Labour and product market reforms in the economy with distortionary taxation*

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Abstract

It is widely accepted that in order to improve the economic position of the EU relative to the USA certain structural reforms need to be undertaken, mainly in the labour market. However few EU countries have undertaken such reforms. The reason lies in the fact that those reforms are going to be costly in terms of economic performance, unemployment and hence the cost of financing them - at least in the short term. Blanchard and Giavazzi (2003) develop a model based on imperfect competition in both product and labour markets in order to show the impact of deregulation on the economy. However they do not consider the question of how to finance such reforms or overcome the short run costs, a key consideration if the short run costs are large relative to the long run gains. We extend their model by including the effects of another inevitable source of imperfections: distortionary taxation - not only the most likely candidate for reform, but also the most likely instrument for financing the restructuring process. By extending the model in this way we can establish formally that reforms imply significant short run costs as well as long run gains; that (political opposition apart) the financing of such reforms will be the main stumbling block. We come to a number of conclusions which reverse the Blanchard and Giavazzi results; and find that, in addition, the composition of the reform package matters, as does the distribution of the tax burden. This model therefore supplies new results on the design and sequencing of reforms.

Keywords: Structural Reform, Wage Bargains, Short vs. Long Runs Substitutability

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1 Introduction

Product market regulation and labour market rigidities are widely blamed for the poor economic performance in Europe. As a result, structural reform has become the leading economic policy issue in the Eurozone. It has been argued from the start that such reforms are an essential prerequisite for a successful monetary union (Delors, 1989). Moreover, since the European Economies appear to be less reformed and less flexible than their American counterparts, efforts to restore economic performance vis-a-vis the US economy have been associated, in particular, with the need for higher productivity, lower costs and more flexible (or more competitive) labour markets.

These arguments have been made, and widely supported, by policy makers and analysts alike under the heading of the Lisbon agenda (Sapir, 2004). The remarkable fact is that, despite structural reforms having been discussed and advocated so widely (and in many cases as a matter of urgency), they have seldom been carried out in practice. And where they have been attempted, it has often been as a piecemeal effort, partial in its scope and quickly abandoned in the face of opposition. Agenda 2010 (Hartz IV) in Germany, labour market deregulation and liberalization (especially in services) in France, reconstructing social security in Italy, or the Lisbon process in general, are just four such examples.

Much of this debate has come to focus specifically on reforms in the labour market. That, it seems, is based on the analytic and empirical evidence of a negative link between economic performance and wage rigidities in many countries (Bruno, 1986). That link has certainly been observed in the labour and product markets of Europe (Koedijk and Kremers, 1996), where performance is measured in rates of growth and employment; and deregulation in competition policy, merger codes and the liberalization of employment practices. The result has been high production costs, especially in non-wage costs; high and persistent unemployment; and sluggish growth without falling costs or inflation. So, while there is little disagreement that performance and market reforms are related, the nature of their relationship is not well understood. For example, Delors (1989) argues that market flexibility is necessary for good performance in a currency union, but views economic structures as exogenous and changeable only through specific policies carried out by nation states. Others, e.g. Frankel and Rose (1998), argue that economic structures may be endogenous. If so, the case for reform is less obvious. It may materialize as a consequence of "globalization" anyway. In that spirit, Andersen et al (2000) have found that monetary unification in Europe is changing labour market structures and inducing wage cost convergence, but only in a small way. By contrast, Calmfors (1998, 2001) suggests that, although money wage flexibility may increase inside

EMU, labour market reform is less likely there since monetary unification was seen to be a vehicle for removing time inconsistencies in government policies. Now that this has happened, the incentive to reform falls away. Sibert (1999) and Sibert and Sutherland (2000) argue that asymmetric shocks will modify this conclusion since countries still have an incentive to adopt measures (mainly wage-cost flexibility) against such shocks to replace exchange rate adjustments. But that means that, where some countries have above average distortions, others will face an incentive to allow similar distortions or rigidities rather than accept the short run costs/performance losses that would ensue when they have to do the adjusting.

In this paper, we use a standard model of wage bargaining with imperfect competition in the product markets and different forms of distortionary taxation in order to understand the likely incentives for, and eventual outcomes of, structural reform programmes. We use the results to explain policy makers' behaviour and draw certain conclusions about the design and sequencing of reform packages.

We examine three specific propositions. First, we examine the proposition that structural reforms may be hindered by the fact that they involve large costs or performance losses up front, and typically only bring benefits in the longer term. Politically sensitive policy makers, and those with high discount factors, may worry that the short term costs will outweigh the long term benefits – especially if the latter are uncertain. Second, we ask if there is a link between the need for fiscal discipline and the difficulty of undertaking structural reforms, which could lead to those reforms not being undertaken. Third, we examine whether the composition of the reform package matters. Specifically whether the distribution of the tax burden matters; whether taxes on earnings (incentives) matter more than payroll/corporate taxes (costs) in the reform process; and whether the degree of wage bargaining power or product market liberalization matters more than either.[1]

2 The Model

In order to consider the various effect of the tax system on wage bargaining behaviour, and thereby to identify the set of possible implications for

[1] These three propositions should sound familiar, although little work has been done on them. Hughes Hallett and Viegi (2003) find a similar pattern of a lack of incentive for reform in a model with monopolistic labour unions. Dellas and Tavlas (2005) find the same, but without detail on how wages and prices are formed. HM Treasury (2003) find it again in their numerical simulations of market flexibility in their tests for UK membership of EMU; as do Hughes Hallett et al (2004, 2005). But no-one has managed to analyse formally *why* these results emerge. Are they due to short run costs vs. long run benefits, or fiscal conflicts that delay the process? Or do they arise because the burden of adjustment has been badly distributed between incentives and costs, between labour and capital, or between the labour market (the social market model) and the product markets (the anglo-saxon approach)? To answer that is our contribution.

reform, we extend Blanchard and Giavazzi's (2003) framework by introducing distortionary taxation into the economy. Together with distortionary taxes, there are two other deviations from the perfect competition which are necessary in order to generate the rationale for both product and labour market reforms. The first one arises from the assumption of the imperfectly competitive product markets. In this case we assume the presence of certain number of the monopolistically competitive firms each of them producing differentiated good. Then, on the labour market side we introduce an imperfection by assuming a formal wage bargaining process between firms and their workers.

The presence of the monopolistically competitive firms leads to the creation of rents in the economy, the size of which is determined by the degree of monopolistic competition. At the same time, the existence of a wage bargaining process leads to a certain distribution of those rents between the firms and the workers. Distortionary taxation is necessary to realistically complete the story since any reform that is going to be undertaken somehow needs to be financed.

We will not explicitly model the dynamics in this paper but in order to allow for difference in the effects over time we will follow Blanchard and Giavazzi by imposing a clear cut difference between the short term and the long term. This is achieved by fixing the number of producers in the market exogenously in the short run, whereas in the long run we allow that number to be determined endogenously by a market entry condition determined solely by a per unit entry cost . One can think of this entry cost as being approximation for certain regulatory or administrative entry barriers present in the product markets. Although there would be no substantial difference in the equilibrium outcomes if this cost were treated as a shadow cost, it is better to think of it as real cost which is proportional to output. The reason is that by assuming this cost to be a shadow cost, it means that firms present in the market would only be able to earn pure profits in the long run, whereas in the case of the real cost assumption these profits would be dissipated in the entry cost. But in order to perform any numerical analysis these costs would need to be treated as real, and may be thought as the cost of the time needed to satisfy all of the regulatory requirements plus the official cost necessary to set the firm up and licence it as a legal entity.

2.1 The Consumers problem

More precisely we assume that economy is populated by the fixed number of workers-consumers L indexed by j, who can choose either to work or not to work and be unemployed. If the worker decides to work he must supply one unit of labour. In other words, we are assuming that labour is indivisible.

The utility function for worker j is given by following expression

$$U_j = \left(m^{1-\delta} \sum_{i=1}^{m} C_{i,j}^{\frac{\delta-1}{\delta}} \right)^{\frac{\delta}{\delta-1}} \tag{1}$$

where $C_{i,j}$ represents individual j's consumption of the i-th product; m represents number of firms or products present in the market ; and δ stands for elasticity of substitution between products (firms) which is defined as $\delta = \overline{\delta} f(m)$. We assume that this elasticity of substitution is increasing function of the number of products, where $f'(m) > 0$ and that $\overline{\delta}$ may be fixed by policy. That is crucial for disentangling the difference between the short and the long run since, by imposing an exogenous number of firms present in the market, it implies that the elasticity of substitution will be constant and exogenous in the short term. But in the long run it will be endogenous and determined by the number of products or firms that emerge in the long run market equilibrium.

As pointed out in Blanchard and Giavazzi (2003) this specification of utility has two important features. First, assuming all the workers are identical, the utility of the workers will not depend directly on the number of products, but on the level of aggregate consumption instead. Second, an increase in the number of products increases the elasticity of consumption between them and thereby reduces monopoly power of the individual producer. That might have indirect consequences on the utility of the individual worker.

When making consumption decisions, each worker maximises (1) subject to the following budget constraint:

$$\sum_{i=1}^{m} P_i C_{i,j} = (1 - t_w) w_j N_j + P w_r(u)[1 - N_j] \tag{2}$$

where N_j takes the value of one if the worker j chooses to work or zero if he or she is unemployed. $w_r(u)$ can be interpreted as the unemployment benefit received from government in the case of unemployment, or equivalently the worker's reservation wage. We assume that this social support, unemployment benefit or reservation wage is a decreasing function of the unemployment rate in the economy as a whole: $w_r'(u) < 0$. This assumption is reasonable since the higher the unemployment rate in the economy, the higher the pressure on the government to finance those benefits; or equivalently the higher the unemployment the more willing are the workers to accept lower wage and hence a lower reservation wage. t_w represents a wage tax paid by all employees; it is explained in more detail in section 2.3. Finally, P stands for the price aggregator obtained after solving consumer's optimization problem.

It is given by:

$$P = \left(\frac{1}{m} \sum_{i=1}^{m} P_i^{1-\delta} \right)^{\frac{1}{1-\delta}} \tag{3}$$

This expression is slightly different from the standard Dixit-Stiglitz aggregator as consequence of the assumed form of the utility function at (1). Solving the consumer's optimization problem, and using the fact that the problem is symmetric across all consumers, we obtain an expression for the wage that would maximise utility for the individual consumer.

It is given by

$$\left[(1 - t_w) \frac{w_j}{P} - w_r(u) \right] N_j + w_r(u) \tag{4}$$

2.2 The Firms problem

We assume that each firm produces a differentiated product indexed by i using the same production technology which is linear in labour. Output is therefore given by [2]

$$Y_i = N_i \tag{5}$$

Since both individual and aggregate demands are determined by the consumer's optimization problem, the firms' problem consists of determining the prices taking demand as given. This allows us to obtain the solution for the partial equilibrium demand function in each product market. It is given by:

$$Y_i = \frac{Y}{m} (\frac{P_i}{P})^{-\delta} \tag{6}$$

2.3 The Wage Bargaining problem and Governments

Before describing wage bargaining problem, we need to introduce several assumptions regarding the tax system. First we will assume that both workers and producers are obliged to pay certain taxes. Workers need to pay a tax on the wages they earn. In our model, it is assumed that an average tax rate will be imposed on every working worker's wage. We also assume that unemployment benefits are not taxed. Next, producers need to pay payroll taxes[3] defined as certain fixed percentage of the workers gross wage. Both of

[2] Alternatively one can think of fixed coefficient production technology in which capital requirement is assumed to be fixed and normalized to one. Another version of our results, starting from a Cobb-Douglas function, is available and is set out in an appendix to this paper. But the final results don't change.

[3] Or hiring and firing costs, or any other corporate taxes that vary with production cost.

these taxes are assumed to be flat taxes, which might reduce reality of our analysis. But it allows tractability of the model. Extensions to a progressive tax system are possible, but lead to extremely complicated expressions which effectively deny us any insight into the scope for reform. Our flat tax specification meanwhile leads to following government budget constraint

$$B = (t_w + t_p)w_j - Pw_r(u)[1 - N_j] \tag{7}$$

where B represents an exogenously imposed ceiling on government debt. For the purposes of this paper, we will treat B as constrained so that any increases in expenditures, or reductions in taxes, must be matched by increases in tax revenues elsewhere in the system. This is a device which allows us to focus on the cost of financing any reforms. On the other hand, deficits do have to be financed by interest payments or tax revenues so B will be limited in practice.

Meanwhile each firm bargains with $\frac{L}{m}$ workers over wage and employment in that industry, in both the short and long run. Intuitively this can be thought of as the situations in which a fraction, $\frac{L}{m}$, of the workers form a union. That union then bargains with the firm over wages and the level of employment. Indivisibility of labour implies that workers can either be employed in the firm or be unemployed.

In what follows we will consider a world of Nash efficient bargaining solutions. There are two reasons for this. First, the efficient bargaining concept allows wages to be bargained off the labour demand curve, which implies that an increase in wages could be achieved without an immediate decrease in employment. And secondly, some empirical studies (Dobbelaere, 2004) have rejected *The Right to Manage Model* in favour of an efficient bargaining model as the appropriate explanation of wage bargaining in many European countries. Since the case for structural reform is particularly acute in Europe, it is important to have a model that captures that feature.

Assuming risk neutrality on the part of the unions, the bargaining problem can now be written as

$$\max_{w_i, N_i} \{\beta \log[(1 - t_w)w_i - Pw_r(u)]N_i + (1 - \beta)\log[P_i - (1 + t_p)w_i]N_i\} \tag{8}$$

where β represents exogenously determined index of union bargaining power; and t_w and t_p represent the tax rates paid by employees and employers respectively ($0 \leq t_w, t_p < 1$). This formulation implies that unions want to maximize the *net* wage surplus from employment represented by the first term within the brackets, whereas firms want to maximize their net profit represented by the second term.

This setup allow us to identify several important consequences of market regulation. On the product market side we have c (entry cost) and $\overline{\delta}$ (the

degree of market regulation preferred by the government). Reduction in the entry cost c can be thought as removal of some administratively imposed restrictions or protections; or simply as replacement of some state owned monopolies by market firms. The degree of product substitutability (competition) in the markets is broken into two parts: a policy component $\left(\overline{\delta}\right)$ whose increase could represent some market liberalisation measure, or the deregulation of some market practice, or a reduction in some trade barrier (domestically or externally) which has the effect of increasing product substitutability. These are all matters that lie under direct government control. The second component $f(m)$ is an index of market competition which increases with the number of products (firms). Implicitly, if we change δ by policy, we change $\overline{\delta}$. But m may then change as well. So, in practice we speak of making a net change to δ.

Finally, on the labour market side we have β representing bargaining power whose increase can be interpreted as the increase in the degree of workers power over wage and employment decisions ranging from rights to strike, employment protection legislation, severance conditions, firing costs, or other collective agreements. In addition both types of taxes represent regulatory instruments under direct government control, whose presence in the economy may have a decisive influence over how structural reforms should be conducted.

3 Solving for equilibrium outcomes

In order to solve the model we proceed in three steps. First we solve for the short run partial equilibrium values for relative prices and real wages. These will be used to obtain the short run general equilibrium prices and wages. After obtaining those solutions we proceed by solving for the corresponding long run equilibrium values.

3.1 Short run partial equilibrium relations

Equilibrium demand for each product, and hence employment will be determined by (6). Since workers and firms bargain over both wages and employment, and since employment is already determined as a function of output, our bargaining problem can be rewritten by substituting (6) into (8) and allowing workers and firms to bargain over wages and prices.

First order conditions for relative prices and real wages are respectively given by

$$\frac{P_i}{P} = \left(\frac{\delta + \beta - 1}{\delta(1 + t_p)}\right) w_r(u) \tag{9}$$

and

$$\frac{w_i}{P} = \left(\frac{\beta}{1+t_p}\right)\frac{P_i}{P} + \left(\frac{1-\beta}{1-t_w}\right)w_r(u) \tag{10}$$

Using the expressions above, we can solve for short run partial equilibrium real wages and relative prices as functions of regulatory parameters in the model. In fact we can now write:

$$\frac{P_i}{P} = [1+\mu]w_r(u) \tag{11}$$

and

$$\frac{w_i}{P} = \left[\frac{1+\beta\mu(1-t_w)-\beta(t_w+t_p)+t_p}{(1+t_p)(1-t_w)}\right]w_r(u) \tag{12}$$

where μ represents a relative price mark-up in a broad sense, defined here as

$$\mu = \frac{\delta(t_w+t_p)}{(\delta-1)(1-t_w)} + \frac{1}{\delta-1} \tag{13}$$

It is easy to show that this mark-up is increasing function of both taxes on wages paid by employees, and the payroll tax paid by employers, when $\delta > 1$. That is

$$\frac{\partial\mu}{\partial t_p}, \frac{\partial\mu}{\partial t_w} > 0 \tag{14}$$

when $\delta > 1$, but decreasingly so as the degree of substitutability increases.[4] This result is to be expected, since it is intuitive that in the case of payroll tax increases it is optimal for producers to bargain for higher prices; whereas in the case of an increase in the taxes paid by employees, the latter will require higher wages (both are increasing functions of μ). However this requirement would lead producers to require an even higher mark-up in order for profits not to change by too much – their ability to do so being limited by the degree of inter-product substitutability.

These results show that μ represents a mark-up in *relative* prices, reflecting the combined rents to the firm and derived rents to the work force. μ may therefore be negative if relative prices are below average for good i. In fact $\mu > \frac{(t_w+t_p)}{(1-t_w)}$, for $\delta \geqslant 1$; and it is a decreasing function of δ which reaches

[4] This follows from $\frac{\partial\mu}{\partial t_p} = \frac{\delta}{(\delta-1)(1-t_w)}$ and $\frac{\partial\mu}{\partial t_w} = \frac{\delta(1+t_p)}{(\delta-1)(1-t_w)^2}$, with the implication that the inequalities in (14) will be reversed if $\delta < 1$.

its minimum value at as $\delta \to \infty$ (a minimum that increases with t_p and t_w). Hence we can think of $\mu - \frac{(t_w+t_p)}{(1-t_w)}$ as the degree of market distortion due to imperfect competition; and $\frac{(t_w+t_p)}{(1-t_w)}$ as the associated degree of tax distortion due to the tax regime. There will therefore always be some distortions, even under perfect competition, so long as there are taxes.

Evidently, $\mu < 0$ is also possible when $\delta < 1$ and the degree of inter-good substitutability is very low. In fact, a temporary mark-down on irreducible input costs is not so unlikely if firms are tied (by sunk costs, and limited adjustment or substitution possibilities) to selling into markets where the degree of inter-good substitution is rather limited. That is a situation which might persist for a time, although actual wages will not be as low as the reservation wage if labour's bargaining power (β) is not so high as to cause mass layoffs. But it is clearly an unsustainable situation. Firms will either go out of business if they cannot cover their costs; or restructure and enter new markets for goods that are more easily substitutable for those produced elsewhere. And as that happens, the average level of substitutability, δ, will necessarily rise. The mechanism is that firms exiting the market reduces m and hence δ. That raises μ, and hence the costs (rents) that firms are willing to pay in order to enter the market. New firms enter, which raises δ again. This will go on until no more firms exit and $\delta \geqslant 1$. We therefore have to make a very clear distinction between the short run where $\delta < 1$ is possible;[5] and long run equilibria where, as a result of restructuring and/or market entry, it is not. We impose that distinction from now on.

3.2 Short run general equilibrium relations

Since in a symmetric equilibrium all producers need to charge the same price, and since not all of them can have relative prices larger then one in a general equilibrium, all relative prices must be equal to one in a general equilibrium setting. Substituting that into (11) provides us with the following condition for the reservation wage

$$w_r(u) = \frac{1}{1+\mu} \tag{15}$$

Taking tax rates as temporarily fixed, this expression implicitly determines short run unemployment rate which is the consequence of the assumed fixed short run coefficient of the elasticity of substitution. Substituting (15) into (12) we obtain a solution for the short run general equilibrium real wage

[5] $\delta = 1$ implies Cobb-Douglas consumption preferences, $\delta = 0$ Leontieff fixed proportions consumption. However, $\delta < 1$ implies $\mu \leq 1$which implies a notional reservation wage that is zero or negative if relative prices are to remain nonegative. We interpret that as a strictly temporary reduction in leisure time by firm i's work force; or as social support, or wage subsidies, offered to those who agree to remain in work – as happened during the German reunification episode for example.

given by:

$$\frac{w_i}{P} = \frac{1 + \beta\mu(1 - t_w) - \beta(t_w + t_p) + t_p}{(1 + t_p)(1 - t_w)(1 + \mu)} \tag{16}$$

3.3 Comparative Statics for the Short Run Equilibrium

Proposition 1 *Short run real wages are an increasing function of labour's bargaining power if and only if mark-up, broadly defined, is greater than the share of the total tax burden on the per unit net wage received by employees: or, equivalently, if the following condition (market distortions exist) is satisfied when* $\delta > 1$*:*

$$\mu > \frac{t_w + t_p}{1 - t_w} \tag{17}$$

Proof. The first derivative of short run equilibrium real wage is positive if (17) holds since

$$\frac{\partial \frac{w_i}{P}}{\partial \beta} = \frac{\mu(1 - t_w) - t_p - t_w}{(1 - t_w)(1 + t_p)(1 + \mu)} \tag{18}$$

when $\delta > 1$ (so that $\mu > 0$). And the result still holds if $\delta < 1$, since $\mu < -1$ when $0 < \delta \leq 1$. ■

In contrast to Blanchard and Giavazzi (2003) who claim that short run equilibrium real wages are always an increasing function of bargaining power, we find that this result actually depends on the relationship between the existing tax rates in the economy and the value of mark-up (i.e. on the impact of market power vs. the effects of distortionary taxation). If the tax system is such that the value of the broadly defined mark-up is larger than the share of the government's total tax receipts in the net wage received by employees, then the Blanchard and Giavazzi conclusion does hold. If not, their conclusion does not hold.

On the other hand, taking the first derivative of the short run equilibrium real wage with respect to that mark-up, shows that short run real wage is always a decreasing function of the mark-up and hence an increasing function of the degree of substitution in the product markets.[6] This result was obtained by Blanchard and Giavazzi as well. It is consequence of two opposite effects. The first is a partial equilibrium effect, in which an increase in the mark-up leads to higher rents to the firms. That in turn, leads to an increase in the worker's nominal wage since they receive a share (β) of the rents. The second is a general equilibrium effect channelled through prices. An increase in the mark-up leads to an increase in prices which represents

[6] Where the derivative is given by $\frac{\partial \frac{W_i}{P}}{\partial \mu} = -\frac{1-\beta}{(1+\mu)^2(1-t_w)}$ which is always less the zero since both β and t_w are positive but less then one.

a loss to the workers since they can buy less of a more expensive product. Since the magnitude of the latter effect is greater than the former, the real wage received by labour falls.

Next we consider the consequences of a change in the two types of taxes on short run real wages and on the reservation wage. They are summarized in the following two propositions.

Proposition 2 *The short run equilibrium real wage is always a strictly decreasing function of payroll taxes, whereas it is unaffected by changes in wage taxes.*

Proof. Substitute the broad definition of mark-up into the solution for the short run equilibrium real wages, and take first order derivatives with respect to t_p and t_w. ■

The intuition behind this conclusion comes from the effect of tax changes on the mark-up. Evidently the mark-up is less responsive to changes in the payroll tax than it is to changes in taxes paid on wages (note 4, $0 \leq t_w < 1$). Thus in the case of an increase in payroll taxes, real wages must fall because firms can always increase their mark-up by enough to more than compensate for the increase in the payroll tax (see again note 4). Their burden is therefore partly transferred to the workers. But if there is an increase in wage taxes, workers will demand higher wages. However, firms are able to compensate this increase by raising their mark-up by even more than they could in the case of a payroll tax. That then results in an increase in the general price level which compensates for the wage increase such that real wages remain unaffected.

Proposition 3 *The short run equilibrium reservation wage is always a strictly decreasing function of both types of taxes.*

Proof. (14) and (15) together imply the result. ■

This result is also intuitive since the equilibrium reservation wage is inversely related to the mark-up, and the mark-up is increasing in both types of taxes. Proposition 3 therefore implies that the equilibrium unemployment rate will increase with increases in both types of taxes, which is something to be expected. But it is important to note that the size of the effect on the reservation wage, and hence the unemployment rate, differs depending on which tax rate has been changed. More precisely, a change in the tax on wages (paid by employees) has larger effect on the equilibrium unemployment rate than a change in the payroll taxes (paid by employers). One possible explanation lies in the fact that real wages are not affected by changes in the wage tax paid by employees. But if real wages do not change, and yet taxes have increased, this change must be accommodated

through a reduction in total demand for the product and hence in employment. This then implies that effect of change in the taxes will be partially offset by the change in the mark-up, and partially by an increase in unemployment. The same will happen with changes to payroll taxes, but the effect on unemployment (and the reservation wage) will be larger because the change in mark-ups will be smaller. This is an important result for the policy implications discussed in section 5.[7]

4 Long run equilibrium relations

4.1 Entry and Exit

The key change here, as we noted above, is that firms can now restructure and enter new markets. We assume that firms need to pay a fixed entry cost which is a proportion of (the price of) their output. This means that firms will enter the market as long as rents cover those entry costs. Since firms get share of $(1-\beta)$ of total rents from which taxes need to be paid, we can define the share of *net* rents available to cover entry cost in the following way

$$(1-\beta)[1-(1+t_p)w_r(u)] \tag{19}$$

Using (15) we can now express the maximum acceptable entry cost as a function of the mark-up, bargaining power and taxes. It is given by

$$c = (1-\beta)\left(\frac{\mu - t_p}{1+\mu}\right) \tag{20}$$

However the mark-up itself is no longer exogenous since the elasticity of substitution coefficient will change as the number of firms, and hence the number and varieties of goods, will change as firms enter and exit the market. As we saw in section 3, the number of firms, and hence the degree of substitution between goods, will adjust endogenously (and probably rise) through restructuring, entry and exit until the rents generated, (19), are fully consumed by the entry costs (20). In other words the number of firms and thereby the degree of competition must be such as to totally dissipate any excess profits/rents over entry cost. Recall that this implies $\delta \geq 1$, since otherwise there are no profits to be dissipated and no firms that survive in the long run. This yields:

Proposition 4 *The number of firms, goods and employment will eventually rise if tax rates of either type are increased; or if market regulation measures lower the degree of substitutability (the degree of competition) between goods or producers.*

[7] The intuition provided for propositions 2 and 3 here, assumes $\delta > 1$. If $\delta < 1$, the same arguments apply but the directions of change will be reversed.

Proof. The first derivative of the maximum acceptable entry cost is positive if $\delta > 1$,

$$\frac{\partial c}{\partial \mu} = (1-\beta)\frac{(1+t_p)}{(1+\mu)^2} \tag{21}$$

Combining (21) with (14), or with $\frac{\partial \mu}{\partial \delta} < 0$ from (13), gives the result. ■

Remark It is important to see what is going on here since proposition 4 appears counterintuitive. But increasing tax rates of either type increases the mark-up that firms can impose, and hence the costs (and rents) they are prepared to pay to enter the market. Moreover, that mark-up will have increased by *more* than the increase in tax rates: see note 4. To achieve this, the number of firms (degree of competition) has to fall in the short term although profits and rents will have risen. That's what (21) says. But if rents and entry costs rise, new firms will enter the market and, in the longer term, the number of firms, goods and employment will rise again. That is what (21) then implies. Hence proposition 4. Increasing the amount of regulation in the product markets will produce the same result if entry remains free.

Corollary 1 *More firms (goods, employment) enter the market in the long term than leave in the short term.*

Proof. The short term mark-up is implied by (14), and the subsequent (long term) adjustments by the partial derivatives from (21), (23) below and then (13) once the new degree of substitutability has been established. Putting these together, the total change is

$$d\mu = \left[1 + \frac{\partial \mu}{\partial \delta}\frac{\partial \delta}{\partial c}\frac{\partial c}{\partial \mu}\right]\mu_j dj \quad \text{where } j = t_w, t_p, \delta \tag{22}$$

where the second term in brackets represents long term changes. But, using (21), (23) and (13), the square bracket is negative if $-2t_w t_p < 0$. That always holds, irrespective of δ, so long as both taxes are present. Given (14), that result confirms proposition 4. ■

Comment The importance of Proposition 4 and Corollary 1 is that they show that a reduction in the number of firms, for whatever reason, will imply a return to equilibrium after rents and shadow entry costs rise. They also demonstrate formally that any reduction in the number of firms caused by $\delta < 1$, will be followed by a rise in the number of firms which continues until $\delta \geqslant 1$ (as claimed in section 3.1).

Corollary 2 *A policy of reducing wage taxes will be more effective than reducing payroll taxes for increasing the number of firms, goods or employment. But a policy of market liberalisation (deregulation) that raises the*

level of competition between producers will be more effective than either at low levels of competition, defined as $\delta(\delta - 1) < 1 - t_w$ *, but less effective if competition (or taxation) are already strong.*

Proof. Competition, and the number of goods and firms all increase if the allowable level of entry costs decreases. By (21), that requires the mark-up μ to rise. The result now follows by comparing the partial derivatives in (14) with each other and with $\frac{\partial \mu}{\partial \delta} < 0$ from (13). Note that (21) implies that the number of firms increases with the entry costs (rents) they are prepared to pay in order to enter a new market, and with the ease with which their goods can substitute others (δ). Note also that employment increases because $\frac{\partial w_r(u)}{\partial c} < 0$ follows from (24) below, so unemployment falls overall (a larger number of firms is not in itself sufficient). ■

Finally, by substituting (13) into (20) and rearranging we can solve for the coefficient of the substitution as an explicit function of the regulatory parameters in the model. That solution is given by

$$\delta = \frac{(1-\beta)(1+t_p(1-t_w)-t_w)}{c(1+t_p)-(1-\beta)(1+t_p)t_w} \tag{23}$$

Hence, using (23) and (13) in (15) and (16), we can solve for the long run reservation wage and the long run real wage. Their equilibrium values are now given by:

$$w_r(u) = \frac{1-c-\beta}{(1-\beta)(1+t_p)} \tag{24}$$

$$\frac{w_i}{P} = \frac{1-c-\beta t_w}{(1+t_p)(1-t_w)} \tag{25}$$

The introduction of taxation in this model has therefore increased the complexity of the solution, but it is fairly straightforward to see the direction of the effects of various regulatory parameters on the equilibrium reservation and real wages.

4.2 Comparative Statics for the Long Run Equilibrium

We first consider the effect of the change in the bargaining power on the reservation wage, and hence on the unemployment rate.

Proposition 5 *Long run equilibrium reservation wage (unemployment rate) is always an decreasing (increasing) function of labour's bargaining power.*

Proof. The first derivative of $w_r(u)$ with respect to labour's bargaining power is given by

$$-\frac{c}{(1-\beta)(1+t_p)} \tag{26}$$

which is always negative. ■

Proposition 6 *It is also easy to see that the long run equilibrium real wage is always a decreasing function of bargaining power.*

Proof. Taking first order derivatives in (25), we obtain $\frac{-t_w}{(1+t_p)(1-t_w)}$ which is always negative. ■

This result also differs from the standard result in the literature; as well as from the result obtained by Blanchard and Giavazzi (2003) in which long run equilibrium real wages are not affected by changes in bargaining power. The question is why does the introduction of taxation into this economy produce such different predictions? In order to explain this result, consider a permanent increase in labour's bargaining power. In the short run, this increase leads to an increase in real wages since the share of the profits going to the workers will have increased. But that means the profits available to firms will be reduced and it will be harder to satisfy requirement imposed by the entry condition – the more so, the greater is β. Therefore the number of the firms present in the market will decrease. A decrease in the number of firms implies a decrease in the elasticity of substitution (demand) faced by the remaining firms. That means that firms will be able to charge higher prices. Even though workers will be demand higher wages to compensate for that, it turns out that, because firms have market power (and because taxation increases the mark-up that this implies, and because the tax wedge increases the nominal wage claim workers have to make to preserve their take home pay), these wage increases will be magnified in the price increase that firms are able to pass on. That leads to reduction in the real wage finally received by the workers. If taxation were to go to zero, this effect would vanish as (25) would be independent of β. Similarly, it would vanish even in the presence of taxation if markets were to become fully competitive: $\delta \to \infty$ implies $c \approx (1-\beta)t_w$ in (23), which makes $\frac{w_i}{P}$ independent of β in (25). Hence either the presence of taxation, or imperfect competition, or both, is responsible for this result.

Let us now consider the effects in the change of taxes on both reservation and real wages.

Proposition 7 *The long run reservation wage is not affected by changes in the taxes paid by employees, but it is a decreasing function of the taxes paid by employers. By contrast, the long run equilibrium wage is an increasing function of the taxes paid by employees, and a decreasing function of the taxes paid by employers.*

Proof. The first derivative of $w_r(u)$ with respect to t_w is zero, and with respect to t_p is

$$-\frac{1-c-\beta}{(1-\beta)(1+t_p)^2} \tag{27}$$

which is negative as long as $c+\beta<1$. Similarly the first derivative of the long run real wage with respect to t_w is

$$\frac{1-c-\beta}{(1+t_p)(1-t_w)^2} \tag{28}$$

whereas the first derivative with respect to t_p is given by

$$-\frac{1-c-\beta t_w}{(1+t_p)^2(1-t_w)} \tag{29}$$

Of these two expressions, the first is always positive and the second always negative so long as $c+\beta<1$. However, it is easy to check that $c+\beta<1$ always holds if $\delta \geqslant 1$ (implying $\mu \geqslant 0$) since $t_p \geqslant 0$. That completes the proof. ■

5 Some policy implications for market deregulation

Based on the model predictions developed above, we can draw some important policy implications. Consider first a simple scenario in which the government wants to decrease the taxes paid by the employers. Let us also assume that the government either wants to keep the budget balanced, or needs to keep it within some strict upper bound such as the 3% of GDP limit imposed by the Stability and Growth Pact. In order to satisfy those requirements and conditional on the fact that government has only two instruments available in this model, what are the short and long run effects of this policy? Are reform measures of this kind really more effective for growth and employment than a simple reduction in wage taxes?

To answer these questions, we present three examples which draw on and extend the short term-long term results in sections 3 and 4. They are designed to highlight the three main areas for structural reform: lowering the burden of fiscal policy, deregulation in the labour markets, and liberalisation in the product markets.

A): According to Proposition 2, the short run increase in the taxes paid by employees needed to keep the budget in balance will not affect real wages, whereas the planned reduction in payroll taxes would lead to an increase in the real wage through its positive effect on the mark-up. But that increase in taxes paid by employees would have the opposite effect on the mark-up,

compared to a reduction in the payroll tax. Moreover, in the short run, it would lead to a decrease in employment since the negative wage tax effect will be larger than the positive payroll tax effect. The overall impact of this type of policy would therefore be to increase unemployment in the short term. It might have been better to have just reduced wage taxes; or simply to have removed the requirement to keep the budget balanced. In any event, there are significant disincentives which might prevent a structural reform programme of this kind. It entails a short run loss in economic performance, political loss of face, and a counter-productive outcome if budget balance is enforced – while abandoning fiscal restraint would have risked destabilising the budget.

But in the long term, the sequence of events is quite different. Indeed, the direction of impact is reversed. By Proposition 7, the *net* long run effect of an increase in the wage taxes needed to compensate for our reduction in payroll taxes, would now lead to an increase in long run real wages; and to a decrease in the unemployment rate (since the reservation wage, which also increases, is negatively related to unemployment).[8] The last statement follows because the rise in wage taxes will not affect the reservation wage (Proposition 7); but any compensating fall in payroll taxes will increase the reservation wage, reflecting a fall in unemployment, even if t_w has had no effect.

This example therefore confirms a quite widely accepted argument that structural reforms (labour market deregulation, in this case) would be beneficial from the long run perspective but would certainly induce short run costs, both in terms of economic performance (indicated here by the increase in the short run unemployment rate) and in its political implications. This short run-long run conflict is then made very much worse by the presence of the budget restraint; and that in itself might be enough to block the reform efforts altogether. But the long term effects are entirely positive, for as long as they last. The question therefore is whether the (discounted) long run benefits would outweigh the short run costs. To make that determination, we need a model with more detailed dynamics than we have here.

B): Let us now consider another scenario, in which the government decides on structural reform to reduce union bargaining power. In the short run, this would lead to a reduction in the real wage received by workers, but would have no effect on the unemployment rate (Proposition 1, where $w_r(u)$ does not depend on β).[9] This result is standard in the labour lit-

[8] This implication is consistent with Proposition 4, and its corollary, because the increase in wage taxes has a larger effect in increasing the mark-up, and hence real wages and the reservation wage, than the decrease in payroll taxes has in decreasing it. In other words, there is a demand side effect despite the neutral budget changes. The distribution of the burden of taxation therefore matters a great deal.

[9] Lower real wages here depends of course on (17) holding. In a competitive economy (large δ, low μ), or one with high taxation, real wages would actually rise and produce

erature, and implies some kind of trade-off between short run real wages and the unemployment rate (a Phillips curve). In other words, in order to keep unemployment rate unchanged real wages must fall to equilibrate the markets. This is achieved because the larger share of the rents now goes to firms, and the smaller portion of the rents going to the workers is a partial determinant of real wages. Notice that the short run mark-up is unaffected by this change in bargaining power.

But once again, the long run effects of such a change in bargaining power run in the opposite direction. A long term reduction in labour's bargaining power leads to both an increase in real wages and a reduction in unemployment (see Propositions 5 and 6). Intuitively this is the consequence of the adjustment in the elasticity of substitution (and hence mark-up) which takes place in the long run. In fact, by (23) and then (13), the long run elasticity of substitution is negatively related to this bargaining power as it reduces the rents that firms have available to pay entry costs. Hence the mark-up is positively related to it. Consequently, a reduction in labour's bargaining power will lead to a fall in wages, an increase in the mark-up and hence rents. That in turn will lead to an increase in the number of products (and firms) in the market. From there we get an increase in employment and the reservation wage. Moreover, since we have an increase in profits as a consequence of the reduction in bargaining power, this policy will also lead to an increase in the long run real wage. Thus, although the short run reduction in real wages leads to reductions in demand and the supply of labour, it increases the mark-up. That increase in the mark-up then translates into a more than offsetting increase in demand as firms restructure and/or enter the market, with the result that employment and real wages increase in the long run and restore the labour supply.

C): Both scenarios so far have been concerned with reforms in the labour market. Our third example highlights the scope for reforms in the product markets. Suppose the government now engages in a programme of market liberalisation and deregulation. Whatever the specifics of the measures pursued, the end result must be an increase in the degree of competition between firms and substitutability between goods: δ rises. However, as the model makes clear, that takes time. Structural reform cannot create new firms or new products, and hence more competitive markets directly – it can only create the conditions under which they operate. Consequently, the elasticity of substitution and mark-up (along with everything else) will remain constant in the short run in this example. But in the long run, δ will rise as firms adjust to (enter) the newly deregulated markets – raising the number of goods, firms and employment (Proposition 4). And the ef-

outcomes more in line with the long run results cited in the next paragraph (but in the short term of course). The barrier to reform here is therefore market power by the producers or unions, not distortionary taxation.

fect will be bigger than in our other two examples if competition has been low in the past, or taxation high. In that sense, a programme of market liberalisation measures may represent a more important option. However, (13) and (21) imply $\frac{\partial \mu}{\partial \delta} < 0$ and $\frac{\partial c}{\partial \mu} > 0$. Hence the expressions at (24) and (25) imply that real wages will rise. But the reservation wage will also rise, and hence unemployment fall, as the implicit rents to labour begin to fall in this more competitive environment. That holds unless taxes of either kind are reduced, or labour's bargaining power is increased at the same time: as in examples A or B. Structural reforms in the labour market and product markets are therefore interdependent, and need to be treated as such.

6 Conclusions and Lessons

We have taken a well known model of the labour market in an economy with imperfect competition in both the product and labour markets. Prices are set by the interaction of supply and demand, while wages are determined by bargaining. Both labour and firms derive rents from their market positions. Firms can therefore enter or exit these markets. We define the short run as too short for this to happen, and the long run the equilibrium after that process is complete.

On this structure we impose distortionary taxes, taxes on wages and payroll or other corporate taxes. We also allow for changes in trade union (wage bargaining) power and for the possibility of market liberalisation in the product/services markets. From the equilibrium outcomes of this model, we find:

a) There is a great difference between the short run and long run results of structural reform measures. The short run effects involve significant costs and losses in performance, but the long run effects are almost uniformly favourable. Structural reform programmes are therefore very likely to be avoided, or abandoned if undertaken, because of their short run costs.

b) Fiscal restraint, and fiscal discipline such as imposed by Europe's Stability Pact, exaggerate this effect and make it even less likely that reforms will be carried out. But to ignore those restraints is to risk destabilising the budget. There is a trade-off here.

c) The type of reform matters. Reducing wage taxes has a bigger impact than reducing payroll taxes. This is a policy which is claimed by many social democrat parties, and it runs counter to the results in Hughes Hallett et al (2005), evidently because there is no cost side to the reasoning that underlies the results. In this model, we can only account for the demand and market structure effects of the reform package.

d) Nevertheless, the advantage of using wage taxes vanishes if markets become fully competitive ($\delta \to \infty$) or union bargaining power becomes too large ($\beta \to 1$). In all other circumstances, the distribution of the burden of

taxation and adjustment matters.

e) Pro-competition liberalisation of the markets is likely to be more effective than tax reform if the level of competition is very low or taxes are high, but less useful if the competition is already significant.

f) Excessive union power ($\beta \to 1$) will mean no reforms are possible since the long term gains vanish ($c \to 0$) and we are left with the case where short run costs dominate.

g) Product and labour market reforms are interdependent, and need to be conducted jointly. They can be done alone, but are seldom effective: in particular market liberalisation measures without deregulation in the labour markets.

The next steps in this research will be to model the dynamics of the reform process explicitly, to give an idea when the short run costs are likely to appear to outweigh the long run benefits, whether fast or slow reform programmes would be preferable, and whether fiscal restraints would actually stop reforms in their early stages. Second, we need some empirical analysis, to show which countries are most in need of reform and whether it should be tax reform, labour market deregulation, or market liberalisation.

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Appendix: Generalizing to a standard production function

In this appendix, we rework all the results of this paper using a fully specified (Cobb-Douglas) production function in place of the simple linear production function at (5). This will allow the elasticity of the demand for labour, and hence capital under the assumption of constant returns to scale to vary and to play a role.

We find that all our results are unchanged, except in so far as the mathematical expressions are inevitably more complicated and less illuminating. Consequently, propositions 1 to 7 continue to hold as before with the exception of minor restrictions on the conditions which have to be met for Proposition 6 still to hold as it stands (the long run impact of labour's bargaining power on real wages); and for one part of Proposition 7 (the long run impact of business taxes on the reservation wage). The sign of these effects could, under certain (unlikely) combinations of the elasticity and wage tax parameters, become reversed. But those two variations aside, all the results of the main text go through intact. Our results are therefore robust to the simple production function given by (5).[10]

Suppose we replace (5) with the Cobb-Douglas production function given by $Y_i = N_i^{\alpha} K_i^{1-\alpha}$, and normalize the capital stock to unity as before. This implies that equations (5) and (6) of the main text will be replaced by

$$Y_i = N_i^{\alpha} \text{ and } N_i = \left(\frac{Y_i}{m}\right)^{\frac{1}{\alpha}} \left(\frac{P_i}{P}\right)^{-\frac{\delta}{\alpha}} \tag{A1}$$

respectively, where $0 < \alpha < 1$ denotes the elasticity of demand for labour and δ is as before. In that case, the bargaining problem between firms and workers becomes, instead of (8),

$$\max_{P_i, w_i} \left\{ \beta \log \left[(1 - t_w) w_i - PA \right] \left(\frac{Y}{m}\right)^{\frac{1}{\alpha}} \left(\frac{P_i}{P}\right)^{\frac{-\delta}{\alpha}} \right]$$

$$+ (1 - \beta) \log \left[P_i \frac{Y}{m} \left(\frac{P_i}{P}\right)^{-\delta} - (1 + t_p) w_i \left(\frac{Y}{m}\right)^{\frac{1}{\alpha}} \left(\frac{P_i}{P}\right)^{\frac{-\delta}{\alpha}} \right] \right\} \tag{A2}$$

Solving the two first order conditions, with respect to P_i and w_i, for this maximization, we get

[10] We do not go on to consider variations in the elasticity of substitution between labour and capital here, since that is already implicit in the entry and exit of firms and the endogenous determination of the elasticity of substitution between goods. That might be an exercise for later work.

$$\frac{P_i}{P}=\left[\frac{\delta(1+t_p)}{\alpha(\delta-1)(1-t_w)}\right]^{\frac{\alpha}{\alpha+\delta(1-\alpha)}}\left(\frac{Y}{m}\right)^{\frac{1-\alpha}{\alpha+(\delta-\alpha)}} w_r(u)^{\frac{\alpha}{\alpha+\delta(1-\alpha)}} \tag{A3}$$

and

$$\frac{w_i}{P}=\frac{\beta}{(1+t_p)}\left(\frac{Y}{m}\right)^{\frac{\alpha-1}{\alpha}}\left(\frac{P_i}{P}\right)^{1+\frac{\delta(1-\alpha)}{\alpha}}+(1-\beta)\frac{1}{(1-t_w)}w_r(u) \tag{A4}$$

to replace (9) and (10). That in turn implies that, in the short run, we will have relative prices given by

$$\frac{P_i}{P}=[1+\mu]^{\frac{\alpha}{\alpha+\delta(1-\alpha)}}\left(\frac{Y}{m}\right)^{\frac{1-\alpha}{\alpha+\delta(1-\alpha)}} w_r(u)^{\frac{\alpha}{\alpha+\delta(1-\alpha)}} \tag{A5}$$

and real wages by

$$\frac{w_i}{P}=\left[\frac{1+\beta\mu(1-t_w)-\beta(t_w+t_p)+t_p}{(1+t_p)(1-t_w)}\right] w_r(u) \tag{A6}$$

where μ is still the mark-up. The mark-up itself now equals

$$\mu=\frac{\delta(1+t_p-\alpha+\alpha t_w)}{\alpha(\delta-1)(1-t_w)}+\frac{1}{(\delta-1)} \tag{A7}$$

Notice that (A5), (A6) and (A7) all revert to their original expressions if $\alpha=1$. Similarly, notice that the signs of the partial derivatives in (14) also continue to hold:

$$\frac{\partial\mu}{\partial t_p}=\frac{\delta}{\alpha(\delta-1)(1-t_w)}>0 \tag{A8}$$

and

$$\frac{\partial\mu}{\partial t_w}=\frac{\delta(1+t_p)}{\alpha(\delta-1)(1-t_w)^2}>0 \tag{A9}$$

From here we can deduce that, in the short run equilibrium, the reservation wage and the real wage will be given by

$$w_r(u)=\frac{1}{1+\mu}\left(\frac{Y}{m}\right)^{\frac{\alpha-1}{\alpha}} \tag{A10}$$

and

$$\frac{w_i}{P}=\left[\frac{1+\beta\mu(1-t_w)-\beta(t_w+t_p)+t_p}{(1+t_p)(1-t_w)(1+\mu)}\right]\left(\frac{Y}{m}\right)^{\frac{\alpha-1}{\alpha}} \tag{A11}$$

Now we turn to the long run equilibrium. Proceeding as in the main text, equations (19), (20) and hence (21) will be unchanged. In addition μ will continue to be given by (A7) once δ has been determined. Using these relations, we can eliminate μ to obtain

$$\delta = \frac{\alpha(1-t_w)(1-\beta)(1+t_p)}{c(1+t_p)-(1-\beta)(1+t_p)+\alpha(1-\beta)(1-t_w)(1+t_p)} \tag{A12}$$

to replace (23). Hence, in the long run we obtain

$$w_r(u) = \frac{\alpha((1-\beta)(2-\alpha)-(1-\alpha)t_w-c)}{(1-\beta)(1+t_p)}\left(\frac{Y}{m}\right)^{\frac{\alpha-1}{\alpha}} \tag{A13}$$

as equilibrium reservation and real wages in the long run.

From here we can determine the comparative static terms which we need to derive new versions of propositions 1 to 7 for this case. We have

$$\frac{\partial w_r(u)}{\partial \beta} = -\frac{c\alpha}{(1-\beta)(1+t_p)}\left(\frac{Y}{m}\right)^{\frac{\alpha-1}{\alpha}} \tag{A14}$$

which is always negative (positive for the unemployment rate). Hence **Proposition 5** holds unchanged. We also have

$$\frac{\partial \frac{w_i}{P}}{\partial \beta} = \left[\frac{(1-t_w)(1-\alpha(1-\alpha))-\alpha}{(1-t_w)(1+t_p)}\right]\left(\frac{Y}{m}\right)^{\frac{\alpha-1}{\alpha}} \tag{A15}$$

in place of the expression in Proposition 6 of the main text, which is always negative so long as

$$\frac{(1-\alpha)^2}{(1-\alpha)^2-\alpha} < t_w < 1 \tag{A16}$$

Hence **Proposition 6** also holds as long as t_w is bounded away from zero, which it almost certainly will be. Indeed (A16) is almost certain to hold for any plausible wage tax rate since $\alpha \geqslant \frac{2}{3}$ is the estimate typically obtained for the elasticity of labour demand in (A1).

Moving on to **Proposition 7**, we have the following partial derivatives

$$\frac{\partial \frac{w_i}{P}}{\partial t_w} = \frac{\alpha(1-c-\beta)}{(1-t_w)^2(1+t_p)}\left(\frac{Y}{m}\right)^{\frac{\alpha-1}{\alpha}} \tag{A17}$$

which is always positive as long as $c+\beta < 1$, just as in expression (28) which it replaces. Likewise

$$\frac{\partial w_r(u)}{\partial t_w} = -\frac{(1-\alpha)\alpha}{(1+t_p)}\left(\frac{Y}{m}\right)^{\frac{\alpha-1}{\alpha}} \tag{A18}$$

which is now negative in all circumstances, instead of zero in the version of **Proposition 7** it replaces. Example A of section 5 would need to be adjusted to that extent (but with no implications for the overall outcome). Finally, (27) will now be replaced by

$$\frac{\partial w_r(u)}{\partial t_p} = -\frac{\alpha((1-\beta)(2-\alpha-(1-\alpha)t_w)-c)}{(1-\beta)(1+t_p)^2} \tag{A19}$$

and

$$\frac{\partial \frac{w_i}{P}}{\partial t_p} = -\frac{\alpha(2-c-\alpha)+(1-\alpha)^2\beta-((1-\alpha)\alpha(1-\beta)+\beta)t_w}{(1-t_w)(1+t_p)^2}\left(\frac{Y}{m}\right)^{\frac{\alpha-1}{\alpha}} \tag{A20}$$

These two expressions are negative as in the original **Proposition 7** if the following inequalities hold:

$$2-\alpha-(1-\alpha)t_w > \frac{c}{(1-\beta)} \tag{A21}$$

and

$$\frac{\alpha(2-c-\alpha)+(1-\alpha)^2\beta}{(1-\alpha)\alpha(1-\beta)+\beta} > t_w \tag{A22}$$

These results allow us to complete the remaining propositions. Taking the short run equilibrium results (A7), (A10) and (A11), we have the partial derivatives (A8) and (A9) plus

$$\frac{\partial \frac{w_i}{P}}{\partial \beta} = \left[\frac{\mu(1-t_w)-t_w-t_p}{(1-t_w)(1+t_p)(1+\mu)}\right]\left(\frac{Y_i}{m}\right)^{\frac{\alpha-1}{\alpha}} \tag{A23}$$

which remains positive as before so long as (17) still holds. So **Proposition 1** remains unchanged. For **Proposition 2** we have

$$\frac{\partial \frac{w_i}{P}}{\partial t_w} = 0 \tag{A24}$$

and

$$\frac{\partial \frac{w_i}{P}}{\partial t_p} = -\frac{(\beta\delta-\alpha(1-\beta-\delta+\beta\delta))}{\delta(1+t_p)}\left(\frac{Y}{m}\right)^{\frac{\alpha-1}{\alpha}} < 0 \tag{A25}$$

where the latter remains negative (as before) provided

$$\frac{\beta\delta}{\delta+\beta-1} > -\frac{\alpha}{1-\alpha} \tag{A26}$$

But (A26) certainly holds if $\delta + \beta > 1$, which it will do since $\delta > 1$ except possibly in the short run while firms restructure. Thus **Proposition 2** is (almost) unchanged. Finally **Proposition 3** is clearly unchanged since it depends only on the signs of (A8), (A9) and (A10), which match (14) and (15) of the main text. **Proposition 3** remains intact therefore. And **Proposition 4** continues to hold because (21) of the main text remains unchanged.