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ON-THE-JOB TRAINING AND THE EFFECTS OF INSIDER POWER

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

Pilar Díaz-Vázquez*and Dennis Snower†

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Abstract

Suppose insiders use their market power to push up their wages, while entrants receive their reservation wages. How will employment be affected? In addressing this question, we focus on the role of on-the-job training. We show that an insider wage hike reduces recession-time employment but, in the presence of on-the-job-training, increases boom-time employment. Thus on-the-job training can make insider wage hikes less detrimental to average employment (over booms and recessions). We show that when such training is sufficiently high and when economic shocks are sufficiently transient, an insider wage hike may even lead to a rise in average employment.

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

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1 Introduction

This paper explores the influence of the insider wage on employment when the incumbent workers of the firm (the insiders) have skills obtained through on-the-job training, so that insiders are more productive than entrants. In the literature on the employment effects of insider wages,[1] it is commonly assumed that all employees are homogenous. In this context, several authors have maintained that changes in insider wages leave a firm's total employment unchanged, provided that entrants receive their reservation wages. The reason, which looks obvious at first glance, is that any increase in the insider wage then leads to a counterveiling decrease in the entrant wage, so that the firm's present value of wage payments over a worker's expected job tenure remains unchanged. More recently, however, Díaz-Vázquez and Snower (2002) have shown that this result no longer holds in the presence of cyclical fluctuations of sufficient magnitude so that there is firing in downturns as well as hiring in upturns. Thus a rise in insider wages reduces average employment. 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 reduces insider profitability and, with it, insider employment. Thus far, however, the influence of skill acquisition on these phenomena has remained unexplored. This paper aims to fill this gap.

We show that on-the-job training plays a remarkable role, with striking policy implications. In the presence of on-the-job training, a rise in the insider wage actually *increases* boom-time employment, for the following reason.[2] As noted, the higher the insider wage, the fewer the insiders that firms will retain in a recession. In the subsequent upturn, these insiders need to be replaced by entrants. And the important point is this: the greater the amount of on-the-job training, the more productive are the current insiders relative to the entrants, and thus the more entrants are required to replace a given number of insiders. Thus, 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. This boom-time effect opens up the possibility that an insider wage hike may actually *increase* average employment. In short,

[1] See, for example, Bertola (1990), Booth (1996), Burda (1992), Díaz-Vázquez and Snower (2002), Fehr (1989), Fehr and Kirchsteiger (1994), Frank (1985), Frank and Malcomson (1994), Gottfries and Sjostrom (2000), Lazear (1990) and Vetter and Andersen (1994).

[2] By contrast, on-the-job training does not affect what happens in a downturn: a rise in the insider wage still reduces recession-time employment.

although insider wages have a direct, negative influence on employment, this may be outweighed by an indirect, positive influence operating via on-the-job training.

Naturally, the indirect, positive influence is able to dominate only when an insiders' productivity is sufficiently large relative to an entrants' productivity, over these workers' tenure at the firm, because then the number of entrants needed to replace each fired insider will be sufficiently large. Needless to say, when on-the-job training is low (i.e. when the insider-entrant productivity differential at any time t is low), the output generated by an insider is similar to that generated by an entrant, and thus the expected present value of revenue over the workers' tenure at the firm will be similar as well. Clearly, when the insiders and entrants are alike in this respect, an insider wage hike will not increase average employment.

Furthermore - and perhaps more surprisingly - when on-the-job training is high (i.e. when the insider-entrant productivity differential at any time t is large), the expected present value of revenue over an insider's and entrant's job tenure is also similar. The reason is that an entrant at time t, if retained, turns into an insider at time $t+1$. If an entrant's probability of being retained is sufficiently large, then the entrant will spend a relatively large part of his job tenure as an insider. The larger the insider's productivity (relative to an entrant), the more important is the insider's productivity (relative to the entrant's productivity) in determining the expected present value of revenue over an entrant's job tenure. Consequently, the more similar the expected present values of revenue for the entrant and insider become. Once again, when insiders and entrants are alike in this respect, the number of entrants that replace each fired insider is low and thus an insider wage hike will not lead to a rise in employment.

In sum, an insider wage hike leads to an increase in employment only if two conditions are fulfilled:

1. Economic shocks are not prolonged, and thus a current entrant cannot be expected to spend much of his job tenure as an insider.

2. The magnitude of on-the-job training must lie in an "intermediate range", so that the expected present value of revenue from an insider is large relative to that of an entrant.

These two conditions are of course not independent of one another. The more transient are the shocks, the larger is the intermediate range of insider-entrant productivity differentials under which an insider wage hike leads to a rise - rather than a fall - in employment.

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. Section 4 concludes.

2 The model

2.1 Underlying Assumptions

Consider an economy with a given number of identical firms. The economy is either in a boom (+) or in a recession (−). The probability of transition between these two states is given 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, the firms do no hiring or firing, retaining their insiders.

When a firm hires entrants, it pays a hiring cost of h (a positive constant) per worker. Entrants can be fired costlessly. If an entrant remains in the firm beyond one period of analysis (what may be called the "initiation period"), she becomes an "insider," whose position is associated with a firing cost f (a positive constant). On account of on-the-job training insiders are more productive than entrants. We also assume that the firm follows a last-in/first-out seniority rule for firing.[3]

The firm has the following production function:[4]

$$Q^i = Z^i \left(n_t^i + AN_t^i\right) - \frac{b}{2}\left(n_t^i + AN_t^i\right)^2, i = +, - \tag{1}$$

where Z^i is a stochastic variable that indexes business conditions (Z^+ in a boom and Z^- in a recession), N_t^i is the number of insiders, n_t^i is the number of entrants and A is the insider's productivity factor, $A \geq 1$. If $A = 1$, insiders

[3]For simplicity, we assume perfect competition in the product market, so that output equals revenue (in real terms). This assumption has no implications for the qualitative conclusions of this paper.

[4]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. By doing so, we ignore for the moment the influence of the curvature of the marginal product function on the effect of the insider wage on average employment.This influence is analysed in Appendix D, that extends the analysis for the production functions with nonlinear marginal product. We comment on the implications below.

and entrants are equally productive (*ceteris paribus*), whereas if $A > 1$, there is on-the-job training, so that insiders are more productive.

Since the paper focuses on the influence of the insider wage on employment, we do not need to specify the wage determination mechanism, so long as wages are predetermined when employment decisions are made. Instead, for simplicity, we take the insider wage as exogenously given: W^+ in a boom and W^- in a recession (both positive constants).[5] We assume that entrants have no bargaining power and receive the reservation wage r_t^+, i.e. the wage for which the entrant is indifferent between employment and unemployment.

2.2 Reservation wage

We now derive the entrant (reservation) wage, given the insider wages. When the entrant receives the reservation wage r_t, the present value of the expected incomes of an entrant, y_t, and an unemployed person, $\mathcal{Y}_t$, are equal:[6]

$$y_t = \mathcal{Y}_t \tag{2}$$

The expected income of an entrant y_t equals

$$y_t = r_t + \delta P Y_{t+1}^+ + \delta(1-P)\mathcal{Y}_{t+1} \tag{3}$$

In the current period the entrant receives income r_t; if the boom continues (with probability P), the entrant becomes an insider and receives the present value of the expected income as an insider Y_{t+1}^+ (δ is the discount factor); if the firm falls into a recession (with probability $1-P$), the worker receives the present value of an unemployed person income $\mathcal{Y}_{t+1}$.[7]

Similarly, the present value of the insider income Y_{t+1}^+ equals[8]

$$Y_{t+1}^+ = W^+ + \delta P Y_{t+2}^+ + \delta(1-P)\mathcal{Y}_{t+1} \tag{4}$$

where $Y_{t+1}^+ = Y_{t+2}^+$.[9] Let b be the unemployment benefit per period. Thus the present value of the income of an unemployed person $\mathcal{Y}_t$ is[10]

$$\mathcal{Y}_t = \mathcal{Y} = \frac{b}{1-\delta} \tag{5}$$

[5] The qualitative conclusions of this paper do not change if we consider that the insider wage is the outcome of a bargaining process.

[6] For simplicity, we assume that workers' utility is measured by their income.

[7] In our stationary two-stage Markov process, all entrants are fired in a downturn.

[8] Following the seniority rule for firing, the "junior" insider is the one fired if there is a recession in the following period.

[9] This follows from the stationary state corresponding to our Markov process.

[10] Observe that $b/(1-\delta)$ is equal to the income of a person that receives the unemployment benefit forever. We can derive the same expression more formaly. The present value

By equations (2), (3), (4) and (5), the reservation wage is

$$r_t = r = b - \frac{\delta P}{1-\delta P}(W^+ - b) \tag{6}$$

Thus, the entrant (reservation) wage is lower than the unemployment benefit b in an amount equal to the expected future income differential between an insider and an unemployed worker.

2.3 The Hiring Decision

In an upturn, the firm hires new entrants n_t^+ to maximize the present value of its profit. We focus on the hiring decision when the firm already has some incumbent workers (insiders) from the last recession N_{t-1}^-. Since wages are set before the employment decision is made, the firm makes its hiring decision given the entrant wage w^+ and the insider wage W^i, $i = +, -$. Thus, the hiring condition that determines total employment $n_t^+ + N_{t-1}^-$ is the solution of the following profit maximization problem:

$$\underset{n_t^+}{Max} Z^+ \left(n_t^+ + AN_{t-1}^-\right) - \frac{b}{2}\left(n_t^+ + AN_{t-1}^-\right)^2 - w^+ n_t^+ - W^+ N_{t-1}^- - hn_t^+ + \delta \Pi_{t+1}^e \tag{7}$$

where $Z^+ \left(n_t^+ + AN_{t-1}^-\right) - \frac{b}{2}\left(n_t^+ + AN_{t-1}^-\right)^2$ is revenue, $w^+ n_t^+ + W^+ N_{t-1}^- + hn_t^+$ is the firm's labor costs, and $\delta \Pi_{t+1}^e$ is expected future profit. The first-order condition for this problem is

$$\left[Z^+ - b\left(n_t^+ + AN_{t-1}^-\right)\right] - (w^+ + h) + \delta P \Pi_{t+1}^{++\prime} = 0 \tag{8}$$

i.e. the firm hires entrants until the present value of their expected marginal profitability is zero. $\left[Z^+ - b\left(n_t^+ + AN_{t-1}^-\right)\right] - (w^+ + h)$ is the profit that the entrant generates in the current period. With probability P economic conditions do not change and all the entrants become insiders, each generating the present value of expected marginal profit $\Pi_{t+1}^{++\prime}$ (where $^{++}$ means that the firm is in a boom in period t and in period $t+1$). (With probability $1-P$ economic conditions deteriorate and, following the seniority rule, the marginal

of an unemployed person's income in a boom equals:

$$\mathcal{Y}_t^+ = b + \delta P(1-u_{t+1})y_{t+1} + \delta P u_{t+1}\mathcal{Y}_{t+1}^+ + \delta(1-P)\mathcal{Y}_{t+1}^-$$

where u_{t+1} is the unemployment rate. Since $y_{t+1} = \mathcal{Y}_{t+1}^+$, and $\mathcal{Y}_t^i = \mathcal{Y}_{t+j}^i$, $i = +, -$ in the stationary state corresponding to our Markov process, thus $\mathcal{Y}^+ = b + \delta P \mathcal{Y}^+ + \delta(1-P)\ \mathcal{Y}^-$. Likewise, in a recession, $\mathcal{Y}^- = b + \delta P \mathcal{Y}^- + \delta(1-P)\ \mathcal{Y}^+$. Solving these two equations, we obtain equation (5).

entrant will be fired. This marginal entrant has no firing costs associated with her position so that the expected marginal profit in that downturn is zero.) The expected marginal profit $\Pi^{++\prime}_{t+1}$ equals

$$\Pi^{++\prime}_{t+1} = A\left[Z^{+} - b\left(An^{+}_{t} + AN^{-}_{t-1}\right)\right] - W^{+} + \delta P\ \Pi^{++\prime}_{t+2} + \delta(1-P)\ \Pi^{-\prime}_{t+2} \quad (9)$$

The term $A\left[Z^{+} - b\left(An^{+}_{t} + AN^{-}_{t-1}\right)\right] - W^{+}$ is the insider marginal profit in period $t+1$ (where the marginal revenue depends on total employment $n^{+}_{t} + N^{-}_{t-1}$ multiplied by A, since the entrants of period t have become insiders in period $t+1$); $\Pi^{++\prime}_{t+2}$ is the present value of expected marginal profit if the boom continues; and $\Pi^{-\prime}_{t+2} = -f$ is the marginal profit if a recession occurs and the worker is fired.[11] Since in the stationary equilibrium $\Pi^{++\prime}_{t+1} = \Pi^{++\prime}_{t+2}$, using equation (8), we can rewrite equation (9) as[12]

$$\begin{aligned}\Pi^{++\prime}_{t+1} &= h - (W^{+} - w^{+}) - \delta(1-P)f + \\ &A\left[Z^{+} - b\left(An^{+}_{t} + AN^{-}_{t-1}\right)\right] - \left[Z^{+} - b\left(n^{+}_{t} + AN^{-}_{t-1}\right)\right] \qquad (10)\end{aligned}$$

Substituting this equation (10) into (8), the marginal hiring condition becomes:

$$\begin{aligned}&\left[Z^{+} - b\left(n^{+}_{t} + AN^{-}_{t-1}\right)\right] - (w^{+} + h) + \delta P\left\{h - \left(W^{+} - w^{+}\right) - \delta(1-P)f + \right. \\ &\left. A\left[Z^{+} - b\left(An^{+}_{t} + AN^{-}_{t-1}\right)\right] - \left[Z^{+} - b\left(n^{+}_{t} + AN^{-}_{t-1}\right)\right]\right\} = 0 \qquad (11)\end{aligned}$$

When entrants receive the reservation wage in (6), the marginal hiring condition (11) becomes

$$\begin{aligned}&\left[Z^{+} - b\left(n^{+}_{t} + AN^{-}_{t-1}\right)\right] - b - h + \delta P\left\{h - \delta(1-P)f + \right. \\ &\left. A\left[Z^{+} - b\left(An^{+}_{t} + AN^{-}_{t-1}\right)\right] - \left[Z^{+} - b\left(n^{+}_{t} + AN^{-}_{t-1}\right)\right]\right\} = 0 \qquad (12)\end{aligned}$$

Since the number of insiders that the firm has from the last recession N^{-}_{t-1} is given at time t, the marginal hiring condition (12) determines the number of entrants n^{+}_{t}:

$$n^{+}_{t} = \frac{Z^{+} - b - h + \delta P\left[h - \delta(1-P)f + (A-1)Z^{+}\right]}{\left[(1-\delta P) + \delta P A^{2}\right] b} - \frac{A(1-\delta P) + \delta P A^{2}}{(1-\delta P) + \delta P A^{2}} N^{-}_{t-1} \qquad (13)$$

[11] $\Pi^{++\prime}_{t+1}$ is the present value of expected marginal profit once the marginal entrant of period t becomes an insider. If a recession occurs in period $t+2$, following the seniority rule for firing, this worker will be the first one to be fired. Since he has already become an insider, the firm pays a firing cost f.

[12] This equation shows that the marginal insider's profitability (when the boom persists) differs from the marginal entrant's profitability in the following respects: first, the cost of hiring the entrant h; second, the difference between the insider marginal revenue and the entrant marginal revenue; third, the cost of firing the insider in a future recession $-\delta(1-P)f$; and last (and this is the relevant difference for the issue of this paper) the difference between the insider wage and the entrant wage $(W^{+} - w^{+})$.

Thus total employment in a boom $M_t^+ = n_t^+ + N_{t-1}^-$ equals:

$$M_t^+ = \frac{Z^+ - b - h + \delta P \left[h - \delta(1-P) f + (A-1) Z^+\right]}{\left[(1-\delta P) + \delta P A^2\right] b} + \left(1 - \frac{A(1-\delta P) + \delta P A^2}{(1-\delta P) + \delta P A^2}\right) N_{t-1}^- \tag{14}$$

Observe that, when entrants receive the reservation wage, the insider wage disappears from the hiring condition (12). This means that the insider wage has no direct influence on boom-time employment in equation (14). The reason, of course, is that 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.

However, when $A > 1$ total employment in a boom in (14) depends on the number of insiders in the firm, which is equal to recession-time employment N_{t-1}^-. We show below that, although the insider wage has no direct influence on boom-time employment, it has an indirect influence via N_{t-1}^-. The reason why, in the presence of on-the-job training, boom-time employment M_t^+ depends on recession-time employment N_{t-1}^- is the following: since insiders are more productive than entrants in the presence of on-the-job training, each insider that is fired in a downturn needs to be replaced by more than one entrant in the next upturn, provided that $\delta P < 1$. Using equation (13), we find that

$$\frac{\partial n_t^+}{\partial N_{t-1}^-} = -\frac{A(1-\delta P) + \delta P A^2}{(1-\delta P) + \delta P A^2} \tag{15}$$

i.e. a fall in the number of insiders leads to the employment of a greater number of entrants, since $-A \square \frac{\partial n_t^+}{\partial N_{t-1}^-} < -1$ when $A > 1$.

2.4 The Firing Decision

The firm's firing decision is the outcome of the following profit maximization problem:[13]

$$\underset{N_t^-}{Max} \;\; Z^- \left(A N_t^-\right) - \frac{b}{2} \left(A N_t^-\right)^2 - W^- N_t^- - f\left(N_{t-1}^+ - N_t^-\right) + \delta \Pi_{t+1}^e \tag{16}$$

where $Z^- \left(A N_t^-\right) - \frac{b}{2}\left(A N_t^-\right)^2$ is revenue and $f\left(N_{t-1}^+ - N_t^-\right)$ is the firing cost. The first-order condition is

$$A\left[Z^- - b\left(A N_t^-\right)\right] - W^- + \delta P \, \Pi_{t+1}^{-\prime} + \delta(1-P)\, \Pi_{t+1}^{+\prime} = -f \tag{17}$$

[13] In the stationary equilibrium, all entrants are fired and the marginal worker is an insider.

i.e. the firm fires until the present value of the expected profitability of the marginal worker equals the firing cost f. In the current recession, the marginal insider's profit is $A\left[Z^{-}-b\left(AN_t^{-}\right)\right]-W^{-}$. If the recession continues (with probability P) the marginal profit is $\Pi_{t+1}^{-\prime}$, whereas if economic conditions improve (with probability $1-P$), the marginal profit will be $\Pi_{t+1}^{+\prime}$.

The insider marginal profit in an upturn $\Pi_{t+1}^{+\prime}$ equals:

$$\Pi_{t+1}^{+\prime}=A\left[Z^{+}-b\left(n_{t+1}^{+}+AN_t^{-}\right)\right]-W^{+}+\delta P\,\Pi_{t+2}^{++\prime}+\delta(1-P)\,\Pi_{t+2}^{-\prime} \quad (18)$$

where $A\left[Z^{+}-b\left(n_{t+1}^{+}+AN_t^{-}\right)\right]-W^{+}$ is the insider profitability in period $t{+}1$, $\Pi_{t+2}^{++\prime}$ is the present value of the insider profitability if the boom continues in period $t+2$ (with probability P) and $\Pi_{t+2}^{-\prime}=-f$ is the present value of the insider profitability if the economy goes into recession in $t+2$ (with probability $1-P$). Thus, from (18) and (8),[14] the insider's profitability in an upturn $\Pi_{t+1}^{+\prime}$ simplifies to[15]

$$\Pi_{t+1}^{+\prime}=h+(A-1)\left[Z^{+}-b\left(n_{t+1}^{+}+AN_t^{-}\right)\right]-(W^{+}-w^{+})-\delta(1-P)f \quad (19)$$

Note that if the firm remains in a recession in period $t+1$, then the marginal insider's expected profitability will continue to be equal to the firing cost ($\Pi_{t+1}^{-\prime}=-f$). Substituting this equation and the marginal insider's profitability in an upturn (19) into (17), we obtain the following marginal condition for firing:

$$\begin{aligned}&A\left[Z^{-}-b\left(AN_t^{-}\right)\right]-W^{-}-\delta Pf+\delta(1-P)\left\{h-\delta(1-P)f\right.\\&\left.-(W^{+}-w^{+})+(A-1)\left[Z^{+}-b\left(n_{t+1}^{+}+AN_t^{-}\right)\right]\right\}=-f\end{aligned} \quad (20)$$

When entrants receive the reservation wage in (6), the marginal condition for firing in (20) becomes:

$$\begin{aligned}&A\left[Z^{-}-b\left(AN_t^{-}\right)\right]-W^{-}-\delta Pf+\delta(1-P)\left\{h-\delta(1-P)f\right.\\&\left.-\frac{1}{1-\delta P}(W^{+}-b)+(A-1)\left[Z^{+}-b\left(n_{t+1}^{+}+AN_t^{-}\right)\right]\right\}=-f\end{aligned} \quad (21)$$

[14] We can write (8) as

$$\left[Z^{+}-b\left(n_{t+1}^{+}+AN_t^{-}\right)\right]-(w^{+}+h)+\delta P\Pi_{t+2}^{++\prime}=0$$

[15] As explained in footnote (12), one of the main differences between the marginal insider's profitability in an upturn and the entrant's marginal profitability is the difference between the insider and the entrant wage $(W^{+}-w^{+})$.

From (21) we can obtain total recession-time employment N_t^-:

$$N_t^- = \frac{AZ^- - W^- - \delta Pf + \delta(1-P)\left[h - \delta(1-P)f - \frac{W^+ - b}{1-\delta P} + (A-1)\left(Z^+ - b\varphi\right)\right]}{A^2 b + \delta(1-P)(A-1)(A + \frac{\partial n_t^+}{\partial N_{t-1}^-})b} \tag{22}$$

where φ is the first right-hand term of (13).[16] Observe that, even if entrants receive the reservation wage, the insider wage still has a direct influence on the marginal firing condition in a downturn, and thereby on employment N_t^-.

3 How on-the-Job Training Influences the Employment Effect of Insider Power

To understand how on-the-job training influences the employment effect of insider wages, it is useful to start by considering what would happen in the absence of any on-the-job training, so that entrants and insiders are equally productive: $A = 1$.

3.1 The Employment Effect in the Absence of on-the-Job Training

Consider the influence of the insider wages W^+ and W^- on employment N_t^- in a downturn. By the expression for total recession-time employment in (22), when $A = 1$, this influence is:

$$\frac{\partial N_t^-}{\partial W^-} + \frac{\partial N_t^-}{\partial W^+} = -\frac{1 + \frac{\delta(1-P)}{1-\delta P}}{b} < 0 \tag{23}$$

i.e. in the absence of on-the-job training, an increase in the insider wage (W^+ and W^-) reduces recession-time employment N_t^-. The reason is that the marginal worker in a downturn is an insider, who not only receives a higher wage in the downturn W^-, but also will receive a higher wage in future booms W^+.

[16] Observe that (21) also depends on n_{t+1}^+, which is determined by equation (13). We can write equation (13) as $n_{t+1}^+ = \varphi + \frac{\partial n_t^+}{\partial N_{t-1}^-} N_t^-$, where φ is the first right-hand term of (13) and $\frac{\partial n_t^+}{\partial N_{t-1}^-}$ is in (15). Substituting this into (21) and solving for N_t^-, we obtain the expression for recession-time employment in (22). Recall that the first right-hand term of (13), φ, does not depend on the insider wage.

In an upturn, however, it can be shown that, when $A = 1$, a rise in insider wages leaves the number of people employed unchanged . To see this, observe that there are two channels whereby insider wages could affect boom-time employment.

First is the "wage channel:" the insider wage hike could affect the expected present value of the firm's wage payments in an upturn and thereby influence boom-time employment. But this does not happen. As shown, the marginal worker in an upturn is an entrant, and the entrant receives the reservation wage.[17] Thus the insider wage hike leads to an equal reduction of the entrant wage (in present value terms), so that the firm's overall wage payments remain unchanged.[18]

The second channel is the "employment channel." As we have seen, the insider wage hike reduces insider employment N_{t-1}^- in a downturn; thus in the subsequent upturn, there will be fewer insiders around, which means that the firm will need to hire more entrants. In short, by (13), the number of entrants in a boom depends on the number of insiders in the previous recession:

$$\frac{\partial n_t^+}{\partial W^-} + \frac{\partial n_t^+}{\partial W^+} = \frac{\partial n_t^+}{\partial N_{t-1}^-} \left(\frac{\partial N_{t-1}^-}{\partial W^-} + \frac{\partial N_{t-1}^-}{\partial W^+} \right) \tag{24}$$

where $\frac{\partial n_t^+}{\partial N_{t-1}^-}$ is in equation (15). But when all the workers are equally productive ($A = 1$), one insider is replaced by one entrant, i.e. $\frac{\partial n_t^+}{\partial N_{t-1}^-} = -1$. Since neither the wage channel nor the employment channel are operative, the insider wage hike leaves boom-time employment unchanged.

In sum, in the absence of any on-the-job training, an insider wages hike reduces recession-time employment while leaves boom-time employment unchanged. Consequently average employment unambiguously falls when the insider wage rises.

3.2 The Employment Effect in the Presence of on-the-Job Training

When workers benefit from on-the-job training ($A > 1$), the result above changes in an important way. We show below that, with the introduction of on-the-job training, a given insider wage hike has an expansionary influence

[17] As equation (12) shows, when entrants receive the reservation wage the insider wages do not appear in the marginal hiring condition, and so they have no direct influence on the hiring decision.

[18] This "wage channel" is only operative when entrants do not receive the reservation wage. We analyse this case in Appendix B and comment on the implications below.

on boom-time employment, and may even lead to an increase in average employment over booms and recessions.

In the recession, the presence of on-the-job training does not change our qualitative result that an insider wage hike reduces recession-time employment. The reason is that the marginal worker in a recession is an insider who receives the insider wage W^- in the downturn, and will receive the insider wage W^+ in the subsequent upturn. We can show this using equation (22):

$$\frac{\partial N_t^-}{\partial W^+} + \frac{\partial N_t^-}{\partial W^-} = -\frac{1 + \frac{\delta(1-P)}{1-\delta P}}{A^2 b + \delta(1-P)(A-1)(A + \frac{\partial n_t^+}{\partial N_{t-1}^-})b} < 0 \tag{25}$$

(As this equation shows, the presence of on-the-job training does influence the size of the effect: the greater is A the less a given rise in the insider wage reduces employment N_{t-1}^-. The reason is that, when workers are more productive, a given increase in the wage cost becomes less relevant for the employment decision.)[19]

In an upturn, as we have seen, the insider wage does not affect the present value of the firm's wage payments but, in the presence of on-the-job training, the insider wage does affect insider employment and thereby also affects entrant employment in an upturn. The reason is simple. When insiders are more productive than entrants (due to the on-the-job training), each insider who is fired in a recession needs to be replaced by more than one entrant in the subsequent boom, as equation (15) shows. Thus, using equation (24), the effect of the insider wage on boom-time employment $M_t^+ = n_t^+ + N_{t-1}^-$ is:

$$\begin{aligned} \frac{\partial M_t^+}{\partial W^+} + \frac{\partial M_t^+}{\partial W^-} &= \left(\frac{\partial N_{t-1}^-}{\partial W^+} + \frac{\partial N_{t-1}^-}{\partial W^-}\right) + \left(\frac{\partial n_t^+}{\partial W^+} + \frac{\partial n_t^+}{\partial W^-}\right) \\ &= \left(\frac{\partial N_{t-1}^-}{\partial W^+} + \frac{\partial N_{t-1}^-}{\partial W^-}\right)\left(1 + \frac{\partial n_t^+}{\partial N_{t-1}^-}\right) \end{aligned} \tag{26}$$

which is positive, by equations (25) and (15). In sum, an insider wage hike reduces the number of insiders in a downturn N_{t-1}^-, and thus the firm needs to hire a larger number of entrants in the subsequent upturn. In this way, a rise in the insider wage leads to an increase in the number of people employed in a boom, $n_t^+ + N_{t-1}^-$.[20]

[19] Appendix A shows the influence that on-the-job training has on the effect of an insider wage hike on recession-time employment. Appendix B shows that these results also hold when entrants do not receive the reservation wage.

[20] Appendix A shows the influence that on-the-job training has on the effect of an insider wage hike on boom-time employment. When entrants do not receive the reservation wage, the effect of the insider wage hike on boom-time employment may also be positive (see Appendix B).

Note that the increase in boom-time employment that it is triggered by the wage hike is related directly to the reduction in employment that it generates in the recession. Nevertheless, the magnitude of this increase depends crucially on the number of entrants that replace each insider fired in the recession $-\frac{\partial n_t^+}{\partial N_{t-1}^-}$.

When the number of entrants that replace one insider $-\frac{\partial n_t^+}{\partial N_{t-1}^-}$ is sufficiently large, an insider wage hike may even lead to an *increase* in average employment.[21] For the symmetric two-state Markov chain, the average between boom-time employment $n_t^+ + N_{t-1}^-$ and recession-time employment N_t^- equals $M = N_t^- + \frac{1}{2}n_t^+$.[22] By equation (24), the influence of the insider wage on average employment is

$$\begin{aligned} \frac{\partial M}{\partial W^+} + \frac{\partial M}{\partial W^-} &= \left(\frac{\partial N_t^-}{\partial W^+} + \frac{\partial N_t^-}{\partial W^-}\right) + \frac{1}{2}\left(\frac{\partial n_t^+}{\partial W^+} + \frac{\partial n_t^+}{\partial W^-}\right) \\ &= \left(\frac{\partial N_t^-}{\partial W^+} + \frac{\partial N_t^-}{\partial W^-}\right)\left(1 + \frac{1}{2}\frac{\partial n_t^+}{\partial N_{t-1}^-}\right) \end{aligned} \tag{27}$$

Since $\frac{\partial N_t^-}{\partial W^+} + \frac{\partial N_t^-}{\partial W^-} < 0$ then an insider wage hike increases average employment when $-\frac{\partial n_t^+}{\partial N_{t-1}^-} > 2$, i.e. when the increase in entrants due to the loss of one insider is greater than 2.[23]

The increase in entrants due to the loss of one insider $-\frac{\partial n_t^+}{\partial N_{t-1}^-}$ depends on the insiders' productivity relative to the entrants' productivity, over these workers' tenure at the firm.[24] 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 one insider is low. However, when the insiders' expected present value of revenue is large relative to the entrants', the number of entrants that replace one insider may be greater than 2, and thus the

[21] When entrants do not receive the reservation wage, average employment unambiguously falls with an insider wage hike in the absence of on-the-job training, whereas it may rise in the presence of on-the-job training (see Appendix B).

[22] We are assuming symmetric Markov transition probabilities, so that the long-run Markov probabilities of boom and recession when $t \to \infty$ are $\frac{1}{2}$. Since long-run employment is calculated for $t \to \infty$, thus, what happens in the first period of the firm (when it is created and it has no insiders) becomes irrelevant. We can then approximate average employment with this expression $M = \frac{1}{2}N_t^- + \frac{1}{2}\left(n_t^+ + N_t^-\right) = N_t^- + \frac{1}{2}n_t^+$.

[23] This cutoff point of $-\frac{\partial n_t^+}{\partial N_{t-1}^-} = 2$ holds for symmetric Markov processes. It is easy to generalize this result for asymmetric processes. We do it in Appendix C.

[24] Observe in (15) that the numerator is the effect that the marginal insider has on the present value of the marginal profitability in (12), and the denominator is the effect that the marginal entrant has on the present value of the marginal profitability.

positive influence on boom-time employment dominates. In what follows we explain under which circumstances this may occur.

When on-the-job training is sufficiently low (i.e. when the insider-entrant productivity differential at any time t is low), the output generated by an insider is similar to that generated by an entrant, and thus the expected present value of revenue over the workers' tenure at the firm will be similar as well. As a consequence, the number of entrants that replace one insider is low, as we can see in equation (15). This implies that the positive influence of an insider wage hike may dominate (and thus an insider wage hike increases average employment) only when A is sufficiently large.[25]

Furthermore, it can be shown that the expected present value of revenue over an insider's and entrant's job tenure is also similar when on-the-job training is sufficiently high. The more important is the insider's productivity (relative to the entrant's productivity) in determining the expected present value of revenue over an entrant's job tenure, the more similar the expected present values of revenue for the entrant and insider become.[26] Consequently, the number of entrants that replace each fired insider will be low, and an insider wage hike will not lead to a rise in employment. There are two conditions under which this happens.

On the one hand, if an entrant's probability of being retained is sufficiently large (i.e. economic shocks are suficiently prolonged), then the entrant will spend a relatively large part of his job tenure as an insider. The more prolonged the economic shocks (and the greater is the discount factor δ), the fewer entrants replace one insider (i.e. the lower is $-\frac{\partial n_t^+}{\partial N_{t-1}^-}$, as equation (15) shows), for any given amount of on-the-job training (A).[27] On the other hand, if the insider productivity A is sufficiently large, then the

[25] As we can see in the expression for the entrant's current revenue $\left[Z^+ - b\left(n_t^+ + AN_{t-1}^-\right)\right]$), only when A is sufficiently large, the number of entrants that replace an insider may be large.

[26] Recall that an entrant at time t, if retained, turns into an insider at time $t+1$.

[27] To see how the number of entrants that replace an insider depends on the probability of switching economic states, suppose that there is no time discounting ($\delta = 1$), and consider the following two extreme cases: 1) If the shock is so transient that the entrant remains with the firm for only one period - i.e. P approches zero - then the marginal condition in equation (12) reduces to $\left[Z^+ - b\left(n_t^+ + AN_{t-1}^-\right)\right] - (b+h) - f = 0$. Thus the number of entrants that replace an insider is equal to $A : \frac{\partial n_t^+}{\partial N_{t-1}^-} = -A$. 2) If the shock is so prolonged that the worker remains with the firm forever - i.e. P approches one - then (in the absence of discounting) the entrant's profitability in the current period is a negligible fraction of the firm's present value of profits and thus the marginal condition becomes $A\left[Z^+ - b\left(An_t^+ + AN_{t-1}^-\right)\right] - b = 0$. Consequently one insider is replaced by one entrant, so that boom-time employment remains unchanged: $\frac{\partial n_t^+}{\partial N_{t-1}^-} = -1$.

insider's productivity (relative to the entrant's productivity) becomes more important in determining the expected present value of revenue over an entrant's job tenure.[28] Consequently, the expected present values of revenue for the entrant and insider become similar and thus the number of entrants that replace each fired insider is low.[29]

In sum, $-\frac{\partial n_t^+}{\partial N_{t-1}^-} > 2$ when:

1. economic shocks are not prolonged (i.e. P is sufficiently low), and thus a current entrant cannot be expected to spend much of her job tenure as an insider; and

2. the magnitude of on-the-job training A lies in an "intermediate range", so that the expected present value of revenue from an insider is large relative to that of an entrant.

Before showing the specific values of P and A for which $-\frac{\partial n_t^+}{\partial N_{t-1}^-} > 2$, and thus for which an insider wage hike increases average employment, we illustrate these two conditions in Figure 1.

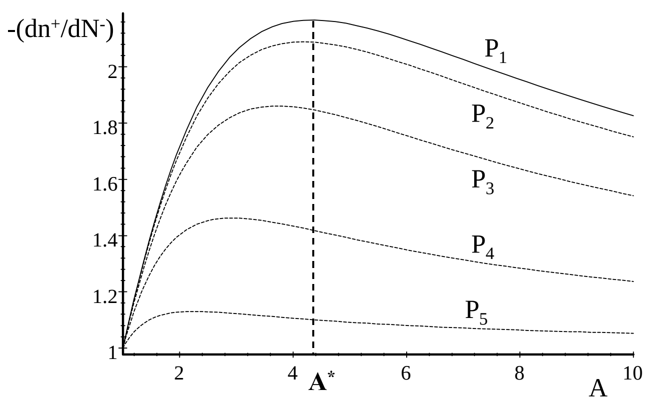

Figure 1. The influence of the amount of on-the-job training on the number of entrants that replace one insider (for several values of P)

[28] The more on-the-job training insiders do, the higher is the expected future revenue of an entrant (once she becomes an insider) $A\left[Z^+ - b\left(An_t^+ + AN_{t-1}^-\right)\right]$ relative to the entrant's current revenue $\left[Z^+ - b\left(n_t^+ + AN_{t-1}^-\right)\right]$. The more important is future expected revenue relative to current revenue in the marginal entrant's profitability, the fewer entrants will replace one insider.

[29] This is also evident in (15).

This figure shows how A and P affect $-\frac{\partial n_t^+}{\partial N_{t-1}^-}$, and has been plotted for ascending values of P: $P_1 = 0.1$, $P_2 = 0.11$, $P_3 = 0.15$, $P_4 = 0.3$ and $P_5 = 0.7$. (In all cases, $\delta = 0.9$.) Note that the number of entrants that replace one insider $-\frac{\partial n_t^+}{\partial N_{t-1}^-}$ is lower the more prolonged are the shocks. In fact, only for P_1 and P_2 in the figure may $-\frac{\partial n_t^+}{\partial N_{t-1}^-} > 2$. For these two curves, the number of entrants that replace one insider is greater than 2 when A lies in an intermediate range of values. [30] The figure also shows that the two conditions above are not independent of one another. The more transient are the shocks, the larger is the intermediate range of insider-entrant productivity differentials under which $-\frac{\partial n_t^+}{\partial N_{t-1}^-} > 2$.

Equation (15) implies that the effect of the wage hike on average employment is positive (i.e. $-\frac{\partial n_t^+}{\partial N_{t-1}^-} > 2$) when A falls within the interval $c < A < d$, where

$$c = \frac{(1-\delta P) - D}{2\delta P} \qquad\qquad d = \frac{(1-\delta P) + D}{2\delta P} \tag{28}$$

and $D = \sqrt{(1-\delta P)^2 - \delta P 8(1-\delta P)}$.[31] Observe that this interval (c, d) does not exist when δP is greater than or equal to a threshold value $(\delta P)^* = 1/9$.[32] Thus when $\delta P > (\delta P)^*$ an insider wage hike reduces average employment (for any A).[33]

[30] Observe in Figure 1 that for curve P_1 the number of entrants that replace one insider reaches its maximum for A^*. For $A < A^*$ a rise in A increases $-\frac{\partial n_t^+}{\partial N_{t-1}^-}$, and for $A > A^*$ a rise in A reduces $-\frac{\partial n_t^+}{\partial N_{t-1}^-}$. The proof is the following. Differentiating (15) with respect to A, we can see the influence of a rise in A on $-\frac{\partial n_t^+}{\partial N_{t-1}^-}$: $-\frac{\partial^2 n_t^+}{\partial N_{t-1}^- \partial A} = 1 - \delta P \frac{A\left[(1-\delta P)(3A-2)+\delta P A^3\right]}{[1+\delta P(A^2-1)]^2}$. The first right-hand term is the influence of A via current revenue, which is positive. The second right-hand term is the influence of A via future expected revenue, and it is negative. From this expression we can see that a rise in A increases the number of entrants that replace an insider (i.e. $-\frac{\partial^2 n_t^+}{\partial N_{t-1}^- \partial A} > 0$), when A is smaller than a threshold value $A^* = 1 + \sqrt{\delta P}/\delta P$, whereas a rise in A reduces the number of entrants that replace an insider (i.e. $-\frac{\partial^2 n_t^+}{\partial N_{t-1}^- \partial A} < 0$) when $A > A^*$.

[31] These critical values c and d are the roots of $-\frac{\partial n_t^+}{\partial N_{t-1}^-} = 2$, which by equation (15) is equal to $\delta P A^2 - (1-\delta P)A + 2(1-\delta P) = 0$.

[32] The interval (c, d) does not exist when $(1-\delta P)^2 - \delta P 8(1-\delta P) \ \square\ 0$, i.e. when $\delta P \geq 1/9$.

[33] Furthermore, observe that c is greater than 2. Provided that the Markov process is symmetric, and recalling that $1 \ \square\ -\frac{\partial n_t^+}{\partial N_{t-1}^-} \ \square\ A$ (i.e. the level of on-the-job training is the upper limit for the number of entrants that replace one insider), if $A \ \square\ 2$ an insider wage

In Figure 2 we represent the relationship between the effect of an insider wage hike on average employment, and the level of on-the-job training A. This figure has been plotted for the values of P: $P_1 = 0.1$, $P_2 = 0.11$ and $P_3 = 0.15$ (in all the cases $\delta = 0.9$).[34] The upper curves labeled P_1 and P_2 are plotted for values of δP smaller than $(\delta P)^*$, whereas the lower curve labeled P_3 is plotted for a value larger than $(\delta P)^*$. As the figure shows for curve P_1, when $\delta P < (\delta P)^*$ there exists a range (c, d) of values of A (where $c > 2$), for which the effect of an insider wage hike on average emploment is positive. Curve P_2 has been plotted to illustrate that the interval (c, d) becomes smaller the greater is δP.

Figure 2. The influence of on-the-job training on the effect of an insider wage hike on average employment (for three values of P).

Figure 2 also shows that when A is smaller than a critical value e,[35] a rise in A makes the effect of an insider wage hike on average employment more expansionary, whereas when $A > e$, a rise in A makes the effect of an insider wage hike on average employment more contractionary. The reason is that when $A < e$, a rise in A increases the number of entrants that replace one insider, while when $A > e$ the influence of A via the number of entrants that

hike must reduce average employment (for any δP).

[34] In Figure 2, the parameter b takes the value $b = 0.01$. The specific value of b does not affect the sign of the effect of a wage hike.

[35] This critical value e has been plotted for P_1 in Figure 1 (the specific value of e depends on P).

replace one insider is either not strong enough or has already disappeared.[36]

In summary, our model shows that the magnitude and the direction of the effect of a wage hike on average employment depends crucially on the level of on-the-job training. We can generalize this model for asymmetric Markov processes. This is done in Appendix C, where we show that the more frequently the economy is in booms, the greater is the interval (c, d), and the more prolonged need to be the booms for the effect of the insider wage hike on average employment to become negative. The reason is the following: since an insider wage hike has a positive effect on boom-time employment, the more frequently the firm is in booms, the more likely is that for a given A the insider wage hike also increases average employment.

In Appendix D we also generalize the model for nonlinear marginal product of labor functions, and we show that the more convex or the less concave is the marginal product function, the greater is the interval (c, d), and the more prolonged need to be the shocks for the effect of the wage hike on average employment to become negative.

[36] That is, for a rise in A to make the effect of the insider wage on average employment more expansionary it must not only increase the number of entrants that replace an insider but such an increase has to be sufficiently large. We can see this differentiating (27) with respect to A: $\frac{\partial^2 M}{\partial W^+ \partial A} + \frac{\partial^2 M}{\partial W^- \partial A} = \left(\frac{\partial^2 N_t^-}{\partial W^+ \partial A} + \frac{\partial^2 N_t^-}{\partial W^- \partial A} \right) \left(1 + \frac{1}{2} \frac{\partial n_t^+}{\partial N_{t-1}^-} \right) + \left(\frac{\partial N_t^-}{\partial W^+} + \frac{\partial N_t^-}{\partial W^-} \right) \frac{1}{2} \frac{\partial^2 n_t^+}{\partial N_{t-1}^- \partial A}$. When the effect of the insider wage on average employment is positive, $\left(1 + \frac{1}{2} \frac{\partial n_t^+}{\partial N_{t-1}^-} \right)$ is negative and the first right-hand additive term is negative (see equation (27) and the argument there). In this situation $\frac{\partial^2 M}{\partial W^+ \partial A} + \frac{\partial^2 M}{\partial W^- \partial A}$ can only be positive when $\frac{\partial^2 n_t^+}{\partial N_{t-1}^- \partial A}$ is negative and when it is large enough to dominate, i.e. to make the absolute value of the second additive term in the expression above larger than that of the first additive term. In particular, $\frac{\partial^2 M}{\partial W^+ \partial A} + \frac{\partial^2 M}{\partial W^- \partial A} = 0$ (the effect of the insider wage hike on average employment reaches its maximum value) for a level of $A = e$ for which $\frac{\partial^2 n_t^+}{\partial N_{t-1}^- \partial A}$ is still negative. This implies that e in Figure 2 is smaller than A^* in Figure 1. The fact that a rise in A makes the effect of an insider wage hike on average employment more expansionary when $A < e$ does not mean that for $A < e$ a rise in A makes the effect of an insider wage hike on boom-time employment more expansionary. Appendix A shows that for a range of values of $A < e$, a rise in A weakens both the negative recession-time effect and the positive boom-time effect. However, the former influence of A is stronger than the latter because for $A < e$ the number of entrants that replace an insider increases with A.

4 Conclusion

Our analysis has shown that the level of on-the-job training can have a major influence on the effect that an increase in the insider wages has on average employment. Depending on how prolonged are the shocks that the firms anticipate, the level of on the job training may affect not only the magnitude but also the direction of the effect of an insider wage hike on employment.

Insider wages have an influence on the firm´s firing and hiring decisions: the higher the wages of the insiders, the less of them the firm will want to keep in a recesion and, as a consequence, hiring will be higher in the recovery. This behaviour is irrelevant for boom-time employment when there is no on-the-job training (so that insiders and entrants have the same productivity). But in the presence of on-the-job training (causing insiders' productivity to exceed that of entrants), insiders who are fired in a slump may need to be replaced by more entrants in the following boom.

This paper shows that when economic shocks are sufficiently transient and the level of on-the-job training is large enough to make the insider-entrant productivity differential fall within an intermediate range, the impact of an insiders wage hike on average employment is positive, since the number of entrants that replace an insider is high. Specifically, the number of entrants hired in a boom more than offsets the reduction in insiders during the recesion due to an increase in the insider wage.

The paper also shows that the range of values of the insider-entrant productivity differential for which the insider wage hike has an expansionary effect on employment increases, first, as the economic shocks become more transient, second, as the probability of booms in the economy increases (relative to recessions), and third, as the marginal product of labor function becomes more convex or less concave.

A Appendix: The influence of on-the-job training on the effect of an insider wage hike on boom-time employment and recession-time employment

Figure 3 represents the relationship between the level of on-the-job training A (in the x-axis) and the effect of an insider wage hike on employment in booms (upper quadrant) and recessions (lower quadrant). (This figure has been plotted for the values of P: $P_1 = 0.1$, $P_4 = 0.3$ and $P_5 = 0.7$. In all the cases $\delta = 0.9$ and $b = 0.01$).[37]

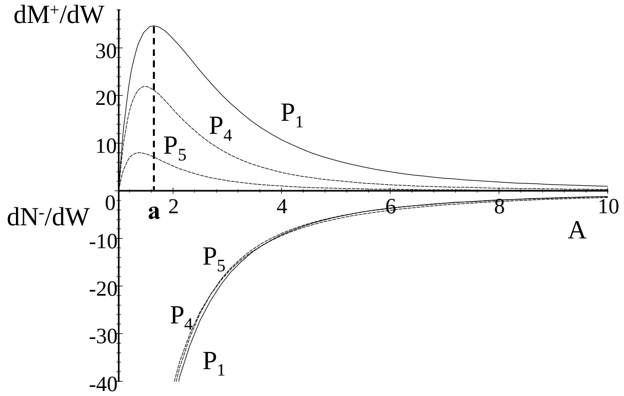

Figure 3. The influence of on-the-job training on the employment effect of an insider wage hike in booms (upper quadrant) and recessions (lower quadrant) (for three different values of P).

We can see in Figure 3 that a rise in A makes the effect of an insider wage hike on boom-time employment more expansionary only when $A < a$ (for P_1), which is smaller than e (in Figure 2). As Figure 3 shows, for $a < A$ a rise in A weakens both, the negative recession-time effect (in the lower quadrant) and the positive boom-time effect of the insider wage hike on employment. However, the former influence of A is stronger than the latter in the interval $a < A < e$. What happens within this interval is that the number of entrants that replace an insider still increases with A,[38] and that the magnitude of the increase is such that a rise in A weakens the positive boom-time effect of the insider wage hike by less than it weakens the negative recession-time effect (as Figure 2 shows, this occurs when $c < A < e$ but not when $e < A < d$).

Recall by equation (26) that the increase in boom-time employment due to an insider wage hike is equal to the reduction in the number of insiders in the recession due to the insider wage hike $\left(\frac{\partial N_{t-1}^-}{\partial W^+} + \frac{\partial N_{t-1}^-}{\partial W^-}\right)$ multiplied by

[37]The value of b does influence the magnitude of the effects, but it does not influence the relative size of the effect of an insider wage hike in booms and recessions.

[38]In footnote 36 we have proved that e in Figure 2 (the value of A from which a rise in A makes the effect of the insider wage hike on average employment less expansionary) is smaller than A^* in Figure 1 (the value of A from which a rise in A reduces the number of entrants that replace one insider).

$\left(1 + \frac{\partial n_t^+}{\partial N_{t-1}^-}\right)$. If the number of entrants that replace one insider $\frac{\partial n_t^+}{\partial N_{t-1}^-}$ were constant (independent of A), a rise in A would make less expansionary the the effect of the insider wage hike on boom-time employment, since it makes less contractionary the effect of an insider wage hike on recession-time employment. (A rise in A diminishes the number of insiders that are fired in the recession, so there are less insiders to be replaced in the boom. This always tends to make the boom-time effect of the wage hike less expansionary.)

However, as Figure 1 shows, the number of entrants that replace one insider depends on A. This is the reason why a rise in A does not have a symmetric influence in booms and recessions, as we can see in Figure 3. Observe that although for $A < A^*$ in Figure 1 a rise in A increases the number of entrants the replace one insider, only for $A < a$ in Figure 3, it makes the boom-time effect of the wage hike more expansionary. Thus in the interval $a < A < A^*$ the increase in the number of entrants that replace one insider only acts as a countervailing force that weakens the effect of the other factor that tends make the boom-time effect of the wage hike less expansionary. Nevertheless, as we have seen, this influence of A via the number of entrants that replace one insider is decisive to make the effect of insider power in the boom greater than the effect in the recession, and thereby to increase average employment.

We also observe in Figure 3 that the influence of the persistence of the shocks is much greater in booms than in recessions. The more persistent are the economic shocks, the smaller is the increase in boom-time employment relative to the decrease in recession-time employment (for any value of A). The reason, once again, is that the more persistent are the economic shocks, the fewer entrants replace one insider.

B Appendix: Entrants receive a constant wage

When entrants receive a constant wage, the "wage channel" is operative in a boom, in contrast to what happens if the entrant receives the reservation wage: since the entrant's wage is a constant, an increase in the future expected insider wages reduces the hiring of new entrants today. By equation (11), in an upturn this effect via the "wage channel" equals:

$$\frac{\partial n_t^+}{\partial W^+} + \frac{\partial n_t^+}{\partial W^-} = -\frac{\delta P}{[1 + \delta P(A^2 - 1)]\, b} < 0 \tag{29}$$

In this appendix we show that the influence of on-the-job training on the employment effect of insider power is similar to the one that exists when entrants receive the reservation wage:

First, the effect of an insider wage hike on recession-time employment is negative and the existence of on-the-job training A makes less contractionary this effect. By equation (20), the effect of the insider wages in a recession when the entrant wage w^+ is a constant equals

$$\frac{\partial N_t^-}{\partial W^+} + \frac{\partial N_t^-}{\partial W^-} = \frac{-\left[1+\delta(1-P)\right] - \delta(1-P)(A-1)\left(\frac{\partial n_t^+}{\partial W^+} + \frac{\partial n_t^+}{\partial W^-}\right)b}{A^2 b + \delta(1-P)(A-1)(A + \frac{\partial n_t^+}{\partial N_{t-1}^-})b} < 0 \tag{30}$$

Recall that a rise in A increases the denominator in absolute value, which weakens this effect. Additionally, since now entrants receive a constant wage, there is another term in the numerator $-\delta(1-P)(A-1)\left(\frac{\partial n_t^+}{\partial W^+} + \frac{\partial n_t^+}{\partial W^-}\right)$. This term, using (29), is equal to $\frac{\delta(1-P)(A-1)\delta P}{1+\delta P(A^2-1)}$, which is positive and smaller than one. So it also reduces the negative influence of the insider wage on recession-time employment. (The reason is that an increase in the insider wage reduces the number of entrants in a future upturn, which, in turn, increases the future expected marginal profitability of the current insiders; the greater is A the larger is this increase.)

Second, the effect of the insider wage on boom-time employment may be less contractionary or more expansionary when there is on-the-job training than when there is not. When $A = 1$, the influence of the insider wage on the number of entrants is only via the "wage channel" in equation (29), i.e. it is negative. When $A > 1$, the influence of the insider wage is

$$\begin{aligned}&\left(\frac{\partial N_{t-1}^-}{\partial W^+} + \frac{\partial N_{t-1}^-}{\partial W^-}\right) + \left(\frac{\partial n_t^+}{\partial W^+} + \frac{\partial n_t^+}{\partial W^-}\right) = \\ &\left(\frac{\partial n_t^+}{\partial W^+} + \frac{\partial n_t^+}{\partial W^-}\right) + \left(\frac{\partial N_{t-1}^-}{\partial W^+} + \frac{\partial N_{t-1}^-}{\partial W^-}\right)\left(1 + \frac{\partial n_t^+}{\partial N_{t-1}^-}\right)\end{aligned} \tag{31}$$

i.e. additionally to the negative effect via the "wage channel", there is an effect via the "employment channel", which is positive.

Thus, average employment may rise with the the insider wage when there is on-the-job training (if the positive effect via the "employment channel" in a boom is sufficiently strong), whereas average employment unambiguously decreases with the insider wage when there is no on-the-job training (when the entrant receives a constant wage, the effect via the "wage channel" is negative both in a boom and in a recession).

C Appendix: Asymmetric Markov chain

Suppose that the probability P^+ of remaining in a boom differs from the probability P^- of remaining in a recession. Then the change of average employment when the insider wage increases is

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

where π^+ is the long-run Markov probability of a boom. (The expression for this probability is $\pi^+ = \frac{(1-P^-)}{(1-P^+)+(1-P^-)}$.) The effect of the wage hike on average employment is positive when $-\frac{\partial n_t^+}{\partial N_{t-1}^-} > \frac{1}{\pi^+}$. Thus the more frequently the economy is in booms the smaller needs to be the increase in boom-time employment for average employment to rise.

The interval (c, d) is determined by $-\frac{\partial n_t^+}{\partial N_{t-1}^-} = \frac{1}{\pi^+}$. As in equation (15), $\frac{\partial n_t^+}{\partial N_{t-1}^-}$ equals

$$\frac{\partial n_t^+}{\partial N_{t-1}^-} = -\frac{A(1-\delta P^+)+\delta P^+ A^2}{(1-\delta P^+)+\delta P^+ A^2}$$

Thus $-\frac{\partial n_t^+}{\partial N_{t-1}^-} = \frac{1}{\pi^+}$ is satisfied when $\delta P^+ A^2(1-\pi^+) - (1-\delta P^+)\pi^+ A + (1-\delta P^+) = 0$, and the roots are:

$$c = \frac{(1-\delta P^+)\pi^+ - D}{2\delta P^+(1-\pi^+)} \qquad d = \frac{(1-\delta P^+)\pi^+ + D}{2\delta P^+(1-\pi^+)}$$

where $D = \sqrt{\pi^{+2}(1-\delta P^+)^2 - \delta P^+ 4(1-\delta P^+)(1-\pi^+)}$. We can see that the more frequently the economy is in booms relative to recessions, the greater is the interval (c, d), since D increases with π^+.

The threshold value $(\delta P^+)^*$ is the one for which $c = d$ (for $\delta P^+ > (\delta P^+)^*$, the effect of the insider wage hike on average employment is negative for any A). $c = d$ is satisfied when $D = 0$, i.e. when $\pi^{+2}(1-\delta P^+) - \delta P^+ 4(1-\pi^+) = 0$. Thus the more frequently the economy is in booms, the greater is the threshold value $(\delta P^+)^*$.

D Appendix: Conditions under which average employment increases with the insider wage when the marginal product is nonlinear

In this appendix we show the following: first, that the interval (c,d) for which the effect of an insider wage hike on average employment is positive is greater, the greater is the convexity or the smaller is the concavity of the marginal product of labor function; and second, that the threshold value $(\delta P)^*$ is greater the greater is the convexity or the smaller is the concavity of the marginal product of labor function.

Consider the production function:

$$Q^i = F^i\left(n_t^i + AN_t^i\right), i = +, - \tag{32}$$

with positive and diminishing returns to labor: $F^{i\prime} > 0$, $F^{i\prime\prime} < 0$. When entrants receive the reservation wage in (6), the hiring condition in equation (11) equals

$$\begin{aligned}&F^{+\prime}(n_t^+ + AN_{t-1}^-) - (b+h) + \delta P\{h+ \\ &\left[AF^{+\prime}\left(A\left(n_t^+ + N_{t-1}^-\right)\right) - F^{+\prime}(n_t^+ + AN_{t-1}^-)\right] - \delta(1-P)f\} = 0\end{aligned} \tag{33}$$

whereas the firing condition in equation (20) equals

$$\begin{aligned}&AF^{-\prime}(AN_t^-) - W^- - \delta Pf + \delta(1-P)\left[h + (A-1)F^{+\prime}(n_{t+1}^+ + AN_t^-)\right. \\ &\left.-\frac{1}{1-\delta P}(W^+ - b) - \delta(1-P)f\right] = -f\end{aligned} \tag{34}$$

A marginal product of labor function is convex when $F^{+\prime\prime}\left(A\left(n_t^+ + N_{t-1}^-\right)\right) > F^{+\prime\prime}(n_t^+ + AN_{t-1}^-)$ (and concave when $F^{+\prime\prime}\left(A\left(n_t^+ + N_{t-1}^-\right)\right) < F^{+\prime\prime}\left(n_t^+ + AN_{t-1}^-\right)$).

By equation (33), the number of entrants that replace an insider $\frac{\partial n_t^+}{\partial N_{t-1}^-}$ equals:

$$\frac{\partial n_t^+}{\partial N_{t-1}^-} = -\frac{A(1-\delta P)F^{+\prime\prime}(n_t^+ + AN_{t-1}^-) + \delta PA^2F^{+\prime\prime}\left(A\left(n_t^+ + N_{t-1}^-\right)\right)}{(1-\delta P)F^{+\prime\prime}(n_t^+ + AN_{t-1}^-) + \delta PA^2F^{+\prime\prime}\left(A\left(n_t^+ + N_{t-1}^-\right)\right)} < -1 \tag{35}$$

For symmetric Markov processes, an insider wage hike increases average employment when $-\frac{\partial n_t^+}{\partial N_{t-1}^-} > 2$. This occus when A is in the interval (c,d), where c and d are the solutions of $-\frac{\partial n_t^+}{\partial N_{t-1}^-} = 2$, which by equation (35) is equal to $\delta P F^{+\prime\prime}\left(A\left(n_t^+ + N_{t-1}^-\right)\right)A^2 - (1-\delta P)F^{+\prime\prime}(n_t^+ + AN_{t-1}^-)A + 2(1-\delta P)F^{+\prime\prime}(n_t^+ + AN_{t-1}^-) = 0$. The two solutions are:

$$c = \frac{(1-\delta P)F^{+\prime\prime}(n_t^+ + AN_{t-1}^-) - D}{2\delta P F^{+\prime\prime}(n_t^+ + AN_{t-1}^-)} \qquad d = \frac{(1-\delta P)F^{+\prime\prime}(n_t^+ + AN_{t-1}^-) + D}{2\delta P F^{+\prime\prime}(n_t^+ + AN_{t-1}^-)}$$

where

$$\begin{aligned} D &= \Big[(1-\delta P)^2\left(F^{+\prime\prime}(n_t^+ + AN_{t-1}^-)\right)^2 \\ &\quad -\delta P 8(1-\delta P)F^{+\prime\prime}\left(A\left(n_t^+ + N_{t-1}^-\right)\right)F^{+\prime\prime}(n_t^+ + AN_{t-1}^-)\Big]^{\frac{1}{2}} \end{aligned}$$

From the values for c and d we can calculate the threshold value $(\delta P)^*$. Recall that a condition for an insider wage hike to have a positive effect on average employment is that $\delta P < (\delta P)^*$, where $(\delta P)^*$ is the value of δP for which $c = d$, i.e. $D = 0$. This occurs when $(1-\delta P)F^{+\prime\prime}(n_t^+ + AN_{t-1}^-) - \delta P 8 F^{+\prime\prime}\left(A\left(n_t^+ + N_{t-1}^-\right)\right) = 0$, which gives the value of $(\delta P)^*$:

$$(\delta P)^* = \frac{F^{+\prime\prime}(n_t^+ + AN_{t-1}^-)}{F^{+\prime\prime}(n_t^+ + AN_{t-1}^-) + 8F^{+\prime\prime}\left(A\left(n_t^+ + N_{t-1}^-\right)\right)}$$

From this analysis we can conclude the following. First, the greater is $F^{+\prime\prime}\left(A\left(n_t^+ + N_{t-1}^-\right)\right)$ relative to $F^{+\prime\prime}(n_t^+ + AN_{t-1}^-)$ (the smaller in absolute value), i.e. the more convex or the less concave is the marginal product of labor function, the greater is the limit value $(\delta P)^*$, and thus the more likely is that the interval (c, d) exists for a given δP. Furthermore, the greater is $F^{+\prime\prime}\left(A\left(n_t^+ + N_{t-1}^-\right)\right)$ relative to $F^{+\prime\prime}(n_t^+ + AN_{t-1}^-)$, i.e. the more convex or the less concave is the marginal product of labor function, the greater is D and thus the greater is the interval (c, d) (provided that $\delta P < (\delta P)^*$).

Thus if we consider as a starting point a linear marginal product of labor function and a value of $\delta P < (\delta P)^*$ for which the interval (c, d) exists, the analysis above implies that, ceteris paribus, for a convex marginal product of labor function the interval (c, d) is greater than the one associated with the linear marginal product of labor function. However, when the marginal product of labor function is concave, the interval (c, d) is smaller than the one associated with the linear marginal product function.

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