Is perfection optimal? Employment and product market competition

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Abstract

This paper proposes a model of efficiency wage with endogenous workers flows in interaction with imperfect competition on the product markets. Subject to economy-wide shocks, firms hire and fire workers thus generating a certain turnover. We show that the intensity of this turnover negatively affects workers' incentives and induces higher efficiency wage premia. Increased competition pushes real wages up but effort incentive requirements prevent large wage adjustments. Hence, adjustments are made with quantities: both the separation and hiring rates increase with competition, increasing the wage premium and contributing to lower employment. As a consequence, an employment-maximising level of competition may exist.

Zusammenfassung

In der Analyse wird ein Effizienzlohn-Modell vorgeschlagen, das endogene Beschäftigten-Ströme mit unvollständigem Wettbewerb auf den Gütermärkten verbindet. Unternehmen reagieren auf volkswirtschaftliche Schocks mit „Heuern und Feuern“ und verstärken so den Umschlag an Beschäftigten. Es wird gezeigt, dass sich das Ausmaß dieses Beschäftigten-Umschlags negativ auf die Anreize für die Arbeitnehmer auswirkt und zu höheren Effizienzlohn-Prämien führt. Ein intensivierter Wettbewerb lässt Reallöhne steigen, aber Anreize zur Steigerung der Arbeitsintensität verhindern Lohnanpassungen im großen Stil. Demzufolge kommt es zu Mengenanpassungen: sowohl Entlassungs- wie Einstellungszahlen wachsen mit zunehmendem Wettbewerb, wodurch die Lohnprämie steigt und die Beschäftigung sinkt. Daraus ist zu folgern, dass es einen beschäftigungsmaximalen Grad des Wettbewerbs geben könnte.

JEL: E24, J41, J63, L13
Keywords: unemployment, efficiency wage, imperfect competition

Table of Contents

PAGE

1 Introduction…………………………………………………….. 2

2 The Model…………………………………………………… 4
2.1 Labor demand………………………………………….. 4
2.2 Wage setting…………………………………………….. 7

3 Macroeconomic Equilibrium…………………………………. 10

4 Labor market performance with less
imperfect product markets…………………………………….. 12

5 Conclusion…………………………………………………… 16

1 Introduction

The detrimental influence of labor market imperfections on employment performance has long been emphasized in the literature[1] and it has led to a large set of policy recommendations in favor of labor market reforms. A recent literature has more specifically focused on the interactions between imperfections in the labor and the product markets.[2] The basic idea is that imperfections in one market combine with those of the other markets to make matters worse in each of them. As a consequence for economic policy, labor market reforms should be accompanied by reforms on the product markets, the latter being expected to alleviate the burden of adjustments on the labor market. International organizations such as the OECD have advocated the implementation of structural reforms both in the labor and the product markets, towards more flexibility regarding wages and employment protection on the one hand, and the promotion of competition on the product markets by regulatory reform on the other side.[3] The elimination of imperfections in one market will facilitate the necessary adjustments in other markets.

This argument can also be stated in terms of employment fluctuations and unemployment persistence. Less imperfect competition would increase price and wage elasticities and would reduce the impact of shocks on (un)employment. This argument is also found in the so-called 'administered pricing' thesis[4] for which concentrated industries should be characterized by more rigid prices than competitive ones. Exogenous demand or cost shocks would therefore lead to wider quantity adjustments; thus for a given adverse shock, employment should decrease more in more concentrated industries.

This assertion is indeed in contrast with recent empirical findings as documented in particular by Weiss [1998] where it is shown that both the long-run level and the rate of adjustment of industry employment decrease with concentration. The latter result, in particular, shows that more competitive industries are characterized by a faster adjustment of employment to shocks, and display stronger fluctuations in employment compared to imperfectly competitive industries. In other words, imperfectly competitive industries are shown to use their market power in such a way as to smooth employment fluctuations. Although Weiss does not provide a clear theoretical explanation to his findings,[5] the empirical result has straightforward implications. This states that it is indeed

[1] See for instance Layard et al. [1991], Nickell [1997], Siebert [1997].

[2] Boeri et al. [2000], Nickell [1999], Nicolletti et al. [2000], Gersbach [1999] and [2000].

[3] OECD [1994], Nicoletti et al. [2000], OECD [2000].

[4] See Lebow [1992] and references in Weiss [1998] for instance.

[5] Weiss [1998] proposes a theoretical model of employment and adjustment costs. Additional justifications for a negative relationship between unemployment and concentration are also given. A conjecture found in Scherer [1980] is mentioned according to which concentrated industries making extra-profits could accept disguised unemployment when demand is low, thus avoiding the costs of rehiring when the demand level increases again.

problematic to assume that increased competition would unambiguously reduce employment adjustments in response to shocks.

Hence, the real nature of the interplay between product market and labor market imperfections is still unclear.[6] One general idea is that market power on the product market generate rents that may be captured by employees through higher wages. The impact of product markets competition on the operation of the labor market depends on the wage setting mechanism which complements the model. Nicoletti et al. [2000] and Nickell [1999] consider mainly that wages are fixed according to a wage bargaining model. One can show that the bargained wage is generally decreasing in the elasticity of labor demand;[7] then, increased competition leads to a lower bargained real wage. Hence, the authors conclude that single unionized firms which face increased competition will benefit from a higher labor demand elasticity and a lower bargained real wage.

This conclusion that increased product markets competition will improve labor market's efficiency needs not hold under different assumptions concerning the wage setting mechanism, particularly if one considers a model of efficiency wages. The link between efficiency wage and market power is not well explored in the literature. As Nicoletti et al. mention it, the determinants of the efficiency wage level are in general 'exogenous' elements: "*in none of these cases does there appear to be any obvious mechanism by which the market power of the firm can enter the story*" (p. 28). This paper will show that a mechanism indeed exists which links up the market power of firms to the determination of the efficiency wage by endogenizing labor market separation following demand or productivity shocks. In fact, one of the exogenous determinants of the efficiency wage level is the separation rate, which is understood at the individual worker level as the probability of losing one's job even when one provides the correct level of effort. *Ceteris paribus* this exogenous element contributes to increasing the level of the efficiency wage. This usually exogenous important determinant of the efficiency wage is made endogenous in this paper.

This paper proposes a model of imperfect competition *à la* Cournot with an endogenous determination of workers flows in and out of unemployment, where wages are determined according to an efficiency wage mechanism. More precisely, we assume that the economy moves across two different states of technology: Good and Bad. When moving, firms respectively hire or fire workers thus generating a certain turnover over time on the labor market. Under the assumption of imperfect monitoring within companies, labor force turnover negatively affects workers' incentives. We show that increased competition on the product market increases workers' separation rate and translates into a higher efficiency wage premium. Hence, our model clearly shows how wage formation can be negatively

[6] The first attempt to systematically evaluate the impact of product market competition on employment at the aggregate level is done by Boeri et al. [2000] and Nicoletti at al. [2000].

[7] See Layard, Nickell and Jackman [1991].

affected by the (endogenous) change in the size of the separation rate which is generated by increased product markets competition. The basic intuition behind the working of the model is the following. The combination of imperfect competition and efficiency wage contributes to smoothing employment differentials across the two states of the economy; this reduces the separation of workers as a response to demand and/or productivity shocks and contains wage pressure. However, because of relative real wage rigidities determined by the wage setting mechanism, an increase in competition leads to larger employment differentials across states, that is to a stronger turnover on the labor market. As a consequence, an adverse effect on workers' incentives is in place which ultimately generates -at the equilibrium- wage pressure, larger separations, and may under certain conditions lead to a higher level of unemployment.

The paper is organized as follows. Section 2 below presents the basic model of efficiency wage and imperfect competition on the product markets. Section 3 presents the macroeconomic equilibrium, which is shown to be unique in certain conditions. section 4 establishes the result that an increase in product market competition may lead to a lower performance in terms of employment. A brief conclusion is proposed in the final section.

2 The Model

This section sets out the model of imperfect competition on the product market and efficiency wage on the labor market. We first derive the labor demand curve and the 'price setting' real wage resulting from the decisions taken by imperfectly competitive firms subject to aggregate shocks.

2.1 Labor demand

We assume the existence of a multi-sector economy with a single final good used for consumption and a continuum of intermediate goods indexed over [0, 1]. The final good is produced according to a constant returns to scale technology using all the intermediate goods:

$$\widetilde{Y}_t = \left(\int_0^1 Y_t(s)^{\frac{\eta-1}{\eta}} ds \right)^{\frac{\eta}{\eta-1}} \tag{1}$$

$\eta > 1$ is the absolute value of the elasticity of substitution between intermediates. The final good is produced competitively, but there is imperfect competition in each of the intermediate sectors. More specifically, it is assumed that there are n firms in each intermediate sector engaged in Cournot-type competition. Each firm is small compared to the economy but has a certain market power within its sector. Such a specification leads to a derived demand addressed to sector s equal to:

$$Y_s = \left(\frac{P_s}{P}\right)^{-\eta} \cdot \widetilde{Y} \tag{2}$$

where P_s is the price of intermediate s and P is the final good's price. One further has:

$$P = \left(\int_0^1 P_s^{1-\eta} ds\right)^{\frac{1}{1-\eta}} \tag{3}$$

Each firm j in every sector s has an identical production function which uses labor as its sole input :

$$y_{jt} = \alpha_{jt} \cdot l_{jt}^{\gamma} \tag{4}$$

$0 < \gamma \leqq 1$, l_j is the input of effective labor, i.e. l_j workers providing the expected effort level. We will later pay special attention to the case where $\gamma = 1$, i.e. the case of constant returns to scale in the intermediate goods production.

Intermediate firms are subject to common aggregate shocks which affect their productivity. One may think of these shocks as either 'demand' shocks resulting from changes in demand or alternatively as 'supply' shocks stemming from fluctuations in factors other than labor or from a varying technological efficiency. We adopt the same shock specification as Bertola [1990], Bertola and Ichino [1995] or Bertola and Rogerson [1997]. The shock's realizations are denoted α_t at time t. More specifically, the αs follow a two-state Markov chain with symmetric transition probability p:

$$\alpha_{t+1} = \begin{cases} \alpha_G \text{ with probability } p \text{ if } \alpha_t = \alpha_B \text{ and with probability } 1-p \text{ if } \alpha_t = \alpha_G \\ \alpha_B \text{ with probability } 1-p \text{ if } \alpha_t = \alpha_B \text{ and with probability } p \text{ if } \alpha_t = \alpha_G \end{cases} \tag{5}$$

and $\alpha_G > \alpha_B > 0$. We further assume some degree of 'persistence' in the shocks' realization: $p < 1/2$.

There are thus two states for the technology and the economy, a 'good' state denoted G with a high labor productivity, and a 'bad' state denoted B characterized by a low value for labor productivity. The long-run probability for the economy to be in either a good or a bad state is 0.5. This specification generates aggregate fluctuations in output and employment.

Firms' hiring decisions are identical across sectors. Only spot markets for labor are open and all intermediate firms know the realization of the shock before taking their employment decisions. Profit maximization for firm j in any intermediate sector gives:

$$P_s \cdot \left(1 + \frac{\partial P_s}{\partial y_j} \cdot \frac{y_j}{P_s}\right) = W^j \cdot \frac{\partial l_j}{\partial y_j} = \frac{1}{\gamma} \cdot W^j \cdot \alpha_j^{-\frac{1}{\gamma}} \cdot y_j^{\frac{1}{\gamma}-1} \tag{6}$$

W_j is the nominal wage paid by firm j

Each sector has the same structure, therefore the price of each intermediate is the same, which implies because of (3) that $P_s = P$ for all s. Therefore, the real wage for the firm (W_j/P_s) will be identical to the real wage for the worker (W_j/P). In what follows, we can drop the subscript s without risk of confusion. We denote: $Y_B = n \cdot y_B$ as the total output of intermediate firms when the economy is in a bad state and $Y_G = n \cdot y_G$ the total output of intermediate firms when the economy is in a good state. Likewise, l_G (l_B) is employment of a representative firm in a good (bad) state. W_G and W_B are nominal wages for a worker employed when the economy is in a good state and a bad state respectively. Following this, (6) can be expressed as:

$$P = \frac{1}{\left[1 - \frac{\varepsilon}{n}\right]} \cdot \frac{W^j}{\frac{\alpha_j}{\gamma} \cdot l_j^{\gamma-1}} \tag{7}$$

$j = G, B$. $\varepsilon \equiv \frac{1}{\eta}$ is the inverse of the elasticity of substitution between intermediates, $\left(1 - \frac{\varepsilon}{n}\right)$ is the inverse of the mark-up applied to marginal costs by imperfectly competitive firms. As is standard in Cournot competition, the mark-up decreases when the number of competing firms n increases. Besides, the mark-up is small when ε is small i.e. when there is a high degree of substitutability among the intermediate goods. ε (η) and n are indicators of the degree of imperfection in competition. Since ε (η) comes from the production function for the final good, we can suppose that it is largely invariant to policy changes designed to promote a more intense competition in the product market. It is essentially a 'technological' parameter in our setting. n on the other hand may be thought of as potentially subject to the influence of competition policy such as the removal of administrative barriers to entry, the opening the economy akin to the completion of the Single European Market or other measures that make entry into an industry easier. This is why we will concentrate in what follows on the effects of a change in the number of competitors n.

(7) gives an expression for the 'price setting' real wages for firms in either states:

$$\frac{\alpha_j}{\gamma} \cdot l_j^{\gamma-1} \cdot \left(1 - \frac{\varepsilon}{n}\right) = w^j \tag{8}$$

with $w_j \equiv \frac{W_j}{P}$. 'Price setting' real wages are influenced by the marginal productivity of labor (the $\frac{\alpha_j}{\gamma} \cdot l_j^{\gamma-1}$ term) and by firms' mark-up behavior (the term between squared brackets). This is standard in the presence of imperfect competition, real wages are lower than the marginal productivity of labor because of the mark-up. This distortion increases with the degree of imperfection of competition (a high ε and a low n).

Having determined the price-setting relative real wage, we can now turn to the 'wage-setting' side of the economy where the levels for the real wages in both a good or a bad state will be determined.

2.2 Wage setting

The economy is populated with a fixed number N of agents who supply labor inelastically within each intermediate sector. Each sector has thus an immobile labor force equal to N. Following the symmetry assumptions used throughout, the sectorial employment rate L/N is equal to the aggregate rate. Each individual worker is characterized by an identical utility function, where instantaneous utility depends on the real wage[8] and on the effort provided on the job:

$$u_t = w_t^j - e_t \tag{9}$$

$j = G, B$; e_t, the effort level, can take two values, 0, which means that the worker is 'shirking' and e, which means that the worker provides the expected work effort. The contribution of a shirker to effective labor is nil, whereas an individual working with the expected effort level e contributes for one unit to effective labor. w_t^j is the real wage. This simple specification will allow us to consider an efficiency wage model in the spirit of Solow [1979], Shapiro and Stiglitz [1984], Akerlof and Yellen [1990] or Saint-Paul [1996]. The basic principle of these models is that a firm may not wish to lower wages even in the presence of unemployment for fear of reducing the incentives to provide the correct level of effort on the job. Each firm has a monitoring device whose inefficiency is measured by the parameter x_t: A worker is caught shirking with probability $1 - x_t$ and, when caught, loses his job at the end of period t.

But, as is common in efficiency wage models, shirking is not the only way to lose one's job. Every model of efficiency wage takes into account an independent and exogenous probability of job loss. In our setting, this probability is made endogenous: firms shed labor when they are hit by an adverse shock which forces them to downward adjust their labor force. We denote q_t the probability of losing one's job following an adverse shock, then:

$$q_t = \frac{l_{Gt} - l_{Bt}}{l_{Gt}} = \left(1 - \frac{1}{l_t}\right) \tag{10}$$

Workers are concerned by this type of job loss only when the economy is in a good state, since in that case firms are likely to be hit by an adverse shock. The situation in a bad state can only improve or at worst stay the same. Assume that the economy is in a good state. Then at each subsequent period, with a given probability the economy is hit by an adverse shock and firms have to shed labor. Workers having lost their job become unemployed for at least one period and get the (real) unemployment allowance $\overline{w}_t$,[9] they may find another job when firms

[8] i.e. the consumption level of the final good.

[9] The financing of this unemployment allowance is not explicitely taken into account. One may think of it as financed by a non distortionary lump-sum tax or alternatively as coming from a 'subsistence' activity nundertaken by individuals.

hire again. The reverse occurs when the economy is in a bad state. The flow probability out of unemployment is a_t, which is the probability for an unemployed of finding a job.

Workers have an infinite horizon and discount future at the rate $\beta \leq 1$. We can now compute the discounted utilities associated with the various possible positions for an individual: being employed when the economy is in a good state or in a bad state, and shirking or not shirking, or being unemployed. The discounted utility of a worker who shirks at time t when the economy is in a good state is V_{St}^{G}, and V_{NSt}^{G} when he does not shirk. The utilities associated to working when the economy is in a bad state are likewise V_{St}^{B} (shirking) and V_{NSt}^{B} (not shirking). The utility of being unemployed in either state is U_t^B and U_t^G. We then have:

$$V_{St}^{G} = w_t^G + \beta \cdot \left\{ \begin{array}{c} x_t \cdot (1-p) V_{t+1}^{G} + (1-x_t) \cdot \left[(1-p) \cdot U_{t+1}^{G} + p \cdot U_{t+1}^{B} \right] + \\ x_t \cdot p \cdot \left[(1-q_t) \cdot V_{t+1}^{B} + q_t \cdot U_{t+1}^{B} \right] \end{array} \right\} \tag{11}$$

$$V_{NSt}^{G} = w_t^G - e_t + \beta \cdot \left\{ (1-p) V_{t+1}^{G} + p \cdot \left[(1-q_t) \cdot V_{t+1}^{B} + q_t \cdot U_{t+1}^{B} \right] \right\} \tag{12}$$

$$V_{St}^{B} = w_t^B + \beta \cdot \left\{ \begin{array}{c} x_t \cdot (1-p) \cdot V_{t+1}^{B} + \\ x_t \cdot p \cdot V_{t+1}^{G} + (1-x_t) \cdot \left[(1-p) \cdot U_{t+1}^{B} + p \cdot U_{t+1}^{G} \right] \end{array} \right\} \tag{13}$$

$$V_{NSt}^{B} = w_t^B - e_t + \beta \cdot \left[(1-p) \cdot V_{t+1}^{B} + p \cdot V_{t+1}^{G} \right] \tag{14}$$

$$U_t^B = \overline{w}_t + \beta \cdot \left\{ (1-p) \cdot U_{t+1}^{B} + p \cdot \left[(1-a_t) \cdot U_{t+1}^{G} + a_t \cdot V_{t+1}^{E} \right] \right\} \tag{15}$$

$$U_t^G = \overline{w}_t + \beta \cdot \left[(1-p) \cdot U_{t+1}^{G} + p \cdot U_{t+1}^{B} \right] \tag{16}$$

V_{t+1}^{E} is the utility of being employed in a firm hiring at time $t+1$. In equilibrium, only firms hit by a positive shock will hire so that V_{t+1}^{E} will be the utility associated with working in a good state.

The level of real wage in each firm must be set at a level such that workers have an incentive not to shirk. These no-shirking conditions are:

$$V_{NSt}^{j} \geq V_{St}^{j} \tag{17}$$

The conditions $V_{NSt}^{j} = V_{St}^{j} = V_t^j$, $j = G, B$ give the two limit wage levels $w_{it}^G \left(w_{it}^B \right), w_{it}^B \left(w_{it}^G \right)$ under which the optimal behavior for the worker is to shirk. Since we are dealing with constant values for all variables at the steady-state equilibrium, we may dispense with the time subscripts from now on. Both $w_i^G \left(w_i^B \right)$ and $w_t^B \left(w_i^G \right)$ are affine functions.

From these conditions, one may deduce the levels of the real wages paid in either state of the economy. This is shown in the proposition below.

Proposition 1 *The incentive-compatible equilibrium wages levels for both type firms are such that:*

$$w_B^* = \overline{w} + e \cdot \left(\frac{1-\beta-p\cdot[2\cdot(1-\beta)-\beta\cdot(a\cdot(1-2\cdot p)-(1-a)\cdot p\cdot q)]}{\beta\cdot(1-x)\cdot[1-p\cdot(2-p\cdot q)]} + 1 \right)$$
$$w_G^* = \overline{w} + e \cdot \left(\frac{1-\beta-p\cdot[2\cdot(1-\beta)-(1-\beta\cdot p)\cdot q]}{\beta\cdot(1-x)\cdot[1-p\cdot(2-p\cdot q)]} + 1 \right)$$

Proof. The no-shirking conditions (17) can be expressed as:

$$\begin{aligned} w_G &\geq w_i^G (w_B) \\ w_B &\geq w_i^B (w_G) \end{aligned} \tag{18}$$

Both $w_i^G (w_B)$ and $w_i^B (w_G)$ are affine functions. In the general case, they define an area in the (w_B, w_G) plane where both incentive constraints are fulfilled. The equilibrium real wage rates must be such that both constraints are simultaneously satisfied since wages in either state depend on the wages paid in the other state. Firms pay the lowest wages compatible with both constraints. The intersection of the two schedules $w_i^G (w_B)$ and $w_i^{B-1} (w_G)$ defines the equilibrium levels of real wages rates for good and bad states: $w_i^G (w_B^*) = w_i^{B-1} (w_G^*)$ ■

The efficiency wage paid by firms in a bad state is higher the higher the hiring rate and the lower the separation rate, while in a good state the efficiency wage is higher the higher the separation rate. The justification for these results is simple.

When the hiring rate increases, shirkers caught (and fired) while the economy is in a bad state will have a higher probability of finding new employment if the economy shifts back to a good state. Therefore, a shirker's utility increases and a compensation in the form of a higher wage in a bad state is required in order to enforce the no-shirking condition.

Firms in a good state can be hit by a bad shock and have to shed labor. Workers can then be fired regardless of their effort. This possibility is all the more plausible that the separation rate is high; thus a higher separation rate reduces the discounted utility associated to a no-shirking strategy, which calls for a higher efficiency wage in a good state.

The separation rate affects also workers in a bad state. In fact, there is always a possibility for firms to be hit by a good shock and shift back to a good state. A higher separation rate, because it pushes real wage up in a good state, also increases the wage prospect for workers who are currently employed (in a bad state) and allows for a decrease of the efficiency wage paid by firms in a bad state.

3 Macroeconomic Equilibrium

This section endogenizes the separation and hiring rates, which have been shown to play an important role in the definition of the wages rates. Wages are set by firms in either state of the economy at the minimum level which respects the effort-incentive constraint and the no-arbitrage condition for workers. Every worker provides the necessary effort so that effective and employed labor are equal. At the beginning of each period, with a probability p, the state of the economy changes. If the economy goes from a good state to a bad state, firms have to shed labor in order to adjust their labor force to its optimal value, while if the economy goes from a bad state to a good state, firms need to make the opposite adjustment. In the former case, laid-off workers join the ranks of the unemployed while, in the latter situation, some unemployed workers find new employment. Recalling that a is the flow probability out of unemployment, and defining: $\widetilde{N} = N/n$, one has:

$$a \cdot \left[\widetilde{N} - l_B\right] = q \cdot l_G \tag{19}$$

Equation (8) defines the price setting real wage for firms in either states:

$$w_{ps}^{j} = \frac{\alpha_j}{\gamma} \cdot l_j^{\gamma-1} \cdot \left(1 - \frac{\varepsilon}{n}\right) \tag{20}$$

and the efficiency wages are:

$$w_{ws}^{B} = \overline{w} + e \cdot \left(1 + \frac{1 - \beta - p \cdot [2 \cdot (1-\beta) - \beta \cdot (a \cdot (1 - 2 \cdot p) - (1-a) \cdot p \cdot q)]}{\beta \cdot (1-x) \cdot [1 - p \cdot (2 - p \cdot q)]}\right) \tag{21}$$

$$w_{ws}^{G} = \overline{w} + e \cdot \left(1 + \frac{1 - \beta - p \cdot [2 \cdot (1-\beta) - (1 - \beta \cdot p) \cdot q]}{\beta \cdot (1-x) \cdot [1 - p \cdot (2 - p \cdot q)]}\right) \tag{22}$$

Production can be expressed as the output of firms in either states:

$$Y_j = n \cdot \alpha_j \cdot l_j^{\gamma} \tag{23}$$

Equation (10) for the steady-state is:

$$q = \frac{l_G - l_B}{l_G} = \left(1 - \frac{1}{l}\right) \tag{24}$$

with $l \equiv \frac{l_B}{l_G}$.

Equations (19), (20), (23), (24), (21), and (22) constitute the reduced form of the model, with w_B, w_G, l_B, l_G, a and q as the endogenous variables. No loss of generality is incurred if we state $e = 1$.

We will simplify matters regarding solving the full model by considering the constant returns to scale case: $\gamma = 1$. Call $\widetilde{\alpha} = (1-p)\cdot\alpha_B + p\cdot\alpha_G$.We can then establish the following result.

Proposition 2 *If* $\frac{1-(1-p)\cdot x\cdot\beta}{(1-p)\cdot(1-x)\cdot\beta} + \overline{w} > \alpha_G$, $\widetilde{\alpha} > 2\cdot\frac{(1-x\cdot\beta)+(1-x)\cdot\beta\cdot\overline{w}}{(1-x)\cdot(2-\varepsilon)\cdot\beta}$, $\overline{w} < \frac{x}{1-x} - \frac{2-p\cdot(4-\varepsilon)}{(1-p)\cdot(1-x)\cdot\beta\cdot(2-p\cdot(2-\varepsilon))}$ *and* $\beta > \frac{2-p\cdot(4-\varepsilon)}{(1-p)\cdot x\cdot(2-p\cdot(2-\varepsilon))}$, *then a unique equilibrium exists characterized by a probability of losing one's job when being employed in a good state given by:*

$$q^* = \frac{(1-2\cdot p)\cdot[n\cdot(x\cdot\beta+\beta\cdot(1-x)\cdot(\alpha_G-\overline{w})-1)-\beta\cdot(1-x)\cdot\alpha_G\cdot\varepsilon]}{p\cdot[n\cdot(1-x\cdot\beta\cdot p-\beta\cdot p\cdot(1-x)\cdot(\alpha_G-\overline{w}))+p\cdot\beta\cdot(1-x)\cdot\alpha_G\cdot\varepsilon]},$$

The corresponding value of the hiring rate applying the bad state is given by:

$$a^* = \frac{n[\beta\cdot(x+(1-x)\cdot(\widetilde{\alpha}-\overline{w}))-1]-\beta\cdot(1-x)\cdot\widetilde{\alpha}\cdot\varepsilon}{(1-p)\cdot p\cdot\beta^2\cdot[n\cdot(x+(1-x)\cdot(\alpha_G-\overline{w}))-(1-x)\cdot\alpha_G\cdot\varepsilon]}.$$

Proof. Consider wage determination in a good state. Equation (22) and (20) must be equalized *ex post* which reads: $\alpha_G\cdot\left[1-\frac{\varepsilon}{n}\right] = \overline{w}+1+\frac{1-\beta\cdot-p\cdot[2\cdot(1-\beta)-(1-\beta\cdot p)\cdot q]}{\beta\cdot(1-x)\cdot[1-p\cdot(2-p\cdot q)]}$. Since w_{ws}^G is uniformly increasing in q, the equality allows the derivation of the equilibrium value of the separation rate $q^*(n)$. To ensure that a positive equilibrium always exists, we impose restrictions on parameters such as to enforce $w_{ws}^G < w_{ps}^G$ when $q = 0$ and $n = 2$, and $w_{ws}^G > w_{ps}^G$ when $q = 1$ and $n \to \infty$. This corresponds to $\alpha_G\cdot\left[1-\frac{\varepsilon}{2}\right] > \overline{w}+1+\frac{1-\beta\cdot-p\cdot 2\cdot(1-\beta)}{\beta\cdot(1-x)\cdot[1-p\cdot 2]}$ and $\alpha_G < \overline{w}+1+\frac{1-\beta\cdot-p\cdot[2\cdot(1-\beta)-(1-\beta\cdot p)]}{\beta\cdot(1-x)\cdot[1-p\cdot(2-p)]}$. We retain the former condition here which fixes a minimum value for α_G. As for the latter condition, we apply the same kind of reasoning to a^* which leads us to define a condition on $\widetilde{\alpha}$ which is similar but more restrictive than the corresponding condition on α_G. Hence, we select to retain the condition on $\widetilde{\alpha}$. To ensure the compatibility of the two conditions on $\widetilde{\alpha}$ and α_G, we need to impose the restriction on $\overline{w}$ reported in the text of proposition 2; this only makes sense under the condition on β stated in the proposition.

As for the bad state, since w_{ws}^B is decreasing in q and increasing in a, wage determination in a bad state defines a hiring schedule $a(q;n)$ with a positive slope. If we now substitute $q^*(n)$ into equation (21) and hold $w_{ws}^B = w_{ps}^B$ we finally obtain the equilibrium value of the hiring rate $a^*(n)$. One can check the equilibrium value of a is always positive under the conditions given above ■

Hence, we have by now established sufficient conditions for the existence of a unique equilibrium to which is associated a certain level for real wage rates and the rate of unemployment. This result has been derived given a certain degree of imperfection in product market competition, i.e. a certain degree of concentration or more precisely a certain number of competing firms n. Building on this, we can now move on to the analysis of the macroeconomic consequences of an increase in competition on the product market.

4 Labor market performance with less imperfect product markets

This section investigates the consequences of an increase in the number of competing firms within each industry. The number of competitors in a given industry is a straightforward measure of imperfection in Cournot-type models of imperfect competition. In such models the mark-up on marginal costs decreases when the number of firms increases, and imperfections in competition vanish when this number goes to infinity. More than the price elasticity of demand, which is technologically derived in our model, the number of competitors in an industry may be considered, if not as a policy variable, at least as influenced by competition policy measures. In most countries, entry in some industries is *de facto* if not *de jure* restricted, making market structures oligopolistic. Some of these restrictions are the consequences of international differences in regulations, norms or other administrative matters that make cross-border competition more difficult that competition between domestic firms. The elimination of such barriers to competition was the aim of the Single European Market completion for instance. As mentioned before, one expects an improved economic performance from the implementation of competition policies.

In this model, the effects of an increase in product market competition cannot just be read off the shift in the labor demand curve. The consequences in terms of wage-setting behavior have to be taken into account too. When the number n of firms increases, the price setting wage in either states of the economy increases, which calls for an adjustment on the labor market to re-equilibrate the levels of the efficiency and price setting wages. Due to real wage rigidities, this adjustment is mainly done through a modification of the separation and hiring rates. The subsequent result in terms of job turnover on the labor market is established in the following proposition.

Proposition 3 *An increase in product market competition characterized by a higher number of competing firms (a higher n) brings about an increase in the separation rate q and the hiring rate a.*

Proof. One simply needs to calculate the total derivatives of q^* and a^* given in the preceding proposition with respect to n. This gives the following results:

$$\frac{\partial q}{\partial n} = \frac{(1-p)\cdot(1-2\cdot p)\cdot(1-x)\cdot\alpha_G\cdot\beta\cdot\varepsilon}{p\cdot\{n\cdot[1-p\cdot\beta\cdot(x+(1-x)\cdot(\alpha_G-\overline{w}))]+p\cdot\beta\cdot(1-x)\cdot\varepsilon\cdot\alpha_G\}^2} > 0,$$

$$\frac{\partial a}{\partial n} = \frac{(1-x)\cdot\varepsilon\cdot[\alpha_G\cdot(1-x\cdot\beta)+\widetilde{\alpha}\cdot x\cdot\beta+(1-x)\cdot\beta\cdot\overline{w}\cdot(\alpha_G-\widetilde{\alpha})]}{(1-p)\cdot p\cdot\beta^2\cdot\{n\cdot[x+(1-x)\cdot(\alpha_G-\overline{w})]-(1-x)\cdot\varepsilon\cdot\alpha_G\}^2} > 0 \quad \blacksquare$$

Therefore, proposition 3 establishes that an increase in product market competition leads to an increase in job turnover. The rationale of this results is straightforward. When the number n of firms increases, the price setting wage in a good state increases, which calls for an increase in the separation rate to re-equilibrate price setting and efficiency wage rates. The same mechanism applies to wage determination in a bad state and explains why the hiring schedule $a(q)$ shifts upward when n increases. The consequences of this conclusion, as far as employment variation across the two states is concerned, are spelled out in the following corollary.

Corollary 4 *Less imperfect product markets lead to larger adjustments of employment on the labor market for any given size of shocks.*

Proof. One can easily derive the expression for employments differentials across the two states of the economy. This is given by : $\Delta L = L_G - L_B = \frac{a \cdot q \cdot N}{a + q \cdot (1-a)}$. One can further show that $\frac{\partial(\Delta L)}{\partial a} = \frac{q^2 \cdot N}{[a+q\cdot(1-a)]^2} > 0$, $\frac{\partial(\Delta L)}{\partial q} = \frac{a^2 \cdot N}{[a+q\cdot(1-a)]^2} > 0$ ■

Hence, more competitive product markets are associated with more *de facto* flexible labor markets; for a given size of shocks, the adjustments in the level of employment are larger when product markets competition is stronger. This runs contrary to the 'administered prices' theory referred to in the introduction. What distinguishes our result from the more standard view that associates a higher degree of product market competition to smaller quantity adjustments is the wage-setting process. Efficiency wage requirements prevent large real wages adjustments, which would not respect the incentive compatibility constraint for workers. As a result, the adjustment is made with quantities. On the basis of these mechanisms, one should therefore expect larger fluctuations in employment to be associated with stronger product markets competition.

The consequence of the above results in terms of the average level of the unemployment rate is not unambiguous. One may take as a measure of average employment $L = \frac{L_G + L_B}{2}$, where L_G and L_B are employment when the economy is in a good state and a bad state respectively. This makes sense because over a long period, the economy is likely to be in a good state (bad state) half of the time. Increased competition will affect differently employment in either state of the economy. The final impact of increased competition on unemployment clearly depends on the overall combination of the effects on the hiring and separation rates. This can be more formally stated as in the following proposition.

Proposition 5 *Average employment always increases with n for small values of n. Further increases in the number of firms may either increase or decrease employment depending on the parameter values.*

Proof.

Average employment is equal to:
$L = \frac{(2-q)\cdot a \cdot N}{2\cdot(a+q-a\cdot q)}$
and we define $\alpha = \frac{\alpha_G}{\alpha_B}$. Solving for equilibrium values for q and a gives:

$$L(n) = \frac{a_1 \cdot n^2 + b_1 \cdot n + c_1}{a_2 \cdot n^2 + b_2 \cdot n + c_2} \cdot \frac{N}{2\cdot(1-p)}$$

with:

$$a_1 = \left\{ \begin{array}{c} \{\beta \cdot [x + (1-x) \cdot (\alpha - \overline{w})] - 1\} \cdot \\ \{1 - [1 - 2 \cdot (1-p) \cdot p] \cdot \beta \cdot [x + (1-x) \cdot (\alpha_G - \overline{w})]\} \end{array} \right\}$$

$$b_1 = \left\{ (x-1) \cdot \beta \cdot \epsilon \cdot \left\{ \begin{array}{c} \alpha + [1 - 2 \cdot (1-p) \cdot p] \cdot \\ \left[\begin{array}{c} \alpha_G - x \cdot \alpha \cdot \beta - (x + 2 \cdot (1-x) \cdot \alpha) \cdot \\ \alpha_G \cdot \beta + (1-x) \cdot (\alpha + \alpha_G) \cdot \beta \cdot \overline{w} \end{array} \right] \end{array} \right\} \right\}$$

$$c_1 = -\left\{ [1 - 2 \cdot (1-p) \cdot p] \cdot (1-x)^2 \cdot \alpha \cdot \alpha_G \cdot \beta^2 \cdot \epsilon^2 \right\}$$

$$a_2 = -\left\{ \begin{array}{c} 1 - \alpha \cdot \beta + x \cdot (-2 + p + \alpha) \cdot \beta - (1-2p) \cdot p \cdot \\ [x + (1-x)\, \alpha_G]^2 \cdot \beta^3 + [x + (1-x) \cdot \alpha_G] \cdot \\ \left\{ \begin{array}{c} \{-2 \cdot p^2 + x + (1-x) \cdot [p \cdot (1-\alpha) + \alpha]\} \cdot \beta^2 \\ +2 \cdot (1-2p) \cdot p \cdot (1-x) \cdot \beta^3 \cdot \overline{w} \end{array} \right\} \\ -(1-x) \cdot \beta \cdot \\ \left\{ \begin{array}{c} (1-p) \cdot (\alpha_G - \overline{w}) - \overline{w} \\ + \left\{ \begin{array}{c} (1-2p) \cdot p \\ + (1-p) \cdot [2 \cdot x + (1-x) \cdot (\alpha + \alpha_G)] \end{array} \right\} \cdot \beta \cdot \overline{w} \\ -(1-x) \cdot \beta \cdot \{1 - p \cdot [1 + (1-2p) \cdot \beta]\} \cdot \overline{w}^2 \end{array} \right\} \end{array} \right\}$$

$$b_2 = \left\{ \begin{array}{c} (1-x) \cdot \beta \cdot \epsilon \cdot \\ \left\{ \begin{array}{c} (p-1) \cdot \alpha_G + \alpha \cdot \left\{ \begin{array}{c} -1 + (1-p) \\ \cdot [x + 2 \cdot (1-x) \cdot \alpha_G] \cdot \beta \end{array} \right\} \\ + \alpha_G \cdot \beta \cdot \left\{ x + p \cdot \left\{ \begin{array}{c} 1 - 2 \cdot p - x \\ +2 \cdot (1-2p) \cdot [x \cdot (\alpha_G - 1) - \alpha_G]\, \beta \end{array} \right\} \right\} \\ -(1-x) \cdot \beta \cdot \left[\begin{array}{c} (1-p) \cdot (\alpha + \alpha_G) \\ -2 \cdot p \cdot (1 - 2 \cdot p) \cdot \alpha_G \cdot \beta \end{array} \right] \cdot \overline{w} \end{array} \right\} \end{array} \right\}$$

$$c_2 = (1-x)^2 \cdot \alpha_G \cdot \beta^2 \cdot [(1-2p) \cdot p \cdot \alpha_G \cdot \beta - (1-p) \cdot \alpha] \cdot \epsilon^2$$

Total employment is ultimately (i.e. when $n \to \infty$) decreasing (increasing) in n when $a_1 \cdot b_2 - a_2 \cdot b_1 < (>)\, 0$ since $\frac{\partial L}{\partial n} \propto (a_1 \cdot b_2 - a_2 \cdot b_1) \cdot n^2 + 2 \cdot (a_1 \cdot c_2 - a_2 \cdot c_1) \cdot n + (b_1 \cdot c_2 - b_2 \cdot c_1)$

$L(n)$ is discontinuous for two values of n, the roots of $a_2 \cdot n^2 + b_2 \cdot n + c_2$. These roots correspond to $(a + q - a \cdot q) = 0$. Both a and q are increasing with n. Let n_1 be the value of n where $a(n)$ is not defined, n_2 be such that $q(n_2) = 0$ and n_3 such that $a(n_3) = 0$. One has $n_1 < n_2 < n_3$[10](Figure 1). We define $\widetilde{n}$ such that a$(\widetilde{n}) = \frac{-q(\widetilde{n})}{1-q(\widetilde{n})}$. $\widetilde{n}$ is the largest n for which $L(n)$ is not defined, and $\lim_{n \to \widetilde{n}} L(n) = -\infty$.

Only values of n strictly above $\widetilde{n}$ make economic sense, and $L(n)$ is always defined for $n > \widetilde{n}$.

[10]It is straightforward to show that $a(n_2) < 0$.

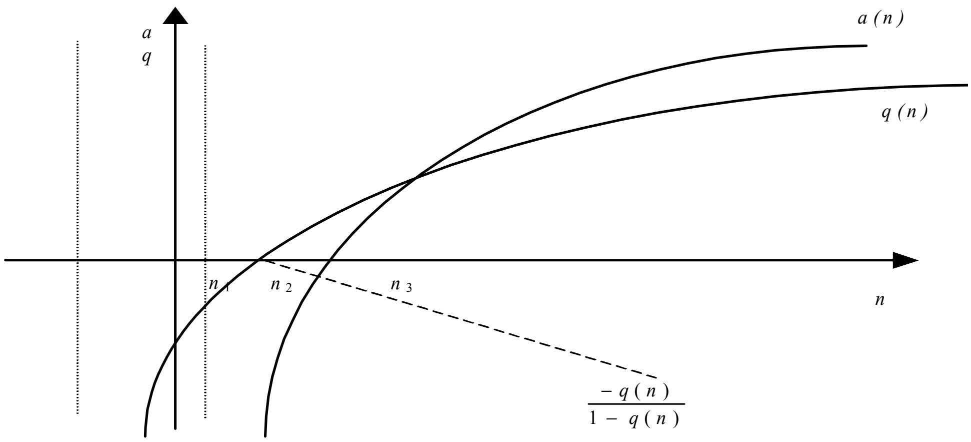

Figure 2

We can conclude that for very small n (above $\widetilde{n}$) the value of employment always goes to $-\infty$. Therefore, there are two possibilities as for the graph of L illustrated in Figure 3.

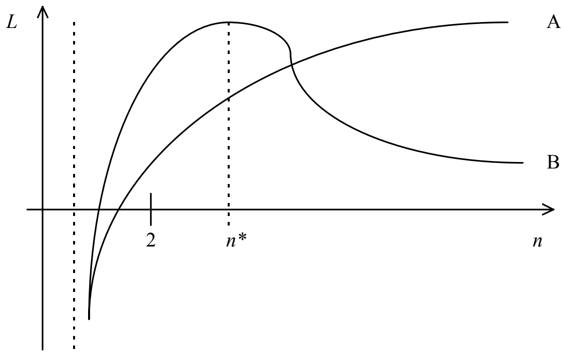

Figure 3. Evolution of average employment

In case A, employment is always an increasing function of the degree of product market competition. In case B however, employment is first increasing then decreasing in product market competition. The critical value n^* where the monotonicity change occurs can be everywhere for $n = n^* > n_e$, with n_e such that $L(n_e) = 0$. This case occurs whenever the largest root of $a_2 \cdot n^2 + b_2 \cdot n + c_2$ is lower than the largest root of $g(n) \equiv \frac{\partial L}{\partial n}$. An interesting case is clearly one where $n^* > 2$. In that case, an optimal level of competition exists which maximizes employment ■

To sum up, the above proposition shows that the effects on employment of increased competition are basically of two sorts. First, one can recognize a 'traditional' positive effect that can be associated to reduced market imperfection and better employment opportunities: this translates in our model through the positive effect of increased competition on the hiring rate (which is shifted upward). However, a second mechanism is present in our model which works through the wage setting process, particularly the efficiency wage formation. Increased competition generates larger separations which in turn lowers employment. One may express the condition for a negative impact of product market competition on employment in terms of elasticities. Denoting η_{aq} the elasticity of a with respect to q, η_{an} its elasticity with respect to n and η_{qn} the elasticity of q to n, one can show that an increase in n leads to a decrease in total employment if $\frac{\eta_{an}}{\eta_{qn}} < \frac{2-a^*}{2-q^*}$.

Hence, one must conclude that in an efficiency wage framework increased competition on product market may indeed have a negative impact on the aggregate employment performance.

5 Conclusion

According to conventional wisdom, increased competition on product markets would unambiguously contribute to alleviating the burden of adjustment which falls on imperfect labor markets when shocks occur. The model presented above suggests that this assertion needs to be carefully qualified. The adverse effects of efficiency wage rigidities on the labor market are indeed worsened by an increase in product market competition, when endogenous labor markets flows are taken into account. In fact, as in standard imperfect competition models, an increase in the number of firms will have for consequence an increase in price setting real wages. However, in our model, the subsequent adjustment of the efficiency wage level on the labor market will tend to push the separation and hiring rates up. As a consequence, the variation of employment levels as a response to any given shock becomes stronger when competition increases.

This shows that adverse shocks lead to stronger adjustments on the labor market when product market competition becomes stronger. As a consequence, stronger competition makes the burden of adjustments that falls on employment heavier: more competition means more turnover on the labor market. Depending on the relative elasticities of the separation and hiring rates to an increase in competition, this may indeed ultimately lead to aggregate employment losses. One should stress that this result being driven by an efficiency wage mechanism, it does apply even in the absence of any direct regulation on the labor market. Therefore, even coordinated labor market and product market reforms may indeed lead to perverse outcomes if the additional/hidden sources of rigidities are overlooked.

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