DISCUSSION PAPER SERIES

IZA

IZA DP No. 586

On-the Job Training and the Effects of Insider Power

Pilar Díaz-Vázquez
Dennis Snower

September 2002

Forschungsinstitut
zur Zukunft der Arbeit
Institute for the Study
of Labor

On-the-Job Training and the Effects of Insider Power

Pilar Díaz-Vázquez
University of Santiago de Compostela

Dennis Snower
Birkbeck College, University of London,
CEPR and IZA Bonn

Discussion Paper No. 586
September 2002 (revised October 2003)

IZA

P.O. Box 7240
D-53072 Bonn
Germany

Tel.: +49-228-3894-0
Fax: +49-228-3894-210
Email: iza@iza.org

IZA Discussion Paper No. 586
September 2002 (revised October 2003)

ABSTRACT

On-the-Job Training and the Effects of Insider Power

Suppose insiders use their market power to push up their wages, while entrants receive their reservation wages. How will employment and productivity be affected? In addressing this question, we focus on the role of on-the-job training. We show that on-the-job training makes insider wage hikes less detrimental to average employment (over booms and recessions), and may even cause employment to be stimulated. Furthermore, such training can make insider wage hikes more detrimental to average productivity.

JEL Classification: E24, J23, J24, J31, J42, J64

Keywords: insider power, employment, on-the-job training, productivity

Corresponding author:

Dennis Snower
Department of Economics
Birkbeck College
University of London
7 Gresse Street
London W1P 1PA
UK
Tel.: +44 (207) 631 6408
Fax: +44 (207) 631 6416
Email: d.snower@economics.bbk.ac.uk

1 Introduction

The influence of insider wage pressure on employment is an important issue for understanding labor markets. Whenever there are labor turnover costs (e.g. costs of hiring and firing, or costs of restrictive practices by incumbent employees that make it costly for employers to replace them), insiders have market power to push up their wages.[1] There is a sizeable literature about how this insider wage pressure influences employment.[2] The early contributions (such as Bertola, 1990) maintained that there would be little, if any, adverse employment effects, since a rise in insider wages would lead to a countervailing fall in the reservation wages of entrants. Since then, however, there has been a growing recognition that insider wage pressure hurts employment, and recent contributions have provided insights into why this could be so. For example, Lindbeck and Snower (2001) provide a variety of reasons why the wages of entrants need not move in tandem with their reservation wages, and Díaz-Vázquez and Snower (2003) show that, even if entrants get the reservation wage, an insider wage hike reduces employment, provided that some insiders are fired in cyclical downturns. The main reason is that when there is firing, the marginal worker is an insider (rather than an entrant) and a rise in the insider wage makes insiders less profitable.

This paper explores the role of on-the-job training in this context. Does such training augment or reduce the adverse employment effects of insider wage pressure? How does training influence the productivity effects of insider power?

This is an important issue because skilled-biased technological change has led to a dramatic rise in the supply of skilled workers and skilled jobs in the OECD over the past three decades, and on-the-job training is an important avenue whereby workers acquire firm-specific skills and thereby benefit from this technological change. Our analysis shows that the growing importance of on-the-job training has remarkable consequences for the role of insider wages in the labor markets of advanced industrialized countries.

In particular, we show that *as on-the-job training increases, an insider wage hike has a less contractionary effect on employment.* There are two channels whereby this happens:

1. *The hiring channel:* An insider wage hike encourages more firing in a cyclical downturn. In the subsequent upturn, these insiders are replaced by entrants. The greater the amount of on-the-job training, the more productive are insiders relative to entrants. Thus the more entrants are required to replace a given number of insiders. When the number of entrants replacing the insiders is sufficiently large, then the rise in entrant hiring during upturns can dominate

[1] See for example Lindbeck and Snower (1989).

[2] See, for example, Bertola (1990), Booth (1997), Burda (1992), Díaz-Vázquez and Snower (2003), Fehr (1989), Fehr and Kirchsteiger (1994), Frank (1985), Frank and Malcomson (1994), Gottfries and Sjostrom (2000), Lazear (1990), Lindbeck and Snower (1989) and Vetter and Andersen (1994).

the rise in insider firing during downturns; and in that event, an insider wage hike may actually *increase* average employment (over booms and recessions).

2. *The firing channel:* In a downturn, an insider wage hike reduces insider employment in *efficiency units of labor*. The greater the amount of on-the-job training, the smaller is the number of insiders represented by these efficiency units. Thus the fewer insiders will be fired.

In this sense, then, on-the-job training takes some of the sting out of insider wage hikes. Let us call this the *employment-promoting influence of training.* It can be shown that the magnitude of this effect depends on two things: (a) the duration of economic shocks, and (b) the length of the entrants' learning period, because these two factors determine the influence of on-the-job training on the number of entrants that replace one fired insider.

The number of entrants that replace one insider depends on the expected present value of revenue of insiders and entrants, over these workers' tenure at the firm. When an entrant's probability of being retained in the future is low (i.e. shocks are transient), and the entrants' learning period is prolonged, then the entrant will spend a relatively small part of his job tenure as a more productive insider. Thus, the number of entrants that replace one insider will be high, provided that the training of insiders is large. The more transient are the economic shocks and the more prolonged is the entrant's learning period, the more a rise in the amount of on-the-job training of the insiders will increase the number of entrants that replace one insider. The resulting increase in the number of entrants hired in a boom, relative to the number of insiders fired in a recession, is the source of the employment-promoting influence of training. In fact, when the magnitude of on-the-job training is sufficiently high, economic shocks are sufficiently transient and the entrant's learning period is sufficiently prolonged, an insider wage hike can even increase average employment.

This paper also shows that *as on-the-job training increases, an insider wage hike has a less contractionary effect on output.* Since in the upturn the output that the fired insiders would have generated is now produced by the entrants that replace them, output in the recovery is hardly affected by an insider wage hike. Thus, an insider wage hike reduces average output basically because it induces firms to fire more insiders in a downturn. The greater is the amount of on-the-job training, the greater is the marginal product of insiders. Thus, fewer insiders are fired and therefore less output is lost. It is for this reason that, as on-the-job training increases, an insider wage hike has a less contractionary effect on average output.

Finally, we show that *when the rise in on-the-job training increases the number of low-productivity entrants that replace high-productivity insiders in a non-negligible way, an insider wage hike has a less expansionary effect on productivity.* As noted, training will indeed increase the number of entrants replacing the insiders when the economic shocks are sufficiently transient and the entrant's learning period is sufficiently long.[3] When the number of entrants replacing one insider is sufficiently large, an insider wage hike may actually reduce average productivity (over booms and recessions).

The paper is organized as follows. Section 2 outlines our model. In this context, Section 3 explores how on-the-job training influences the employment effect of insider power, while Section 4 deals with the effect on output and productivity. Section 5 concludes.

2 The model

2.1 Underlying assumptions

Consider an economy with a given number of identical firms (perfect competitors in the product market[4]). The firm has a production function $Z_t E_t - \frac{c}{2}(E_t)^2$,[5] where Z_t is a random variable that represents business conditions, E_t is employment in efficiency units of labor (i.e. number of people employed times their productivity), and c is a positive constant. We assume that the economy can only be in two states: when $Z_t = Z^+$ the economy is in a "boom", and when $Z_t = Z^-$ the economy is in a "recession".[6] The probability of transition between these two states is described by a Markov chain, where P represents the probability of remaining in the same economic conditions and $(1-P)$ the probability of changing state. The firms' real marginal product of labor is assumed to be sufficiently higher in a boom than in a recession, so that workers are hired in an upturn and fired in a downturn. When economic conditions remain unchanged, firms do no hiring or firing, retaining their workers.

In the upturn, the firm hires n_t^+ new entrants, with an associated hiring cost of h per worker. These entrants spend a fixed period of time (coinciding with the period of analysis) - call it the "initiation period" - in the firm, during which their positions are not associated with firing costs. If the entrants remain in the firm after the initiation period, they become "insiders", whose positions are associated with a firing cost f. We assume that the firm follows a last-in/first-out seniority rule for firing; thus, in a downturn (at time t) all the n^+ workers hired in the previous upturn are fired and the firm retains a number of insiders N_t^-.[7] Thus, in the stationary equilibrium, the firm employs $L_t^+ = n_t^+ + N_{t-1}^-$ number

[3] As we show below, it is even possible for training to reduce the number of entrants replacing the insiders, but this effect is negligible for plausible parameter values and thus we ignore it.

[4] This assumption has no implications for the qualitative conclusions of this paper.

[5] In order to present our argument in the simplest and clearest form, we assume a production function with linear marginal product of labor, with the same slope in booms and recessions. Thus Z_t pre-multiplies only the first term of the production function. We comment below on the implications of relaxing this assumption.

[6] Notation convention: The superscript "$^+$" stands for "boom" and the superscript "$^-$" stands for "recession".

[7] Notation convention: Lower-case n stands for entrants and upper-case N stands for insiders.

of workers in a boom,[8] and N_t^- insiders in the recession. This paper focuses on the analysis of long-run steady states. Since the long-run Markov probabilities of a boom and a recession are $\frac{1}{2}$, the average number of people employed in the long run (over booms and recessions) is $L = \frac{1}{2}(L_t^+ + N_t^-)$.

On account of on-the-job training, insiders are more productive than entrants. Let us call "junior insiders" the workers who are in their first period as insiders, and "senior insiders" the insiders who remain longer in the firm. In this context, $A > 1$ represents the ratio of the productivity of a senior insider relative to the productivity of an untrained entrant, and a represents the ratio of the productivity of a junior insider relative to the productivity of an entrant.

For simplicity, we consider only two training scenarios. In the "short learning scenario", all training takes place in the initiation period, so that all entrants are untrained and all insiders (junior and senior) are trained, so that $a = A$. In the "long learning scenario", workers receive all their training when they are junior insiders, so that $a = 1$.

The firing costs give the insiders bargaining power, as shown below. Entrants have no power and thus they receive the reservation wage, i.e. the wage for which the entrant is indifferent between employment and unemployment.

The insiders in each firm belong to a firm-specific, risk-neutral union, which bargains over the wage with the firm every time economic conditions change, before the hiring and the firing decisions are made. The union seeks to maximize the utility of its median voter. We assume that this median voter is an insider who is not fired in a downturn.

2.2 Employment decisions and wage setting

In an upturn the firm hires new entrants (n_t^+) to maximize the present value of its profit, for given wages:[9]

$$\underset{n_t^+}{Max} Z^+ \left(n_t^+ + AN_{t-1}^-\right) - \frac{c}{2}\left(n_t^+ + AN_{t-1}^-\right)^2 - r_t n_t^+ - W_t^+ N_{t-1}^- - hn_t^+ + \delta \Pi_{t+1}^e \tag{1}$$

where $\left(n_t^+ + AN_{t-1}^-\right)$ is employment in efficiency units in the upturn, r_t is the reservation wage, W_t^+ is the insider wage, Π_{t+1}^e is expected future profit and δ is the discount factor. Let M_t^+ be the present value of entrants' expected marginal product, ω_t^+ be the present value of entrant's expected income, φ be the probability of firing the marginal worker in the future, and f be the firing

[8] In the upturn, the firm employs $L_t^+ = n_t^+ + N_{t-1}^-$ workers. If the boom persists, the firm retains these workers.

[9] We focus on the hiring decision when the firm has already some incumbent workers from the last recession (N_{t-1}^-).

cost per insider. Then the marginal condition that determines employment is:[10]

$$M_t^+ - \omega_t^+ - \varphi f = h \tag{2}$$

which states that the firm hires entrants until the present value of the entrants' expected marginal product minus the present value of the entrant's expected income minus the present value of the expected firing costs in a future downturn equals the hiring cost (h). The expression for the present value of entrants' expected marginal product is:

$$\begin{aligned} M_t^+ &= Z^+ - c\left(n_t^+ + AN_{t-1}^-\right) + \delta Pa\left[Z^+ - c\left(an_t^+ + AN_{t-1}^-\right)\right] \\ &\quad + \frac{\delta^2 P^2}{1-\delta P} A\left[Z^+ - cA\left(n_t^+ + N_{t-1}^-\right)\right] \end{aligned} \tag{3}$$

where $Z^+ - c\left(n_t^+ + AN_{t-1}^-\right)$ is the unskilled entrants' marginal product (in period t), $a\left[Z^+ - c\left(an_t^+ + AN_{t-1}^-\right)\right]$ is the junior insiders' marginal product (in period $t+1$), and $\frac{\delta^2 P^2}{1-\delta P} A\left[Z^+ - cA\left(n_t^+ + N_{t-1}^-\right)\right]$ is the present value of the marginal product when all the workers are senior insiders with productivity A (from period $t+2$).

The expression for the present value of the entrant's expected income is:

$$\omega_t^+ = r_t + \delta P w_t^+ + \frac{\delta^2 P^2}{1-\delta P} W_t^+ \tag{4}$$

where w_t^+ is the junior insider wage.[11] Since entrants receive the reservation wage, the present value of the entrant's expected income (ω_t^+) equals the one of an unemployed person. The unemployed person receives the unemployment benefit b per period. Thus, the present value of the entrant's expected income in the firm equals:

$$\omega_t^+ = \frac{b}{1-\delta P} \tag{5}$$

In a downturn, the firm's firing decision is the outcome of the following profit maximization problem, for given insider wage (W_t^-):

$$\underset{N_t^-}{Max} \;\; Z^-\left(AN_t^-\right) - \frac{c}{2}\left(AN_t^-\right)^2 - W_t^- N_t^- - f\left(N_{t-1}^+ - N_t^-\right) + \delta \Pi_{t+1}^e \tag{6}$$

where $f\left(N_{t-1}^+ - N_t^-\right)$ is the firing cost. The first order condition for firing equals:

$$M_t^- - \omega_t^- = -f \tag{7}$$

[10] The first-order conditions in (2) and (7) are derived in Appendix A.

[11] The insider wage in the recession (W_t^-) does not appear in the expression of the present value of the entrant's expected income because, as explained above, the new entrants are fired in a recession.

i.e. the firm fires workers until the present value of the insiders' expected marginal product (M_t^-) minus the present value of the insider's expected income (ω_t^-) equals the firing cost ($-f$). The expression for M_t^- is:

$$\begin{aligned} M_t^- &= (1+\phi)\left\{A\left(Z^- - cAN_t^-\right) + \delta(1-P)\left[A\left(Z^+ - c\left(n_{t+1}^+ + AN_t^-\right)\right)\right.\right. \\ &\quad \left.\left. +\delta PA\left(Z^+ - c\left(an_{t+1}^+ + AN_t^-\right)\right) + \frac{\delta^2 P^2}{1-\delta P}A\left(Z^+ - c\left(An_t^+ + AN_{t-1}^-\right)\right)\right]\right\} \\ &\quad -\frac{\partial\omega_t^-}{\partial N_t^-} \end{aligned} \tag{8}$$

where $A\left(Z^- - cAN_t^-\right)$ is the insiders' marginal product in the current recession, $A\left(Z^+ - c\left(n_{t+1}^+ + AN_t^-\right)\right)$ is the insiders' marginal product in a future recovery, $A\left(Z^+ - c\left(an_{t+1}^+ + AN_t^-\right)\right)$ is the marginal product when the recovery lasts two periods, the term $\phi = \frac{\delta P(1-\delta P)+\delta^2(1-P)^2}{(1-\delta P)^2-\delta^2(1-P)^2}$ is the probability of future recessions, and $\frac{\partial\omega_t^-}{\partial N_t^-}$ is the influence that the marginal insider has on future insider wages.[12]

The present value of the insider's expected income (ω_t^-) equals:

$$\omega_t^- = (1+\phi)\left(W_t^- + \frac{\delta(1-P)}{1-\delta P}W_{t+1}^+\right) \tag{9}$$

i.e. it depends on the wage of the insiders that remain in the firm in a recession (W_t^-) and also on the wage of these insiders in any possible future boom (W_{t+1}^+).

As (2) and (5) show, the insider wages do not affect the hiring decision, whereas as (7) and (9) show, the firing decision is affected by the senior insiders' wages.[13] These senior insiders' wages are set in the following way. As noted above, the insider wage is determined in a negotiation between the union and the firm, before the employment decision. The insider wage is the solution of a Nash bargain,[14] where the union maximizes the utility of the median voter (an insider that remains in the firm in a downturn). Under disagreement in the negotiation, the union goes on strike. The purpose of the strike is to impose a cost on the firm, so as to worsen the firm's fall-back position and thereby to increase the negotiated wage. Let β represent the cost of the strike per worker for the firm. We assume that the union can manipulate this cost in accordance with

[12] Recalling that the insiders negotiate the wage before the employment decision is made, the marginal insider in the downturn of period t has no influence on the insider wage in that recession (W_t^-), but it has an influence on all the future insider wages that may be negotiated when economic conditions change. From (9) and (10) below, we can see that $\frac{\partial\omega_t^-}{\partial N_t^-}$ is a constant.

[13] In particular, by (2), (4) and (5) we can see that the junior insider wage does not affect the hiring decision. Furthermore, since the new entrants in an upturn are fired in the next downturn, then there are no junior insiders employed in the recession (the marginal insider retained is a senior insider). Thus, the wages of the junior insiders do not affect the firm's hiring or firing decisions.

[14] See Appendix B for the details.

their own interests. Then the union will set β as high as possible, but not as high that the firm could fire the representative insider and replace him with a new worker. Thus, since the insider remains in the firm in any case, we can consider that the future expected income of the insider under agreement is the same as under disagreement, and the same happens with the future expected profit of the firm. Thus, the wage is a weighted average between, on the one hand, the income that the insiders could obtain during the strike (w^0) and, on the other hand, the insiders' average product in the current period, $(Z^i A - \frac{b}{2}A^2 N_t^-)$,[15] plus the cost of the strike (β):

$$W_t^i = (1-\mu)w^0 + \mu\left(Z^i A - \frac{c}{2}A^2 N_t^- + \beta\right) \tag{10}$$

where the weight μ is the union's bargaining strength, which is a constant.[16]

Since the union sets β subject to the restriction that the representative insider is not replaced by an entrant, then β cannot be higher than the cost of firing the insider (f) plus the cost of hiring the entrant (h) minus the current profitability of the new worker (ψ) (for simplicity, we take ψ as given).[17] This restriction is satisfied with equality, since the union seeks to maximize the wage in (10),

$$\beta = f + h - \psi \tag{11}$$

A greater cost of firing gives more power to the insiders in the wage negotiation since it increases the cost of disagreement in such a negotiation (β), and as a result the insider wage (W_t^i) in (10) is higher. In the next sections, we analyze how a change in the amount of on-the-job training (A) affects the influence on employment, output and productivity of this greater insider power, represented by a rise in β.

[15] In the recession, the insiders' average product is $Z^- A - \frac{b}{2}A^2 N_t^-$ because we consider that the wage is negotiated for the representative insider, who is remaining in the firm. In a boom, the insiders' average product equals $Z^+ A - \frac{b}{2}A^2 N_t^-$, since we assume that the union negotiates the wage on the basis of the product generated by the insiders, before the new entrants are hired.

[16] Although the wage setting in the recession (W_t^-) affects the average product in the recession (since it affects employment), for simplicity we consider that the union takes the average product as given at the time of the negotiation. This simplifying assumption does not affect the qualitative results of the paper, as shown in Appendices B and C.

[17] We assume that the current insider's future expected profitability is equal to that of the potential entrant.

3 The influence of on-the-job training on the effects of insider power

3.1 The effect of insider power on employment

The influence of a rise in insider power on long-run employment equals:

$$\frac{\partial L}{\partial \beta} = \frac{1}{2}\left(\frac{\partial L_t^+}{\partial \beta} + \frac{\partial N_t^-}{\partial \beta}\right) \tag{12}$$

i.e. it is an average between the effect on boom-time employment (L_t^+) and the effect on recession-time employment (N_t^-).

In a boom, a rise in insider power has no *direct* influence on employment (L_t^+), as we can see in (5) and (2). The reason is that the marginal worker is an entrant that receives the reservation wage. Thus, any change in the insider wage is associated with a countervailing change in the entrant (reservation) wage, leaving the firm's expected present value of wage payments to the worker unchanged.

By contrast, a rise in insider power reduces recession-time employment (N_t^-): since the marginal worker is an insider, the rise in insider power that increases W_t^i raises the present value of the marginal worker's expected income (ω^-) in (9), and therefore reduces employment in efficiency units of labor. The consequence is that the number of insiders in the recession is smaller.[18]

This reduction in the number of insiders in the recession will have an *indirect* influence on the hiring decision in the subsequent upturn. Since there are fewer insiders around, the firm will need to hire more entrants. Since entrants are less productive than insiders, the firm will replace each fired insider with more than one entrant. As a consequence *boom-time employment (L_t^+) will be higher* due to the increase in insider wages.

Thus, the effect of an insider wage hike on average employment (L) depends not only on how many insiders are fired in the recession, but also on how many entrants replace each fired insider in the subsequent upturn. Let $(-\frac{\partial n_t^+}{\partial N_t^-})$ be the number of entrants that replace one insider. We can then rewrite (12) as:[19]

$$\frac{\partial L}{\partial \beta} = \frac{1}{2}\frac{\partial N_t^-}{\partial \beta}\left(2 + \frac{\partial n_t^+}{\partial N_t^-}\right) \tag{13}$$

In what follows we show that the amount of on-the-job training of the insiders (A) plays a crucial role in determining both the number of insiders fired in the

[18] By (7), the rise in ω_t^- implies an increase in the present value of the insiders' expected marginal product (M_t^-) in (8), and therefore a reduction in employment in the recession.

[19] As explained above, the effect of a rise in β on $L_t^+ = n_t^+ + N_t^-$ equals:

$$\frac{\partial L_t^+}{\partial \beta} = \frac{\partial N_t^-}{\partial \beta} + \frac{\partial n_t^+}{\partial N_t^-}\frac{\partial N_t^-}{\partial \beta}$$

recession due to the insider wage hike ($\frac{\partial N_t^-}{\partial \beta}$) and the number of entrants that replace them ($-\frac{\partial n_t^+}{\partial N_t^-}$). Thus A plays a crucial role in determining the magnitude of the effect of an insider wage hike on average employment ($\frac{\partial L}{\partial \beta}$). In this regard, we can state the following proposition:

Proposition 1 *(1) The greater the amount of on-the job training, the fewer insiders are fired in recession in response to an insider wage hike, i.e. a rise in A weakens the negative effect of a rise in insider power (β) on recession-time employment (N_t^-).*

(2.) The greater the amount of on-the job training, the greater is the number of entrants that replace each fired insider in the subsequent upturn, i.e. a rise in A increases $-\frac{\partial n_t^+}{\partial N_t^-}$ when $P < P^*$ (where $P^* = \frac{1}{\delta(A-1)}$ when $a = 1$, and $P^* = \frac{1}{\delta(A-1)^2}$ when $a = A$). This effect is stronger when the workers' learning period is prolonged (i.e. $a = 1$) and economic shocks are transient (i.e. P is small).

(3.) Thus, the greater is the amount of on-the-job training, the less contractionary is the effect of an insider wage hike on average employment*, i.e. a rise in A makes the effect of insider power (β) on average employment (L) less negative. This influence is more important when $a = 1$ and P is small.*

(4.) An insider wage hike increases *average employment when the magnitude of on-the-job training (A) is sufficiently high, economic shocks are sufficiently transient and the workers' learning period is prolonged, i.e. a rise in insider power (β) increases average employment (L) when $(-\frac{\partial n_t^+}{\partial N_t^-}) > 2$. This occurs when $a = 1$ and the amount of on the job training (A) is greater than $A^* = \frac{1+\delta P-\sqrt{(1+\delta P)^2-8(1+\delta P)\frac{\delta^2 P^2}{1-\delta P}}}{2\frac{\delta^2 P^2}{1-\delta P}}$. This threshold value A^* only exists if $\delta P < \frac{1}{3}$.*

Proof. See Appendix C. ∎

These results can be explained intuitively as follows.

(1) As noted, a rise in the present value of the marginal worker's expected income (ω_t^-) reduces recession-time employment *in efficiency units of labor* (AN_t^-). Since on account of on-the-job training (A) insiders are more productive, the number of people that these efficiency units actually represent is smaller the greater is A.[20] Thus, the greater is the amount of on-the-job training, the fewer insiders are fired in the recession in response to the insider wage hike.

(2) On the other hand, the greater is the amount of on-the-job training, the more productive are the insiders relative to the entrants and the greater is the number of entrants that replace each insider fired in the recession ($-\frac{\partial n_t^+}{\partial N_{t-1}^-}$). The importance of this second channel depends on the persistence of economic

[20] Furthermore, the greater is A the smaller is the fall in E_t^-, because the marginal product in (8) is higher.

shocks and on the duration of the workers's learning period, as we can see in the expression for $(-\frac{\partial n_t^+}{\partial N_{t-1}^-})$:[21]

$$\frac{\partial n_t^+}{\partial N_{t-1}^-} = -\frac{A + \delta PaA + \frac{\delta^2 P^2}{1-\delta P}A^2}{1 + \delta Pa^2 + \frac{\delta^2 P^2}{1-\delta P}A^2} \tag{14}$$

The explanation is the following. The number of entrants that replace one insider $(-\frac{\partial n_t^+}{\partial N_{t-1}^-})$ depends on the expected present value of revenue of insiders and entrants, over these workers' tenure at the firm. When the insiders' expected present value of revenue is large relative to the entrants', the number of entrants that replace one insider is high. However, when insiders and entrants are alike in the sense that their expected present value of revenue is similar, then the number of entrants that replace an insider $(-\frac{\partial n_t^+}{\partial N_{t-1}^-})$ is low. The latter occurs when the entrant will spend a relatively large part of his job tenure as an insider, i.e. when the probability of being retained (P) is sufficiently large (shocks are sufficiently prolonged), and when the workers' learning period is short.[22] Conversely, if a current entrant cannot be expected to spend much of his job tenure as an insider (because shocks are transient or the workers' learning period is prolonged), then the number of entrants that replace one insider is high, provided that A is high.[23] We can see this in Figure 1,[24] that plots the relationship between $(-\frac{\partial n_t^+}{\partial N_{t-1}^-})$ (in the y-axis) and A (in the x-axis) for several values of P: $P_1 = 0$, $P_2 = 0.3$, $P_3 = 0.5$, $P_4 = 0.7$, $P_5 = 0.9$, and for the two different values of a: $a = A$ (i.e. when the workers' learning period is short) and $a = 1$ (i.e. when the workers' learning period is prolonged).[25]

But the important point is this one: only when the current entrant cannot be expected to spend much of his job tenure as an insider (because P is low and $a = 1$), a further rise in the insiders' productivity factor (A) may increase the number of entrants that replace one insider in an important manner, as we can see in Figure 1. Conversely, when the entrant is expected to spend a relatively large part of his job tenure as an insider (because P is large and $a = A$), a further increase in on-the-job training has a very small impact on the number of

[21] This expression is derived from (3).

[22] The more prolonged are the economic shocks, the fewer entrants replace one insider (for any given value of A). For instance, for $\delta = 1$ and $P = 0$, $(-\frac{\partial n_t^+}{\partial N_{t-1}^-}) = A$. Conversely when $P = 1$, $(-\frac{\partial n_t^+}{\partial N_{t-1}^-}) = -1$. In the same vein, $(-\frac{\partial n_t^+}{\partial N_{t-1}^-})$ in (14) is lower when $a = A$ (i.e. when the workers' learning period is short) than when $a = 1$ (i.e. when the workers' learning period is prolonged).

[23] Under these conditions, the expected present value of revenue of insiders and entrants is sufficiently different.

[24] In Figures 1 and 2, the discount factor $\delta = 0.9$.

[25] The reason why we do not plot the curves $a = A$ for low values of P is explained in footnote 31.

entrants that replace one insider. This very small impact may even be negative, as Figure 1 shows.[26]

(3) Thus, for the two reasons explained above, the effect of an insider wage hike on average employment becomes less contractionary the greater is the amount of on-the-job training (A). This is illustrated in Figure 2, which represents the relationship between the effect of an increase in insider power (β) on average employment (L) (in the y-axis) and the amount of on-the-job training (A) (in the x-axis).[27] This figure also shows that the influence of on-the-job training is more important when economic shocks are transient and when the workers' learning period is prolonged.

(4) Moreover, the magnitude of $(-\frac{\partial n_t^+}{\partial N_{t-1}^-})$ can even change the sign of (13): as we can see, an insider wage hike *increases* average employment when $(-\frac{\partial n_t^+}{\partial N_{t-1}^-}) > 2$, and this occurs when the magnitude of on-the-job training is sufficiently large,[28] economic shocks are sufficiently transient and the entrant's learning period is prolonged.[29] In particular, as Figure 2 shows, when the workers' learning period is prolonged, i.e. $a = 1$, and there is no probability that the shock persists, i.e. $P = 0$, the insider wage hike increases average employment for any A greater than 2.[30] Likewise, when $a = 1$ and $P = 0.3$, i.e. when the probability that the shock persists is 0.3, the insider wage hike increases average employment for any A greater than 2.5.[31]

[26] When entrants are expected to spend a long period in the firm as insiders, a rise in the amount of on-the-job training significantly increases the present value of their future revenue as insiders, and thus the expected present value of revenue of insiders and entrants may become more alike. In this situation, a rise in the amount of on-the-job training reduces the number of entrants that replace one insider.

[27] In this Figure, $c = 0.001$ and $\mu = 0.1$. The same qualitative results hold for any other values of these parameters.

[28] Note that, in the absence of on-the-job training, an insider wage hike unambiguously reduces average employment.

[29] We extend this analysis for asymmetric Markov processes and nonlinear marginal product functions in Appendix G. There we show that the more frequently the economy is in booms, the more relevant it becomes that the insider wage hike increases boom-time employment. We also show that the same happens the more convex, or the less concave is the marginal product function. When the probability that the economy is in booms is sufficiently large and the marginal product function is sufficiently convex, an insider wage hike may increase average employment.

[30] In Appendix D, we explain the behavior of the curves in Figure 2 when $\frac{\partial L}{\partial \beta}$ is positive.

[31] As noted by one referee, the case in which $a = A$ is only relevant when economic shocks are sufficiently prolonged, i.e. the firm will not fully train the entrants in the initiation period if it expects to fire them before they become insiders. This is the reason why the case in which $a = A$ is meaningless for low values of P. Conversely, when $a = 1$, the model is meaningful for low values of P, since the entrants do not receive any training in the initiation period.

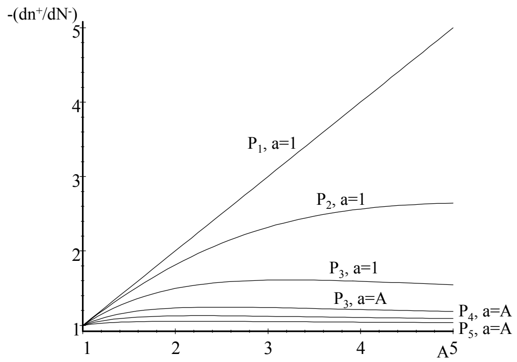

Figure 1

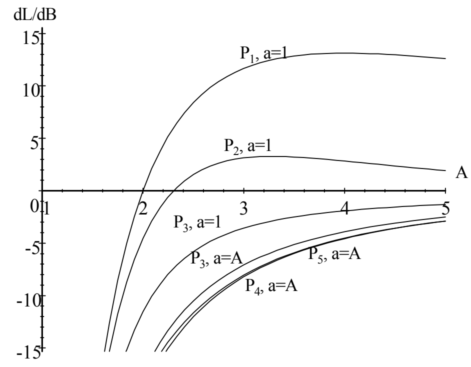

Figure 2

3.2 The effect of insider power on output and productivity

In the recession, an insider wage hike reduces the number of insiders, and thus it reduces recession-time output. The existence of diminishing returns to labor implies that the productivity of the remaining insiders in the recession is higher.

In the subsequent upturn, each fired insider is replaced by several less productive entrants. Thus the output that the fired insiders would have generated is now produced by the entrants that replace them. As a consequence, boom-time output is hardly affected. For instance, in the simple case in which the economic recovery lasts only one period, i.e. $P = 0$, the number of entrants that replace one insider fired in the recession equals the efficiency of that insider, i.e. $(-\frac{\partial n_t^+}{\partial N_{t-1}^-}) = A$. Thus the output in the boom remains unaffected.[32] Since the proportion of less productive entrants has increased, the consequence is that the productivity of the workforce in the boom is lower.

Thus, there is one main force that tends to reduce average output: there are less insiders in the recession. The influence of on-the-job training in this context is summarized in the following proposition:

Proposition 2 *A rise in A weakens the negative effect of a rise in insider power (β) on recession-time output (Q_t^-) and therefore it weakens the negative effect of a rise in insider power (β) on average output (Q).*

Proof. See Appendix E. ■

[32] In the more general case in which $0 < \delta P < 1$, the fact that several entrants replace one fired insider produces a reallocation of employment in efficiency units of labor between the upturn and the subsequent booms. Although this may affect (average) boom-time output for realistic values of δ close to 1, this change is unimportant compared to the reduction in recession-time output due to the insider wage hike. See Appendix E.

The explanation of the result of proposition 2 is the following. The greater is the amount of on-the-job training, the greater is the marginal product of insiders in (8). Thus, fewer insiders are fired due to the insider wage hike and therefore less output is lost. As a result, as on-the-job training increases, the effect of an insider wake hike on recession-time output, and thus on average output, becomes less contractionary.

Regarding average productivity, there are two countervailing forces that affect it. On the one hand, an insider wage hike means fewer insiders in the recession, which in turn means a greater productivity of these insiders. On the other hand, the fired insiders are replaced by less productive entrants, which tends to lower productivity. The following proposition describes the influence of on-the-job training in this context:

Proposition 3 *(1.) A rise in the amount of on-the-job training (A) has a negligible influence on the positive effect of insider power (β) on recession-time productivity ($\frac{Q_t^-}{N_t^-}$).*

(2.) A rise in A increases the number of less productive entrants that replace one insider in the upturn ($-\frac{\partial n_t^+}{\partial N_t^-}$) when $P < P^*$. This effect is more important when $a = 1$ and P is small. This tends to magnify the fall in boom-time productivity in response to an insider wage hike (unless both the increase in ($-\frac{\partial n_t^+}{\partial N_t^-}$) is very small and A is sufficiently large).

(3.) Thus, a rise in A makes the effect of insider power (β) on average productivity ($\frac{Q}{L}$) less positive when it increases ($-\frac{\partial n_t^+}{\partial N_t^-}$), i.e. when $P < P^*$ (unless both the increase in ($-\frac{\partial n_t^+}{\partial N_t^-}$) is very small and A is sufficiently large). This influence is more important when $a = 1$ and P is small.

(4.) When the number of entrants that replace one insider is sufficiently large, i.e. ($-\frac{\partial n_t^+}{\partial N_{t-1}^-}$) $> \left(2 - \frac{L}{Q}\frac{\partial Q}{\partial N_t^-}\right)$, a rise in insider power (β) reduces average productivity ($\frac{Q}{L}$).

Proof. See Appendix F. ■

The intuition behind these results is the following:

(1.) A rise in on-the-job training A weakens the negative effect of insider power on recession-time employment and also weakens the negative effect of insider power on recession-time output. Thus, its influence on recession-time productivity is negligible.[33] For instance, in the simple case in which the eco-

[33] As we show in the proof of Proposition 3, as on-the-job training increases, the effect of an insider wage hike on recession-time productivity becomes less expansionary. The main reason is that the greater is the amount of on-the-job training, the less contractionary is effect of insider power on recession-time employment, and thus the existence of diminishing returns to labor implies that the effect on recession-time productivity is less expansionary. However, this influence of on-the-job training is negligible.

nomic recovery lasts only one period, i.e. $P = 0$, a rise in A has no influence on the effect of a rise in insider power β on recession-time productivity $\frac{Q_t^-}{N_t^-}$.

(2.) and (3.) On the other hand, the greater is the amount of on-the-job training, the greater is the number of less productive entrants that replace one skilled insider, and thus the less expansionary is the effect of an insider wage hike on average productivity. As noted above, this influence of on-the-job training is important when economic shocks are sufficiently short and the workers' learning period is prolonged. This tends to magnify the fall in boom-time productivity in response to an insider wage hike.

Nevertheless, when the increase in the number of entrants that replace one insider due to the rise in A is very small, and A is sufficiently large, it may occur that a further rise in A makes more expansionary the effect of an insider wage hike on boom-time productivity (and thus on average productivity). The reason is that the rise in A significantly increases the productivity of the remaining insiders,[34] while the loss in productivity due to the number of less productive entrants that replace one insider is very small.

(4.) When the number of entrants that replace one insider is sufficiently large (because on-the-job training is sufficiently high, shocks are sufficiently short and the workers' learning period is prolonged), the insider wage hike will actually *reduce* average productivity. This occurs when:[35]

$$-\frac{\partial n_t^+}{\partial N_{t-1}^-} > 2 - \frac{L}{Q}\frac{\partial Q}{\partial N_t^-} \tag{15}$$

Note that when $2 - \frac{L}{Q}\frac{\partial Q}{\partial N_t^-} < -\frac{\partial n_t^+}{\partial N_{t-1}^-} < 2$, an increase in insider power reduces both average employment and average productivity.[36]

4 Conclusions

In summary, we have shown that when insiders push up their wages and thereby discourage insider employment in the recession, they make room for larger numbers of less productive entrants in the next upturn. Thus the fall in recession-time insider employment is what paradoxically increases total boom-time employment. Consequently, on-the-job training mitigates the contractionary effect of insider

[34] Recall that a rise in A reduces the number of insiders fired in response to an insider wage hike, which means that there are more insiders in the boom (who are very productive since A is already large). This tends to increase boom-time productivity.

[35] An increase in insider power has no effect on productivity when $\frac{\partial Q}{\partial \beta}L = Q\frac{\partial L}{\partial \beta}$. This expression implies that $-\frac{\partial n_t^+}{\partial N_{t-1}^-} = 2 - \frac{L}{Q}\frac{\partial Q}{\partial N_t^-}$, since $\frac{dQ}{d\beta} = \frac{dQ}{dN_t^-}\frac{dN_t^-}{d\beta}$ and using (13).

[36] This occurs because the reduction in output is greater than the reduction in employment, since the increase in new entrants in the boom is not associated with an increase in boom-time output.

wage hikes on average employment. In other words, our analysis suggests that as on-the-job training grows in importance in the industrialized economies, it may cause insider wage hikes to have a less contractionary influence on employment. Furthermore, it can make the effect of insider wage hikes on productivity less expansionary. These effects are stronger, the shorter are the economic shocks, and the more prolonged is the learning period of the new recruits. These conclusions are important because, in particular, the greater insider power in continental European countries relative to the US has been perceived as a drag on employment, but possibly harmless for productivity. But as result of skill-biased technological change, these conclusions need to be revised.

Some important policy implications stem from our analysis. In contrast to what some authors suggest and in line with the general perception of policymakers, there is a case for policies aimed at insider wage moderation on employment grounds, since the higher insider wages are harmful for employment and output in the recession. Our analysis shows, however, that the growing importance of on-the-job training may weaken such a case.

Our analysis also provides an additional argument for insider wage moderation in the presence of on-the-job training, based on the negative effect of insider wages on productivity. Insider wage increases reduce the rate of retention of insiders with the consequent waste of skills and loss of productivity. In this context, policies that help to reduce the learning period of entrants may mitigate the negative effect on productivity in a scenario of insider wage increases.

A Appendix: Derivation of (2) and (7)

The solution of (1) is:

$$\begin{aligned}&\left[Z^{+}-c\left(n_t^{+}+AN_{t-1}^{-}\right)\right]-r_t+\\&\delta P\left\{a\left[Z^{+}-c\left(an_{t+1}^{+}+AN_t^{-}\right)\right]-w_t^{+}+\delta P\Pi_{t+2}^{++\prime}-\delta(1-P)f\right\}=h\end{aligned}\quad(16)$$

where $\Pi_{t+2}^{++\prime}$ is the present value of expected marginal profit if the boom persists:

$$\Pi_{t+2}^{++\prime}=\ A\left[Z^{+}-c\left(An_t^{+}+AN_{t-1}^{-}\right)\right]-W_t^{+}+\delta P\ \Pi_{t+3}^{++\prime}-\delta(1-P)f\quad(17)$$

Since in the stationary equilibrium $\Pi_{t+2}^{++\prime}=\Pi_{t+3}^{++\prime}$, we can solve (17) for $\Pi_{t+2}^{++\prime}$, and substitute it into (16) to obtain the first order condition in the boom:

$$\begin{aligned}&\left[Z^{+}-b\left(n_t^{+}+AN_{t-1}^{-}\right)\right]-r_t+\delta P\left\{a\left[Z^{+}-b\left(an_t^{+}+AN_{t-1}^{-}\right)\right]-w^{+}\right\}\\&+\frac{(\delta P)^2}{1-\delta P}\left\{A\left[Z^{+}-bA\left(n_t^{+}+N_{t-1}^{-}\right)\right]-W_t^{+}\right\}-\frac{\delta^2P(1-P)}{1-\delta P}f=h\end{aligned}\quad(18)$$

where $\frac{\delta^2P(1-P)}{1-\delta P}=\varphi$ in the text.

The solution of (6) is:

$$A\left[Z^{-}-c\left(AN_t^{-}\right)\right]-W_t^{-}-\delta Pf+\delta(1-P)\,\Pi_{t+1}^{+\prime}=-f \tag{19}$$

where $\Pi_{t+1}^{+\prime}$ is the marginal profit if economic conditions improve:

$$\begin{aligned}\Pi_{t+1}^{+\prime} &= A\left[Z^{+}-c\left(n_{t+1}^{+}+AN_t^{-}\right)\right]-W_t^{+}+\delta P\left\{A\left[Z^{+}-c\left(an_{t+1}^{+}+AN_t^{-}\right)\right]\right.\\ &\quad \left.-W^{+}+\delta P\Pi_{t+3}^{++\prime}-\delta(1-P)f\right\}-\delta(1-P)f \end{aligned}\tag{20}$$

Substituting $\Pi_{t+3}^{++\prime}$, that can be obtained from (17), we obtain:

$$\begin{aligned}\Pi_{t+1}^{+\prime} &= A\left[Z^{+}-c\left(n_{t+1}^{+}+AN_t^{-}\right)\right]-\frac{W_t^{+}}{1-\delta P}+\delta P\left\{A\left[Z^{+}-c\left(an_{t+1}^{+}+AN_t^{-}\right)\right]\right.\\ &\quad \left.+\frac{\delta P}{1-\delta P}A\left[Z^{+}-c\left(An_t^{+}+AN_{t-1}^{-}\right)\right]\right\}-\frac{\delta(1-P)}{1-\delta P}f \end{aligned}\tag{21}$$

Substituting (21) into (19), we obtain the marginal condition in the recession. Collecting the terms with f in the right-hand side, we obtain that the coefficient is $\frac{\delta^2(1-P)^2-(1-\delta P)^2}{1-\delta P}$, which is equal to $\frac{1}{1+\phi}$, where $\phi=\frac{\delta P(1-\delta P)+\delta^2(1-P)^2}{(1-\delta P)^2-\delta^2(1-P)^2}$.

B Appendix: The Nash bargain

The Nash bargain is:

$$\underset{W_t^i}{Max}\Omega=\left[W_t^i+\theta^{ei}-\left(w^0+\theta^{ei}\right)\right]^{\mu}\left[Z^iA-\frac{c}{2}A^2N_t^{-}-W_t^i+\vartheta^{ei}-\left(-\alpha+\vartheta^{ei}\right)\right]^{1-\mu} \tag{22}$$

where $i=+,-$. Under agreement, the worker's utility is $W_t^i+\theta^{ei}$, where θ^{ei} is expected utility in the future, and the firm's profit is $Z^iA-\frac{c}{2}A^2N_t^{-}-W_t^i+\vartheta^{ei}$, where ϑ^{ei} is the future expected average profit. Under disagreement workers go on strike: the worker's utility is $w^0+\theta^{ei}$, and the firm's expected profit is $-\beta+\vartheta^{ei}$. Note that θ^{ei} is identical under agreement and disagreement, and the same happens to ϑ^{ei}, since we assume that the union sets β to avoid the representative worker being fired during the strike and replaced by a new worker. The expression for the wage W_t^i is the solution of (22). In the boom, W_t^{+} equals:

$$W_t^{+}=(1-\mu)w^0+\mu\left(AZ^{+}-\frac{c}{2}A^2N_t^{-}+\beta\right) \tag{23}$$

In the recession, W_t^{-} equals

$$W_t^{-}=w^0+\frac{\mu}{\lambda}\left(AZ^{-}-\frac{c}{2}A^2N_t^{-}-w^0+\beta\right) \tag{24}$$

where $\lambda = 1 + (1-\mu)\frac{c}{2}A^2\frac{\partial N_t^-}{\partial W_t^-}$, and $\frac{\partial N_t^-}{\partial W_t^-}$ equals (from (7) and (14)):

$$\frac{\partial N_t^-}{\partial W_t^-} = -\frac{\frac{\partial \omega^-}{\partial W_t^-}}{\frac{\partial M^-}{\partial N^-}} = -\frac{1}{cA^2 + \frac{\delta(1-P)}{1-\delta P}cA^2 + \delta(1-P)c\left(A + \delta PaA + \frac{\delta^2 P^2}{1-\delta P}A^2\right)\frac{\partial n_t^+}{\partial N_{t-1}^-}}$$

The term λ appears because, since the wage negotiation occurs before the employment decision, the union must take into account that a rise in the insider wage reduces employment in the recession. This, in turn, increases the average product, which will further increase the wage. (In the expression for W_t^+ in (23), this term λ does not appear because when W_t^+ is being negotiated, employment N_{t-1}^- is already given.) We show in Figure A1 that λ behaves nearly as a constant. This Figure plots λ is in the vertical axis, A is in the y-axis, on the right-hand side, and P is in the x-axis, on the left-hand side, for given μ and c.[37]

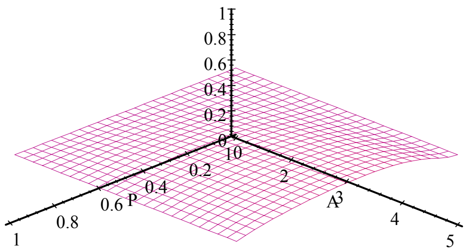

Figure A1

Thus, the term λ is going to play no role in the analysis. In fact, when we include this term in the proofs of the propositions below (see Appendix C) we obtain exactly the same qualitative conclusions. Thus, for simplicity we ignore the term λ in the expression for the wage in (10).

As noted, the union sets β to avoid the workers being fired during the strike and replaced by new workers. Thus β satisfies the condition $-\beta + \vartheta^{ei} \geq -(f + h) + \psi + \vartheta^{ei}$ (we assume that ϑ^{ei} is identical for the potential entrants and the current insiders). The value of β is set by the union before the wage negotiation. Since the union seeks to maximize the wage, then the restriction is satisfied with equality and thus β is the expression in (11).

[37] As in the Figures of the text, $c = 0.001$ and $\mu = 0.1$.

C Appendix: Proof of Proposition 1

Proof. (1.) Using (8), (9) and (14), a rise in β has the following effect on N_t^-:

$$\frac{\partial N_t^-}{\partial \beta} = -\frac{\frac{\partial \omega^-}{\partial \beta}}{\frac{\partial (M^- - \omega^-)}{\partial N^-}} = \frac{-\mu\left(1+\frac{\delta(1-P)}{1-\delta P}\right)}{A^2\left(1-\frac{\mu}{2}\right)\left(1+\frac{\delta(1-P)}{1-\delta P}\right)c - \delta(1-P)\frac{\left(A+\delta PaA+\frac{\delta^2P^2}{1-\delta P}A^2\right)^2}{1+\delta Pa^2+\frac{\delta^2P^2}{1-\delta P}A^2}c} \tag{25}$$

The denominator of (25) is greater the greater is A. Figure A2 plots $\frac{\partial N_t^-}{\partial \beta}$ (y-axis) with respect to A (x-axis), for the same values of the parameters as Figures 1 and 2, and shows that the greater is A, the less negative is $\frac{\partial N_t^-}{\partial \beta}$. Observe that, if we consider the expression for the wage in (24), the numerator of $\frac{\partial N_t^-}{\partial \beta}$ equals $-\mu\left(\frac{1}{\lambda}+\frac{\delta(1-P)}{1-\delta P}\right)$. Figure A3 uses this numerator, and shows that the inclusion of the term λ does not affect the qualitative results (Figure A3 is almost identical to Figure A2).

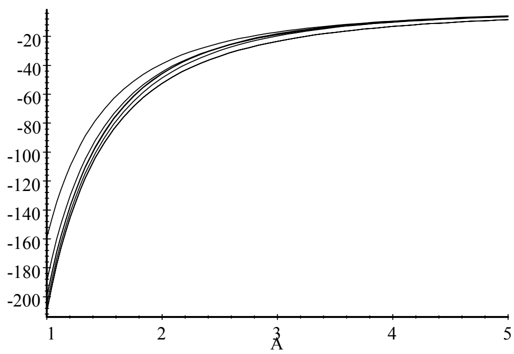

Figure A2

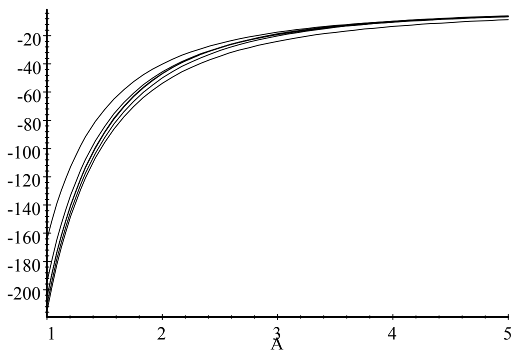

Figure A3

(2.) The expression for $(-\frac{\partial n_t^+}{\partial N_{t-1}^-})$ is in (14). When $a = A$, the influence of a rise in A on $-\frac{\partial n_t^+}{\partial N_{t-1}^-}$ equals:

$$-\frac{\partial^2 n_t^+}{\partial N_{t-1}^- \partial A} = \frac{(1-\delta P)\left[1-\delta P(A-1)^2\right]}{\left[1+\delta P(A^2-1)\right]^2} \tag{26}$$

It is positive when $P < P^* = \frac{1}{\delta(A-1)^2}$, and the expression is greater the smaller is P.

When $a = 1$, the influence of a rise in A on $-\frac{\partial n_t^+}{\partial N_{t-1}^-}$ equals:

$$-\frac{\partial^2 n_t^+}{\partial N_{t-1}^- \partial A} = \frac{(1-\delta^2P^2)\left[1-\delta^2P^2(A-1)^2\right]}{\left[1+\delta^2P^2(A^2-1)\right]^2} \tag{27}$$

It is positive when $P < P^* = \frac{1}{\delta(A-1)}$, and the expression is greater the smaller is P.

Thus a rise in A increases $(-\frac{\partial n_t^+}{\partial N_{t-1}^-})$ more when $a = 1$ and P is sufficiently small, provided that $P < \frac{1}{\delta(A-1)}$. The expressions (26) and (27) also show that when P is sufficiently large, the rise in A has a very small effect on $(-\frac{\partial n_t^+}{\partial N_{t-1}^-})$.

(3.) It follows from (1.) and (2.)

(4.) From (13) we can see that $\frac{\partial L}{\partial \beta}$ is positive when $-\frac{\partial n_t^+}{\partial N_{t-1}^-} > 2$. By (14), when $a = 1$, $-\frac{\partial n_t^+}{\partial N_{t-1}^-} > 2$ when $A > A^* = \frac{1+\delta P - D}{2\frac{\delta^2 P^2}{1-\delta P}}$, where $D = \sqrt{(1+\delta P)^2 - 8(1+\delta P)\frac{\delta^2 P^2}{1-\delta P}}$. This threshold value does not exist when $D \leq 0$, i.e. when $P > 0.37$ (for $\delta = 0.9$). That is, when $a = 1$, if $P > 0.37$, it holds that $\frac{\partial L}{\partial \beta} < 0$. ■

D Appendix: Comments on Figure 2

In Figure 2, we see that the effect of an insider wage hike on employment may be positive for sufficiently large A when $a = 1$ and P is low (for $\delta = 0.9$). The proof of proposition 1 in Appendix C gives the value of the threshold value A^*. As Figure 2 shows, $\frac{\partial L}{\partial \beta}$ starts becoming less expansionary from a specific value of A. The reason is twofold. First, as explained above, the greater is the amount of on-the-job training A, the less workers are fired in a recession in response to an insider wage hike. This tends to make less expansionary $\frac{\partial L}{\partial \beta}$, since there are less insiders fired and thus less workers to be replaced. Second, when A is very large, a further rise in A may in fact reduce $-\frac{\partial n_t^+}{\partial N_{t-1}^-}$, as indicated in Footnote 26. The reason is that when the insiders' marginal product $A\left[Z^+ - b(An_t^+ + AN_{t-1}^-)\right]$ has an important weight in determining the present value of the expected product over the marginal entrant's job tenure (relative to the entrant's current marginal product $\left[Z^+ - b(n_t^+ + AN_{t-1}^-)\right]$), a rise in A may increase this weight further. Thus the present value of the entrants' expected marginal product and that of the insiders become more similar, and as a result the number of entrants that replace one insider $-\frac{\partial n_t^+}{\partial N_{t-1}^-}$ is smaller.

We can show that, although $\frac{\partial L}{\partial \beta} > 0$ becomes less expansionary when A is sufficiently large, it does not become negative again unless A reaches implausibly high values. By (14), for $a = 1$ it holds that $-\frac{\partial n_t^+}{\partial N_{t-1}^-} < 2$ not only when $A < A^*$ but also when $A > A^{**} = \frac{1+\delta P + D}{2\frac{\delta^2 P^2}{1-\delta P}}$. Thus, if $\frac{\partial L}{\partial \beta}$ becomes positive for $A > A^*$, it becomes negative again when $A > A^{**}$. When $P = 0.3$ and $\delta = 0.9$, the value of $A^{**} = 10.2$. When $P = 0.2$ and $\delta = 0.9$, the value of $A^{**} = 27.7$. (When $P = 0.4$, $-\frac{\partial n_t^+}{\partial N_{t-1}^-}$ is smaller than 2 for any A, and thus $\frac{\partial L}{\partial \beta} < 0$ for any A.)

E Appendix: Proof of Proposition 2

Proof. We show the following result: (1.) An increase in insider power β reduces recession-time output Q_t^-, $\frac{\partial Q_t^-}{\partial \beta} < 0$, and a rise in A weakens this negative effect. (2.) An increase in β reduces average output Q_t, $\frac{\partial Q_t}{\partial \beta} < 0$, and a rise in A weakens this negative effect. (3.) The effect of an increase in β on boom-time output Q_t^+ is ambiguous and negligible. We can then conclude proposition 2.

(1.) Recession-time output is

$$Q_t^- = \left(Z^- - \frac{c}{2}E_t^-\right)E_t^- \tag{28}$$

Thus $\frac{\partial Q_t^-}{\partial \beta}$ equals:

$$\frac{\partial Q_t^-}{\partial \beta} = \left(Z^- - cE_t^-\right)\frac{\partial E_t^-}{\partial \beta} < 0 \tag{29}$$

i.e. it is negative since $\frac{\partial E_t^-}{\partial \beta} = A\frac{\partial N_t^-}{\partial \beta} < 0$ (see (25)). A rise in A makes this effect less contractionary:

$$\frac{\partial^2 Q_t^-}{\partial \beta \partial A} = -c\frac{\partial E_t^-}{\partial A}\frac{\partial E_t^-}{\partial \beta} + \left(Z^- - cE_t^-\right)\frac{\partial^2 E_t^-}{\partial \beta \partial A} > 0 \tag{30}$$

This is positive because $\frac{\partial E_t^-}{\partial A} > 0$ and $\frac{\partial^2 E_t^-}{\partial \beta \partial A} = A\frac{\partial^2 N_t^-}{\partial \beta \partial A} > 0$ (as shown in the proof of Proposition 1, in Appendix C). Figure A4 plots $\frac{\partial Q_t^-}{\partial \beta}$ with respect to A (for the same values of the parameters as Figures 1 and 2).[38]

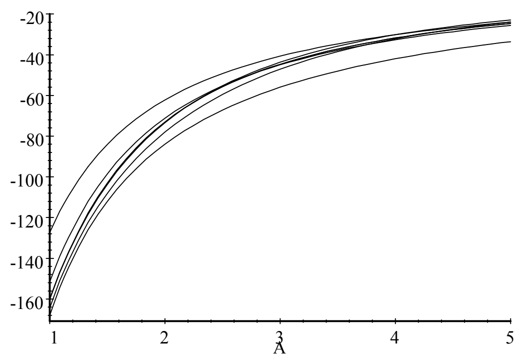

Figure A4

[38] Note that $\frac{\partial Q_t^-}{\partial \beta}$ depends on the value of N_t^-, and thus it depends on the value of all the parameters that determine N_t^-. For simplicity, we give an arbitrary value to $N_t^- = 100$. $\frac{\partial Q_t^-}{\partial \beta}$ also depends on Z^-, which we give the value 0.9.

2. Average output equals $Q = \frac{1}{2}\left(Q_t^+ + Q_t^-\right)$, where (average) boom-time output is:[39]

$$\begin{aligned} Q_t^+ &= (1-P)\left(Z^+ - \frac{c}{2}E_t^{+u}\right)E_t^{+u} + (1-P)P\left(Z^+ - \frac{c}{2}E_t^{++}\right)E_t^{++} \\ &\quad + P^2\left(Z^+ - \frac{c}{2}E_t^{+s}\right)E_t^{+s} \end{aligned} \tag{31}$$

where $E_t^{+u} = n_t^+ + AN_{t-1}^-$ is employment in efficiency units in an upturn, $E_t^{++} = an_t^+ + AN_{t-1}^-$ is employment in efficiency units in a boom that lasts two periods and $E_t^{+s} = n_t^+ + AN_{t-1}^-$ is employment in efficiency units in a boom in which all the workers are skilled workers. Note that $\left(Z^i - \frac{c}{2}E_t^i\right)E_t^i$ is output per efficiency unit of labor times employment in efficiency units. For simplicity, we consider that $a = 1$ (although the analysis also holds for $a = A$), so $E_t^{+u} = E_t^{++}$. The effect of a rise in β on Q is:

$$\begin{aligned} \frac{\partial Q}{\partial \beta} &= \frac{1}{2}\Bigg\{(1-P^2)\left(-\frac{c}{2}\frac{\partial E_t^{+u}}{\partial \beta}\right)E_t^{+u} + P^2\left(-\frac{c}{2}\frac{\partial E_t^{+s}}{\partial \beta}\right)E_t^{+s} + \left(-\frac{c}{2}\frac{\partial E_t^{-}}{\partial \beta}\right)E_t^{-} \\ &\quad + (1-P^2)\left(Z^+ - \frac{c}{2}E_t^{+u}\right)\frac{\partial E_t^{+u}}{\partial \beta} + P^2\left(Z^+ - \frac{c}{2}E_t^{+s}\right)\frac{\partial E_t^{+s}}{\partial \beta} \\ &\quad + \left(Z^- - \frac{c}{2}E_t^-\right)\frac{\partial E_t^-}{\partial \beta}\Bigg\} \end{aligned} \tag{32}$$

This expression can be rewritten as (since $\frac{\partial E_t^{+u}}{\partial \beta} = (A + \frac{\partial n_t^+}{\partial N_{t-1}^-})\frac{\partial N_t^-}{\partial \beta}$ and $\frac{\partial E_t^{+s}}{\partial \beta} = A(1 + \frac{\partial n_t^+}{\partial N_{t-1}^-})\frac{\partial N_t^-}{\partial \beta}$):

$$\begin{aligned} \frac{\partial Q}{\partial \beta} &= \frac{1}{2}\frac{\partial N_t^-}{\partial \beta}\Bigg[(1-P^2)\left(-\frac{c}{2}(A + \frac{\partial n_t^+}{\partial N_{t-1}^-})\right)E_t^{+u} \\ &\quad + P^2\left(-\frac{c}{2}A(1 + \frac{\partial n_t^+}{\partial N_{t-1}^-})\right)E_t^{+s} + \left(-\frac{c}{2}A\right)E_t^-\Bigg] \\ &\quad + \frac{1}{2}\frac{\partial N_t^-}{\partial \beta}\Bigg[(1-P^2)\left(Z^+ - \frac{c}{2}E_t^{+u}\right)(A + \frac{\partial n_t^+}{\partial N_{t-1}^-}) \\ &\quad + P^2\left(Z^+ - \frac{c}{2}E_t^{+s}\right)A(1 + \frac{\partial n_t^+}{\partial N_{t-1}^-}) + \left(Z^- - \frac{c}{2}E_t^-\right)A\Bigg] \end{aligned} \tag{33}$$

where $\frac{\partial n_t^+}{\partial N_{t-1}^-}$ is in (14). Figure A5 plots $\frac{\partial Q}{\partial \beta}$ (y-axis) with respect to A (x-axis) for the same values of the parameters as Figures 1, 2 and A4 (so it includes different

[39] From the Markov chain, $\frac{1-P}{2}$ is the long-run Markov transition probability of an upturn, $\frac{P(1-P)}{2}$ is the long-run Markov transition probability of a boom that lasts two periods, and $\frac{P^2}{2}$ is the long-run Markov transition probability of a boom that lasts at least three periods. Since $\frac{1}{2}$ is the probability of a boom, and now we are only considering the boom, then $1-P$ is the probability of an upturn, $P(1-P)$ is the probability of a boom that lasts two periods, and P^2 is the probability of a boom that lasts at least three periods.

scenarios in which $a = 1$ and $a = A$).[40] It shows that $\frac{\partial Q}{\partial \beta} < 0$ and that a rise in A weakens the effect (for any value of P). Figure A6 plots only the third and fourth rows of (33). This Figure is almost identical to Figure A5, which means that the main influence of β on Q is via employment in efficiency units of labor.

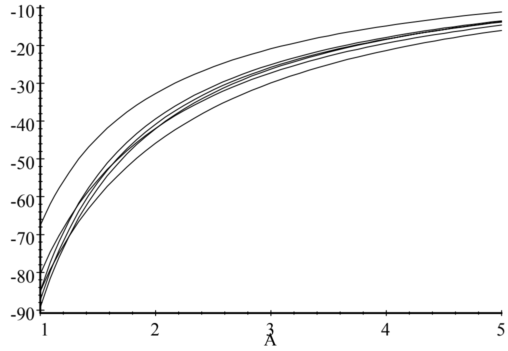

Figure A5

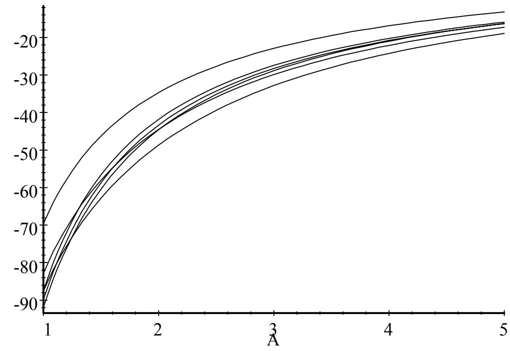

Figure A6

3. The effect of a rise in β on Q_t^+ is:

$$\begin{aligned}\frac{\partial Q_t^+}{\partial \beta} &= \frac{\partial N_t^-}{\partial \beta}\left[(1-P^2)\left(-\frac{c}{2}(1+\frac{\partial n_t^+}{\partial N_{t-1}^-})\right)E_t^{+u} + P^2\left(-\frac{c}{2}(A+\frac{\partial n_t^+}{\partial N_{t-1}^-})\right)E_t^{+s}\right] \\ &+\frac{\partial N_t^-}{\partial \beta}\left[(1-P^2)\left(Z^+ - \frac{c}{2}E_t^{+u}\right)(A+\frac{\partial n_t^+}{\partial N_{t-1}^-})\right. \\ &\left.+P^2\left(Z^+ - \frac{c}{2}E_t^{+s}\right)A(1+\frac{\partial n_t^+}{\partial N_{t-1}^-})\right] \qquad (34)\end{aligned}$$

Figure A7 shows that the effect of a rise in β on Q_t^+ is negligible compared with the effect of β on Q_t^- plotted in Figure A4 (this Figure is plotted for the same values of the parameters as Figure A4 and A5, so it includes different scenarios in which $a = 1$ and $a = A$).

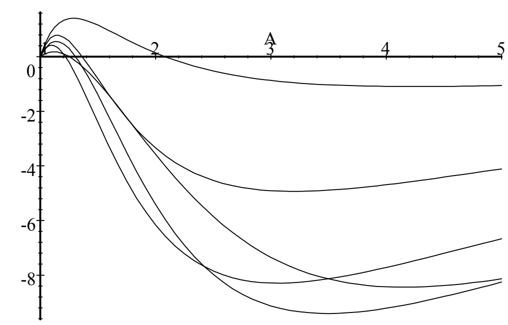

Figure A7

In fact, as the figure shows, the greater is A, the more likely the effect of a rise in β on Q^+ is negative. The reason is the following. Average employment in

[40] Note that $\frac{\partial Q}{\partial \beta}$ depends on two more variables than Figure A4, which are n_t^+ and Z^+. For the reason explained in footnote 38, we give an arbitrary value to $n_t^+ = 10$, and $Z^+ = 1$.

efficiency units in a boom E^+ equals (we consider $a = 1$, although the analysis also holds for $a = A$):

$$E^+ = (1-P)(1+P)E_t^{+u} + P^2 E_t^{+s}$$

Recalling that by (3) boom-time employment in efficiency units of labor must satisfy the condition $(1+\delta P)E_t^{+u} + \frac{(\delta P)^2}{1-\delta P} A E_{t+1}^{+s} = C$, where C is a constant, then we can write the effect of β on E^+ as

$$\frac{\partial E^+}{\partial \beta} = \left[(1-P)(1+P) + P^2 \left(-\frac{(1+\delta P)(1-\delta P)}{A(\delta P)^2}\right)\right] \frac{\partial E^{+u}}{\partial E^-} \frac{\partial E^-}{\partial \beta} \tag{35}$$

The expression for $\frac{\partial E^{+u}}{\partial E^-} = \frac{\partial n_t^+}{\partial E_{t-1}^-} + 1 = -\frac{1+\delta P + \frac{(\delta P)^2}{1-\delta P} A}{1+\delta P + \frac{(\delta P)^2}{1-\delta P} A^2} + 1 > 0$ (which implies that a rise in β that reduces E^- also reduces E_t^{+u}, and as a consequence, it increases E_{t+1}^{+s}). Thus (35) becomes negative when

$$\left[(1-P)(1+P) + \left(-\frac{(1+\delta P)(1-\delta P)}{A\delta^2}\right)\right] > 0$$

which means that $A > \frac{1-(\delta P)^2}{\delta^2(1-P^2)}$, i.e. the greater is A, the more likely $\frac{\partial E^+}{\partial \beta}$ is negative. Furthermore, the greater is A, the smaller is $\frac{\partial E^{+u}}{\partial E^-}$. ■

F Appendix: Proof of Proposition 3

Proof. (1.) Average product (productivity) in the recession equals $\frac{Q_t^-}{N_t^-} = AZ^- - \frac{c}{2} A^2 N_t^-$. A rise in β has the following effect on it:

$$\frac{\partial \left(\frac{Q_t^-}{N_t^-}\right)}{\partial \beta} = -\frac{c}{2} A^2 \frac{\partial N_t^-}{\partial \beta} > 0 \tag{36}$$

i.e. it is positive because a rise in β reduces N_t^-, as shown in section (1.) of Appendix C. Figure A8 plots $\frac{\partial \left(\frac{Q_t^-}{N_t^-}\right)}{\partial \beta}$ with respect to A (for the same values of the parameters as Figures 1, 2 and A4). This Figure shows that a rise in A makes $\frac{\partial \left(\frac{Q_t^-}{N_t^-}\right)}{\partial \beta}$ less positive, although this influence is negligible.

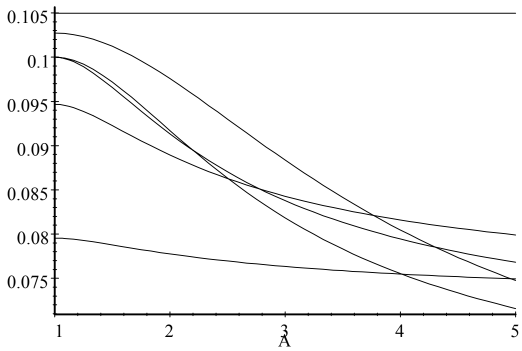

Figure A8

(2.) See the proof in section (2.) of Appendix C. Average product (productivity) in the boom equals Q^+ in (31) divided by L^+ (for simplicity, we consider that $a = 1$):

$$\frac{Q_t^+}{L^+} = (1 - P^2)\left(Z^+ - \frac{c}{2}E_t^{+u}\right)\frac{E_t^{+u}}{L^+} + P^2\left(Z^+ - \frac{c}{2}E_t^{+s}\right)\frac{E_t^{+s}}{L^+} \tag{37}$$

The effect of a rise in β equals:

$$\begin{aligned}\frac{\partial\left(\frac{Q^+}{L^+}\right)}{\partial\beta} &= \frac{\partial N_t^-}{\partial\beta}\left\{\left[-(1-P^2)\frac{E_t^{+u}}{L^+}\frac{c}{2}(A + \frac{\partial n_t^+}{\partial N_{t-1}^-}) - P^2A^2\frac{c}{2}(1 + \frac{\partial n_t^+}{\partial N_{t-1}^-})\right]\right. \\ &\left. + \left[(1-P^2)\left(Z^+ - \frac{c}{2}E_t^{+u}\right)\frac{(A + \frac{\partial n_t^+}{\partial N_{t-1}^-})L^+ - E_t^{+u}(1 + \frac{\partial n_t^+}{\partial N_{t-1}^-})}{(L^+)^2}\right]\right\}\end{aligned} \tag{38}$$

which is negative. Figure A9 plots $\frac{\partial\left(\frac{Q^+}{L^+}\right)}{\partial\beta}$ (y-axis) with respect to A (x-axis) for the same values of the parameters as Figures 1, 2, A7 and A8, and shows that $\frac{\partial\left(\frac{Q^+}{L^+}\right)}{\partial\beta}$ is negative (this Figure includes different scenarios in which $a = 1$ and $a = A$, where $P_1 = 0, a = 1$ is the lowest curve and $P_5 = 0.9, a = A$ is the highest one). This Figure also shows that a rise in A (that increases $-\frac{\partial n_t^+}{\partial N_t^-}$) magnifies the fall in boom-time productivity in response to an insider wage hike, unless the values of the parameters are such that both the increase in $(-\frac{\partial n_t^+}{\partial N_t^-})$ is very small (see Figure 1) and A is sufficiently large.

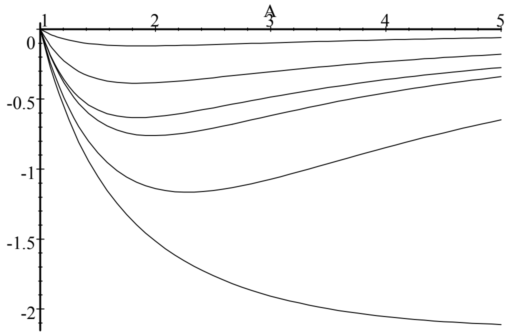

Figure A9

(3.) It follows from (1.) and (2.). Figure A10 plots the effect of a rise in β on average productivity $\frac{\partial\left(\frac{Q}{L}\right)}{\partial\beta} = \frac{1}{2}\left(\frac{\partial\left(\frac{Q^+}{L^+}\right)}{\partial\beta} + \frac{\partial\left(\frac{Q^-}{N^-}\right)}{\partial\beta}\right)$ (where $\frac{\partial\left(\frac{Q^+}{L^+}\right)}{\partial\beta}$ is in (38) and $\frac{\partial\left(\frac{Q^-}{N^-}\right)}{\partial\beta}$ is in (36)) with respect to A ($\frac{\partial\left(\frac{Q}{L}\right)}{\partial\beta}$ is in the y-axis and A is in the x-axis). This Figure is plotted for the same values of the parameters as Figures 1, 2, A8 and A9, where $P_1 = 0$, $a = 1$ is the lowest curve and $P_5 = 0.9, a = A$ is the highest one:

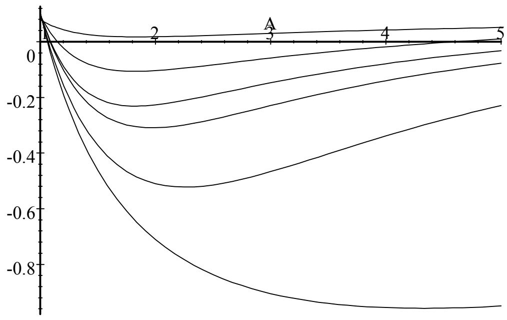

Figure A10

Figure A10 shows that a rise in A makes the effect of insider power β on average productivity $\frac{Q}{L}$ less positive. Using Figure 1, we can see that this occurs when the rise in A increases $(-\frac{\partial n_t^+}{\partial N_t^-})$ (unless both the increase in $(-\frac{\partial n_t^+}{\partial N_t^-})$ is very small and A is sufficiently large). This Figure also shows that this influence is more important when $a = 1$ and P is small.

(4.) An increase in insider power reduces average productivity when $\frac{\partial Q}{\partial\beta}L < Q\frac{\partial L}{\partial\beta}$. This expression implies that $-\frac{\partial n_t^+}{\partial N_{t-1}^-} > 2 - \frac{L}{Q}\frac{\partial Q}{\partial N_t^-}$, since $\frac{dQ}{d\beta} = \frac{dQ}{dN_t^-}\frac{dN_t^-}{d\beta}$ and using (12). Figure A10 shows that for sufficiently large A (since $-\frac{\partial n_t^+}{\partial N_{t-1}^-}$ is larger), $\frac{\partial\left(\frac{Q}{L}\right)}{\partial\beta}$ becomes negative. ■

G Appendix: Asymmetric Markov chain and nonlinear marginal product function

Consider the production function $Q_t^i = F^i\left(E_t^i\right),\ i = +,-\ ,\ F^{i\prime} > 0, F^{i\prime\prime} < 0$. Suppose that P^+ is the probability of remaining in a boom and P^- is the probability of remaining in a recession. (The long-run Markov probability of a boom is $\pi^+ = \frac{1-P^-}{(1-P^+)+(1-P^-)}$). In this context $\frac{\partial n_t^+}{\partial N_{t-1}^-}$ equals:

$$\frac{\partial n_t^+}{\partial N_{t-1}^-} = -\frac{A + \delta P^+ aAY + \frac{\left(\delta P^+\right)^2}{1-\delta P^+}A^2X}{1 + \delta P^+ a^2 Y + \frac{\left(\delta P^+\right)^2}{1-\delta P^+}A^2X} \tag{39}$$

where $Y = \frac{F^{+\prime\prime}\left(an_t^+ + AN_{t-1}^-\right)}{F^{+\prime\prime}\left(n_t^+ + AN_{t-1}^-\right)}$ and $X = \frac{F^{+\prime\prime}\left(An_t^+ + AN_{t-1}^-\right)}{F^{+\prime\prime}\left(n_t^+ + AN_{t-1}^-\right)}$. The $MRPL$ function is convex when $Y < 1$ and $X < 1$ and concave when $Y > 1$ and $X > 1$. The change of average employment when insider power increases is

$$\frac{\partial L}{\partial \beta} = \frac{\partial N_t^-}{\partial \beta}\left(1 + \pi^+ \frac{\partial n_t^+}{\partial N_{t-1}^-}\right) \tag{40}$$

On the one hand, observe that $\pi^+ \frac{\partial n_t^+}{\partial N_{t-1}^-}$ is greater the higher is π^+ and the more convex is the $MRPL$. When π^+ is sufficiently large and X and Y are sufficiently small, (40) is positive. On the other hand, now the denominator of $\frac{\partial N_t^-}{\partial \beta}$ depends directly on the magnitude of $F^{i\prime\prime}(\cdot)$. If the function is convex, a rise in A reduces the magnitude of $F^{i\prime\prime}(\cdot)$ and thus a rise in the amount of on-the-job training reduces to a lesser extent the number of people fired in the recession due to the increase in insider power.

References

Bertola, G., 1990, "Job Security, Employment and Wages", *European Economic Review* 34(4), 851-879.

Booth, A.L., 1997, "An Analysis of Firing Costs and their Implications for Unemployment Policy", in D. Snower and G. de la Dehesa, eds., *Unemployment Policy: Government Options for the Labor Market*, CEPR, London.

Burda, M.C., 1992, "A Note on Firing Costs and Severance Benefits in Equilibrium Unemployment", *Scandinavian Journal of Economics* 94(3), 479-489.

Díaz-Vázquez, P. and D. Snower, 2003, "Can Insider Power Affect Employment?", *German Economic Review* 4(2)*, 139-150.*

Fehr, E., 1989, "A Theory of Short- and Long-run Equilibrium Unemployment", *Journal of Economics (Zeitschrift fur Nationalokonomie)* 50(3), 201-222.

Fehr, E. and G. Kirchsteiger, 1994, "Insider Power, Wage Discrimination and Fairness"*, Economic Journal* 104(424), 571-583.

Frank, J., 1985, "Trade Union Efficiency and Overemployment with Seniority Wage Scales", *Economic Journal* 95, 1021-1034.

Frank, J. and J.M. Malcomson, 1994, "Trade Unions and Seniority Employment Rules", *European Economic Review* 38(8), 1595-1611.

Gottfries, N. and T. Sjostrom, 2000, "Insider Bargaining Power, Starting Wages and Involuntary Unemployment", *Scandinavian Journal of Economics* 102(4),669-688.

Lazear, E.P., 1990, "Job Security Provisions and Employment", *Quarterly Journal of Economics* 105(3), 699-726.

Lindbeck, Assar, and Dennis J. Snower, 1989, *The Insider-Outsider Theory of Employment and Unemployment*, Cambridge, Mass: MIT Press.

Lindbeck, Assar, and Dennis J. Snower, 2001, "Insiders versus Outsiders", *Journal of Economic Perspectives 15(1), 165-188.*

Vetter, H. and T. Andersen, 1994, "Do Turnover Costs Protect Insiders?", *Economic Journal* 104(422), 124-130.

IZA Discussion Papers

No.	Author(s)	Title	Area	Date
571	O. Ashenfelter M. Greenstone	Using Mandated Speed Limits to Measure the Value of a Statistical Life	5	09/02
572	C. Y. Co I. N. Gang M.-S. Yun	Self-Employment and Wage Earning: Hungary During Transition	4	09/02
573	R. T. Riphahn O. Serfling	Item Non-Response on Income and Wealth Questions	6	09/02
574	R. Kuhn S. Stillman	Understanding Interhousehold Transfers in a Transition Economy: Evidence from Russia	4	09/02
575	H. Antecol D. A. Cobb-Clark S. J. Trejo	Human Capital and Earnings of Female Immigrants to Australia, Canada, and the United States	5	09/02
576	M. Fertig C. M. Schmidt H. Schneider	Active Labor Market Policy in Germany – Is There a Successful Policy Strategy?	6	09/02
577	K. Ariga G. Brunello	Are the More Educated Receiving More Training? Evidence from Thailand	2	09/02
578	I. N. Gang F. L. Rivera-Batiz M.-S. Yun	Economic Strain, Ethnic Concentration and Attitudes Towards Foreigners in the European Union	1	09/02
579	I. N. Gang M.-S. Yun	Decomposing Inequality Change in East Germany During Transition	4	09/02
580	I. N. Gang J. Landon-Lane M.-S. Yun	Gender Differences in German Upward Income Mobility	1	09/02
581	P. Cahuc F. Malherbet	Unemployment Compensation Finance and Labor Market Rigidity	5	09/02
582	P. Cahuc C. Gianella D. Goux A. Zylberberg	Equalizing Wage Differences and Bargaining Power: Evidence from a Panel of French Firms	6	09/02
583	P. Cahuc F. Fontaine	On the Efficiency of Job Search with Social Networks	5	09/02
584	C. J. Heinrich P. R. Mueser K. R. Troske	Welfare to Temporary Work: Implications for Labor Market Outcomes	3	09/02
585	M. Cervellati U. Sunde	Human Capital Formation, Life Expectancy and the Process of Economic Development	3	09/02
586	P. Díaz-Vázquez D. Snower	On-the Job Training and the Effects of Insider Power	3	09/02

An updated list of IZA Discussion Papers is available on the center‘s homepage www.iza.org.