The impact of product market competition on employment and wages

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Abstract

Standard economic wisdom generally stresses the benefits of increased competition on the product market. This paper proposes a model of monopolistic competition with an endogenous determination of workers flows in and out of unemployment, where wages are determined according to an efficiency wage mechanism. We show that an increase in product market competition boosts the hiring rate as well as the separation rate. Hence, the efficiency wage schedule compatible with more competition shifts upward. An adverse effect on workers' incentive is at work which pushes real wages up to the point that increased competition may indeed generate employment losses rather than gains.

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1 Introduction

The detrimental influence of labour market imperfections on employment performance has long been emphasized in the literature[1] and has led to a large set of policy recommendations in favor of labour market reforms. A recent literature has more specifically focused on the interactions between imperfections in the labour 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, labour market reforms should be accompanied by reforms on the product markets, the latter being expected to alleviate the burden of adjustments on the labour market thus favouring employment.[3]

The channels of positive interaction between product market competition and employment are clearly spelled out for instance in Nickell [1999]. First, an increase in product market competition will augment output and shift out labour demand curves, bringing about an increase in firms' labour demand for any *given* wage level. The positive effect, i.e. the external shift of the labour demand curve, derives from the modification of firms' pricing behaviour when competition becomes stronger. The rationale is straightforward: higher competition reduces market power for each firm, this lowers the price mark-up that firms are able to enforce, and increases employment at any given level of real wages. This first effect is clearly positive, however the final

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

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

[3] 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 (see OECD [1994], Nicoletti et al. [2000]).

outcome in terms of employment and wages depends on the response stemming from the wage setting process.

This observation stresses the need for an analysis of the wage setting behaviour and leads to the second positive effect put forward by Nickell: more competition on the product market being associated with a decreasing elasticity of labour demand, this lowers the bargained real wage schedule. The main reason for this is the following: when the labour demand elasticity becomes higher, the negative impact on both employment and profits of any increase in wages is larger; this reduces unions' claims and the bargained level of the real wage.[4] Hence, the author concludes that single unionised firms which face increased competition will benefit from a higher labour demand elasticity and a lower bargained real wage schedule: the final outcome of increased competition is therefore higher employment possibly combined with higher real wages.

Empirical results on the impact, at the aggregate level, of increased competition on labour markets and employment are provided by recent contributions such as Boeri *et al.* [2000] and Nicoletti *et al.* [2000]. Both papers are based on a new OECD index of product market regulation which proves to be strongly correlated to different measures of labour market regulation. Interestingly enough, the only measure of product market (de)regulation that is not correlated with labour market (de)regulation (that is the outward-oriented regulation - trade and investment barriers) generates a positive impact on wages and a negative impact on employment. As a consequence of the

[4] See Layard, Nickell and Jackman [1991], Nickell et al. [1994] and Nickell [1999].

correlation between product and labour market reforms ([5]), the outcome in terms of employment should consider both the direct effect of product market reforms on employment (for instance, via lower market power and mark-up) as well as the indirect effects on labour market operation, the latter effect being possibly negative as shown for instance in the literature on turnover and job security (see Bertola [1990]).

Nickell [1999] does provide a theoretical intuition of a possible relation between workers turnover and wage formation which passes through the "filter" of product market competition: the author suggests that reduced labour demand elasticity (associated with market power) may induce stronger rent capture (by insiders) and higher retention rates; this increases job security for any given level of wages. The overall outcome would then be a higher bargained real wage schedule.

The idea that increased competition on the product market may be associated with stronger turnover on the labour market puts forward the tight links between the operation of product and labour markets which are also stressed by Boeri *et al.* [2000] and Nicoletti *et al.* [2000]. Moreover, according to these two contributions, product market competition would be stronger in economies such as the US and UK, which would then be coherent with the fact that workers flows are stronger in those two countries and that retention and tenure are higher in continental Europe as well as in Japan (see OECD [1994] and [1997]) ([6]).

In spite of this, Nickell's argument that increased competition reduces job secu-

[5] Andersen [2000] proposes a model which suggests that product marker integration may indeed reduce workers' market power thus changing labour market structure by acting as an implicit labout market reform.

[6] The evidence on this point is indeed mixed. Bertola and Rogerson [1997] and Burda and Wyplosz [1994] suggest that job (and to some extent, workers) flows are similar across the US and Europe.

rity **and** wages, thus favouring employment, implies on the one side that a negative correlation exists between product market competition and wages, and on the other side that job security is associated with higher real wages. However, the evidence in this regard is at best mixed: concerning the latter, Bertola [1990] shows for instance that job security provision yields no negative impact on employment and is indeed associated with lower aggregate real wages;[7] as for competition and wages, Nickell [1999] reports that a negative correlation only shows on micro- and industry data from unionized firms, while such a correlation cannot be observed for non unionized firms. This suggests that the impact of competition and turnover on wages (and employment) is indeed sensitive to the nature of the prevailing wage setting mechanism.

A perverse impact of turnover on employment emerges for instance in two recent papers addressing the relation between turnover, wages and employment under the assumption of perfect competition on the product markets. Snower and Diaz-Vazquez [1996] develop a model of wage bargaining and macroeconomic fluctuations which shows that stronger turnover (i.e. lower firing and hiring costs) can lead to perverse employment consequences when fluctuations are transient and union power moderate. Fella [2000] investigates this issue in an efficiency wage framework and shows that redundancy pay may exercise a positive effect on welfare by reducing the (suboptimally) high rate of turnover determined by employment decisions of individual firms in the presence of intertemporal externalities; this paper also shows that increased job security actually reduces the level of the (efficiency) wages at the equilibrium.

[7] However, Lazear [1990] provides evidence of a negative impact of dismissal regulation on employment levels.

Our model builds on this intuition and addresses the impact of product market competition on turnover, wages and employment, in an efficiency wage framework. In this respect, Nickell [1999] notes that efficiency wages generally depend on 'exogenous' factors such as: external opportunities, monitoring technologies, quit and turnover functions. He therefore submits that "*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. 7). This conclusion is indeed misleading. In fact, we will show that a mechanism exists which links up the market power of firms to the efficiency wage premium by endogenising labour market turnover following demand or productivity shocks.

To address the issue, this paper proposes a model of monopolistic competition where firms endogenously determine workers flows in and out of unemployment by setting wages according to an efficiency wage mechanism. More precisely, we assume that firms move across two different states of technology: Good (type-G) and Bad (type-B). When moving, they respectively hire and fire workers thus generating a certain turnover on the labour market. Workers have to be indifferent across the two options of working in firing (formerly type-G firms experiencing a Bad shock) or hiring (formerly type-B firms experiencing a Good shock) firms, which generates a positive wage differential across firms in different states. At the same time, due to the monopolistic competition assumption, productivity differentials across firms are (partially) translated into price differentials across type-B and type-G firms: this contributes to smoothing employment differentials across firms in different states, thus reducing the size of workers flows as a response to demand and/or productivity shocks.

In this setup, increased competition (that is a higher elasticity of demand) clearly compresses price differentials and consequently leads, due to real wage rigidities stemming from the efficiency wage setting, to larger employment differentials across type-G and type-B firms. The rationale is that stronger competition on the product market means that relative prices tend to approach unity. Hence, as competition increases firms are increasingly forced to adjust to shocks through quantities' adjustments rather than through price adjustments. As a consequence, under stronger competition firms modify employment in response to shocks more than they would under weak competition. As more competition exacerbates the differential in employment levels existing across type-G and type-B firms, more separations as well as hiring are generated as response to shocks: this unambiguously rises turnover on the labour market. [8]

Two are the main consequences of this mechanism. First, the wage premium paid by potentially firing firms always rises with respect to the premium paid by hiring firms, which may lead to rising relative wages. Second, due to the impact of turnover on efficiency wages premia, an adverse effect on workers' incentives is in place which generates wage pressure and may ultimately result in a higher level of unemployment.

The paper is organised 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. Section 5 briefly concludes.

[8] This result is consistent with empirical evidence on industry data provided by Weiss [1998].

2 The model

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:

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

$\eta > 1$ 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 is only one firm in each intermediate sector[9]. Each firm is small compared to the economy but has a monopoly 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

[9] This assumptions is not crucial to our results. We could alternatively assume Cournot competition in each intermediate sector and study the consequence of free entry (increase in n). This would not affect our results but would make things a bit more complicated. That is why we have preferred to stick to the simplifying assumption of monopolistic competition.

labour as its sole input :

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

$0 < \gamma \leq 1$, l_j is the input of effective labour, i.e. l_j workers providing the expected effort level. Firms are subject to 'productivity' shocks which can be thought as stemming from fluctuations in factors other than labour 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 realisations are denoted α_{jt} for firm j at time t, they are independent across firms. More specifically, the αs follow a two-state Markov chain with symmetric transition probability p:

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

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

There are thus two states for the technology: a 'good' state G with a high labour productivity, and a 'bad' state B with a low value for labour productivity. The long-run probability for a given firm to be in either a good or a bad state is 0.5. In what follows, we will then assume that at each time t, 50% of the firms are in the good state while 50% are in a bad state [10]. Therefore, there will be no aggregate fluctuations in either output or employment.

[10] We assume that the number of firms is large enough. This also means that firms will not consider the impact on the aggregate price index, when maximising profits.

2.1 wage setting

The economy is populated with a fixed number N of agents who supply labour inelastically. Each individual worker is characterised by an identical utility function, where instantaneous utility depends on the real wage[11] and on the effort provided on the job:

$$u_t = w_t^j - e_t \tag{6}$$

$j = G, B$; 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 labour is nil, whereas an individual working with the expected effort level e contributes for one unit to effective labour. w_t^j is the real wage. This simple specification and 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 x_t and, when caught, loses his job at the end of period t. The probability of getting away with shirking is thus $1 - x_t$.

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

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

exogenous probability of job loss. In our setting, this probability is made endogenous: firms are subject to shocks which affect their productivity in a way that will be shown in the next section. As a consequence, firms shed labour when they are hit by an adverse shock which forces them to downward adjust their labour force. If l_G (l_B) is employment of a representative firm in a good (bad) state and we denote q_t the probability of losing one's job following an adverse shock, then:

$$q_t = \frac{l_{Gt} - l_{Bt}}{l_{Gt}} = \left(1 - \frac{1}{l_t}\right) \tag{7}$$

with $l = \frac{l_{Gt}}{l_{Bt}}$.

Only workers inside a type-G firm are concerned by this type of job loss since only type-G firms are likely to be hit by an adverse shocks. The situation of type-B firms can only improve or at worst stay the same. At each time, a certain proportion[12] of type-G firms is hit by an adverse shock and has to shed labour, whereas some type-B firms enjoy a favourable shock and have to hire workers out of the pool of unemployed in order to adjust their labour force. Workers having lost their job become unemployed: we will assume that there is no unemployment allowance. The flow probability out of unemployment is a_t, which is the probability for an unemployed of finding a job[13].

As in Fella [2000], we assume that workers have an infinite horizon and discount future at the rate r. We can now compute the discounted utilities associated with the

[12] A proportion p when one applies the law of large numbers.

[13] This probability is also endogenous and will be determined at the equilibrium by a flow equilibrium condition, as shown in section 3.

various possible positions for an individual: being employed in a type$-G$ or a type-B firm and shirking or not shirking, or being unemployed. The discounted utility of a worker who shirks at time t in a type-G firm is V_{St}^G, and V_{NSt}^G when he does not shirk. The utilities associated to working in a type- firm are likewise V_{St}^B (shirking) and V_{NSt}^B (not shirking). The utility of being unemployed is U_t. We then have:

$$r \cdot U_t = a \cdot \left(V_t^G - U_t\right)$$

$$r \cdot V_{St}^G = w_t^G + (x + p \cdot q) \cdot \left(U_t - V_{St}^G\right) + p \cdot (1-q) \cdot \left(V_t^B - V_{St}^G\right)$$

$$r \cdot V_{NSt}^G = w_t^G - e + p \cdot q \cdot \left(U_t - V_{NSt}^G\right) + p \cdot (1-q) \cdot \left(V_t^B - V_{NSt}^G\right)$$

$$r \cdot V_{St}^B = w_t^B + x \cdot \left(U_t - V_{St}^B\right) + p \cdot \left(V_t^G - V_{St}^B\right)$$

$$r \cdot V_{NSt}^B = w_t^B - e + p \cdot \left(V_t^G - V_{NSt}^B\right)$$

V_t^B and V_t^G are equilibrium levels associated with working in a $B-$firm and in a $G-$firm respectively.

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

$$V_{NSt}^j \geq V_{St}^j \tag{8}$$

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 behaviour 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.

By imposing the no-shirking conditions, one obtains:

$$V_S^G = V_{NS}^G \rightarrow x \cdot \left(U_t - V^G\right) = -e$$

$$V_S^B = V_{NS}^B \rightarrow x \cdot \left(U_t - V^B\right) = -e$$

from which one can easily see that the following arbitrage condition always holds at the equilibrium:

$$V^G = V^B \tag{9}$$

which ensures that workers are indifferent between working in a type-G firm and working in a type-B firm. From these conditions, one may deduce the following proposition:

Proposition 2 *Real wages in type-G firms are always higher than real wages in type-B firms. The wage-premium increases with the probability of experiencing a bad shock p and is independent of the realisations of the shocks.*

Proof. Condition (9) gives a relationship between the wage in a type-G firm and that in a type- firm:

$$w_G = w_e^G\left(w_B\right) = \frac{(a + r + p \cdot q) \cdot w_B - p \cdot q}{a + r} \tag{10}$$

The incentive conditions for each type firms give two relationships, $w_i^G\left(w^B\right)$ and $w_i^B\left(w^G\right)$. Solving $w_e^G\left(w_B\right) = w_i^G\left(w^B\right)$ and plugging into $w_i^B\left(w^G\right)$ give the equilibrium values for w^B and w^G:

$$\begin{aligned} w^G &= \frac{a + p \cdot q + r + x}{x} \\ w^B &= \frac{a + r + x}{x} \end{aligned} \tag{11}$$

■

The efficiency wage paid by either type of firms is higher the higher the hiring rate is. The justification for this result is simple. When the hiring rate increases, shirkers caught (and fired) will have a higher probability of finding new employment in a type-G firm. Therefore, a shirker's utility increases and a compensation in the form of a higher wage is required in order to enforce the no-shirking condition. A higher separation rate will have the consequence of raising wages in type-G firms. Workers can be fired regardless of their effort when the firm employing them is hit by a bad shock. Every employed worker has then to face the possibility of losing his position. 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 (potentially) firing firms.

2.2 labour demand

To define firms' hiring decisions across sectors one should consider that wages are set by type-G and type-B firms at the minimum level which respects the effort-incentive constraint for workers; every worker then provides the necessary effort so that effective and employed labour are equal. Since the value of the efficiency wage for type-G firms depends on the separation rate $q = 1 - \frac{1}{l}$, profit maximisation for firm j in any intermediate sector gives: [14]

$$\frac{P_s}{P} \cdot \left(1 + \frac{\partial P_s}{\partial y_j} \cdot \frac{y_j}{P_s}\right) = w^j \cdot \frac{\partial l_j}{\partial y_j} + \frac{\partial w^j}{\partial l_j} \cdot \frac{\partial l_j}{\partial y_j} \cdot l_j \tag{12}$$

w_j is the real wage paid by firm j. The term $\frac{\partial w^j}{\partial l_j}$ captures the impact of firms' labour demand on the relative employment level and thus on the separation rate; this affects the efficiency wage level for type-G firms. One should further note that w^B only depends on the hiring rate (the average variable a) and therefore $\frac{\partial w^B}{\partial l_B} = 0$.

Because firms have market power within their sector, the price of intermediate vary across type$-G$ and type$-B$ firms: we denote it respectively P_G and P_B. Assuming for simplicity $P = 1$, we can rewrite (12) as follows:

$$\begin{aligned} P_G \cdot \left(1 - \frac{1}{\eta}\right) &= \frac{w^G}{\alpha_G} + p \cdot \frac{1-q}{x \cdot \alpha_G} \\ P_B \cdot \left(1 - \frac{1}{\eta}\right) &= \frac{w^B}{\alpha_B} \end{aligned} \tag{13}$$

The two price setting equations relate the price of intermediate goods (relative to the price index P) to the real wage level in each sector of the economy. From the price index (3) and aggregate production (1), one can derive the expression for intermediate goods' prices. We can denote Y_B as total output of firms in a bad state and Y_G is total output of firms in a good state; likewise employment is respectively given by L_B and L_G. As within the economy at any given time, there will be half of

[14] The maximisation is state-contingent. It could be written in its intertemporal form as follows: $r \cdot J_j = \frac{\partial \pi_j}{\partial Y_j} + p \cdot (J_i - J_j)$ with J_j being the value of a job in state j. In the absence of firing and hiring costs, firms will hire and fire workers so as to ensure $J_j = 0$. This gives the condition presented in the text.

the firms in a bad state and half of the firms in a good state, from (1) one obtains that:

$$\begin{aligned}\widetilde{Y}_t &= \left(\int_0^1 Y_t(s)^{\frac{\eta-1}{\eta}} ds\right)^{\frac{\eta}{\eta-1}} \\ &= \left(\tfrac{1}{2}\cdot Y_B^{\frac{\eta-1}{\eta}} + \tfrac{1}{2}\cdot Y_G^{\frac{\eta-1}{\eta}}\right)^{\frac{\eta}{\eta-1}}\end{aligned}$$

Since $Y_s = P_s^{-\eta}\cdot \widetilde{Y}$, defining $\alpha = \frac{\alpha_G}{\alpha_B}$ one has:

$$\begin{aligned}P_B &= Y_B^{-\frac{1}{\eta}}\cdot\left(\frac{1}{2}\cdot Y_B^{\frac{\eta-1}{\eta}} + \frac{1}{2}\cdot Y_G^{\frac{\eta-1}{\eta}}\right)^{\frac{1}{\eta-1}} \\ &= \left(\frac{1+(\alpha\cdot l)^{\frac{\eta-1}{\eta}}}{2}\right)^{\frac{1}{\eta-1}}\end{aligned} \tag{14}$$

and:

$$P_G = \left(\frac{1+(\alpha\cdot l)^{\frac{1-\eta}{\eta}}}{2}\right)^{\frac{1}{\eta-1}} \tag{15}$$

Moreover, an expression for the relative price of intermediates $\frac{P_B}{P_G}$ can also be derived from the demand curves (2). One easily obtains:

$$\frac{P_B}{P_G} = \left(\frac{Y_G}{Y_B}\right)^{\frac{1}{\eta}} = (\alpha\cdot l)^{\frac{1}{\eta}} \tag{16}$$

Firms in the intermediate sectors earn positive profits at the equilibrium. However, these profits clearly vanish as competition increases that is as the price elasticity of demand within each industry rises (we will come to this point in section 4).[15]

[15] One should further note that the set-up of the model implies profits and wages being entirely spent in consumption of the final (competitive) good.

3 Macroeconomic equilibrium

At any instant t, half of the firms in every intermediate sector experience a favourable shock while the other half experience a bad shock: a fraction p of the type-G firms switch positions with a fraction p of the type-B firms. The formerly type-G turned type-B firms have to shed labour in order to adjust their labour force to its optimal value, while formerly type-B now type-G firms need to make the opposite adjustment. Laid-off workers join the ranks of the unemployed while some unemployed workers find new employment with firms having switched from B to G. At the steady state equilibrium, the unemployment rate stays constant and the flows in and out of unemployment balance each other out. Recalling that a is the flow probability out of unemployment, one has:

$$a \cdot \left(N - \frac{L_G + L_B}{2} \right) = \frac{p}{2} \cdot q \cdot L_G \tag{17}$$

Since we know that $q = 1 - \frac{1}{l}$, (17) allows us to define aggregate employment as a function of the separation and hiring rates. Hence, we can solve the model by deriving the equilibrium values of the latter two endogenous variables. To do that, we shall show that the price setting equations (13) taken together define the equilibrium value of the employment ratio of type-G to type-B firms as well as the hiring rate. This will allow us to define the level of employment and wages in firms of either type.

First, it must be observed that combing the two price setting equations (13), one has

$$\frac{P_B}{P_G} = \frac{\alpha \cdot w^B}{\varphi_G} \tag{18}$$

with $\varphi_G = w^G + p \cdot \frac{1-q}{x}$. Then, using (16) to substitute for $\frac{P_B}{P_G}$ and (11) to substitute for w_B and φ_G, one can easily rewrite the condition above, to obtain $\frac{(a+r+x)\cdot\alpha}{a+p+r+x} = (\alpha \cdot l)^{\frac{1}{\eta}}$. This defines a first expression for relative employment l that we denote:

$$l_1(a,\eta) = \left(\frac{\alpha^{1-\frac{1}{\eta}} \cdot (s-p)}{s}\right)^{\eta}$$

where to simplify notations, we use the variable $s \equiv a + x + r + p$ which is a simple linear transformation of the endogenous variable a. One can show that $\frac{\partial l_1}{\partial s} > 0$, $\frac{\partial l_1}{\partial \eta} > 0$.

To define the equilibrium solution, a second expression for relative employment can be derived from (13). In fact, we shall note that (13) ensures $P_G \cdot \left(1 - \frac{1}{\eta}\right) = \frac{\varphi_G}{\alpha_G}$. Substituting (15) for P_G and using the value of efficiency wage to replace for φ_G, one obtains:

$$\left(\frac{1+(\alpha \cdot l)^{\frac{1-\eta}{\eta}}}{2}\right)^{\frac{1}{\eta-1}} \cdot \left(1 - \frac{1}{\eta}\right) = \frac{(a+p+r+x)}{x \cdot \alpha_G}$$

from which the following expression for relative employment l can be derived:

$$l_2(a,\eta) = \frac{\left(-1 + 2 \cdot x^{1-\eta} \cdot s^{-1+\eta} \cdot \alpha_G^{1-\eta} \cdot \left(\frac{-1+\eta}{\eta}\right)^{1-\eta}\right)^{\frac{-\eta}{-1+\eta}}}{\alpha}$$

One can show that $\frac{\partial l_2}{\partial \eta} > 0$ and $\frac{\partial l_2}{\partial s} < 0$ [16].

The rationale for these results is the following. Take, for instance, the relative price

[16] In fact, $\frac{\partial l_2}{\partial s} < 0$ if $1 - 2 \cdot \left(\frac{s \cdot \eta}{x \cdot \alpha_G \cdot (\eta - 1)}\right)^{\eta-1} < 0$, while $\frac{\partial l_2}{\partial s} > 0$ corresponds to $-1 + 2 \cdot x^{1-\eta} \cdot s^{-1+\eta} \cdot \alpha_G^{1-\eta} \cdot \left(\frac{-1+\eta}{\eta}\right)^{1-\eta} < 0$, in which case $l_2(s,\eta)$ is only defined for $\eta = 2$. Therefore, for non complex solutions of $l_2(s,\eta)$, one has $\frac{\partial l_2}{\partial s} < 0$.

equilibrium condition (18) which generates $l_1(a, \eta)$. The ratio of the intermediate goods' prices $\frac{P_B}{P_G}$ being a function of the relative demand for intermediate goods and thus of relative employment l, a higher value of η has the consequence of compressing relative prices towards unity thus producing an increase in l for any given level of wages. On the other hand, a higher value of the endogenous variable a pushes the labour costs ratio $\frac{\alpha \cdot w^B}{\varphi_G}$ up and lowers the demand for labour from type-B firms relative to type-G firms; hence, the increase in l. This explains the sign of the derivatives of $l_1(a, \eta)$ with respect to a and η. Similar arguments can then be proposed as regards the $l_2(a, \eta)$ function.

The equilibrium can now be deduced from the condition:

$$l_1(a, \eta) = l_2(a, \eta)$$

which leads us to the following proposition.

Proposition 3 *There exists a unique equilibrium for the model if*

$$-\left(\frac{(r+x)\,\alpha^{\frac{-1+\eta}{\eta}}}{p+r+x}\right)^{\eta} + \alpha^{-1}\left(-1 + 2\,x^{1-\eta}\,(p+r+x)^{-1+\eta}\,\alpha_G^{1-\eta}\left(\frac{-1+\eta}{\eta}\right)^{1-\eta}\right)^{-\frac{\eta}{\eta-1}} > 0$$

and

$$\frac{(1+r+x)^{\eta}\,\alpha^{\eta}}{(1+p+r+x)^{\eta}} - \left(-1 + 2\,x^{1-\eta}(1+p+r+x)^{-1+\eta}\,\alpha_G^{1-\eta}\left(\frac{-1+\eta}{\eta}\right)^{1-\eta}\right)^{-\frac{\eta}{\eta-1}} > 0.$$

Proof. The first condition ensures that $l_2(0, \eta) > l_1(0, \eta)$, and the second that $l_2(1, \eta) < l_1(1, \eta)$. $l_2(a, \eta)$ being a decreasing function of a, $l_1(a, \eta)$ an increasing function, there exists a unique $a \in \,]0, 1[$. Since $s \equiv a + x + r + p$, the solution for a^* is identified by the value of s which solves the following equality: $\left(\frac{s}{s-p} \cdot \frac{1}{\alpha}\right)^{\eta-1} = 2\left(\frac{s}{x \cdot \alpha_G} \cdot \frac{\eta}{\eta-1}\right)^{\eta-1} - 1$ ■

Hence, we have by now established sufficient conditions for the existence of a unique equilibrium to which is associated a certain level for real wages and unemployment. This result has been derived given a certain degree of imperfection in product market competition, i.e. a certain value of the price elasticity of demand that monopolistic firms are facing. 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 The consequences of an increased competition on the product market

This section investigates the consequences of an increase in the price elasticity of demand within each industry. In our model, imperfections in competition vanish when this elasticity goes to infinity. The price elasticity of demand may be considered as a policy variable or at least influenced by competition policy measures. In some industries in most countries, firms' entry is *de facto* if not *de jure* restricted, making market structures oligopolist: 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.

In this model, the effects of an increase in product market competition cannot just be read off the shift in the labour demand curve. The consequences in terms of wage-setting behaviour have to be taken into account too. One determinant of the efficiency wage is job turnover, which is function of the hiring rate a and of the separation rate q. *Ceteris paribus* a decrease in job security and/or in unemployment duration leads to an increase in the efficiency wage. A first result concerning the effect of product market competition on job turnover is established in the following proposition.

Proposition 4 *An increase in η always raises the separation rate*

Proof. Since $q = 1 - \frac{1}{l}$, the result immediately derives from the shifts of the $l_1(a, \eta)$ and $l_2(a, \eta)$ curves when competition increases. This can easily be seen in Fig. 1 below.

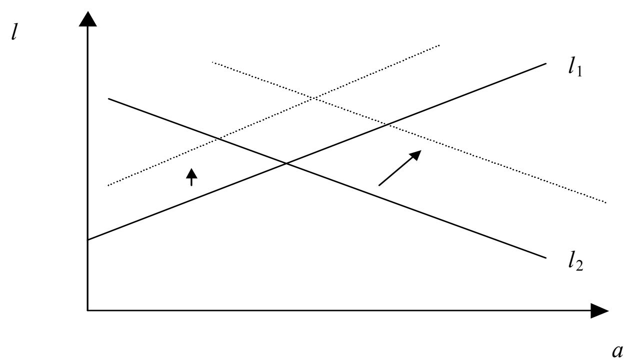

Figure 1. The effect of increased competition on l

Another way to prove the result is the following. Consider that $\frac{dl}{d\eta} = \frac{\partial l_1}{\partial \eta} + \frac{\partial l_1}{\partial a} \cdot \frac{da}{d\eta} = \frac{\partial l_1}{\partial \eta} + \frac{\partial l_1}{\partial a} \cdot \left(-\frac{\frac{\partial l_1}{\partial \eta} - \frac{\partial l_2}{\partial \eta}}{\frac{\partial l_1}{\partial a} - \frac{\partial l_2}{\partial a}} \right)$. This can be rearranged as $\frac{-\frac{\partial l_1}{\partial \eta} \cdot \frac{\partial l_2}{\partial a} + \frac{\partial l_1}{\partial a} \cdot \frac{\partial l_2}{\partial \eta}}{\frac{\partial l_1}{\partial a} - \frac{\partial l_2}{\partial a}}$. Since $\frac{\partial l_1}{\partial a} > 0$ and $\frac{\partial l_2}{\partial a} < 0$, the result immediately follows from the fact that $\frac{\partial l_1}{\partial \eta} > 0$ and $\frac{\partial l_2}{\partial \eta} > 0$. ■

This proposition establishes that an increase in product market competition leads to an decrease in job security. The immediately leads us to the following corollary.

Corollary 5 *An increase in η raises the wage differential between firing and hiring firms*

Proof. This result simply derives from $w^G - w^B = \frac{a+p\cdot q+r+x}{x} - \frac{a+r+x}{x} = \frac{p}{x} \cdot q$. ■

The reduced job security associated with increased competition rises the wage paid by (potentially) firing firms relative to the wage paid by (potentially) hiring firms. A similar result can also be established concerning the hiring rate.

Proposition 6 *An increase in η raises the probability of finding a job when unemployed.*

Proof. We already know that the solution for a^* is identified by the value of s (with $s \equiv a + x + r + p$) solving $\left(\frac{s}{s-p} \cdot \frac{1}{\alpha}\right)^{\eta-1} = 2\left(\frac{s}{x\cdot\alpha_G} \cdot \frac{\eta}{\eta-1}\right)^{\eta-1} - 1$. Denoting $S_1(s,\eta) = \left(\frac{s}{s-p} \cdot \frac{1}{\alpha}\right)^{\eta-1}$ and $S_2(s,\eta) = 2\left(\frac{s}{x\cdot\alpha_G} \cdot \frac{\eta}{\eta-1}\right)^{\eta-1} - 1$, one has $\frac{ds}{d\eta} = -\frac{\frac{\partial S_1}{\partial \eta} - \frac{\partial S_2}{\partial \eta}}{\frac{\partial S_1}{\partial s} - \frac{\partial S_2}{\partial s}}$. From the price setting equations we know that $\frac{s}{s-p} \cdot \frac{1}{\alpha} < 1$ and $\frac{s}{x\cdot\alpha_G} \cdot \frac{\eta}{\eta-1} < 1$. It can easily be shown that $\frac{\partial S_1}{\partial s} < 0$ and $\frac{\partial S_2}{\partial s} > 0$. The sign of $\frac{ds}{d\eta}$ thus depends on the sign of $\frac{\partial S_1}{\partial \eta} - \frac{\partial S_2}{\partial \eta}$ which can be shown to be positive. In fact, one can see that both $S_1(s,\eta)$ and $S_2(s,\eta)$ are monotonically decreasing functions of η (that is, $\frac{\partial S_1}{\partial \eta} < 0$ and $\frac{\partial S_2}{\partial \eta} < 0$); moreover $S_1(s,\infty) = 0 > -1 = S_2(s,\infty)$. Therefore, for the two curves to cross and define a positive integer $s(\eta)$ the following condition must hold: $\frac{\partial S_1}{\partial \eta} > \frac{\partial S_2}{\partial \eta}$. One can also see this from the figure below.

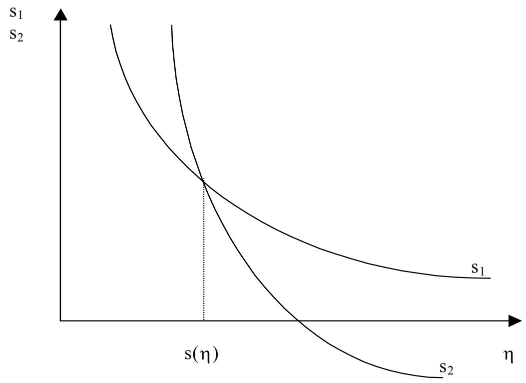

Figure 2. Defining $s(\eta)$

■

These results establish a strict correlation between the structures of product and labour markets as measured respectively by the intensity of competition and of turnover. The rationale for these results is the following. First one should note that, as the ratio of the intermediate goods' prices $\frac{P_B}{P_G}$ is a function of relative employment l, an increase in the intensity of competition η tends to compress relative prices and therefore pushes relative employment l up for any given level of wages. This modification of relative and absolute prices requires also an adjustment of wage levels, which is done through a change in the endogenous hiring rate a: in order for the efficiency wages to keep up with price increase, the hiring rate has to increase.

If we now go back to the flow equilibrium condition (17) we can easily deduce the expressions of aggregate and sectorial employment levels as functions of a and l. Hence, the results on the separation and hiring rate taken together lead us to the following corollary.

Corollary 7 *More competitive product markets are associated with more de facto flexible labour markets; for a given size of shocks, the adjustments in the level of* *employment are larger when product market competition is stronger*

Proof. Employment adjustments are then given by $\Delta L = \frac{L_G - L_B}{2} = \frac{a \cdot (l-1) \cdot N}{a \cdot (1+l) + (l-1) \cdot p}$. One can finally show that $\frac{\partial \Delta L}{\partial a} = \frac{a \cdot (l-1)^2 \cdot N}{(a \cdot (1+l) + (l-1) \cdot p)^2} > 0$ and $\frac{\partial \Delta L}{\partial l} = \frac{a^2 \cdot (l-1) \cdot N}{(a \cdot (1+l) + (l-1) \cdot p)^2} > 0$

■

This result contradicts the common view according to which more competition, associated with larger price adjustments, should lead to smaller quantity adjustments. What distinguishes our result from this standard view 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 only adjustment variables left are quantities.

We may now establish the result concerning the effects of increased product market competition on the level of unemployment. In fact, if we now go back to the flow equilibrium condition (17) we can easily deduce that $L = \frac{a \cdot (1+l) \cdot N}{a \cdot (1+l) + (l-1) \cdot p}$, which allows us to define employment as a function of a and l. One can intuitively see that the combination of higher hiring and separation rate determined by increased competition may call for a adverse compensation in terms of the employment levels. In fact, two opposite forces are at work as it is formally established below.

Proposition 8 *Increased competition on the product market leads to a decrease in total employment if*

$$\frac{L_s}{-L_\eta} \cdot s_\eta^* < 1$$

with $s^* = a^* + p + x + r$

Proof. We can substitute $l_1(a, \eta)$ for l into the expression of total employment.

We obtain: $L = \left(1 + \frac{p - \frac{2 \cdot p \cdot \alpha}{\alpha + \left(\frac{s-p}{s} \cdot \alpha\right)^{\eta}}}{s - p - x - r}\right)^{-1}$. If one totally differentiates the expression for employment, one has:

$$dL = \frac{\partial L}{\partial s} \cdot s_{\eta} \cdot d\eta + \frac{\partial L}{\partial \eta} \cdot d\eta$$

Rearranging gives:

$$\frac{dL}{d\eta} = L_s \cdot s_{\eta} + L_{\eta}$$

where L_x is $\frac{\partial L}{\partial x}$. We know that $s_{\eta} > 0$; it can be show that $L_{\eta} < 0$. The expressions for the partial derivatives of L can be computed:

$$\begin{aligned}
L_{\eta} &= \frac{2 \cdot p \cdot s^{\eta} \cdot (s-p)^{\eta} \cdot (s-p-r-x) \cdot Log\left(\frac{s}{s-p} \cdot \frac{1}{\alpha}\right)}{\left(2 \cdot p \cdot s^{\eta} \cdot \alpha - (s-x-r) \cdot (s^{\eta} \cdot \alpha) + (s-p)^{\eta} \cdot \alpha^{\eta}\right)^2} < 0 \\
L_s &= \frac{p \cdot \left(\begin{array}{c} -s^{1+2\cdot\eta} \cdot (s-p) \cdot \alpha^2 + s \cdot (s-p)^{1+2\cdot\eta} \cdot \alpha^{2\eta} \\ -2 \cdot p \cdot s^{\eta} \cdot (s-p)^{\eta} \cdot (s-p-x-r) \cdot \alpha^{1+\eta} \cdot \eta \end{array}\right)}{(s-p) \cdot s \cdot \left(2 \cdot p \cdot s^{\eta} \cdot \alpha - (s-x-r) \cdot (s^{\eta} \cdot \alpha) + (s-p)^{\eta} \cdot \alpha^{\eta}\right)^2}
\end{aligned}$$

The sign of L_s depends on the term $(-s^{1+2\cdot\eta} \cdot (s-p) \cdot \alpha^2 + s \cdot (s-p)^{1+2\cdot\eta} \cdot \alpha^{2\eta} - 2 \cdot p \cdot s^{\eta} \cdot (s-p)^{\eta} \cdot (s-p-x-r) \cdot \alpha^{1+\eta} \cdot \eta) \gtreqless 0$. Rearranging one has: $2 \cdot p \cdot \eta \lesseqgtr T(s,\eta) = s \cdot (s-p) \cdot \frac{\left(\frac{s}{s-p}\right)^{\eta} \cdot \left(\alpha^{\eta-1} - \left(\frac{1}{\alpha}\right)^{\eta-1}\right)}{s-p-x-r} > 0$. The sign of L_s is thus hard to determine. We can nevertheless conclude that $\frac{dL}{d\eta} < 0$ if $L_s \cdot s_{\eta} + L_{\eta} < 0$ which immediately leads to the condition stated in the proposition. ■

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 hiring opportunities on employment. 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 generates an direct negative impact of competition on aggregate employment.

A second result is immediately linked to the previous one. Defining the relative wage $W^R = \frac{w^G}{w^B}$, one can establish the following proposition.

Proposition 9 *Increased competition on the product market rises relative wages if*

$$\frac{-W_s^R}{W_\eta^R} \cdot s_\eta < 1$$

Proof. We can substitute $l_1(a, \eta)$ for q into the expression of relative wages $W^R = 1 + p \cdot \frac{q}{s-p}$. We obtain: $W^R = p \cdot \frac{1 - s^\eta \cdot (s-p)^{-\eta} \cdot \alpha^{1-\eta}}{s-p}$. Totally differentiating this expression gives:

$$dW^R = \frac{\partial W^R}{\partial s} \cdot s_\eta \cdot d\eta + \frac{\partial W^R}{\partial \eta} \cdot d\eta$$

Rearranging gives:

$$\frac{dW^R}{d\eta} = W_s^R \cdot s_\eta + W_\eta^R \tag{19}$$

where W_x^R is $\frac{\partial W^R}{\partial x}$. We know that $s_\eta > 0$; it can be show that $W_\eta^R > 0$.

The expressions for the partial derivatives of L can be computed:

$$\begin{aligned} W_\eta^R &= -p \cdot s^\eta \cdot (s-p)^{-\eta-1} \cdot \alpha^{1-\eta} \cdot Log\left(\frac{s}{s-p} \cdot \frac{1}{\alpha}\right) > 0 \\ W_s^R &= p \cdot \frac{-s + s^\eta \cdot (s-p)^{-\eta} \cdot \alpha^{1-\eta} \cdot (s + p \cdot \eta)}{(s-p)^2 \cdot s} \end{aligned}$$

The sign of W_s^R is determined by $-s+s^{\eta}\cdot(s-p)^{-\eta}\cdot\alpha^{1-\eta}\cdot(s+p\cdot\eta)\gtrless 0$. Rearranging, one obtains: $s^{\eta-1}\cdot(s-p)^{-\eta}\cdot\alpha^{1-\eta}\cdot(s+p\cdot\eta)\gtrless 1$. One can see that: $s^{\eta-1}\cdot(s-p)^{-\eta}\cdot\alpha^{1-\eta}\cdot(s+p\cdot\eta)=\left(\frac{s}{s-p}\cdot\frac{1}{\alpha^{1-\frac{1}{\eta}}}\right)^{\eta}\cdot\left(1+\frac{p\cdot\eta}{s}\right)$. Since $\frac{s}{s-p}\cdot\frac{1}{\alpha^{1-\frac{1}{\eta}}}<1$, the sign of W_s^R is hard to determine. However, one can see that $\frac{dW^R}{d\eta}>0$ if $\frac{W_s^R\cdot s_\eta}{W_\eta^R}>-1$ which immediately leads to the condition stated above. ■

A complete characterisation of the possible cases where the conditions above are met would be extremely difficult to undertake. An example is however presented in Appendix 1, where a simulation is proposed showing that increased competition indeed has a negative impact on employment and widens the wage ratio.

5 Conclusion

According to conventional wisdom, increased competition on product markets would unambiguously contribute to alleviating the burden of adjustment which falls on imperfect labour 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 labour market may indeed be worsened by an increase in product market competition, when the impact on endogenous labour markets flows is taken into account.

In fact, endogenous workers flows are generated through firms adjusting to shocks through either quantities or price(wage) adjustments; employment differentials across firms hit by either bad or good shocks endogenously determine the hiring and firing rates, i.e. workers turnover which in turn positively affect the level of the efficiency wages.

As in standard imperfect competition models, increased competition will push up labour demand and squeeze price differentials across firms in either a good or bad state. In other words, increased competition reduces the extent to which firms can use price variations to adjust to shocks. As a consequence, in the absence of appropriate relative real wages adjustments, employment variation across firms would become stronger, for any given size of shocks. In our model, it is the presence of efficiency wage rigidities that induce stronger variations of employment as a response to given shocks, as competition increases on the product market. In fact, widening employment adjustments (following increased competition) generate increased efficiency wage premia by pushing the separation and hiring rates up.

This shows that more competition means more turnover on the labour market, which may indeed make the burden of adjustments that falls on employment heavier. Depending on the relative elasticities of the separation and hiring rates to an increase in competition, this may ultimately lead to rising relative wages and aggregate employment losses.

To conclude 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 labour market. This tells us that even coordinated labour market and product market reforms may lead to perverse outcomes if the additional hidden source of rigidities generated by efficiency wage mechanisms is overlooked[17].

[17] This point relates directly to the issue of policy complementarities discussed in recent contributions such as in particular, Snower and Orszag [1998] and Snower and Coe [1997].

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A Appendix 1: an example of negative impact of increased competition on employment and wages

To run the simulations we solve for an explicit value of $a*$ by linearizing $\left(\frac{s}{s-p}\cdot\frac{1}{\alpha}\right)^{\eta-1} = 2\left(\frac{s}{x\cdot\alpha_G}\cdot\frac{\eta}{\eta-1}\right)^{\eta-1} - 1$ through a first degree expansion around $p = 0$. We then plug the value of $a*$ into $l_1(a,\eta)$ to obtain $l*$. The simulations that follow use the following parameters values: $\overline{L} = 1$, $p = 0.03$, $x = 0.4$, $r = 0.1$, $\delta = 0.043$, $\alpha_B = 1.6 - \delta$, $\alpha_G = 1.6 + \delta$. Results are presented below. The variable $\eta > 1$ appears on the horizontal axis in all figures. One should further note that by increasing the productivity differential δ (given all other parameters values) the sign of the effect of increased competition on aggregate employment and relatives wages changes as shown in figures 6 and 7.

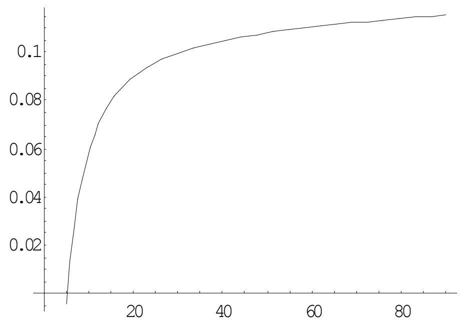

Figure 2. Hiring rate

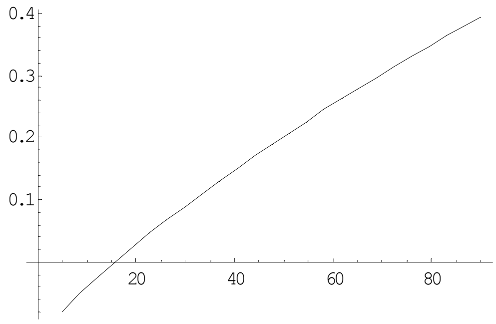

Figure 3. Separation rate

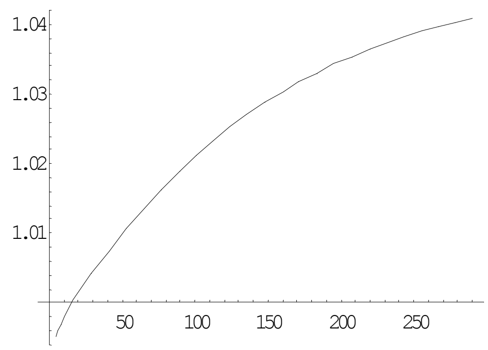

Figure 4. Relative wages with low δ

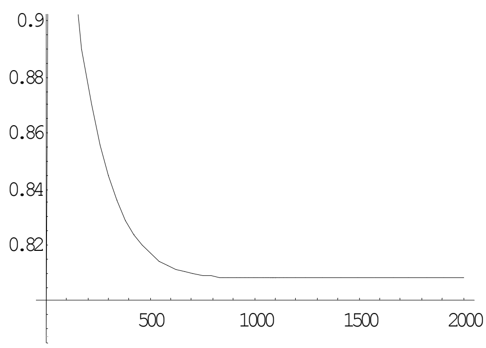

Figure 5.Total employment with low δ

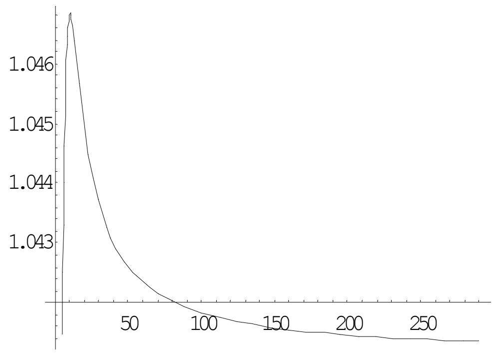

Figure 6. Relative wages with high δ

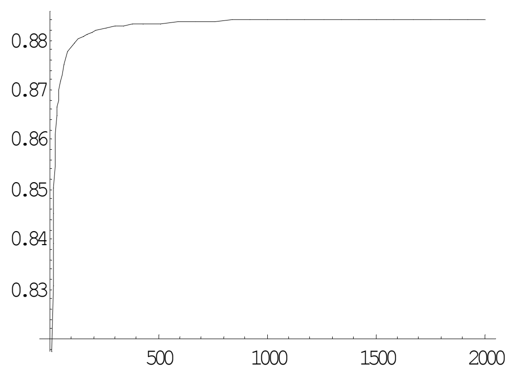

Figure 7. Total employment with high δ