The Impact of Tax and Market Distortions on the Phillips Curve and the Natural Rate of Unemployment

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Abstract:

Most people accept that structural and labour market reforms are needed in Europe. However few have been undertaken. The usual conjecture is that reforms are costly in economic performance and costly to finance. Blanchard and Giavazzi (2003) and Spector (2004) develop a general equilibrium model with imperfect competition to show the impact of labour *or* product market deregulation. We extend that model to combine these two types of reform, and then to include the effects of lowering tax distortions, the costs of financing these reforms and the conflict between long run gains and short run costs. Specifically, we use the model to explain the natural rate of unemployment and non-wage employment costs in order to show the impact of these reforms on the short and long run Phillips curve parameters. We find that structural reforms imply short run costs but long run gains; that the long run gains outweigh the short run costs; and that the financing of such reforms will be the main stumbling block. Likewise, we find an ambiguous effect on flattening the Phillips curve in the short run, but favourable effects on the natural rate in the long run. However the implications for welfare improvements and employment generation are quite distinct. Tax reforms are more effective for welfare gains, but market liberalisation is more valuable for generating employment.

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1   Introduction

Tax reform, market liberalisation and deregulation in the labour markets are widely seen as the key to improved economic performance – particularly in Europe. As a result, structural reform has become a leading policy issue in both Europe and the OECD. In fact the European Commission has declared the coordination of structural reform to be its top priority (EC, 2008). Yet the academic literature has provided very little formal analysis of the reform process itself; or of how far structural reforms can be expected to improve economic performance. At the same time, many countries have proved extremely reluctant to embrace such reforms despite being keen to advocate their virtues in public. Such inconsistencies require an explanation.

In Europe, arguments for market or institutional reforms have been made, and supported, at the political level under the heading of the Lisbon agenda (Sapir, 2004). Nevertheless, despite these reforms having been advocated widely, governments often fail to carry them out in practice (Dellas and Tavlas, 2005; Hughes Hallett et al., 2005). And where they have been attempted, it has usually been a piecemeal effort and quickly abandoned in the face of opposition. The Hartz IV programme in Germany; or pensions, labour market reform and the liberalization of services in France; and the reconstruction of social security in Italy, are three obvious and specific examples. The usual conjecture is that such reforms are costly in terms of economic performance and costly to finance in the short term - a conjecture that we examine below.

Much of this debate has come to focus on reforms in the labour market. That is based (loosely) on the analytic and empirical evidence of a negative link between economic performance and wage rigidities in many countries (Bruno, 1986). Such a link has certainly been observed in the labour and product markets of Europe (Koedijk and Kremers, 1996) where performance is measured in terms of growth and employment; and deregulation is measured in competition policy, merger codes and the liberalisation of employment practices. Yet, however powerful the case for structural reform, previous papers analysing the reform process have been forced to rely on ad hoc reasoning. The economics literature does not have a model to describe the impact of tax distortions on economic performance, nor the consequences and costs of structural reform (and hence of the incentives for undertaking reforms in the first place). Indeed, a leading OECD survey commented: "…because there is neither a well-established model of the political economy of structural reform, nor an extensive empirical literature on the topic…it is necessary to adopt a pragmatic, ad hoc approach" (Høj et al., 2006). Most analysts have therefore found themselves restricted to studies of the political economy factors that make reforms more likely, or that show institutional or market distortions can go some way to explaining the persistence of unemployment.[1]

Second, it is obvious that at least as much effort has also gone into arguing for reforms that reduce the distortionary effects of taxation, as has gone into market deregulation programmes. Yet the literature also contains remarkably little analysis of the benefits (or costs) of tax reform, or of whether it could be more effective than market or institutional reforms. In this paper, we try to redress that deficiency.

To analyse these issues, we need a model of the reform process sufficiently general to encompass the usual reform instruments and the range of structural parameters found

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[1] Høj et al. (2006); or Blanchard and Wolfers (2000); Daveri and Tabellini (2000); Nickell et al. (2005).

in the candidate countries. Starting from a standard model of deregulation, we develop a theoretical model of wage bargaining, with imperfect competition in the product markets and different forms of tax distortions, in order to understand the likely incentives, costs and potential benefits of structural reform. We use the results to explain policy makers' behaviour, and to derive certain conclusions about which reform measures are the most effective.

We then trace out how the implicit inflation-unemployment trade-offs have been affected by different kinds of market distortions, and how far they could be eased by structural reform or deregulation. We also show how different tax or market distortions affect the natural rate of unemployment, and which structural reforms would be the most effective from a welfare or employment perspective.

We find that, contrary to conventional wisdom, it is the removal of tax distortions rather than market distortions which makes the greatest difference. Hence the answer to our first question: those countries that are fiscally constrained, or find themselves unable to finance the consequences of their reforms, are typically the ones that fail to carry them out. That in turn implies it is essential to provide an analysis that combines fiscal policy and reform instruments. Nevertheless, the crucial conflict remains the inter-temporal trade-off faced by workers: lower real wages (welfare) in the short run vs. lower unemployment and higher real wages in the long run.

2   The Model

In order to consider the impact of the tax system on wage bargaining behaviour, and hence the consequences of tax reform, we extend the Blanchard and Giavazzi (2003) model to include distortionary taxation. In addition to distortionary taxes, we consider two deviations from perfect competition to generate the need for product and labour market reforms. The first 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 a 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 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 firms and workers. However, distortionary taxation is necessary to complete the story since any reform programme that needs to be undertaken needs to be financed. And if fiscal expenditures are to be endogenous, potentially, then taxes must ultimately be endogenous too.

We do not model the dynamics of adjustment explicitly in this paper. But in order to allow for differences in the effects over time we will follow Blanchard and Giavazzi by imposing a clear cut distinction 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 we allow that number to be determined by a market entry condition in the long run. One can think of this entry condition as a *per unit* entry cost, *c*, representing certain regulatory or administrative entry barriers present in the product markets. Although there would be no difference to the equilibrium outcomes if this cost were treated as a

shadow cost, it is perhaps better to think of it as real cost which is proportional to output. If this cost were to be a shadow cost, firms present in the market would be able to earn pure profits in the long run; whereas if it is a real cost, firms can earn "excess" profits only in the short run since that excess would eventually be dissipated in the entry cost. Moreover, in order to perform any numerical analysis, the entry costs would need to be treated as real and could be thought as the cost of the time needed to satisfy all of the regulatory requirements plus the cost of setting the firm up and licensing it as a legal entity.

2.1   The Consumer's Problem

To model consumption, we assume that the economy contains a fixed number of workers-consumers L, indexed by j, who can choose to either work, or not to work. If the worker decides to work he must supply one unit of labour. If he does not work he is unemployed. Labour is therefore indivisible.

The utility function for worker j is given by following expression

$$(1) \qquad U_j = [m^{1-\delta} \sum_{i=1}^{m} C_{i,j}^{\frac{\delta-1}{\delta}}]^{\frac{\delta}{\delta-1}}$$

where $C_{i,j}$ represents individual j's consumption of the i-th product; m represents the number of firms or products present in the market; and δ stands for the elasticity of (gross) substitution between products which is defined as $\delta = \bar{\delta} f(m)$. We assume this elasticity to be an increasing function of number of products with $f'(m) > o$, and that $\bar{\delta}$ may be fixed by policy. This specification of δ 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, we assume that the elasticity of substitution is constant and exogenous in the short term. But in the long run, it will be endogenous and determined by the number of products that emerge in the final equilibrium.

This specification has three important features. First, assuming that all 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 substitution between them and thereby reduces monopoly power of the individual producer. This may have indirect consequences for the utility of the individual worker. Third, with a fixed labour supply, employment generation and reducing unemployment are synonymous.

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

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

where $N_{i,j}$ takes the value of one if worker j chooses to work in firm i, or zero if he or she is unemployed; t_w is the average tax rate on wages; and P is the price aggregator

defined in Section 2.3 below. $w_r(u)$ may therefore be interpreted as the real value of the unemployment benefits, or support received from government in the case of unemployment; or equivalently as the worker's reservation wage.

2.2   Unemployment

We now show that the level of social support (unemployment benefits), and hence the reservation wage will increase with government expenditures and decrease with the rate of unemployment in the economy as a whole: that is, $w_r'(u) < 0$.

There are several ways to justify this assertion. Informally $w_r(u)$ may represent the labour market institutions that affect wage bargains: minimum wages, firing costs, the size and duration of unemployment benefits, or the level of social support itself. Increases in any one of those factors would increase the reservation wage when employment is high (unemployment low) since they are funded by the public sector.[2] Or it might be that market reforms create temporary unemployment, but lower the reservation wage since workers know that their old jobs may not be preserved. Again, higher employment would lead to higher wages and higher reservation wages and to lower unemployment since the size of the labour force is fixed (Spector, 2004).[3]

More formally, it can be shown to be the natural outcome of an optimal wage bargain between firms and wage bargainers, as defined by (10) below, when the government's (social security) budget remains balanced.[4] Both Spector, and Fiori et al. (2007), show that, in such circumstances, reservation wages will be proportional to the employment rate with a coefficient that depends on the price mark-up, labour's bargaining power, and tax rates. With the labour force fixed, that means the reservation wage will vary inversely with the unemployment rate. We accept that explanation here; the inverse relationship itself being derived explicitly in Section 3.2 below.

However this $w_r'(u) < 0$ relationship only defines a direction of change; it does not tie down a level of unemployment. To do that, and in order to be able to show how the employment position is influenced by labour market institutions and employment legislation, it is useful to link the unemployment outcomes to a search model with layoff risks, wage changes once in a job, differential wage offers to insiders vs. outsiders, and wage bargaining (Rogerson et al. (2005)). In those models, the equilibrium (natural) rate of unemployment is given by

$$(3) \qquad\qquad u_N = \lambda / [\lambda + \alpha_w]$$

where $\alpha_w = \alpha_0 [1 - F(w_r)]$ describes the probability of receiving an acceptable job offer in the current period, and F(w) is the cumulative probability distribution of all wage offers made in that period. Hence $[1 - F(w_r)]$ describes the probability of the arrival of *acceptable* job offers.

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[2] There are no other outside income opportunities for the unemployed in this model.

[3] Spector's argument is that the reservation wage will rise with employment. However if labour supply changes, this result can be overturned: as shown by Fang and Rogerson (2008).

[4] A constraint which has not been imposed in earlier tax reform studies: Bayoumi at al.(2004); Coenen et al. (2008). Imposing it here means that the budget will remain in balance throughout our analysis.

In this formulation α_0 is the contact rate, reflecting the probability of contact between employers and employees. In that case, α_w describes the arrival rate of offers that actually lead to employment. And λ reflects the layoff risk; that is, the separation rate implied by the probability that a job will be terminated in the current period. Both probability distributions remain unspecified in this paper, but are often taken to be independent Poisson distributions in which case α_0 and α_w become constants which describe the *average* rates of contact and employment per period.

Given this, the short run movements in the rate of unemployment will be determined by the difference between current separations and new hires:

(4) $$\partial u / \partial t = \lambda(1-u) - \alpha_0[1 - F(w_r)]u$$

which, over time, converges to u_N. This formula therefore ties down the speed at which unemployment converges on u_N.

2.3 Welfare Indicators

Finally P stands for the price aggregator obtained after solving the consumer's optimization problem. It is given by:

(5) $$P = [\frac{1}{m} \sum_{i=1}^{m} P_i^{1-\delta}]^{\frac{1}{1-\delta}}$$

This expression is slightly different from the standard Dixit-Stiglitz aggregator as a 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 can obtain an expression for the consumption that would maximise utility for the individual consumer. It is given by

(6) $$[(1-t_w)\frac{w_j}{P} - w_r(u)]N_{i,j} + w_r(u)$$

This expression is proportional to the individual's maximised utility level and can be used to make welfare comparisons in what follows. All welfare comparisons that follow will therefore be in terms of consumption equivalents.

2.4 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[5]

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[5] Alternatively one can think of (7) as a production technology in which capital is fixed and normalized to one. Interestingly, Spector (2004) claims that capital plays a key role in the outcomes of deregulation in the product and labour markets because unions and employers bargain over the rents created by the irreversibility of capital investment, as well as over the rents derived from imperfect competition.

$$(7) \qquad\qquad\qquad\qquad\qquad Y_i = N_i$$

where $N_i = \sum_j N_{i,j}$ represents total employment in firm *i*. Since both individual and aggregate demands are determined by the consumer's optimization problem, the firms' problem consists of determining prices taking costs and demand as given. This allows us to obtain the partial equilibrium demand function for each product market. It is given by:

$$(8) \qquad\qquad\qquad\qquad\qquad Y_i = \frac{Y}{m}(\frac{P_i}{P})^{-\delta}$$

2.5   Wage Bargaining and the Government

Before describing wage bargaining problem, we need to introduce the tax system. We assume first 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 a common 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[6], t_p, defined as a certain fixed percentage of the workers gross wage. Both of these taxes are assumed to be flat taxes. Extensions to a progressive tax system are possible, but lead to very complicated expressions which limit any insight into the scope for reform[7]. Our flat tax specification meanwhile implies the following government budget constraint, over and above any fixed or lump sum elements in taxation or expenditures:

$$(9) \qquad\qquad\qquad B = (t_w + t_p)w_i N_i - P w_r(u)[1 - N_i]$$

We treat *B* as being constrained by a ceiling on government debt. That means any increases in expenditures, or reductions in tax rates, must be matched by increases in tax revenues elsewhere in the system. This is just an artificial device which allows us to focus on the cost of financing any reforms. However, deficits do have to be financed by interest payments or tax revenues. So *B* will always be limited in practice.

Meanwhile each firm bargains with *L/m* workers over wages and employment in that industry, in both the short and the long run. Intuitively, a fraction *L/m* of the workers forms 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.

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However, in a discussion paper version of this paper (Bokan and Hughes Hallett, 2006), we show that the introduction of capital (via a Cobb-Douglas production function) complicates the analysis but does not change the results. Hence it makes no difference if we include capital or treat it as fixed.

[6] Or training costs, firing costs; or any profit or corporate taxes that vary in line with production costs.

[7] Lockwood and Manning (1993) allow progressive taxes and then show that changes in the marginal and average tax rates may have different effects. That is ruled out here. Note also that (9) implies equal tax bases so we pick up none of the Koskela and Schoeb (1999) effects on wages when tax bases vary.

In what follows, we consider a world of Nash efficient bargaining solutions. There are three 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 ("stronger workers may obtain higher wages without a decrease in employment"). Second, 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 strong in Europe, it is important to have a model that can capture that feature. Third, this assumption ensures incentive compatibility on both sides of the labour market.[8]

Assuming risk neutrality for the unions, the wage bargaining problem can be written as:

$$(10) \qquad \max_{w_i, N_i} \{ \beta \log[(1-t_w)w_i - Pw_r(u)]N_i + (1-\beta) \log[P_i - (1+t_p)w_i]N_i \}$$

where β is an exogenously determined index of union bargaining power; and where t_w and t_p represent the average tax rates paid by employees and employers respectively ($0 \le t_w, t_p < 1$). This formulation implies that unions will choose w_i to maximize the *net* wage surplus from employment, the first term within the brackets, while firms will choose N_i to maximize their net profit (the second term).

2.6 Regulatory Instruments

Several important consequences of market regulation now follow. On the product market side we have c and $\delta = \bar{\delta} f(m)$. Reductions in the entry cost, c, can be thought as the removal of administrative restrictions; or the replacement of some state owned monopolies by market firms. The degree of product substitutability in the markets is broken into two parts. First, a policy component ($\bar{\delta}$) whose increase could represent some market liberalisation measure, or a reduction in some domestic/external trade barrier which has the effect of increasing product substitutability. These are matters which lie within government control. The second element, *f(m)*, is an index of market competition which increases with the number of firms. If we change δ by policy, we change $\bar{\delta}$. But *m* may then change. So, in practice we speak of a *net* change to δ.

Finally, in the labour markets, we have β representing bargaining power whose increase can be interpreted as the increase in the degree of the workers' power over wage and employment decisions ranging from rights to strike, employment protection legislation, severance conditions, firing costs, or other collective matters. In addition both types of taxes represent regulatory instruments under direct government control.

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[8] Since the empirical evidence in favour of efficient bargaining is not conclusive, it is might be better to rely on the first and third of these reasons for adopting a Nash bargaining approach. However Spector (2004) and Fiori et al. (2007) have stressed that essentially the same results emerge from the Right to Manage model. So this distinction is actually unimportant here.

3   Solving for Equilibrium Outcomes

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

3.1   Short Run Partial Equilibrium Relationships

Equilibrium demand for each product, and hence employment, will be determined by (8). 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 resolved by substituting (7) and (8) into (10), and then allowing workers and firms to bargain over wages and prices. The solution to that problem is given by:

$$(11) \qquad \frac{P_i}{P} = \frac{\delta(1+t_p)w_r(u)}{(\delta-1)(1-t_w)}$$

which follows from the first order conditions for relative prices and real wages:

$$(12) \qquad \frac{P_i}{P} = \left(\frac{\delta+\beta-1}{\delta(1+t_p)}\right)\frac{w_i}{P} \qquad \text{and}$$

$$(13) \qquad \frac{w_i}{P} = \left(\frac{\beta}{1+t_p}\right)\frac{P_i}{P} + \left(\frac{1-\beta}{1-t_w}\right)w_r(u)$$

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

$$(14) \qquad \frac{P_i}{P} = [1+\mu]w_r(u) \qquad \text{and}$$

$$(15) \qquad \frac{w_i}{P} = \left[\frac{1+\beta\mu(1-t_w)-\beta(t_w+t_p)+t_p}{(1+t_p)(1-t_w)}\right]w_r(u)$$

where μ represents the mark-up in relative prices[9], defined as

$$(16) \qquad \mu = \frac{\delta(t_w+t_p)}{(\delta-1)(1-t_w)} + \frac{1}{\delta-1}.$$

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[9] This expression shows the composition of the mark-up. Note that (14) and (11) show that this model solves for relative prices, not the price level, and requires the usual elasticity restriction $\delta \geq 1$ to hold.

It is easy to see that this mark-up is an increasing function of both taxes on wages paid by employees, and the payroll tax paid by employers. That is,

(17) $\quad \dfrac{\partial \mu}{\partial t_p} = \dfrac{\delta}{(\delta-1)(1-t_w)} > 0\,, \qquad \dfrac{\partial \mu}{\partial t_w} = \dfrac{\delta(1+t_p)}{(\delta-1)(1-t_w)^2} > 0 \qquad \text{and} \quad \dfrac{\partial \mu}{\partial t_w} > \dfrac{\partial \mu}{\partial t_p} > 1$

when $\delta > 1$. This result is to be expected since, in the case of increases in payroll taxes, 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 demand higher wages. However, the latter would lead producers to require an even higher mark-up in order to prevent profit margins from changing too much – their ability to do so being limited only by the degree of inter-product substitutability.

These results also show that μ represents a mark-up in *relative* prices, reflecting the combined rents to the firm and the derived rents to the work force. However we can be sure that $\mu > (t_w + t_p)/(1-t_w)$ holds for all $\delta \geq 1$; and that μ is a decreasing function of δ which reaches its minimum at $\theta = (t_w + t_p)/(1-t_w)$ when $\delta \to \infty$; a minimum value which increases with t_p and t_w. Hence we can think of $\mu - (t_w + t_p)/(1-t_w)$ as the degree of market distortion due to imperfect competition; and $(t_w + t_p)/(1-t_w)$ as the degree of distortion due to the tax regime.

Thus there will always be some distortions, even under perfect competition, so long as there are taxes. We are restricted to a second best world. Finally $\delta \geq 1$ is indeed required, by (11), since otherwise prices will turn negative.

3.2   Short Run General Equilibrium

Since in a symmetric equilibrium all producers need to charge the same price, and since not all of them can have relative prices larger than one in a general equilibrium, all relative prices must be equal to one in the general equilibrium setting. Substituting that into (14) provides us with the following condition for the reservation wage:

(18) $$w_r(u) = \dfrac{1}{1+\mu}$$

Taking tax rates as temporarily fixed, this expression implicitly determines the short run unemployment rate which is a consequence of the assumed fixed short run coefficient of the elasticity of substitution. Substituting (18) into (15) we obtain an expression for the short run general equilibrium real wage in terms of μ:

(19) $$\dfrac{w_i}{P} = \dfrac{1 + \beta\mu(1-t_w) - \beta(t_w + t_p) + t_p}{(1+t_p)(1-t_w)(1+\mu)}$$

But real wages are proportional to the reservation wage: (15) and (19) both imply

(20)
$$\frac{w_i}{P} = \left[\frac{1 + \beta[\mu(1 - t_w) - t_w] + (1 - \beta)t_p}{(1 + t_p)(1 - t_w)}\right] w_r = A w_r$$

where $A > 0$. So, if the social security budget is kept in balance, (9) with $B = 0$ becomes

$$(t_w + t_p)\ell A w_r = (1 - \ell)w_r, \quad \text{or} \quad \ell[1 + (t_w + t_p)A] = 1$$

where $\ell = \sum N_i / L$ is the employment *rate* for the economy as a whole. Hence,

$$w_r = \frac{[1 + (t_w + t_p)A]}{(1 + \mu)}\ell \quad \text{and} \quad w_r'(u) = -\frac{[1 + (t_w + t_p)A]}{(1 + \mu)} < 0$$

since $\ell = 1 - u$. This is the negative relationship introduced in Section 2.2.[10] Hence a higher reservation wage, or a higher level of social support, will automatically lead to lower unemployment, and vice versa (higher unemployment implies lower reservation wages), both in the long and the short run – as claimed.

3.3   Comparative Statics in the Short Run

Proposition 1: *Short run real wages are an increasing function of labour's bargaining power if and only if the 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, as long as the following condition (market distortions exist) is satisfied:*

(21)
$$\mu > \frac{t_w + t_p}{1 - t_w}$$

Proof: The first derivative of short run equilibrium real wage is positive if (21) holds,

since then $\quad \dfrac{\partial \frac{w_i}{P}}{\partial \beta} = \dfrac{\mu(1 - t_w) - t_p - t_w}{(1 - t_w)(1 + t_p)(1 + \mu)} > 0 \quad$ holds, given that $\delta \geq 1$ implies $\mu \geq 0$. ∎

Notice that, whatever the tax system, (21) will hold as long as $\delta < \infty$. But if $\delta \to \infty$, and product market competition increases, then (21) will become an equality and labour's bargaining power will have no impact on real wages. This conclusion is new and shows that the composition of the mark-up matters. In addition, it conflicts with Spector's (2004) analysis which finds the effect of increasing competition to be ambiguous for the reasons discussed in Section 3.5 below.

Next we consider the consequences of a change in the two types of taxes:

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.*

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[10] An extension to allow budget imbalances, $B \neq 0$, can easily be incorporated at some cost to the algebra.

Proof: Substitute the broad mark-up, (16), into the solution for 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 (see (17); 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 more than enough to compensate for the increase in the payroll tax: see again (17). The burden is therefore partly transferred to the workers. But if there is an increase in wage taxes, workers will demand higher wages. Firms are able to compensate for this increase by raising their mark-up by more than they could have done in the payroll tax case. But that results in an increase in the general price level 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: (18) and (17) 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.

Corollary 1: *Proposition 3 therefore implies that the equilibrium unemployment rate will increase with increases in both types of taxes, in contrast to the competition effect which causes the unemployment rate to fall (Spector, 2004). But the size of the impact on reservation wages, and hence on the unemployment rate, will differ depending on which tax rate has been changed: (17) implies $\partial \mu / \partial t_w > \partial \mu / \partial t_p$ in (18).*

3.4 The Long Run: Entry and Exit

In the long run, firms can restructure or enter new markets. We assume that firms need to pay a fixed entry cost which is a fraction of the price per unit of output. This means that firms will enter the market so long as rents cover those entry costs.

Since firms get a share $(1-\beta)$ of the total rents from which taxes need to be paid, we can define the share of *net* rents available to cover per unit entry costs as follows:[11]

$$(22) \qquad\qquad (1-\beta)[1-(1+t_p)w_r(u)]$$

Substituting (18) for $w_r(u)$, we can now express the maximum acceptable entry cost as a function of the mark-up, bargaining power and taxes. It is given by

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[11] This expression defines the net rents going to firms from *all* sources: from price setting, wage setting and tax distortions, over and above what they would receive with perfect competition in all markets and no distortions. In that case, real wages would equal $w_r(u)$ as can be seen from (27) and (28) below. Hence (22) represents net rents per unit, in excess of "normal profits", and the scale factor (Y) plays no role once excess profits per unit of output are determined since the production function is monotonic.

$$(23) \qquad c = (1 - \beta)\left(\frac{\mu - t_p}{1 + \mu}\right)$$

However the mark-up itself is no longer exogenous since the elasticity of substitution coefficient will change because the number of firms, and the number and varieties of goods, will change when firms enter and exit the market. In fact, the number of firms and the degree of substitution between goods will adjust through entry and exit until the rents, (22), are fully consumed by the entry costs (23). 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 we require $\delta \geq 1$. Hence:

Proposition 4: *The number of firms, goods and employment will rise in the transition from short to long run if tax rates of either type are increased; or if market regulation lowers the degree of substitutability (or the degree of competition) between goods and between producers.*

Proof: The first derivative of the maximum acceptable entry cost is positive:

$$(24) \qquad \frac{\partial c}{\partial \mu} = (1 - \beta)\frac{(1 + t_p)}{(1 + \mu)^2}$$

Combining (24) with (17), or with $\partial \mu / \partial \delta < 0$ from (16), gives the result. ∎

Non-Monotonicity: It is important to see what is going on here. Increasing the tax rates of either type increases the mark-up that firms can impose, and hence the costs (and rents) they are prepared to pay in order to enter the market. Moreover, that mark-up will have increased by *more* than the original increase in tax rates. That follows from (17). Hence, the number of firms and degree of competition has to fall in the medium term (the first phase of the long term), although profits and rents will rise as (24) shows. But if rents rise, then new firms will enter the market and, in the longer term, the number of firms, goods and employment will rise again. In other words, there is a non-monotonic response. First output and then the number of firms fall; but in the long run they will both rise, and by more than they fell in the short to medium term.

Corollary 2: *More firms (goods, employment) enter the market in the transition from short to long run than leave in the short term.*

Proof: The changes in the short term mark-up, $\partial \mu / \partial j = \mu_j,$ are given by (17); and the subsequent long term adjustments by the partial derivatives from (24), (26) below, and from (16), once the new degree of substitutability has been established. Putting these together, the total change is

$$(25) \qquad \mathrm{d}\mu = \left[1 + \frac{\partial \mu}{\partial \delta} \cdot \frac{\partial \delta}{\partial c} \cdot \frac{\partial c}{\partial \mu}\right]\mu_j \mathrm{d}j \qquad \text{for } j = t_w, t_p, \delta$$

where the second term on the right represents long run changes. But, using (24), (26) and (16), 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 (17), that result confirms Proposition 4. ∎

Corollary 3: *In the long run, a policy of reducing wage taxes will be more effective than reducing payroll taxes for increasing the number of firms, goods or employment. However, a policy of market liberalisation that raises the level of competition between producers will be more effective than either at low levels of competition (defined by $\delta(\delta-1)<1-t_w$); but less effective if competition or taxation are already high.*

Proof: Competition, and the number of goods and firms all increase if the allowable level of entry costs increases. By (24), that requires the mark-up μ to rise. The result now follows by comparing the partial derivatives in (17) with each other, and with $\partial\mu/\partial\delta <0$ from (16). Note that (24) implies that the number of firms increases with the entry costs they are prepared to pay in order to enter a new market, and with the ease with which their goods can be substituted for others (δ). And employment increases because $\partial w_r(u)/\partial c <0$ follows from (27) below. ∎

Finally, by substituting (16) into (23) and rearranging, we can solve for the long run elasticity of substitution as a function of the regulatory parameters. That solution is:

$$(26) \qquad \delta = \frac{(1-\beta)(1-t_w)}{c-(1-\beta)t_w}$$

Using (23) and (18) in (18) and (19), we can now solve for the long run reservation wage and the long run real wage. Their equilibrium values are given by:

$$(27) \qquad w_r(u) = \frac{1-c-\beta}{(1-\beta)(1+t_p)} \quad \text{and}$$

$$(28) \qquad \frac{w_i}{P} = \frac{1-c-\beta t_w}{(1+t_p)(1-t_w)}$$

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

3.5 Comparative Statics in the Long Run

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

Proof: The first derivative of $w_r(u)$ with respect to labour's bargaining power is always negative:

(29)
$$- \frac{c}{(1-\beta)(1+t_p)} < 0. \ \blacksquare$$

Proposition 6: *Long run equilibrium real wages are always a decreasing function of bargaining power.*

Proof: Taking first order derivatives in (28), we obtain $-t_w/[(1+t_p)(1-t_w)]$ which is also negative. $\blacksquare$

To explain Propositions 5 and 6, consider a permanent increase in labour's bargaining power. In the short run, this leads to a rise in real wages since the share of the profits (rents) going to the workers will have increased. But that means the profits available to firms will be reduced and it will become harder to satisfy the 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 faced by the remaining firms. That means that firms will charge higher prices. Workers will demand higher wages to compensate. But, because firms have market power [and because taxation increases the mark-up that this implies; and also because the tax wedge increases the nominal wage claim workers have to make in order to preserve their take home pay], these wage increases will be passed on in price increases. That leads to a reduction in the real wage finally received by the workers. If taxation were to go to zero, this effect would vanish as (28) would be independent of β. It would also vanish even if markets were to become fully competitive since $\delta \rightarrow \infty$ implies $c \approx (1-\beta)t_w$ in (26), which makes w_i/P independent of β in (28). Hence, either distortionary taxes or imperfect competition, or both, is responsible for the decreasing value of bargaining power.

Finally we consider the effects of a change in taxes on reservation and real wages.

Proposition 7: *The long run reservation wage is not affected by changes in the taxes paid by employees, but 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

(30)
$$- \frac{1-c-\beta}{(1-\beta)(1+t_p)^2}$$

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

(31)
$$\frac{1-c-\beta}{(1+t_p)(1-t_w)^2}$$

whereas the first derivative with respect to t_p is given by

(32)
$$- \frac{1 - c - \beta t_w}{(1 + t_p)^2 (1 - t_w)}$$
.

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 $\delta \geq 1$ (implying $\mu \geq 0$) since $t_p \geq 0$.[12] ∎

3.6 Business Tax Reform: An Example

A much discussed area of economic reform is to reduce tax distortions. Consider a scenario in which a government plans to reduce the taxes faced by employers. Let us also assume that the government is either required to keep the budget balanced, or needs to keep the deficit within some strict upper bound such as demanded by the Stability and Growth Pact. Wage taxes would have to rise to compensate. What are the short and long run effects of this policy?

According to Proposition 2, the short run increase in the wage taxes 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 favourable (lower) effect on the mark-up. But the extra taxes paid by employees will have the opposite effect, increasing the mark-up where the lower payroll taxes reduce it. This combination of tax changes would therefore lead to a short run decrease in employment since the negative wage tax effect will be larger than the positive payroll tax effect on $w_r(u)$ (see Corollary 1). Thus the short term impact of this type of policy would increase unemployment. It might have been better to have just reduced wage taxes; or to have removed the short term requirement to keep the budget balanced. In either case, these are disincentives which may block this kind of structural reform programme. It entails a short run loss in economic performance, political loss of face, and counter-productive outcomes if budget balance is enforced – although abandoning the fiscal restraint altogether might 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 lead to a reinforcing 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. This outcome follows because a rise in wage taxes will not affect the reservation wage (Proposition 7). But the compensating fall in payroll taxes will in-

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[12] From Proposition 7, and its short run counterparts (Propositions 2 and 3), we can see that the ambiguous effect of increasing competition on wages noted by Spector (2004) is in fact a temporal effect; not a capital-labour conflict since capital is not needed to obtain the result. In the short run wages fall due to myopia in the wage bargains struck by workers. In the long run wages rise because competition in the product markets reduces mark-ups and therefore increases consumption and employment.

crease the reservation wage, reflecting a fall in unemployment, even if t_w has had no effect. The final outcome is a fall in unemployment therefore.

The outcome of this example is therefore summarised in Table 1. It highlights the non-monotonicity property in Proposition 4, which arises here because the increase in wage taxes has had a larger effect in increasing the mark-up [and hence real wages and the reservation wage], than the decrease in payroll taxes has had in decreasing it.

Table 1: The Implications of Lowering Business Taxes

a) *In the short run* (by Propositions 2 and 3)

$$\frac{\partial w_i / P}{\partial t_w} = 0, \quad \frac{\partial w_i / P}{\partial t_p} < 0 \quad \text{and} \quad \frac{\partial w_r(u)}{\partial t_w} < 0, \quad \frac{\partial w_r(u)}{\partial t_p} < 0$$

So $t_p \downarrow$ implies $w_i / P \uparrow$, but also $w_r(u) \uparrow$ so $u \downarrow$. But $t_w \uparrow$ implies no change in w_i / P, while $w_r(u) \downarrow$ so $u \uparrow$. And of the two, t_w has the stronger effect. Hence u rises overall.

b) *In the long run* (by Proposition 7)

$$\frac{\partial w_i / P}{\partial t_w} > 0, \quad \frac{\partial w_i / P}{\partial t_p} < 0 \quad \text{and} \quad \frac{\partial w_r(u)}{\partial t_w} = 0, \quad \frac{\partial w_r(u)}{\partial t_p} < 0$$

So $t_p \downarrow$ implies $w_i / P \uparrow$, and $w_r(u) \uparrow$ so $u \downarrow$ as before. But $t_w \uparrow$ now implies $w_i / P \uparrow$ and no change in $w_r(u)$, which leaves u unchanged. And, as before, t_w has the stronger effect (although we don't need that). This time u falls unambiguously.

In other words, there is a demand side effect here despite the neutral budget changes, and the distribution of the burden of taxation matters a great deal. This result therefore rationalizes what the Scandinavians call their "flexicurity" approach to fiscal reform.

Comment: This example confirms a widely accepted premise that structural reforms (an easing of business taxes in this case) would be beneficial in the long run; but would induce short run costs, both in terms of economic performance (indicated here by the increase in the short run unemployment rate) and in their political implications. This short run-long run conflict has been made all the sharper 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, as indicated by the falling unemployment. The question therefore is whether the *discounted* long run benefits will outweigh the short run costs. To make that determination, we need a model with explicit dynamics. That is a topic for further research. At this point we have only a comparative statics answer to that question.

4 Unemployment, the Natural Rate and the Phillips Curve

The next step is to consider how structural reforms affect unemployment.

For a decade now, economists have been arguing that the traditional Phillips curve has become flatter or has shifted its position, and they have offered a remarkable variety of explanations for why this might happen. It could be the result of transnational wage bargaining; or the effect of locational competition and globalization on the slope and position of the Phillips curve (Demertzis and Hughes Hallett, 1998; Bean, 2006; Pain et al., 2006). Or, as Razin and Binyamini (2007) show, it could be the result of trade, increased competition and migration as product markets integrate. But equally it could be the result of reduced market frictions (Smets and Wouters, 2007); or of greater credibility and effectiveness in monetary policy (Roberts 2006, Boivin and Giannoni, 2006), especially as expectations become anchored (Williams, 2006). The next obvious question is: could structural reforms not have a similar flattening or shifting effect on the Phillips curve? In this section, we find that slope changes in the Phillips curve could be the result of reducing business taxes, or wage taxes if the price margins of the imperfectly competitive firms are sufficiently sensitive. By contrast, reducing wage bargaining power, or employment protection, or hiring and firing costs, have little effect on the slope as opposed to the position of the Phillips curve.

To summarise what we have so far:

In the short run: Proposition 1 does not extend to reservation wages or unemployment since μ is invariant to β in the short term: $\partial w_r / \partial \beta = 0$ in (19). But w_r and u do change with both tax rates. Proposition 3 implies that short term unemployment will rise with both kinds of taxes, but more so with wage taxes than business taxes. These are the reforms which could be used to improve the short run Phillips curve trade-off.

In the long run: Section 3.4 shows that w_r and u change with δ, when the latter starts to change with the entry of new firms. So taxes, competition policy and labour market deregulation will all affect unemployment in the long run. Proposition 7 shows that u_N is unaffected by wage taxes t_w, but increases with business taxes t_p. Proposition 5 shows that u_N is also increasing in labour's bargaining power β. These are structural reforms that influence the natural rate of unemployment by shifting the long run Phillips curve to the left and to a lower u_N value. Changing $\bar{\delta}$ will have the same effect.

Product market liberalisation: It is open to the government to increase δ by increasing $\bar{\delta}$ through competition policy or market deregulation. In that case the following hold:

$$\frac{\partial \mu}{\partial \delta} = \frac{-(1+t_p)}{(\delta-1)^2(1-t_w)} < 0 \text{ from (17); and } \frac{\partial w_r}{\partial \delta} = \frac{1}{\delta^2(1+t_p)} > 0 \text{ using (27), (24), (17).}$$

Thus, unemployment will fall in the short run if either tax rate is reduced: but by more if wage taxes fall. It also falls if competition policy, $\bar{\delta}$, is applied more vigorously (recall that the government cannot affect the *f(m)* component of δ in the short run). And in the long run, unemployment will fall with deregulation in the labour markets, β; with business taxes t_p (but not wage taxes); and with market liberalisation δ.

The Effects on the Phillips Curve and the Natural Rate of Unemployment:

How does this affect unemployment and its natural rate? In this standard framework, three things can happen. The slope of the short run Phillips curve's might change or be flattened; or the curve might be displaced downwards; or the (vertical) long run curve might shift to the left.

The first possibility implies an improvement in the short run Phillips curve trade off: the inflationary implications of any expansionary policy or events are reduced, even if the unemployment consequences of a monetary contraction become more severe. The second and third possibilities imply short and long run gains in that *any given* rate of monetary expansion/inflation will generate lower rates of unemployment in both the short and long run. Conversely, targeting a lower rate of unemployment would trigger less inflation in the short run; and also in the long run if that the underlying rate of monetary expansion is reduced at the same time.

The implications of structural reform for the natural rate of unemployment and the Phillips curve are now clear. In the short term, the slope of the Phillips curve is given by $d\dot{P}/du$, where $\dot{P}$ denotes the rate of price inflation. Since $\dot{P}$ is not determined in the model, we will assume the underlying rate of monetary growth remains constant: $\dot{m}$ say. Then $\dot{P} = \dot{\mu} + \dot{m}$; and the mark-up falls with either tax rate, or if $\bar{\delta}$ increases. But the mark-up can only change *while* the tax rates or $\bar{\delta}$ are changing. Thus there will be a temporary decrease in inflation while the reforms are being introduced. Thereafter it reverts to its previous level.

Now to determine du. Notice that $du = (du/dw_r)/dw_r/dx$, where x can be t_p, t_w or $\bar{\delta}$ depending on the reform type chosen. Notice also that du/dw_r is independent of the reform measure. Using the expressions above, (19) and (18), we find:

$$\frac{\partial w_r}{\partial t_p} = \frac{-1}{(1+\mu)^2} \frac{\delta}{(\delta-1)(1-t_w)}, \quad \frac{\partial w}{\partial t_w} = \frac{-1}{(1+\mu)^2} \frac{\delta(1+t_p)}{(\delta-1)(1-t_w)^2} \text{ or } \frac{\partial w_r}{\partial \bar{\delta}} = \frac{f(m)}{\delta^2(1+t_p)}$$

respectively. Consequently du will become larger (in absolute value) if t_p is reduced since μ has become smaller and the rest remains unchanged. Similarly du will become smaller if $\bar{\delta}$ is increased. But, and by contrast, du will become either larger or smaller if t_w is reduced, depending on whether the μ effect (larger) or the t_w effect (smaller) turns out to dominate.

Overall then, a temporary flattening effect on the short run Phillips curve is possible. But after that it is hard to make a general statement because the outcome depends on the reform instrument used. If business taxes are lowered, the short run Phillips curve gets flatter unambiguously. If competition policy is increased, it gets steeper. And if wage taxes are reduced, the outcome is ambiguous and will vary from economy to economy. Meanwhile the wage bargaining arrangements have no short run effect.

In the longer term, the effect of these market based reforms is straight forward. A reduction in either tax rate will reduce the natural rate of unemployment, both shifting the short run Phillips curve down and shifting the long run curve to the left. At the same time, the short run curve will be flattened if the instrument is business taxes; possibly also if it is wage taxes. And it will certainly be steeper if competition policy is used. In

addition, deregulating wage bargains and also the dynamic effects of the measures cited above will reduce the natural rate by shifting the long run curve to the left.

Institutional Reforms:

We can extend our results to include the impact of institutional reforms on the natural rate of unemployment. From Section 2.2, an increase in hiring costs would imply a fall in α_w since $F(w)$ would decline. Higher firing costs, on the other hand, would be reflected in a fall in both α_0 and λ. And an increase in union density, or an increase in insiders vs. outsiders, would mean a lower contact probability between employers and the unemployed and hence a lower value of α_0. Lastly, we can incorporate increases in unemployment benefits or the minimum wage as an exogenous increase in the reservation wage, w_r. Each of these changes in the institutional arrangements can be included in our list of potential structural reforms, and their effects on unemployment inferred from (5) for changes in α_w (for hiring costs); or, for all other cases, from

$$(33) \qquad \frac{\partial u_N}{\partial \alpha_0} = \frac{-\lambda[1 - F(w_r)]}{(\lambda + \alpha_w)^2} < 0 \quad \text{and} \quad \frac{\partial u_N}{\partial \lambda} = \frac{\alpha_w}{(\lambda + \alpha_w)^2} > 0$$

where $du_N = [\alpha/(\lambda + \alpha_w)^2](d\lambda - \lambda d\alpha_0) > 0$ if $d\lambda/\lambda > d\alpha_0$, but negative otherwise.

Sensitivity and Robustness:

From (30) we can infer that u_N will improve under lower business taxes by more in those countries where t_p is low, or where c is low or δ large; that is in countries that already have low business taxes, low entry costs and competitive product markets. So it is the deregulated economies which have most to lose from a lack of reform; and who would gain the most, at least in employment, from a reform of business taxes. Trade union or wage bargaining power of plays no role in that comparison.

Similarly, starting from (29), deregulating the labour market will reduce u_N by more in those countries with competitive goods markets, but strong wage bargaining power or regulated labour markets: entry costs do not play a role in this comparison. Lastly, liberalising the product markets will have a greater effect in reducing u_N in those economies where competition or taxes of either kind are low.

5 Which Reforms Will be Most Effective?

a) **From a Welfare Perspective:** It is natural to ask which reform strategy would be the most effective in terms of increasing the number of goods and employment in an economy. We define effective to mean getting the mark-up or acceptable cost of entry to fall as taxes, or labour and product market regulation falls because, if a measure is effective in that sense, then it will raise real wages and the reservation wage at the same time [by (27) and (28)]. That implies an increase in welfare and a decrease in unemployment. Hence one way to determine which reforms are most effective is to determine which instrument has the largest impact on real wages and welfare.

From Corollary 3, we already know that a reform of wage taxes, t_w, will be the more effective of the two tax instruments. We also know that deregulation of the product markets will be better than tax reform if $\delta(\delta - 1) < 1 - t_w$; from which we can calculate the maximum value of δ, $\delta_{\max}$, such that market liberalisation would be the preferred option, given the tax rate on wages. Following a similar approach, we can compare the size of the partial derivatives of w_i / P with respect to β, δ and t_w to determine the thresholds for the most efficient instrument. After some algebra, this yields:

Corollary 4: a) *Product market liberalisation is more effective (welfare enhancing) as a reform programme than deregulating the labour market if*

$$(34) \qquad \delta < 1 + \sqrt{(1 - \beta)(1 - t_w) - t_w} \leq 2,$$

or if $\delta > 1 + 1/\theta$ where θ is the measure of tax distortion defined in Section 3.

b) Labour market deregulation is more effective than tax reform if

$$(35) \qquad t_w < (1 - \beta)(\delta - 1) / \delta$$

Proof: Compare $\partial(w_i / P) / \partial\delta$, $\partial(w_i / P) / \partial\beta$ and $\partial(w_i / P) / \partial t_w$ in absolute size. ∎

Corollaries 3 and 4 therefore provide a set of simple sufficient conditions to assess the relative efficiency of each type of reform programme, each condition being expressed as the maximum δ value that can hold if the given instrument is to be more effective for increasing welfare.

b) From an Employment Perspective: The corresponding results for which reform strategy is most effective for reducing unemployment are rather different. Because the structural and institutional reforms that affect employment take some time, we will only consider the long run consequences of the different measures on u_N. We also only consider the case in which the relationship between w_r and u is not changed: so the source of reform does not alter the relationship between reservation wages and the rate of unemployment. That may not always be true, but the results easily generalise.

From Proposition 7, business taxes t_p are clearly a more effective reform instrument than wage taxes t_w as far as employment generation is concerned. Given that, we have:

Corollary 5: a) *Product market reforms are more effective than business tax reforms as an instrument for generating employment if*

$$(36) \qquad \delta < \left\{ 1 + \sqrt{1 + 4\psi} \right\} / 2 \quad \text{where} \quad \psi = (1 + t_p) / (1 - t_w)^2$$

b) *But business tax reforms are more effective for generating employment than labour market deregulation if*

$$(37) \qquad \delta < (2 + t_p) / (1 + t_p)$$

c) *Liberalising product markets is more effective than deregulating labour markets if*

(38) $\delta < (1 - \beta)\sqrt{(1 - t_w)/c}$

Proof: Compare $\partial w_r / \partial t_p, \partial w_r / \partial \delta$ and $\partial w_r / \partial \beta$ in absolute size, using the results of Sections 3.4, 3.5 and 2.2 with the parameters in (5) fixed. Note that (36) and (37) are sufficient conditions. ∎

There is a clear ranking here if δ is small**.** In the long run, unemployment is best reduced and employment generated by liberalising the product markets; then by reducing business taxes; and finally by deregulating the labour markets. That is for economies with imperfectly competitive markets. Reducing wage taxes would have no effect, either positive or negative, except as a short term measure.

But in economies with competitive markets, the ranking will become reversed: deregulating the labour markets will be most effective, then reforming business taxes, and then product market liberalisation.

Evidently the inequalities in (36), (37) and (38) are the crucial terms for determining which ranking applies in practice. It seems likely that the second ranking will apply to the developed economies since, even with tax rates as high as $t_w = 0.5$ and $t_p = 0.5$, and with unit entry costs as low as c=0.1, the upper bounds on δ will remain below 2 or 3. And that is what the data in our sample of OECD/EU economies shows (Table 4 on page 25).

Corollary 6: *The reform measures that are effective for reducing unemployment (generating employment) will, in general, be different from those that are most effective for increasing welfare.*

Proof: Compare Corollaries 5 and 4; they produce different rankings by effectiveness for each objective, except for when *δ* is very small**.** ∎

Thus in core Europe, and in contrast to the welfare comparisons, the effective reforms for job creation will lie in deregulating the labour markets; then in reduced business taxes; and then in market liberalisation. Could Mrs Thatcher have been right after all?

6   Empirical Results

To evaluate the practical significance of our results, we have used the OECD's *Tax Data Base* and unemployment figures from the OECD's *Main Economic Indicators.* The former supplies t_w and t_p defined as "all in" average tax rates on manufacturing wages and corporate incomes, inclusive of social security contributions; the latter, unemployment rates on a standard definition.[13] For the remaining parameters, we set β (the wage bargaining parameter) at 0.25, being the mid-range estimate from the Layard, Nickell and Jackman (1991) study, and then consider β=0 and β=0.5 – decentralised and centralised wage bargaining respectively – as alternatives.

Finally, and perhaps more controversially, we set δ at 3.5 for the short run substitutability between products[14], and δ=10 for the long run substitutability. These figures are based on the few within-period product substitutability studies in the literature and may be compared to δ=∞ for perfectly competitive markets.[15] All data are for 2005.

Table 2 records the tax and price distortions, as they stood in 2005, for the 24 OECD economies and the EU as a whole. There is considerable variation, but three features stand out.

First, all of Europe suffers greater tax and price distortions than the US. Ireland is an exception. But outside Europe, only Canada does. Similarly, core Europe (Belgium, France, Italy, Germany, and Sweden in this instance) are noticeably more distorted than the EU as a whole. And the Netherlands, Czech Republic, Hungary, Poland and Finland come close. In most cases European tax distortions and price distortions are equally serious. But in the Netherlands, Poland, Finland and Denmark, it is the price distortions which are more serious (implied by the high values of *c*, reflecting above average mark-ups), while tax distortions are more serious in France and Italy. There is therefore a small vs. large economy distinction in terms of competitive markets.

Second, countries can be grouped by the strength of their overall market distortions:

(i) Core Europe: Belgium, Germany, France, Italy Sweden and the EU-25 (μ>1.5).

(ii) The Hapsburgs: Czech Republic, Hungary, Poland, Slovakia, Finland, Netherlands, Austria, Denmark (1.5 > μ>1.35)[16].

(iii) Periphery Europe: Greece, Spain, Norway, Portugal (1.35 >μ>1.07)

(iv) The Anglo-Saxons: the US, the UK, Switzerland, Canada, and Australia where 1.07>μ>0.95; and

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[13] The OECD figures agree with Eurostat's ESA95 data, except that the latter does not separate employer from employee social security contributions. As a result, we don't have consistent data for the smaller states of the EU (Estonia, Cyprus, Latvia, Lithuania, Malta, and Slovenia) who are not yet members of the OECD. Splitting those contributions 50-50 between employers and employees gives us rough estimates of the figures in Tables 2 to 4 for those countries. Their figures are available on request.

[14] We impose δ=3.5 to give a 20% mark-up on average, following Rotemberg and Woodford (1992).

[15] Ogaki and Reinhart (1998a,b) suggest 2.9-3.9 for the US, while developing countries have lower figures which again suggests 2.9-3.9 would be about right for the OECD economies. Ravn et al. (2004) prefer 2.0; Papadaki et al (2004) 3.0-5.0; and Gali et al. (2003) calculate mark-ups which imply δ = 3.3 for the EU. Long run figures correspond to the midpoint US estimates in Duca and VanHoose (2000).

[16] With surprisingly little violence to history: the Netherlands was under Hapsburg rule for a limited period, and Poland only partly, but Finland and Denmark never were.

(v) Recovery Economies: Japan, Ireland ($\mu<0.95$). The smaller transition economies (not shown here) also fit into this group.

This grouping, while arbitrary, remains unchanged for different values of δ and β.

Third, tax distortions are larger than price distortions in Belgium, the Czech Republic, Denmark, Germany, France, Italy, Netherlands Sweden, Austria, Finland, Poland, Hungary and Slovakia. But price distortions are more important in Spain, Greece, Ireland, Portugal, the UK and the non-EU economies. That may reflect the size of the domestic markets; but more likely a generally lower incidence of taxation.

Table 2: Price and Tax Distortions, by Country, with β=0.25, δ=3.5 and Variations

Country	tax distortion: $\theta = \dfrac{t_w + t_p}{1 - t_w}$	β=0.25 δ=3.5 price distortion			β=0.25 δ=10.0 price distortion			β=0.25 δ=∞ price distortion		
		μ	μ-θ	c	μ	μ-θ	c	μ	μ-θ	c
Belgium	1.183	2.050	0.873	0.431	1.426	0.243	0.348	1.183	0	0.304
Germany	1.032	1.845	0.813	0.431	1.258	0.226	0.348	1.032	0	0.304
France	0.899	1.659	0.760	0.357	1.110	0.211	0.355	0.899	0	0.273
Italy	1.018	1.825	0.807	0.363	1.242	0.224	0.263	1.018	0	0.208
Netherlands	0.773	1.482	0.709	0.399	0.970	0.197	0.307	0.773	0	0.258
Austria	0.708	1.391	0.683	0.368	0.898	0.190	0.269	0.708	0	0.216
Spain	0.612	1.257	0.645	0.316	0.791	0.179	0.203	0.612	0	0.176
Ireland	0.314	0.840	0.526	0.298	0.460	0.146	0.181	0.314	0	0.119
Portugal	0.484	1.078	0.594	0.303	0.649	0.165	0.187	0.484	0	0.124
Finland	0.779	1.491	0.712	0.377	0.977	0.198	0.280	0.779	0	0.303
Greece	0.536	1.150	0.614	0.303	0.696	0.170	0.184	0.536	0	0.125
Denmark	0.709	1.393	0.684	0.435	0.899	0.190	0.353	0.709	0	0.309
Sweden	0.923	1.692	0.769	0.380	1.137	0.214	0.284	0.923	0	0.232
UK	0.453	1.035	0.582	0.344	0.610	0.160	0.240	0.453	0	0.191
Czech Rep	0.774	1.484	0.709	0.342	0.971	0.197	0.236	0.774	0	0.179
Hungary	0.781	1.494	0.713	0.353	0.979	0.198	0.250	0.781	0	0.194
Poland	0.757	1.461	0.704	0.383	0.953	0.195	0.288	0.757	0	0.236
Slovakia	0.723	1.412	0.689	0.382	0.914	0.191	0.219	0.723	0	0.160
EU-25	0.811	1.535	0.724	0.376	1.014	0.201	0.279	0.811	0	0.226
US	0.421	0.989	0.568	0.343	0.579	0.158	0.238	0.421	0	0.182
Japan	0.362	0.907	0.544	0.308	0.513	0.151	0.192	0.362	0	0.131
Canada	0.477	1.067	0.590	0.347	0.641	0.164	0.242	0.477	0	0.185
Australia	0.400	0.960	0.560	0.344	0.556	0.156	0.239	0.400	0	0.182
Switzerland	0.405	0.966	0.561	0.326	0.561	0.156	0.216	0.405	0	0.154
Norway	0.584	1.219	0.638	0.368	0.761	0.176	0.269	0.584	0	0.215

Notes: a). δ= 3.25 represents a consensus estimate of the average short run inter-product substitutability in the advanced OECD economies, derived from the references given in the text. It corresponds to price mark-ups which range from about 5% in the US or UK, to 55% in the EU-25, and 60%-85% in France, Germany or Italy. δ=10 is a consensus estimate of the likely long run degree of within period substitutability, taken from estimates for the US economy (Duca and van Hoose 2000, 2006). Finally, δ=∞ represents perfect competition. b). Further results for β=0 and β=0.5, representing decentralised and centralised wage bargaining respectively, are available from the authors upon request. But those variations make little difference to our comparisons and are not reported here.

Tables 3 and 4 meanwhile give the upper bounds on δ, or the degree of competition in the markets, to show which different reform measures would be the most effective for generating either welfare improvements or new employment opportunities.

In fact, Table 3 shows that tax reform is almost always the most effective instrument for welfare purposes unless the labour market is very distorted. For the OECD and EU members displayed in Table 3, we find:

i) Product market liberalisation is more effective than tax reform if $\delta \leq 1.5$.

ii) Product market liberalisation is more effective than labour market deregulation when $\delta \leq 2$ (if $\beta \approx 0$), or when $\delta \leq 1.5$ (if $\beta \approx 0.25$).

iii) Tax reform is better than labour market deregulation unless $\delta \leq 1.3$ ($\beta \approx 0$); or unless $\delta \leq 1.5$ (when $\beta \approx 0.25$), and for δ values above 4 or 5 if $\beta = 0.5$.

Table 3: Threshold Values for Policy Effectiveness for Improving Welfare, δ_{max} values:

Country	Market liberalisation better than tax reform if $\delta < \delta_{max}$, for any β value:	Market liberalisation beats labour reform if $\delta < \delta_{max}$			Tax reform beats labour market reform if $\delta < \delta_{max}$		
		a)	b)	c)	a)	b)	c)
Belgium	1.42	2.00	1.20	never	1.68	2.17	5.26
Germany	1.54	2.00	1.68	never	1.20	1.28	1.50
France	1.49	2.00	1.53	never	1.36	1.55	2.15
Italy	1.49	2.00	1.51	never	1.39	1.59	2.25
Netherlands	1.45	2.00	1.38	never	1.50	1.85	3.21
Austria	1.48	2.00	1.49	never	1.40	1.62	2.36
Spain	1.53	2.00	1.65	never	1.23	1.34	1.61
Ireland	1.55	2.00	1.69	never	1.19	1.26	1.46
Portugal	1.54	2.00	1.68	never	1.20	1.28	1.50
Finland	1.47	2.00	1.47	never	1.43	1.68	2.54
Greece	1.54	2.00	1.68	never	1.20	1.28	1.50
Denmark	1.42	2.00	1.17	never	1.70	2.22	5.68
Sweden	1.47	2.00	1.45	never	1.45	1.70	2.63
UK	1.50	2.00	1.57	never	1.32	1.48	1.95
Czech Rep	1.51	2.00	1.57	never	1.31	1.47	1.92
Hungary	1.50	2.00	1.54	never	1.35	1.53	2.07
Poland	1.47	2.00	1.45	never	1.46	1.72	2.70
Slovakia	1.52	2.00	1.61	never	1.27	1.40	1.74
EU-25	1.47	2.00	1.47	never	1.43	1.67	2.52
US	1.50	2.00	1.57	never	1.32	1.48	1.94
Japan	1.54	2.00	1.45	never	1.21	1.30	1.53
Canada	1.50	2.00	1.56	never	1.33	1.49	1.98
Australia	1.50	2.00	1.57	never	1.32	1.48	1.94
Switzerland	1.52	2.00	1.62	never	1.26	1.39	1.72
Norway	1.48	2.00	1.50	never	1.40	1.62	2.35

Notes: a) with $\beta=0$; b) $\beta=0.25$; and c) $\beta=0.5$ ("never" means δ_{max} is complex).

Thus tax reform is always the most effective type of reform unless δ is *very* small, which is unlikely in any of the advanced OECD economies.[17] An exception would be in an economy with severe labour market distortions ($\beta \geq 0.5$). In that case, labour market deregulation is likely to be the most effective instrument.

By contrast, Table 4 shows that market liberalisation will be the most effective instrument for generating new employment, followed by business tax reforms, and then labour market regulation – except in the case of core Europe (which, in this case, comprises France, Germany, Belgium, Netherlands, Italy, Austria, Finland, Denmark, Sweden, Czech Republic and Poland) where labour market reform would be more important than lowering business taxes.

Table 4: Threshold Values for Policy Effectiveness in Lowering Unemployment, δ_{max}.

Country	Tax reform is less effective than market liberalisation if $\delta < \delta_{max}$, for any β value:	Tax reform is more important than deregulating labour markets if $\delta < \delta_{max}$ for any β value:	Market liberalisation beats deregulating labour markets if $\delta < \delta_{max}$		
			a)	b)	c)
Belgium	2.48	19.81	1.18	never	never
Germany	2.41	12.48	1.18	never	never
France	2.19	4.85	1.43	1.08	never
Italy	2.24	5.60	1.41	1.06	never
Netherlands	2.22	5.55	1.28	never	never
Austria	2.13	4.36	1.39	1.04	never
Spain	1.91	3.32	1.60	1.20	never
Ireland	1.84	2.65	1.68	1.26	never
Portugal	1.92	2.97	1.66	never	never
Finland	2.17	4.86	1.36	1.02	never
Greece	1.94	3.06	1.66	1.24	never
Denmark	2.28	6.77	1.16	never	never
Sweden	2.42	5.71	1.35	1.01	never
UK	1.97	3.25	1.48	1.11	never
Czech Rep	2.11	4.08	1.49	1.12	never
Hungary	2.13	3.13	1.45	1.14	never
Poland	1.92	4.93	1.34	never	never
Slovakia	2.06	3.72	1.55	1.16	never
EU-25	2.19	4.99	1.36	1.02	never
US	1.96	3.17	1.48	1.12	never
Japan	1.89	2.79	1.64	1.23	never
Canada	1.99	3.33	1.47	1.10	never
Australia	1.95	3.12	1.48	1.11	never
Switzerland	1.92	2.99	1.56	1.17	never
Norway	2.07	3.90	1.39	1.04	never

Notes: a) with $\beta=0$; b) $\beta=0.25$; and c) $\beta=0.5$; where "never" implies $\delta_{max} < 1$.

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[17] But governments are still free to use combinations of instruments to boost their reform packages.

7   Conclusions

We have taken a standard model of the labour market in an economy with imperfect competition in the product and labour markets, and extended it to allow for the endogenous entry of firms, the implications for unemployment, distortionary taxation, and to show the composition of the price mark-up, and for different parameters that affect labour market separation and hiring rates. The main contributions have been to show how tax reforms can contribute to the reform process; how the composition of the price mark-up determines the long run effects of structural reform; and how the effectiveness of different reform instruments varies depending on whether welfare or employment creation is the ultimate objective.

From the general equilibrium outcomes of this model, we find:

a) There is a difference between the short run and long run consequences of reform. The short run involves significant costs or losses in employment and welfare, but the long run effects are almost uniformly favourable. Structural reform programmes are therefore likely to be avoided, or abandoned if undertaken, if policy makers become sensitive to their short run costs.

b) Fiscal restraints, such as those imposed by Europe's Stability and Growth Pact, exaggerate this effect and make it less likely that such reforms will be carried out.

c) The choice of reform instrument matters. Tax reforms tend to be most effective for raising welfare; whereas labour market deregulation will be best for creating employment if product markets are competitive, but product market liberalisation if they are not. Thus reforms for welfare and for generating employment would not be the same.

d) These instrument rankings are only intended to demonstrate comparative advantage for different objectives. They do not rule out the possibility of creating optimal reform packages for different objectives. But deregulating the labour market is only effective where wage bargaining distortions are large.

e) Institutional reforms that underlie the parameters λ, α_0 or α_w can also be effective for generating employment (ranked by whether $\lambda > \alpha_0$ or not). But these reforms have little effect on the general level of welfare as measured by consumption units.

f) Business and wage taxes do not have the same effects on wages, output or employment as is often assumed in the public finance literature.[18]

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 outweigh the discounted long run benefits, and whether fast or slow reform programmes would prove to be more effective.

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[18] This result explains Prescott's (2004) claim that payroll taxes are the prime cause of poor growth and high unemployment. This is true if business taxes are the only candidate for reform; but product/labour market liberalisation would be better if employment generation and output growth is the objective.

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