma$ , entry to insiders' jobs is restricted;

**RDV': "Revolving doors" and "Voluntary unemployment":** Here the firm keeps replacing entrants with new recruits, since the entrants are more profitable than insiders, even though the entrants receive the (high) revolving door reservation wage. It can be shown that:

- when  $\alpha < \frac{\delta}{1-\delta}\gamma - \tau - \beta$  and  $\varphi \geq \frac{1}{1-\delta^2}\gamma - \frac{\alpha+\tau+\beta}{1-\delta}$ , entry to insiders' jobs is blocked;
- when  $\alpha < \delta\varphi - \tau - \beta$  and  $\varphi < \frac{1}{1-\delta^2}\gamma - \frac{\alpha+\tau+\beta}{1-\delta}$ , entry to insiders' jobs is restricted.

As in the original model, the parameter values in this more general setting allow for both a "Japanese case" and an "US case" to arise as alternative equilibria; thus, there are values of labor turnover costs such that life-long contracts or a repetition of short term employment contracts can be sustained in equilibrium.

## 5 Concluding remarks.

Our conclusions differ markedly from some central results of the conventional wage bargaining theories in labor economics. First, in contrast to the conventional theories, labor turnover costs in our analysis do not just affect the outside options or the fall-back positions of the negotiators, but influence the nature of the bargaining process itself. We have seen that the different labor turnover costs considered here, such as the firing cost and the insider-entrant productivity differential, play quite different roles in this respect.

Second, whereas the conventional strategic account of the wage bargaining process has an axiomatic counterpart, our theory does not. The seminal contribution of Binmore (1987) and Binmore, Rubinstein, and Wolinsky (1986) shows that as the time interval between offers and counter-offers in the (suitably modified) strategic bargaining process shrinks to zero, the strategic bargaining outcome approaches the Nash bargaining outcome. It is easy to verify that this is not necessarily the case in our model.

The basic reason for this difference is that in our analysis labor turnover costs determine the relationship between the firm's bargain with its insider and that with outsiders, whereas the standard Nash bargaining problems are specified exclusively in terms of a single bargain in which the external environment is depicted entirely in terms of outside options and fall-back positions, which are usually taken to be exogenously given<sup>18</sup>.

<sup>18</sup>However in Osborne (1988), for example, the firm's fall-back position is endogenous, and its value is given by the outcome of a bargain with a varying number of members of a union. A more recent

However, even if one amends the bargaining problem by endogenizing the alternative bargains available to the firm, it is not possible to retrieve the whole set of outcomes derived in our analysis. Specifically, the cooperative approach to bargaining cannot capture the “bonding” and “involuntary unemployment” case (BI) analyzed in Proposition 2, since such setting does not consider the dynamic interactions between the firm’s bargaining with its entrants and insiders.

Third, our theory provides a new game-theoretic view of the role of labor turnover costs in wage bargaining and their implications for unemployment. In contrast to Shaked and Sutton (1984), who view labor turnover costs in terms of the time span over which the employer and employee are committed to bargain with each other, our theory covers various labor turnover costs that do not hinge on such a temporal commitment. Our theory explains how employees may be able to achieve bargaining power on account of monetary costs of labor turnover and insider-entrant productivity differentials.

Fourth, in contrast to other strategic theories of wage bargaining, our theory reflects the common observation that workers often have little if any bargaining power when they enter the firm, but may accumulate substantial power after a period of job tenure. Many models of involuntary unemployment (e.g. Shaked and Sutton (1984)) ignore this observation by assuming that insiders and entrants face identical bargaining conditions and receive identical wages. In fact, it is on the basis of this assumption that unemployment becomes voluntary in these models. In our analysis, by contrast, involuntary unemployment may arise even though outsiders have no bargaining power in wage negotiations.

In examining the fundamental role of labor turnover costs in structuring the wage bargaining process, our analysis delivers a new theory of wage determination. Our contention is that most wage bargaining theories thus far have been significantly incomplete, in that they provide no account of employees’ bargaining power in terms of the firm’s labor turnover costs. We have argued that labor turnover costs are a fundamental source of this bargaining power and our analysis shows how these costs determine the degree of competition between insiders and outsiders.

## References

K. Binmore, A. Rubinstein, and A. Wolinsky. “The Nash Bargaining Solution in Economic contribution on the same lines is Stole and Zwiebel (1996b) and Stole and Zwiebel (1996a). Notice that such models have a rather different perspective from ours, since they consider bargains between a firm and a “composite opponent” (typically a union), focusing on the size of its membership.

- Modelling". *Rand Journal of Economics*, 17:176–188, 1986.
- K. Binmore, A. Shaked, and J. Sutton. "An Outside Option Experiment". *Quarterly Journal of Economics*, 104:753–770, 1989.
- K. Binmore. Nash bargaining theory ii. In K. Binmore and P. Dasgupta, editors, *The Economics of Bargaining*. Blackwell, Oxford, 1987.
- R. Fernandez and J. Glazer. "Striking for a Bargain Between Two Completely Informed Agents". *American Economic Review*, 81:240–252, 1991.
- H. Haller and S. Holden. "A Letter to the Editor on Wage Bargaining". *Journal of Economic Theory*, 52:232–236, 1991.
- S. Holden. "Bargaining and Commitment in a Permanent Relationship". *Games and Economic Behaviour*, 7:169–176, 1994.
- R. Layard, S. Nickell, and R. Jackman. *Unemployment: Macroeconomic Performance and the Labour Market*. Oxford University Press, Oxford, 1991.
- A. Lindbeck and D. J. Snower. *The Insider-Outsider Theory*. MIT Press, Cambridge, Massachusetts, 1988.
- I. McDonald and R. M. Solow. "Wage Bargaining and Employment". *American Economic Review*, 71(5):896–908, 1981.
- J. F. Nash. "The Bargaining Problem". *Econometrica*, 18:155–162, 1950.
- J. F. Nash. "Two-Person Cooperative Games". *Econometrica*, 21:128–140, 1953.
- M. Osborne. "Capitalist-Worker Conflict and Involuntary Unemployment". *Review of Economic Studies*, 51:111–127, 1988.
- A. Rubinstein. "Perfect Equilibrium in a Bargaining Model". *Econometrica*, 50:97–109, 1982.
- H. Sabourian. "Wage Norms and Involuntary Unemployment". *Economic Journal*, 90:177–188, 1988.
- A. Shaked and J. Sutton. "Involuntary Unemployment as a Perfect Equilibrium in a Bargaining Model". *Econometrica*, 52:1351–1364, 1984.
- L.A. Stole and J. Zwiebel. "Intra-firm Bargaining under Non-binding Contracts". *Review of Economic Studies*, 63:375–410, 1996a.
- L.A. Stole and J. Zwiebel. "Organizational Design and Technology Choice under Intrafirm Bargaining". *American Economic Review*, 86:195–222, 1996b.

## Appendix

**Proof of Propositions 1, 2 and 3.** The three propositions describe the solution to the game. Checking for subgame perfection by the one step deviation property is straightforward, thus is omitted. Next, since the strategies described in the Propositions constitute a subgame perfect equilibrium (S.P.E.) in stationary strategies (and with immediate agreement), we show that such S.P.E. is unique.

### Uniqueness

The proof follows closely Shaked and Sutton (1984).

We notice that all subgames of the same kind starting with an offer by the firm are homeomorphic, as all subgames starting with an offer by the worker; however the identity of the workers called in the bargaining may change depending on the branch of the game tree, which of course will matter in terms of payoff to the specific worker involved in any particular subgame. Bearing this in mind, and recalling that we assumed symmetric strategies (that is, all workers of a specific type adopt the same strategy), let  $M_i^j$  and  $m_i^j$  be the supremum and the infimum payoffs, respectively, for player  $i$  (with  $i = W, F$ )<sup>19</sup> in any subgame perfect equilibrium of subgames of type  $G_i^j$  ( $j = I, O$ ) where player  $i$  is the first mover. Moreover, let  $A, a$ , respectively, be the supremum and infimum of the sum of total payoffs in present discounted value which accrue to the firm in subgames of type  $G^{E20}$ . Then:

### Subgames of type $G_i^I$

1.  $\frac{m_F^I}{1-\delta} \geq \frac{1}{1-\delta} - \frac{\delta M_W^I}{1-\delta}$ : the infimum the firm can get is at least  $1 - \delta M_W^I$  from the date of the agreement onwards, or more if the worker doesn't manage to attain his supremum payoff;
2.  $\frac{M_W^I}{1-\delta} \leq \frac{1}{1-\delta} - \max \left[ \frac{\delta m_F^I}{1-\delta}, m_F^O - \varphi + g\delta a \right]$ , where  $g$  is a variable which takes value 1 if an agreement is reached in a subgame of type  $G_i^O$  and 0 otherwise. Consider the case when the worker is the first mover. If the outside option is relevant to the firm, then in order to have the firm accept his proposal, the insider will have to offer the firm at least the (infimum) value its outside option can take, that is  $m_F^O - \varphi + g\delta a$ . On the other hand, if the outside option is not relevant for the firm, the insider will have to give the firm at least the present discounted value of the (infimum) payoff the firm could attain in the following subgame, in which the firm is first mover,  $\frac{\delta m_F^I}{1-\delta}$ .

<sup>19</sup> In what follows we keep the same index  $W$  for all types of workers for notational simplicity.

<sup>20</sup>Here no subscript index is needed, since a subgame of type  $G^E$  starts with the decision problem of the firm alone.

This implies that  $\frac{M_W^I}{1-\delta} \leq \frac{1}{1-\delta} - \frac{\delta m_F^I}{1-\delta}$ . Since the firm's decision whether or not to opt out depends on what is greater between  $\frac{\delta m_F^I}{1-\delta}$  and  $m_F^O - \varphi + g\delta a$ , the above follows.

By the same token, one obtains the following:

3.  $\frac{m_W^I}{1-\delta} \geq \frac{1}{1-\delta} - \max \left[ \frac{\delta M_F^I}{1-\delta}, M_F^O - \varphi + g\delta A \right]$  and  $\frac{M_F^I}{1-\delta} \leq \frac{1}{1-\delta} - \frac{\delta m_W^I}{1-\delta}$ ;
4. If  $\frac{\delta m_F^I}{1-\delta} \geq m_F^O - \varphi + g\delta a$ , then:  $M_W^I \leq \frac{1}{1+\delta} \leq m_F^I$ . If the outside option is not relevant to the firm in a bargain with an outsider, then the expression in **2.** reduces to:  $\frac{M_W^I}{1-\delta} \leq \frac{1}{1-\delta} - \frac{\delta m_F^I}{1-\delta}$  which we can couple with that *sub 1.* to obtain our claim: in a similar way one can show:
5. If  $\frac{\delta M_F^I}{1-\delta} \geq M_F^O - \varphi + g\delta A$ , then:  $M_F^I \leq \frac{1}{1+\delta} \leq m_W^I$ . Since by hypothesis  $M_i^I \geq m_i^I$  it follows that whenever labor turnover costs are sufficiently high to make the outside option unattractive to the firm, there is a unique subgame perfect equilibrium agreement between the two parties:  $M_F^I = \frac{1}{1+\delta} = m_F^I$  and  $M_W^I = \frac{1}{1+\delta} = m_W^I$ . We now need investigate what happens when the outside option is indeed relevant in bargains between the firm and its insider.
6. If  $\frac{\delta M_F^I}{1-\delta} < M_F^O - \varphi + g\delta A$ , then  $\frac{M_W^I}{1-\delta} \leq \frac{1}{1-\delta} - m_F^O + \varphi - g\delta a \Rightarrow \frac{m_F^I}{1-\delta} \geq \frac{1}{1-\delta} - \delta \left( \frac{1}{1-\delta} - m_F^O + \varphi - g\delta a \right)$ , and analogously, by straightforward substitution, one can show that:
7. If  $\frac{\delta m_F^I}{1-\delta} < m_F^O - \varphi + g\delta a$ , then  $\frac{m_W^I}{1-\delta} \leq \frac{1}{1-\delta} - M_F^O + \varphi - g\delta A$ , which implies that  $\frac{M_F^I}{1-\delta} \geq \frac{1}{1-\delta} - \delta \left( \frac{1}{1-\delta} - M_F^O + \varphi - g\delta A \right)$ . However, so far it is still not possible to determine a threshold level of labor turnover costs above which the outside option becomes profitable for the firm: it is first needed to examine the other two types of subgames.

#### Subgames of type $G^E$

8. If  $\frac{m_F^I}{1-\delta} \geq m_F^O + g\delta a$ , then  $a = \frac{m_F^I}{1-\delta}$ , whereas if  $\frac{m_F^I}{1-\delta} < m_F^O + g\delta a$ , then  $a = \frac{m_F^O}{1-\delta}$ .

At the beginning of a subgame of type  $G^E$  the firm has to choose whether or not to fire its entrant. If it decides to keep him and to allow him to turn into an insider, then the firm can obtain at least  $\frac{m_F^I}{1-\delta}$ , whereas if the firm decides to replace him with a new recruit, its infimum payoff is  $m_F^O$  for that period (out of a cake of size just  $1 - \alpha$ ), and then, if and after reaching an agreement with the outsider, it would enter again a subgame like  $G^E$ . Hence,  $a = \max \left[ \frac{m_F^I}{1-\delta}, m_F^O + g\delta a \right]$ , from which the above follows. Notice that in subgames of type  $G^E$ , if an action (keeping the current employment or switching bargaining partner) is considered optimal once, then it is

always optimal in all other subgames of that type. In the same manner one can show the following:

9. If  $\frac{M_F^I}{1-\delta} \geq M_F^O + g\delta A$ , then  $A = \frac{M_F^I}{1-\delta}$ , whereas if  $\frac{M_F^I}{1-\delta} < M_F^O + g\delta A$ , then  $A = \frac{M_F^O}{1-\delta}$ , which comes from the fact that  $A = \max \left[ \frac{M_F^I}{1-\delta}, M_F^O + g\delta A \right]$ .

Subgames of type  $G_F^O$

10.  $m_F^O + g\delta a \geq k \left( \frac{1}{1-\delta} - \alpha \right) + (1-k) \left( \frac{1-\alpha}{1-\delta} \right) - \delta \left\{ k \left[ M_W^O + \frac{g\delta(1-m_F^I)}{1-\delta} \right] + (1-k) \left( \frac{M_W^O}{1-\delta} \right) \right\}$ .

The infimum payoff the firm can achieve in a subgame  $G_F^O$  is the infimum payoff from an agreement with the outsider plus the infimum of the stream of future payoffs it can obtain in the following subgame  $G^E$ , conditional on a settlement being agreed, which explains the left hand side of the above inequality. In order for its proposal to be accepted by the worker, such infimum payoff will have to be no less than what is left of the discounted sum of all profits that can be generated over time net of the most the worker can claim in the following round. Here, then, we can have two alternative cases. Suppose that  $\frac{m_F^I}{1-\delta} \geq m_F^O + g\delta a \Rightarrow a = \frac{m_F^I}{1-\delta}$ . Then, we can rearrange the inequality as  $m_F^I \geq m_F^O$ . In this case the outsider knows that once hired the firm will be prepared to keep him in the following round, turning him into an insider. However, we need to distinguish further between the case in which this condition holds with equality, and the case where it does not. If the latter, the most the outsider can obtain in subgames in which he is a proposer is his supremum payoff plus what it could get afterwards - conditional on an agreement being reached - in a subgame of type  $G^E$ , that is,  $M_W^O + \frac{g\delta(1-m_F^I)}{1-\delta}$ . Alternatively, the value of the infimum payoff to the firm when bargaining with an outsider is going to be exactly equal to the infimum payoff when bargaining with an insider, since otherwise the firm would not retain the entrant; hence  $m_F^O = m_F^I$ .

On the other hand, if  $\frac{m_F^I}{1-\delta} < m_F^O + g\delta a \Rightarrow a = \frac{m_F^O}{1-\delta}$ , the outsider anticipates that if hired, he will be laid off in the subsequent period (the firm is a “revolving door”), so that he will be prepared to bargain only over one period profits; however from the point of view of the firm, it will have to forego  $M_W^O$  in each of the following (infinite) rounds, that is  $\frac{M_W^O}{1-\delta}$ .

If we let  $k$  be a variable which takes value 1 in case of bonding between the worker and the firm and value 0 in case of short term agreement, the above follows.

11.  $M_W^O \leq 1 - \alpha - m_F^O$ . To start with, it is worth recalling that after any proposal from the worker, the firm can choose between moving to the following round, in which it is its turn to make a proposal, and opting out and start another bargain with

another outsider (being again the first mover). In both cases the firm acquires the right to make an offer, finding itself at the beginning of two identical subgames: however by opting out it does not need wait until the following period, so that opting out is always optimal. Hence the above comes as a reduction of  $M_W^O \leq 1 - \alpha - \max \{m_F^O, \delta m_F^O\}$ .

Consider now the “revolving door” outsider; in order for his proposal to be accepted, he will have to offer the firm at least the infimum it could get if it were to disagree and opt out, that is  $1 - \alpha - m_F^O$  (since his bargaining objective is how to share just one period profits). Next, let us turn to the “long run” outsider. Since he anticipates that the firm is going to keep him as an insider - conditional on an agreement being reached -, his supremum payoff will be given by the sum of the most he can get in the present agreement and of what the firm will concede in the subsequent subgames of type  $G_F^I$  and from then onwards, that is  $M_W^O + \frac{\delta(1-m_F^I)}{1-\delta}$ . Such supremum payoff will be no more than the discounted sum of all future profits net of the infimum payoff the firm could obtain by opting out, that is its share of profits for that round plus the present discounted value of the continuation game,  $\delta A$ . However the outsider will be prepared to bargain over the infinite time horizon only if the firm has no incentive to deviate at the beginning of the subsequent subgame  $G^E$ , that is if:

$$\frac{m_F^I}{1-\delta} \geq m_F^O + g\delta a \Rightarrow \frac{m_F^I}{1-\delta} \geq m_F^O + g \frac{\delta m_F^I}{1-\delta} \Rightarrow g = 1 \Rightarrow m_F^O \leq m_F^I,$$

which will be true either if the above inequality holds, or else, if the firm decides to concede on a wage  $m_F^O = m_F^I$ . Therefore the supremum payoff to the worker is:  $M_W^O + \frac{\delta(1-m_F^I)}{1-\delta} \leq \frac{1-\alpha}{1-\delta} - \alpha - \left(m_F^O + \frac{\delta m_F^I}{1-\delta}\right)$  which can be rearranged as  $M_W^O \leq 1 - \alpha - m_F^O$ . Hence, in both the “long run” and the “short run” case we have the same behavior, and **11.** follows. Proceeding in a similar way, but this time substituting supremum for infimum and *viceversa* one can show that the following holds:

12.  $M_F^O + g\delta A \leq k \left( \frac{1-\alpha}{1-\delta} - \alpha \right) + (1-k) \left( \frac{1-\alpha}{1-\delta} \right) - \delta \left\{ k \left[ m_W^O + \frac{g\delta(1-M_F^I)}{1-\delta} \right] + (1-k) \left( \frac{m_W^O}{1-\delta} \right) \right\}$   
and  $m_W^O \geq 1 - \alpha - M_F^O$ . At this point we can analyze what happens in the various cases.

13. *revolving door case*:  $k = 0$ . Then,  $A = \frac{M_F^O}{1-\delta}$  and  $a = \frac{m_F^O}{1-\delta}$ . Equations *sub 10.* and **11.** reduce to  $M_W^O \leq 1 - \alpha - m_F^O$  and:

$$m_F^O + g\delta a \geq \frac{1-\alpha}{1-\delta} - \delta \left( \frac{M_W^O}{1-\delta} \right) \Rightarrow m_F^O + g\delta \frac{m_F^O}{1-\delta} \geq \frac{1-\alpha}{1-\delta} - \delta \left( \frac{M_W^O}{1-\delta} \right)$$

which can be rearranged as  $(1 - \delta + g\delta - \delta)m_F^O \geq (1 - \delta)(1 - \alpha)$ . Since however this implies that  $g = 1$ , we can rewrite it as  $m_F^O \geq 1 - \alpha$ , so that  $M_W^O \leq 0$ . Proceeding in a similar manner for equations *sub 12.* one obtains  $M_F^O \leq 1 - \alpha$ , so that  $m_W^O \geq 0$ .



Again, since  $M_i^j \geq m_i^j$  it follows that  $M_F^O = 1 - \alpha = m_F^O$ , and  $M_W^O = 0 = m_W^O$ . Notice that this implies that  $A = \frac{M_F^O}{1-\delta} = \frac{m_F^O}{1-\delta} = a$ , and that  $g = 1$ . Moreover, notice that this is a “self contained” result which does not depend on whether or not the outside option is relevant to the firm when it bargains with its insider. We showed above (sub 5.) what happens when labor turnover costs are so high that replacing the incumbent worker is not profitable for the firm; in that case an agreement is struck on the bilateral monopoly outcome. We can then turn to what happens in bargains between the firm and the insider when the outside option is valuable to the firm.

By direct substitution in  $\frac{M_F^I}{1-\delta} \leq \frac{1}{1-\delta} - \delta \left( \frac{1}{1-\delta} - M_F^O + \varphi - g\delta A \right)$  and  $\frac{m_F^I}{1-\delta} \geq \frac{1}{1-\delta} - \delta \left( \frac{1}{1-\delta} - m_F^O + \varphi - g\delta a \right)$  we get  $\frac{M_F^I}{1-\delta} \leq \frac{1}{1-\delta} - \delta \left[ \frac{1}{1-\delta} - M_F^O + \varphi - \frac{\delta M_F^O}{1-\delta} \right]$ , which implies that  $M_F^I \leq 1 - \delta[\alpha + (1-\delta)\varphi]$ , and  $\frac{m_F^I}{1-\delta} \geq \frac{1}{1-\delta} - \delta \left[ \frac{1}{1-\delta} - m_F^O + \varphi - \frac{\delta m_F^O}{1-\delta} \right]$ , from which  $m_F^I \geq 1 - \delta[\alpha + (1-\delta)\varphi]$  follows. which coupled together yield:  $M_F^I \leq 1 - \delta[\alpha + (1-\delta)\varphi] \leq m_F^I \Rightarrow M_F^I = m_F^I$ .

We can now proceed and compute the subgame perfect unique equilibrium partitions in subgames starting with an offer by the worker in subgames of type  $G_W^I$ . Recall that in 6. and 7. we showed that  $\frac{M_W^I}{1-\delta} \leq \frac{1}{1-\delta} - m_W^O + \varphi - g\delta a$  and  $\frac{m_W^I}{1-\delta} \geq \frac{1}{1-\delta} - M_W^O + \varphi - g\delta A$ ; thus, by substitution it is easy to check that  $\frac{m_W^I}{1-\delta} \geq \frac{1-m_F^O}{1-\delta} + \varphi \geq M_W^I$  which implies  $m_W^I = \alpha + (1-\delta)\varphi = M_W^I$ .

14. “bonding” case:  $k = 1$ . Then,  $A = \frac{M_F^I}{1-\delta}$  and  $a = \frac{m_F^I}{1-\delta}$ . Equations sub 10. and 11. reduce to  $m_F^O + g\delta a \geq \frac{1}{1-\delta} - \alpha - \delta \left[ M_W^O + g \frac{\delta(1-m_F^I)}{1-\delta} \right]$ , from which it follows that  $m_F^O + g \frac{\delta m_F^I}{1-\delta} \geq \frac{1}{1-\delta} - \alpha - \delta \left[ M_W^O + g \frac{\delta(1-m_F^I)}{1-\delta} \right]$  and  $M_W^O \leq 1 - \alpha - m_F^O$ . Next, we have to distinguish further between the “plain” bonding case (in which  $m_F^I > m_F^O$ ), and the case for  $m_F^I = m_F^O$ .

- (a) “plain” bonding case: Then by substitution of the expression for  $a$  and  $A$  above, we can reduce the infimum payoff to the firm to:

$$m_F^O + g \frac{\delta m_F^I}{1-\delta} \geq \frac{1}{1-\delta} - \alpha - \delta \left[ 1 - \alpha - m_F^O + \frac{g\delta(1-m_F^I)}{1-\delta} \right] \Rightarrow (1-\delta)m_F^O \geq 1 - (1-\delta)\alpha - \frac{\delta(1-g\delta)}{1-\delta} m_F^I,$$

and repeating the same argument for the supremum equilibrium payoff to the firm and the infimum for the worker it easy to verify that  $m_W^O \geq 1 - \alpha - M_F^O$  and  $(1-\delta)M_F^O \leq 1 - (1-\delta)\alpha - \frac{\delta(1-g\delta)}{1-\delta} m_F^I$ . As before, we have to distinguish whether or not the outside option is relevant to the firm when bargaining with the insider in order to determine the value of  $m_F^I$  and  $M_F^I$ ; hence:

- i. *outside option not relevant*: Again, as seen before:  $M_W^I = M_F^I = \frac{1}{1+\delta} = m_F^I = m_W^I$ , so that we can express the infimum equilibrium payoff to the outsider as  $(1-\delta)m_F^O \geq 1 - (1-\delta)\alpha - \frac{\delta(1-g\delta)}{1-\delta} \frac{1}{1+\delta}$ . But this implies that  $g = 1$ , so that we can simplify this expression and re-arrange it to yield  $m_F^O \geq \frac{1}{1-\delta^2} - \alpha$ . Similarly for the supremum:  $M_F^O \leq \frac{1}{1-\delta^2} - \alpha$ , so that, since  $M_F^I \geq m_F^I$ , it must be true that  $M_F^I = m_F^I$ . This implies that  $M_W^O \leq 1 - \alpha - M_F^O = 1 - \alpha - m_F^O \leq m_W^O$ ; from which it follows that:  $M_W^O = -\frac{\delta^2}{1-\delta^2} = m_W^O$ .
- ii. *relevant outside option*: In this case, as we saw above:  $(1+\delta)m_F^I \geq 1 + \delta m_F^O - \delta\varphi$ , so that:  $(1-\delta)m_F^O \geq 1 - (1-\delta)\alpha - \frac{\delta(1-g\delta)}{1-\delta} \frac{1+\delta m_F^O - \delta\varphi}{1+\delta}$ . Since this implies that  $g = 1$ , we can simplify the above inequality and re-arrange it to obtain  $m_F^O \geq 1 + \delta^2\varphi - (1-\delta^2)\alpha$ , so that  $m_F^I \geq 1 - \delta(1-\delta)(\varphi + \alpha)$ . Reiterating this procedure it is easy to verify that  $M_F^O \leq 1 + \delta^2\varphi - (1-\delta^2)\alpha$ , and  $M_F^I \leq 1 - \delta(1-\delta)(\varphi + \alpha)$ , which implies that  $M_F^I = m_F^I$  and  $M_F^O = m_F^O$ , since we assumed  $M_i^j \geq m_i^j$ . Then straightforward substitution determines  $M_W^O = -\delta^2(\varphi + \alpha) = m_W^O$  and  $M_W^I = (1-\delta)(\varphi + \alpha) = m_W^I$ .
- (b) *indifference case*: We now consider the case where although  $m_F^I \not> m_F^O$ , still the two parties in equilibrium engage in a permanent relationship. Then the infimum the firm can achieve in any S.P.E. in which it makes an offer is  $m_F^O = m_F^I$ ; analogously, for the supremum it has to be that  $M_F^O = M_F^I$ . The value of  $m_F^I$  and  $M_F^I$  will depend on whether or not the outside option is relevant in the bargaining between the firm and the insider; therefore:
- i. *outside option not relevant*: In this case, as we showed before.  $M_W^I = M_F^I = M_F^O = \frac{1}{1+\delta} = m_F^O = m_F^I = m_W^I$ . Therefore the unique s.p.e. payoff to the outsider can be expressed as  $m_W^O = 1 - \alpha - \frac{1}{1+\delta} = \frac{\delta}{1+\delta} - \alpha = M_W^O$ .
- ii. *relevant outside option*: In this case, as we showed sub 6. and 7.,  $\frac{m_F^I}{1-\delta} \geq 1 + \delta \left( m_F^O + \varphi - g\delta\alpha \right) = 1 + \delta \left( m_F^O + \varphi - g\frac{\delta m_F^I}{1-\delta} \right) \Rightarrow \frac{1-g\delta^2}{1-\delta} m_F^I \geq 1 + \delta(m_F^O - \delta\varphi)$ , and  $\frac{M_F^I}{1-\delta} \leq 1 + \delta \left( M_F^O + \varphi - g\delta A \right) = 1 + \delta \left( M_F^O + \varphi - g\frac{\delta M_F^I}{1-\delta} \right)$ , which implies  $\frac{1-g\delta^2}{1-\delta} M_F^I \leq 1 + \delta(M_F^O - \delta\varphi)$ . By substituting the above expressions in those for  $m_f^O$  and  $M_F^I$ , and noticing that now  $g = 1$ , one obtains  $M_F^I \leq 1 - \delta\varphi$ , which implies that  $M_F^I = m_F^I = M_F^O = m_F^O$ . Then, by substituting back in the expressions for the supremum and infimum payoffs to the outsider and the insider, it is straightforward to verify that  $M_W^I \leq \delta\varphi \geq m_W^I$ , which can be true only if  $M_W^I = m_W^I$ ; and  $M_W^O \leq \varphi \geq m_W^O$ , which implies  $M_W^O = m_W^O$ .

Therefore in all cases the supremum and the infimum payoff coincide, so that there

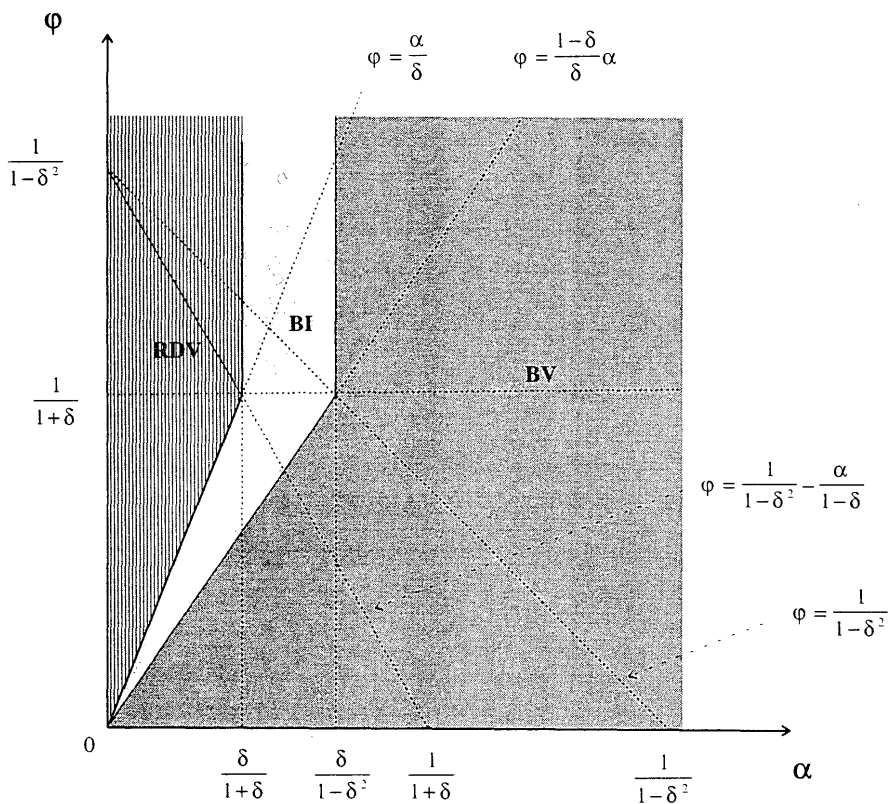
is a unique subgame perfect equilibrium agreement.

Finally, by substituting the s.p.e. payoffs in the inequalities which distinguish the various cases it is straightforward to derive the threshold values<sup>21</sup> has to be derived from for the parameters  $\alpha$  and  $\varphi$ .

This concludes the proof. ■

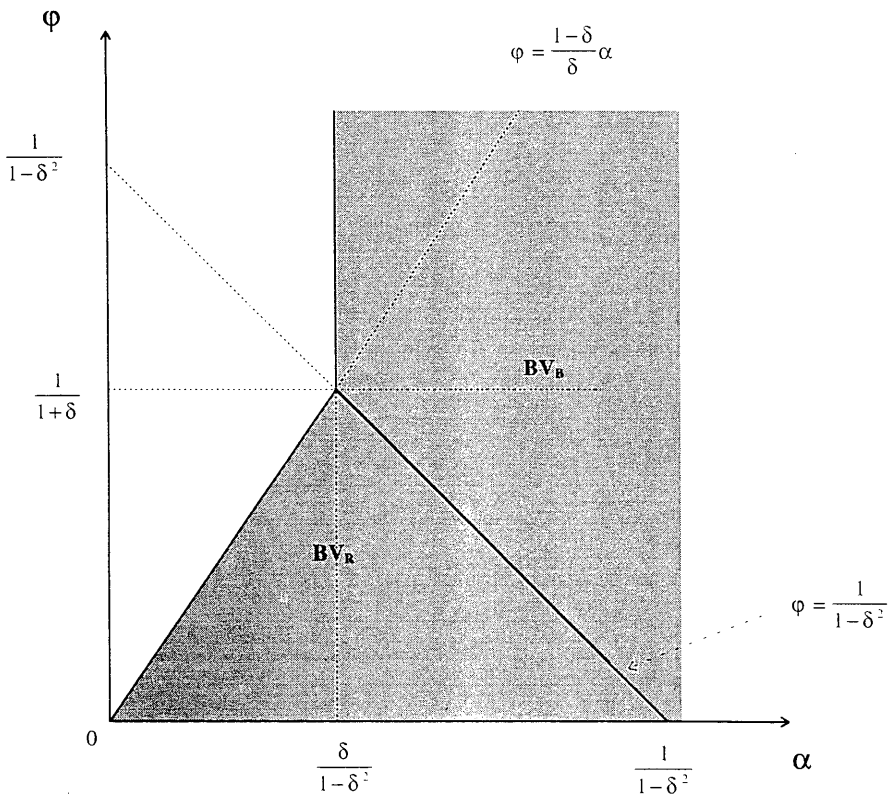
---

<sup>21</sup> Observe that for the “indifference case” the condition for  $\alpha$  comes from requiring life-long earnings for an entrant to be non-negative.



- ☐ "Bonding" and "voluntary unemployment" (BV)
- ☒ "Bonding" and "involuntary unemployment" (BI)
- ☒ "Revolving doors" and "voluntary unemployment" (RDV)

**Figure 3:** The three scenarios.



**Figure 3a:** “Bonding” and “voluntary unemployment”

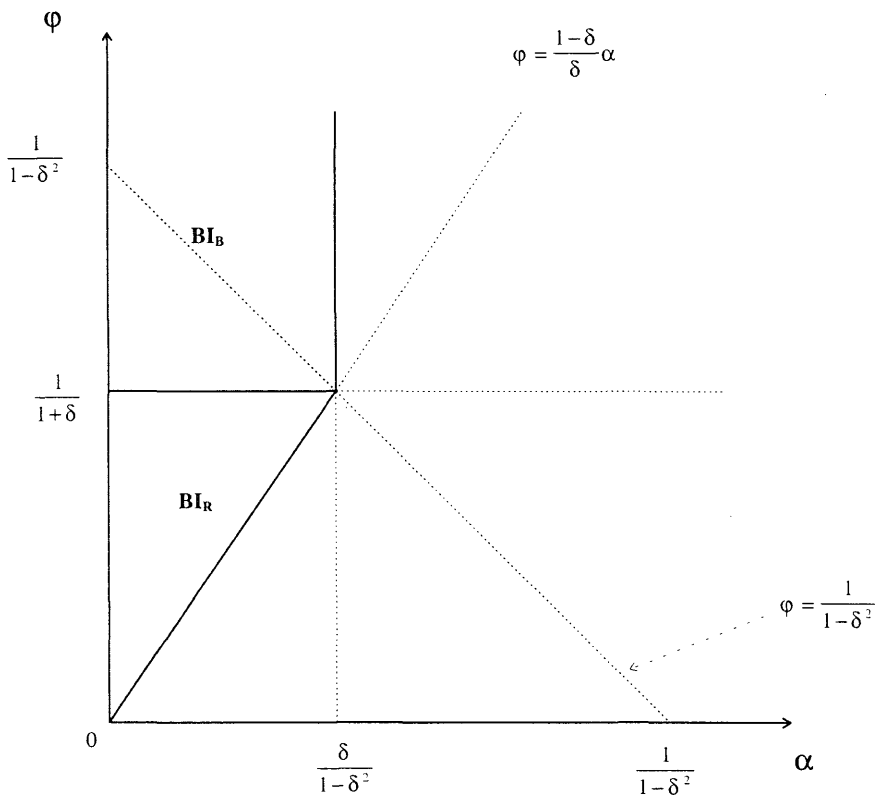
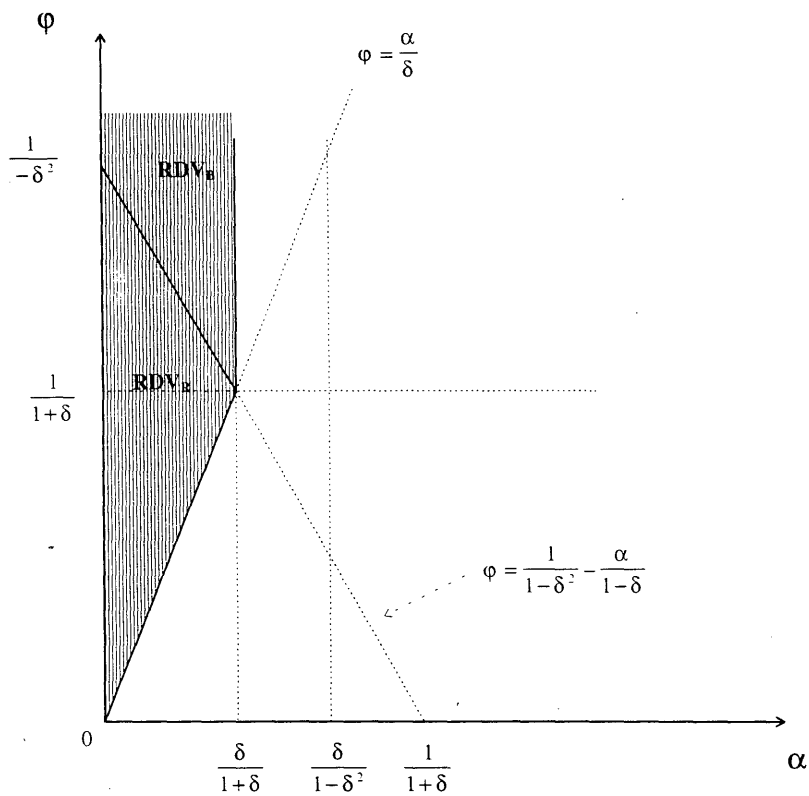


Figure 3b: “Bonding” and “involuntary unemployment”



**Figure 3c:** “Revolving doors” and “voluntary unemployment”