FINAL REPORT

THE EMPLOYMENT EFFECT OF SUBSIDIES

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J K Swales*
D R Holden†
G Beacon‡

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* Fraser of Allander Institute and Department of Economics, University of Strathclyde
† Department of Economics, University of Strathclyde
‡ Beacon Dodsworth Ltd

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EXECUTIVE SUMMARY

High levels of unemployment, particularly amongst unskilled groups, is a serious structural problem for many European countries. In this report we build on previous work by Jackman and Layard, Johnson and Beacon and Monk to investigate the effectiveness of general labour subsidies in tackling this problem. We find that the government can influence long-run employment levels by introducing an appropriate tax and subsidy system, even where the economy is working in a perfectly competitive way.

The specific policy package which we considered in detail involves the introduction of a fixed *per capita* labour subsidy, equal to 5% of the average wage, financed by an increase in VAT. The subsidy/tax scheme works by allowing some substitution of capital for labour, but more generally by pricing workers into jobs through subsidisation and increasing the incentive to work, especially amongst lower paid workers. Estimates are made of the output and disaggregated employment effects under various assumptions about the capital market and the nature of labour supply. Total employment and total output always increase. The proportionate expansion in total output lies within the range 0.8% and 2.8% and the increase in employment in the range 1.45% to 4.0%. Low paid sectors of the labour force are stimulated the most so that the policy has favourable distributional aspects. The existence of savings on unemployment benefit acts to reinforce employment effects.

Governments are generally concerned about the overall level of taxation within the economy and therefore question the desirability of automatic subsidy programmes. However, the type of subsidy and tax plan that we outline could, in principle, be operated as an integrated tax scheme in which the change in the firm's tax bill is calculated as the net difference between the additional VAT and the *per capita* subsidy. In so far as the scheme increases total employment, and thereby reduced payments of unemployment benefit, it would be associated with a reduction in the required overall tax take. That is to say, the introduction of the new tax scheme would simultaneously increase employment and reduce taxation.

There is at present an increased faith in "market forces" and a general desire to reduce subsidies that artificially maintain inefficient or inappropriate industries. However, where there are high levels of structural unemployment amongst primarily low skilled workers, and where these unemployed are supported by welfare payments which lower the real income of workers and reduce their incentive to work, the possibility of long-term persistent labour subsidies should be considered. Such subsidies potentially improve, rather than impair, productive efficiency by offsetting market failure in other parts of the economy. They restore, rather than distort, appropriate price signals. They do not rob the private sector of resources but reallocate resources within that sector. And as we have seen, such subsidies generate an expansion, not contraction, of private sector economic activity. Further, if such subsidies can be packaged as tax rebates the possibility occurs of a simultaneous fall in taxation and increase in employment.

1. INTRODUCTION

High levels of unemployment, particularly amongst unskilled groups, is a serious structural problem for many European countries. In this report we make a theoretical investigation of the use of labour subsidies to tackle this problem. In Section 2 we review previous work in this area. In Section 3 we outline a simple general equilibrium model for identifying the impacts of a labour subsidy, give a specific form of the model which can be used for simulation purposes and then report the results of some illustrative simulations. Attention is drawn in this section to the balanced budget requirement for the financing of such a subsidy and the interaction with the unemployment benefit system. In Section 4 we discuss the appropriateness of the model for investigating this problem. In Section 5, we consider political issues.. Section 6 is a short conclusion.

2. REVIEW OF EXISTING MODELS

In two articles in *Economica*, Jackman and Layard (1980) and Johnson (1980) argue for government intervention in the labour market in order to reduce total unemployment. One of the policies that they consider is a subsidy on employment for particular segments of the labour market. Whilst these articles are rather abstract and technical, they have a number of important strengths. These are that

* They explicitly consider neo-classical models. That is to say, systems in which competitive product markets clear. When labour-market distortions are investigated, they are of the most straightforward type. The most common is the existence of unemployment benefit, which might reduce the labour supply for some low-wage groups. However, both papers also deal with cases where there is a degree of wage rigidity, either in the form of minimum wages or fixed wage differentials.

* They adopt a general, rather than partial, equilibrium approach.

* They impose a neutral budget condition so that the financing of any subsidies must be made explicit.

Even though both papers adopt rather sparse models, which are solved analytically, the solutions that they adduce are quite complex.

2.1 Jackman and Layard (1980)

Their basic model has the following characteristics:

* There is only one commodity which is produced from two inputs only. These are different types of labour, which the authors label "skilled" and "unskilled".

* The production function is linear homogeneous.

* The output is sold and labour is bought in perfectly competitive markets.

* The supply of each labour type is an increasing function of the real take-home wage.

* There is no international trade.

* Government expenditure on public goods is fixed.

* Initially the PSBR is zero, with taxes on labour income covering expenditure on public goods and unemployment benefit.

This model is used to analyse the impact on total employment, output and welfare of two labour tax and subsidy schemes.

First, the authors consider a "self-financing" tax and subsidy regime where one group of workers is taxed and the other subsidised and the total value of the taxes on one group just equals the total value of the subsidies on the other labour group. The results here are very straightforward. If group 1 is taxed and group 2 subsidised, total output, employment and welfare will rise as long as

$$e_2 > e_1 \; ; \quad W_1 e_2 > W_2 e_1 \; ; \quad m_2 e_2 > m_1 e_1$$

respectively, where:

e_i is the labour supply elasticity of group i with respect to the relevant gross wage,

W_i is the gross wage of an individual in group i, and

m_i is the labour market distortion which is defined as

$$m_i = t_i + \frac{B_i}{W_i}$$

where t_i is the average tax rate payed by workers in group i and B_i is the unemployment benefit which such a worker would qualify for.

Although the schemes here are called "self-financing", this is a little misleading. In general such a scheme will lead to an increase in employment in unskilled (type 2) labour and a reduction in employment in skilled (type 1) labour. There will therefore be foregone taxation on the income from newly unemployed skilled workers and increased unemployment benefit payments to these workers. On the other hand, there will be increased tax receipts from newly employed unskilled workers and a reduction in the benefit payments for this group.

These changes will have effects on the overall public sector budget which will lead to variations in the general taxation levied to meet the financing of public goods (whose provision is assumed constant) and unemployment benefit. Jackman and Layard take these general taxes to be levied at a constant rate on (wage) income, so that changing the general level of taxation implies varying this tax rate. Clearly it could be the case, on the criteria above, that the introduction of the "self-financing" tax-subsidy regime will lead to an increase in employment whilst generating a public sector deficit. This would occur if the increase in employment were modest and there was a big difference in the average wage and the unemployment benefits paid to the two groups, the levels of both being assumed to be higher

for skilled than unskilled workers. Such an increase in general taxation would reduce the net returns from work, decrease the supply of both types of labour and thereby reduce employment. Such reductions would partly, and might wholly, offset any gains predicted from the earlier analysis.

However, Jackman and Layard show that where there are positive welfare gains from the introduction of the "self-financing" subsidy, the public sector finances will improve also. Under these circumstances, the introduction of the self-financing tax-subsidy scheme will allow a reduction in general taxation, which will generate further increases in employment. We therefore concentrate on the conditions both for an increase in "self-financing" employment and welfare. Therefore from the analysis presented in this paper a sufficient condition for employment to increase is

$$\frac{e_2}{e_1} > \max\left[\frac{W_2}{W_1}, \frac{m_1}{m_2}\right]$$

We would normally assume that the wages of unskilled workers are lower that skilled ($W_1 > W_2$) and that the distortion in the labour market caused by taxation and unemployment benefit is higher for lower waged workers ($m_2 > m_1$), this implies

$$1 > \max\left[\frac{W_2}{W_1}, \frac{m_1}{m_2}\right]$$

so that a sufficient requirement for employment to unambiguously increase is simply that the elasticity of labour supply is greater for unskilled labour than skilled labour.

$$\frac{e_2}{e_1} > 1$$

Note that this condition also ensures that economic welfare will rise and that there will be a more even distribution of income as employment and wage rates for unskilled workers will rise, as against skilled workers.

Although Jackman and Layard are primarily concerned with a situation in which the wage rates for both types of labour are flexible, they do also analyse the case where there is

some wage rigidity. In particular, they consider a set up where there are a set of rigid wage differentials. Specifically:

* the relative gross pay of skilled to unskilled workers is fixed.

* skilled workers are on their labour supply curve but there is excess supply of unskilled workers at the relevant wage, so that the unskilled labour supply curve is suspended.

Under these conditions the potential benefits from wage subsidies, financed by a tax on employers for each skilled worker, generates an even greater welfare gain.

2.2 Johnson

Johnson is concerned with a very similar analytical framework to that adopted by Jackman and Layard. However, his work differs in a number of important respects.

* There are an undetermined number of inputs (n).

* Two are not fully employed, youth labour and unskilled labour.

* The causes of unemployment in these two sectors of the labour market are as follows. In the youth market, there is some form of minimum real wage which prohibits labour market clearing. In the market for unskilled labour, a similar sort of arrangement might occur or the presence of unemployment benefit might reduce effective labour supply below the registered labour force.

* All other inputs are taken to be in fixed (totally inelastic) supply and their price set at the market clearing level.

* A central concern is the distribution of costs and benefits between different factor owners.

In Johnson's analysis, *ad valorem* subsidies are paid at different rates to employers of youth and unskilled workers. These subsidies, together with all government expenditure on public goods, are financed by a proportionate tax on all other factor inputs. That is to say, it is assumed that youths and unskilled workers pay no tax, so that the burden of all government expenditure is borne by the other factors of production.

The impact of the subsidies on total employment depends solely on their impact on the two "target" groups. This is because the supply of all other factors is fixed and their market price is set at their market clearing rate. The effect of a subsidy on one labour group is always to increase the employment of that group. Therefore if there is only a subsidy on youths, youth employment will rise. However, the effect on the other group suffering unemployment (in this case, unskilled workers) is ambiguous and depends on whether they are complements or substitutes for the subsidised group. If they are complements, the employment of the unsubsidised labour group will rise: if they are substitutes it will fall. Three points are important here.

* Where both labour groups are subsidised, the effect of their own subsidy on their own employment is positive.

* Conventional production functions have inputs as complements: the productivity of one input rises as the supply of a second input rises. In this case, the subsidy on one input increases the demand for the second subsidised input.

* Even where the two inputs are substitutes, the negative cross-effect between the two inputs have to dominate the own effects if employment is not to rise.

The employment effects identified by Johnson are rather more complex than those in Jackman and Layard. The reason is that he allows the factors to be substitutes, whereas in a two-factor well-behaved production function, inputs must be complements. However, Johnson's main interest is in the effect of the subsidy on the gross and net-of-tax earnings of the other factor owners. His argument is essentially that if the income of one group is adversely effected by a subsidy, that group might mobilise to block such a subsidy.

If we start with the introduction of subsidies where the wages of both youths and the unskilled are fixed in real terms (by minimum-wage legislation, for example), the gross earnings of the other n-2 factor owners are increased by the amount spent on the subsidies. Moreover, if the employment of unskilled workers is increased, expenditure on unemployment benefit for that group is reduced. (Youths are assumed not to qualify for unemployment benefit). This implies that for taxpayers as a whole, net after-tax income rises. As Johnson remarks, this implies that if the target labour groups have inflexible wages set too high to clear their segments of the labour market, subsidies are an excellent deal for taxpayers as a whole. One caveat here is that whilst taxpayers in general benefit, the after-tax income of certain groups of factor owners might fall, if their factors are substitutes for the subsidised labour.

In the more complex case, the youth labour market again has a fixed real wage, but the labour market for unskilled workers clears.[1] However, this does not mean that there is no unskilled unemployment. In this segment of the labour market, the position is similar to that analysed in Jackman and Layard: the supply of unskilled labour is not perfectly inelastic, and there is a gap between the level of employment and the number of unskilled workers registered for employment. Changes in the demand for unskilled workers will therefore effect both the wage and employment of unskilled workers.

Under these conditions, the subsidy programme for low-skilled adults increases the post-tax income of taxpayers as a whole as long as

$$\varepsilon > \frac{1}{\rho}$$

where ε is the elasticity of supply of unskilled workers and ρ is the replacement ratio in the unskilled labour market, that is the ratio of the unemployment benefit to the unskilled wage. Where this condition holds, the youth subsidy will increase the taxpayer's real income as long as youth and unskilled employment are complements. Finally, it is important to state that even where other taxpayers are made worse off by the introduction of labour subsidies for some labour groups, that does not necessarily imply that there are not welfare gains to such subsidies.

Whilst these two papers are rather abstract, they are important in that they show:

* In a long-run equilibrium perfectly-competitive system, a self-financing tax-subsidy regime can generally increase employment. This has nothing to do with traditional Keynesian macroeconomic influences, non-governmentally induced labour market imperfections or terms-of-trade effects.

* Where the government pays unemployment benefit, there are straightforward conditions under which the introduction of a subsidy will increase economic welfare, even where economic welfare is defined in a very conventional (and conservative) manner. That is to say, we need not take into consideration issues such as a link between unemployment and ill health, crime or other forms of social breakdown, for this argument to go through. This is not, of course, to assert that these social issues are unimportant. Howeverr, the UK, at least, seems extremely reluctant to accept any evidence of a relationship between these forms of social problems and unemployment.

* Where the government pays unemployment benefit, there are clear conditions under which a subsidy will increase the post-tax income of the average owners of non-subsidised factors. These conditions are not arcane of extreme. Moreover, the notion of income here is the straightforward one of command over goods and takes no account of any real increase in welfare that employed workers of one type may gain from reducing the level of unemployment in other sectors of the labour market, or their own risk of becoming unemployed.

These arguments are important to counter views that labour market intervention reduces employment and welfare and that the issues involved in such policies are the familiar efficiency versus equity ones. Such erroneous views are expressed by the UK Government in HM Treasury (1991, p. 70) in its discussion of the rules to be used in the evaluation of industrial and regional assistance whose central goal is job creation. "Because of crowding out at the macroeconomic level, effects on employment ... should not be included as benefits of projects in an efficiency test." As has been demonstrated by Jackman and Layard (1980) and Johnson (1980), such "crowding out" would not, in general, be expected to occur.

2.3 Beacon and Monk

The work of Jackman and Layard (1980) and Johnson (1980) is purely analytical and each concentrate on two types of labour. In the case of Jackman and Layard, there are only two productive inputs, skilled and unskilled labour: for Johnson, there are n inputs but all but two, youth and low skilled adults, are in completely inelastic supply. Beacon and Monk (1987) approach the problem in a more flexible manner. Their analysis is similar to those of Jackman and Layard (1980) and Johnson (1980) in that they employ a closed-economy, one-sector model and the subsidies investigated are fully funded so that the public sector budget is always balanced. However, their model differs in the following characteristics:

* There are six factor of production, capital and five separate labour categories.

* The supply of each factor input is sensitive to the factor's price. That is to say, no factor has a completely inelastic supply.

* The model is concerned with aggregate unemployment, not simply unemployment within one or two employment groups.

* This is a numerical model where the results are derived by computer simulation.

Beacon and Monk (1987) simulate the impact of a fixed *per capita* labour subsidy financed by an increase in VAT. They argue that one would expect that such a subsidy would have two important effects.

* A substitution of labour for capital.

* A substitution of lower paid workers for higher paid workers. This effect applies because the proportionate impact of a fixed subsidy is greater where the original wage is lowest. This is seen as important because unemployment is regarded as being a problem primarily for lower paid workers. According to Beacon and Monk, this is because the wages of lower-paid workers are close to the unemployment benefit level,

and such workers are, in essence, likely to be "voluntarily" unemployed.

If such substitution effects increase the level of employment, and thereby reduce unemployment, then the employment impact will be further amplified by the downward adjustment which can be made to the VAT rate because government expenditure on unemployment benefit will have fallen.

Because of the differential impact of the fixed *per capita* subsidy on labour groups with different wages, Beacon and Monk (1987) separate the labour force by wage level. That is to say, the five groups identified in their analysis are simply the five quintiles of the labour force ranked by wage. It is assumed that workers in a given quintile earn the same wage. It is also assumed that workers in different quintiles will have different labour supply characteristics. In particular, the lower the wage, the higher the wage elasticity of supply.

The simulations that Beacon and Monk perform are stylised and indicative. For a fixed *per capita* labour subsidy equal to 20% of the average wage, there is an increase in total employment of 3.5%. Employment in all segments of the labour market rises, by a maximum of 9.6% in the lowest wage quintile to 0.03% in the highest wage quintile. Capital employment falls by 5.9%. In these simulations all workers benefit, in the form of increased employment and wages and there is a reduction in the payment of unemployment benefit. Owners of capital loose.

The work of Beacon and Monk (1987) in some respects extends the earlier analytical models of Jackman and Layard (1980) and Johnson (1980), but it has a couple of drawbacks. First, it seems to imply a fixed output, so that all the effects come through substitution. From the earlier work, we know that there will be output effects too, which are likely to increase the positive employment impact identified in the simulations. Second, the treatment of capital is rather cavalier. This would be less important were it not the case that the role of capital is crucial in their simulations. Capital is the only factor whose real payments fall as the result of the introduction of the subsidy scheme: both the use of capital and its real return decline, though Beacon and Monk (1987) do not comment on the economic or political implications of these reductions. Moreover, if capital were to be treated differently, it might be that

conflict would occur between labour groups. In particular, in their reported simulations, high wage groups experience a very small gain in real income from the labour subsidy. However, such high wage groups might be faced with lower employment and real wages if the supply of capital were more elastic.

3. MODEL

We wish here to extend the work of Beacon and Monk (1987) in considering a numerically-solved model with many inputs, none of which are inelastically supplied. We first outline a general model for tackling this sort of problem. We then give a specific example, adopting a Cobb-Douglas technology. The model employs a similar stylised initial data set and the same combined tax and subsidy scheme as used in Beacon and Monk (1987).

3.1 General Model

We start with a linear homogeneous production function (3.1) where the output, Q, in the single sector is produced with n labour inputs, L_1, L_2, ..., L_n and a capital input K.

$$Q = Q(L_1, L_2, ..., L_n, K) \qquad (3.1)$$

The supply of each labour input L_i is a positive function of the real consumption wage, w^c_i, equation (3.2).

$$L_i = L_i(w_i^c) \qquad (3.2)$$

Capital is a produced factor of production and given that we assume a single sector, the one commodity is used for both capital and consumption purposes. This has the implication that the price of capital and consumption goods cannot diverge. The treatment of capital goods in the work that we have reviewed is either absent (Layard and Jackman, 1980) or *ad hoc* (Johnson, 1980; Beacon and Monk, 1987). We here wish to consider two possibilities.

First we adopt the Keynesian savings function: we assume that savings are a fixed proportion, s, of income. In long run equilibrium, such savings just cover capital depreciation, which occurs at a rate δ. This implies that

$$\delta K = sQ$$

so that

$$K = \left[\frac{s}{\delta}\right] Q \qquad (3.3a)$$

The fact that the capital-output ratio remains constant means that the user cost of capital r^p (here taken to be the sum of the interest rate, the rate of depreciation, δ and tax) remains constant.

A second approach is to take the supply of capital to be infinitely elastic at the existing post-tax rate of return r^c. In this formulation, the capital output ratio is dependent on this rate of return and the tax rate, so that

$$K = K(r^c, t)\ Q \qquad (3.3b)$$

This would be the implication if national and international financial markets were perfectly integrated so that there was a unique ruling post-tax rate of return. This assumption is the reverse of that underlying the Keynesian savings function where the domestic supply of finance is taken to determine the level of domestic investment and this supply is price inelastic.

Production is taken to be perfectly competitive. This has the implication that the demand for inputs is set such that the value of the marginal product equals the producer price of the factor w^p_i. Taking the product price as the numeraire, this implies that

$$w_i^p = w_i^p(L_1, L_2, \ldots, L_n, K) \qquad (3.4)$$

Equation (3.4) defines the producer price of a factor as a function of the chosen set of factor inputs. Taxes, t, and subsidies, S, drive a wedge between the consumption wage and the producer price of labour, so that

$$w_i^p = w_i^p(w_i^c, S, t) \qquad (3.5)$$

Finally, we impose a balanced government budget. We identify only two forms of

government expenditure, the labour subsidy and unemployment benefit, and this is paid for by a value-added tax. This government's budget position is expressed as

$$X(L_1, L_2, ..., L_n, P, b, S) = T(Q, t) \qquad (3.6)$$

where X(.) is the government's expenditure function, T(.) its tax function, b is the unemployment benefit payment *per capita* and P is the registered working population.

Essentially the model operates in the following way. If the government introduces a subsidy, S, with an appropriate increase in tax to cover the subsidy, this changes the wedge between the real consumption wage and the producer price of labour via equation (3.5). For example, the scheme suggested by Beacon and Monk (1987) introduces a *per capita* subsidy financed by a proportionate tax. With fixed real consumption wages, this reduces the producer price of labour in the lowest wage groups but, from equation (3.4), increases the producer price of labour for at least one high wage labour group. These input price changes affect producer demand for these inputs and there is a subsequent change in employment and consumption wages in the various labour groups.

In general, as a result of these adjustments, total employment changes, with a corresponding alteration in output through equation 3.1. This affects the total bill for unemployment benefit and the total tax take. There therefore has to be an adjustment to the tax rate to rebalance the government budget and this has further impacts on output and employment. To take a simple example, if output and employment have both increased as a result of the first round of the adjustment process, unemployment benefit payments will be lower whilst tax revenues are higher. A reduction in the tax rate in order to reinstate a balanced government budget will here stimulate the supply of all labour inputs as consumption wages rise, further expanding employment and output. Of course other scenarios are possible, including ones in which employment rises but total output falls in the first round of adjustment.

3.2 Specific Formulation

3.2.1 One Labour Input, Keynesian Savings Function

The most straightforward case is where the technology is Cobb-Douglas, there is only one labour input and there is a Keynesian savings function. The analysis proceeds by taking total differentials of the relevant equations. Equation 3.7 is derived from the production function. Note here that from equation 3.3a capital inputs are endogenous, rising in equilibrium in line with output, so that only changes in labour inputs are required to predict changes in output.

$$\dot{Q} = \left[\frac{\alpha_L}{1-\alpha_K}\right]\dot{L} = \dot{L} \qquad (3.7)$$

where the dot notation indicates a proportionate change in the relevant variable, α_L and α_K represent the share of output going to labour and capital respectively (so that $\alpha_L + \alpha_K = 1$) and these values are the corresponding coefficients on the input terms in the Cobb-Douglas production function. Equation 3.8 is obtained from taking total differentials of the labour supply functions, where β is the labour supply elasticity.

$$\dot{L} = \beta \dot{w}^c \qquad (3.8)$$

Equation 3.9 is implied by the factor demand equations.

$$\dot{w}^p = \dot{Q} - \dot{L} \qquad (3.9)$$

Equation 3.10 defines the operation of the wedge. S is the labour subsidy which is assumed to take an initial value of zero, t is the proportionate VAT rate.

$$\dot{w}^p = \dot{w}^c - \frac{S}{w^c} + \frac{dt}{1-t} \qquad (3.10)$$

Equation 3.11 is derived from the total differential of the public sector balanced budget equation

$$\frac{LS}{Qt}\left[1+(1-\frac{kb}{S})\dot{L}\right] = \dot{Q} + \dot{t} \qquad (3.11)$$

This very simple model has two heuristic strengths. First, the results do not depend on any substitution effects: there is no substitution of labour for capital. The point here is not that such substitution effects are unimportant in reality, but rather that employment can be stimulated without substitution and this model identifies such behaviour very clearly. Second, within this type of approach there is the possibility of model instability and again it is pedagogically instructive to consider such instability in the simplest case.

If we substitute equation (3.7) into equation (3.9), we get the result that

$$\dot{w}^p = 0 \qquad (3.12)$$

This means that the producer price of labour, and therefore the cost-minimising (profit-maximising) technique, does not vary with the subsidy. Given that output is rising at the same rate as employment in this model, this is not surprising. However, labour supply is a function of the consumption wage. The introduction of a tax and subsidy scheme will change the wedge between the producer and consumption wage, so that labour supply, and therefore output, will in general change with the introduction of a subsidy. Substituting equation (3.12) into equation (3.10) gives

$$\dot{w}^c = \frac{S}{w^c} - \frac{dt}{1-t} \qquad (3.13)$$

and combining this with (3.8) yields

$$\dot{L} = \beta \left[\frac{S}{w^c} - \frac{dt}{1-t} \right] \qquad (3.14)$$

Given that the subsidy is only given to labour but taxes are levied on both labour and capital, the consumption wage must rise for a neutral tax/subsidy scheme, even if no unemployment benefit were paid. This implies that in this model employment will always rise under such a scheme, even though no substitution of labour for capital occurs. Moreover, the higher the savings in unemployment benefit that are generated by the increased employment, the more such effects will be magnified.

It is instructive to analyse the change in employment a little more formally.

Combining equations (3.7), (3.11) and (3.14), simplifying and using the relationship implied by the Cobb-Douglas production function

$$w^c = (1-t)\frac{\alpha_L Q}{L} \tag{3.15}$$

gives

$$\dot{L} = \frac{\dfrac{\alpha_K \beta S}{w^c}}{1 - \beta\left[\dfrac{\alpha_L(kb-S)}{w^c} + \dfrac{t}{1-t}\right]} \tag{3.16}$$

We know that the introduction of a subsidy will generate an increase in employment. In equation (3.16) the numerator here is positive. However, the denominator is negative if

$$\beta\left[\frac{\alpha_L(kb-S)}{w^c} + \frac{t}{1-t}\right] > 1 \tag{3.17}$$

But this is the necessary and sufficient condition for the government's budget deficit to move into surplus with a fall in the tax rate. This would correspond to an economy operating on the downward section of the Laffer curve. Under these conditions the imposition of a balanced public sector budget renders the economy dynamically unstable with respect to changes in the tax regime. The introduction of a subsidy would lead to a fall in the (unstable) equilibrium employment level. However, the original employment level would be higher than this and, given that the equilibrium is unstable and that a balanced budget is imposed throughout, employment would rise, and taxes fall, continuously.

3.2.2 One Labour Input and a Perfectly Elastic Supply of Capital

This model is identical to that outlined in the previous section, except for the fact that in this case the supply of capital is not a constant proportion of national output, but rather is infinitely elastic at the ruling post-tax rate of return. We therefore need to consider changes in the producer price of both inputs of capital and labour as the owners maintain their post-tax return to capital r^c.[2] This is defined as

$$r^c = r^p(1-t) \tag{3.18}$$

where r^p is the producer price of capital and t is the VAT rate. Where there is a perfectly elastic supply of capital, r^c does not vary, so that

$$\dot{r}^c = 0 \tag{3.19}$$

Totally differentiating equation (3.18) and substituting in (3.19) produces

$$\dot{r}^p = \dot{r}^c + \frac{dt}{1-t} = \frac{dt}{1-t} \tag{3.20}$$

This implies that the introduction of a tax on capital is passed on to the producer. Given the producer price of capital, the demand for capital is derived as

$$K = \frac{\alpha_K Q}{r^p} \tag{3.21}$$

Totally differentiating equation (3.21) and substituting in equation (3.20) generates

$$\dot{K} = \dot{Q} - \dot{r}^p = \dot{Q} - \frac{dt}{1-t} \tag{3.22}$$

Note that in contrast to the analysis in the previous section with the Keynesian savings function, here capital increases less rapidly than output after an increase in the tax. Changes in output are determined by equation (3.1) and (3.22)

$$\dot{Q} = \dot{L} - \frac{\alpha_K}{\alpha_L}\frac{dt}{1-t} \tag{3.23}$$

We are now able to find the change in the producer price of labour and the consumption wage, which are

$$\dot{w}^p = \dot{Q} - \dot{L} = -\frac{\alpha_K}{\alpha_L}\frac{dt}{1-t} \tag{3.24}$$

$$\dot{w}^c = \frac{S}{w^c} - \frac{1}{\alpha_L}\frac{dt}{1-t} \qquad (3.25)$$

respectively. We can see here a key aspect of this formulation of the model. With the introduction of the tax/subsidy package, the producer price of labour falls. This is what is powering the substitution of labour for capital. However, for employment to rise, the consumption wage must rise. Compare equation (3.25) with equation (3.13), the equation that identifies the change in the consumption wage where we adopt the Keynesian savings function. It is clear that the negative impact of tax changes on the consumption wage is higher with the perfectly elastic supply of capital.

Using equation (3.25), the change in labour supply is

$$\dot{L} = \beta\left[\frac{S}{w^c} - \frac{1}{\alpha_L}\frac{dt}{1-t}\right] \qquad (3.26)$$

and from the government budget constraint and using equation (3.25), the change in the tax rate, dt, is

$$dt = \left[\frac{t(1-t)\alpha_L}{\alpha_L - t}\right]\left(\frac{LS}{Qt}\left[1 + \left(1-\frac{kb}{S}\right)\dot{L}\right] - \dot{L}\right) \qquad (3.27)$$

Combining equations (3.26) and (3.27) and rearranging gives the expression for the change in employment, which is

$$\dot{L} = \frac{-\frac{BS}{w^c}\frac{t(1-\alpha_L)}{\alpha_L - t}}{1 - \beta\left[\frac{(\alpha_L(1-t))(kb-S)}{w^c(\alpha_L - t)} + \frac{t}{\alpha_L - t}\right]} \qquad (3.28)$$

Clearly expression (3.28) is more complex than where we assume a Keynesian savings function. In this case, there is no automatic increase in employment. The numerator is negative (as long as $\alpha_L > t$) but the denominator is only negative where

$$\beta(1-t)\frac{(kb-S)}{w^c} + \frac{(\beta+1)t}{\alpha_L} > 1 \qquad (3.29)$$

3.2.3 Many labour inputs

In the previous subsection we have presented two forms of the model where there are only two factors of production, homogeneous capital and labour, and we have solved the model analytically. Here we present the more general Cobb-Douglas case where there are a number of different labour inputs. Again we present two alternative capital supply functions: the Keynesian savings function and the infinitely elastic capital supply. Both models are solved numerically.

The equations for labour supply, the producer price of labour, the consumption wage and the budget constraint are identical for both models. Their form is similar to those for the two-factor models. The i and j subscripts indicate the particular labour sub-group. Therefore labour supply is

$$\dot{L}_i = \beta_i \dot{w}_i^c \qquad (3.30)$$

Producer price of labour is

$$\dot{w}_i^p = \dot{Q} - \dot{L}_i \qquad (3.31)$$

The consumption wage is

$$\dot{w}_i^p = \dot{w}_i^c - \frac{S}{w_i^p} + \frac{dt}{1-t} \qquad (3.32)$$

And the total differential of the public sector balanced budget equation is

$$\frac{LS}{Qt}\left[1+(1-\frac{kb}{S})\sum_i \sigma_i \dot{L}_i\right] = \dot{Q} + \frac{dt}{t} \qquad (3.33)$$

Where the two models differ is in the determination of output. When we impose the Keynesian savings assumption

$$\dot{Q} = \sum_i a_i \dot{L}_i \qquad (3.34a)$$

where

$$a_i = \frac{\alpha_i}{1-\alpha_K}$$

For the perfectly elastic supply of capital

$$\dot{Q} = \sum_i a_i \dot{L}_i - \frac{\alpha_K}{1-\alpha_K}\frac{dt}{1-t} \qquad (3.34b)$$

If equations (3.30) to (3.34) are employed the two alternative models can be expressed in the following equations (3.35) and (3.36). For the model with the Keynesian savings function

$$\dot{L}_i\left[1 - a_i + \frac{1}{\beta_i}\right] - \sum_{j\neq i} a_j \dot{L}_j + \frac{dt}{1-t} = \frac{S}{w_i^c} \qquad (3.35a)$$

$$\sum_i \left[a_i - \frac{LS}{Qt}(1-\frac{kb}{S})\sigma_i\right]\dot{L}_i + \frac{dt}{t} = \frac{LS}{Qt} \qquad (3.36a)$$

For the perfectly elastic capital supply the corresponding equations are

$$\dot{L}_i\left[1 - a_i + \frac{1}{\beta_i}\right] - \sum_{j\neq i} a_j \dot{L}_j + \frac{dt}{(1-t)(1-\alpha_K)} = \frac{S}{w_i^c} \qquad (3.35b)$$

$$\sum_i \left[a_i - \frac{LS}{Qt}(1-\frac{kb}{S})\sigma_i\right]\dot{L}_i + dt\left[\frac{1-\alpha_k-t}{t(1-t)(1-\alpha_k)}\right] = \frac{LS}{Qt} \qquad (3.36b)$$

Equations 3.35 and 3.36 give n+1 equations in n+1 unknowns: the n proportionate employment changes and the change in the tax rate.

3.3 Simulation

We have used equations 3.35 and 3.36 as the basis for a set of simulation exercises. These give estimates of the impact of a similar type of tax and subsidy scheme as that investigated in Beacon and Monk (1987): a fixed *per capita* labour subsidy equal to 5% of the average wage financed through increased general taxation of a VAT type. We start with a stylised representation of the initial equilibrium position of the economy which follows that given in Beacon and Monk (1987). This is presented in detail in the Appendix. Essentially we break the workforce down into 5 equal groups (quintiles) classified by their wage. Each quintile is taken to have a separate elasticity of labour supply, with low-wage workers having larger values than highly-paid workers. This assumption is motivated by existence of alternative non-market opportunities and welfare payments for the unemployed.

Table 1: Alternate Sets of Labour Supply Elasticities

	High elasticities	Low elasticities
β_1	0.2	0.1
β_2	0.5	0.3
β_3	1	0.75
β_4	2	1.5
β_5	5	3

Two alternative assumptions are made concerning three key characteristics of the system. These are the nature of the supply of capital, the elasticities of labour supply (β_is), and the proportion of new employment that comes from the unemployed (k). With the supply of capital, we model the two extreme cases outlined in the previous section. These are where the savings function is of a Keynesian character and where the supply of capital is infinitely elastic at the existing post-tax rate of return. For the supply elasticities we use two sets of values. These are identified in Table 1 and labelled as high and low elasticities respectively.

Finally we consider two extreme positions, zero and one, with respect to the proportion (k) of the newly employed who come from the registered unemployed.

In Tables 2 and 3 we report results from the simulations involving the infinitely elastic supply of capital and the Keynesian savings function respectively. In each table we report the employment change for each quintile of the labour force, the total employment change, the total output change. We also identify the increase in VAT and the fall in the net private sector contribution to the public sector. If the labour subsidy could be incorporated into a tax scheme, this would be the overall change in taxation.

In all the simulations reported here there is an increase in total employment and output. Increases in total employment range from 1.45% to 4.00% and 0.76% to 2.84% respectively. In general, the effect on economic activity is greatest for the Keynesian savings function, the higher labour supply elasticities and the higher percentage of workers coming from the unemployment register. For all the simulations there are major increases in employment at the lower end of the labour market. The smallest percentage change in the employment in the poorest quintile is 5.63, with the relatively low labour supply elasticities, the fixed post-tax return to capital and no feedback from reduced unemployment benefit payments. In some simulations there are reductions in employment for the highest quintiles, but these reductions are relatively small. The pattern of employment change is such that output increases by less than employment but in no case does output fail to increase. Although the VAT rate increases by about 5%, where unemployment is assumed to fall as a result of the increased employment the net payment from industry to the public sector falls. If the labour subsidy could be incorporated as part of a tax scheme, in the form of tax rebates, the total tax take would actually fall. However, it should be noted that even where there is no effects from reduced benefit payments, the subsidy still has a positive impact on employment and output.

The employment impacts are greater than those identified by Beacon and Monk (1987). There are two main reasons for this. We are adopting a production function where there is a greater elasticity of substitution between inputs. In the Cobb-Douglas case this takes the value of unity, whilst Beacon and Monk used a more conservative value of 0.6.

Table 2: The Impact of a Fixed per capital Labour Subsidy with a Fixed Post-Tax Return on Capital

	High labour supply elasticities		Low labour supply elasticities	
	k=0	k=1	k=0	k=1
Employment change				
Quintile 1	-0.26	-0.04	-0.24	-0.06
Quintile 2	-0.21	0.22	-0.16	0.06
Quintile 3	0.36	1.02	0.29	0.69
Quintile 4	2.00	2.88	1.77	2.34
Quintile 5	6.31	7.40	5.63	6.34
Total Employment	1.64	2.30	1.45	1.87
Output change	0.85	1.40	0.76	1.10
Change in VAT	5.10	4.54	5.10	4.63
Change in net tax take	0	23.0	0	18.7

Table 3: The Impact of a Fixed per capital Labour Subsidy with a Keynesian Savings Function

	High labour supply elasticities		Low labour supply elasticities	
	k=0	k=1	k=0	k=1
Employment change				
Quintile 1	0.24	0.53	0.09	0.19
Quintile 2	0.78	1.36	0.45	0.72
Quintile 3	1.86	2.72	1.42	1.92
Quintile 4	4.00	5.14	3.35	4.05
Quintile 5	8.80	10.23	7.61	8.48
Total Employment	3.14	4.00	2.58	3.07
Output change	2.12	2.84	1.69	2.08
Change in VAT	5.10	4.13	5.09	4.33
Change in net tax take	0	40.0	0	30.7

Secondly we treat capital differently and also allow for a more systematic treatment of output effect. We can see by comparing the results in Tables 2 and 3 that the particular treatment of capital supply has an important effect on the employment outcomes and in all cases output rises with the introduction of the subsidy so that there are output as well as substitution effects.

4 DISCUSSION

The results coming from both the theoretical and simulation models discussed in Sections 2 and 3 suggest that in principal there is scope for the government to improve the employment and output performance of the economy through the use of a balanced-budget tax and subsidy scheme. However, the models used to derive these results are extremely simple. On balance we believe that this simplicity is an advantage, although it is important to be aware of their limitations.

4.1 Perfect Competition

In the analysis reported above factor markets are taken to be perfectly competitive. This is clearly a gross simplification. It suggests that the appropriate time frame in which to locate the analysis is the long run: in the short run many frictions and imperfections will apply. This is an issue to which we shall return later. It also means that the subsidy schemes under consideration here are being set difficult hurdles to clear: if a subsidy can increase employment and welfare in a perfectly-competitive setting, it is likely to be even more effective in an imperfectly-competitive situation. This is certainly the finding in Jackman and Layard (1980)

However, a major question seems to arise with the adoption of a perfectly competitive labour market. This is that even if employment can be increased by employment subsidies, why should the government intervene? If individuals are choosing to be unemployed, why should the government attempt to influence that choice? A corollary of this is that it is sometimes argued that where the labour market is perfectly competitive, there will be no unemployment problem. But there are at least three arguments to support intervention under

these circumstances. The first is that the usual explanation for voluntary unemployment is that the wage is not high enough to cover the opportunity cost of "leisure". However, in practice, "leisure" might involve operating in the informal or criminal sectors. Politicians might wish to subsidise jobs in the formal economy to counteract the expansion of these other sectors. The second point is that although the labour market is here perfectly competitive in terms of the determination of wage rates, there is already government intervention in the form of unemployment benefit. This is the argument put forward in Beacon and Monk (1987) and Jackman and Layard (1980). The payment of unemployment benefit distorts the market and labour subsidies are here known to generate potentially welfare improving outcomes. Third, there may be other externalities involved with unemployment, including ill health and family breakdown. At the very least these are likely to involve increased welfare expenditure.

4.2 Long-run Equilibrium

In specifying perfectly competitive factor markets and a complete absence of fixed factors in the production function, we are implicitly adopting a long-run perspective. That is to say, we are considering how a particular subsidy scheme will affect the long-run equilibrium of the economic system. This has one major drawback. We can say nothing about the particular path the economy will take in attaining the new equilibrium. In particular we say nothing about the speed of adjustment, but in so far as full adjustment here requires changes in the capital stock, this is likely to be a long drawn-our process. However, a strength of the analysis is that, independently of the particular short-run dynamics, the economy will be attracted systematically towards the new long-run equilibrium. In short, it would be fitting to regard the policies analysed here as appropriate to deal with long-run structural problems, rather than short-run adjustment difficulties.

4.3 Single Sector

Using a single-sector model greatly eases the general equilibrium analysis. It focuses attention on substitution between factors, which is the central mechanism at work, but neglects substitution amongst commodities. However, if a labour subsidy policy were to be implemented, the impact on individual commodities would be important and this might affect

the political acceptability of such a scheme.

Consider the case used in the simulations of a fixed *per capita* labour subsidy, financed by an increase in VAT. This would increase the price of those commodities which use high wage labour, as against the price of commodities which are intensive in the use of low-wage labour. If this leads to substitution away from the higher priced commodities in consumption, the story told by the single-sector model is reinforced: not only is there a shift towards more labour intensive techniques but there is also a move to more labour intensive products. However, this might imply that there are some sectors of the economy which face large adjustments in total activity. Where this is a contraction, and especially where the industry is locationally concentrated, this might create political difficulties and some care would be required in timing the adjustment to the new equilibrium.

4.4 Closed Economy

The models investigated here are of a closed economy: there is no external trade. This has the advantage that any effects on economic activity and employment generated by the subsidy are not due to some form of implicit devaluation. It is not the case that the increase in employment is at the expense of employment in other countries with which the economy trades. The expansion in activity is therefore not vulnerable to retaliatory action from other countries.

However, the assumption of a closed economy is clearly unrealistic from the point of view of one of the members of the EU. Moreover, if we relax this assumption, and also the assumption of one single sector, such subsidies might attract considerable opposition in some traded sectors. For example, a capital intensive exporting sector would find itself less competitive in external markets. Similarly, a traded sector which extensively uses low-wage labour will be more competitive and this might generate complaints from trading partners. However, if the policy were to apply on an EU level, these sorts of problems would be minimised.

5 POLITICAL ISSUES

5.1 Public Expenditure

A major concern about automatic, general subsidies involves their impact on the total level of public expenditure. This has led to a questioning of the efficacy of subsidies in general and a move away from automatic general subsidies towards marginal and discretionary subsidies (HM Treasury, 1991; Swales, 1989 and 1995). There are three levels of defense for an automatic labour subsidy scheme of the form outlined here.

First, an informed discussion of the appropriate level of the public sector needs to distinguish between different types of government expenditure. The appropriate division between public and private provision of goods and services is a legitimate political concern. Moreover, one ought to be attentive to the possible adverse incentive effects generated by a heavy burden of welfare transfers on workers or shareholders. However, subsidies to aid the operation of the economic system do not fit into these categories. Such subsidies should improve, not impair, productive efficiency by offsetting market failure in other parts of the economy. They restore, rather than distort, appropriate price signals. They do not rob the private sector of resources but reallocate resources within that sector. And as we have seen, such subsidies generate an expansion, not contraction, of private sector economic activity. In principal, the absolute level of tax and subsidy flows associated with these balanced budget schemes should not worry the politician or civil servant, aside from low administration and compliance costs (Sandford *et al*, 1989).

All these points having been made, it clearly is the fact that governments are generally concerned about the overall level of taxation within the economy. However, the type of integrated subsidy and tax scheme that we investigate in the simulations could, in principle, be operated as a uniform tax scheme. That is to say, the change in the firm's tax bill could be calculated as the net difference between the additional VAT and the *per capita* subsidy. In so far as the scheme increased total employment, and thereby reduced payments of unemployment benefit, it would be associated with a reduction in the required overall tax take. That is to say, the introduction of the new tax scheme would increase employment and reduce taxation.

In the UK labour subsidies are very popular. Battu (1995) reports that 15 separate employment subsidy schemes have been introduced by the British government in the last 30 years. However these schemes have almost invariably been of a short-run marginal and/or discretionary type. Such subsidies might be an appropriate response to some short-run problem of employment adjustment or a reaction to perceived hysteretic effects in the labour market. But such schemes are costly to administer and potentially discriminate between aided and unaided firms. They are necessarily short-run in operation and are therefore not incorporated into the long-run decision making by firms (investment decisions, for example). It is difficult not to believe that one of the reasons why the UK government has favoured these marginal and discretionary approaches is the limited direct public expenditure cost associated with these policies. However, as we have observed, in so far as an automatic integrated tax scheme increases employment, total government expenditure will fall.

5.2 Distributional Issues

The impact of a subsidy/tax regime which changes the wedge between the consumption wage and the producer price of labour for different employment groups will have distributional consequences. In the simulations reported in Table 1 we notice that the employment impact is concentrated on lower income groups. In one sense this is a desirable outcome if one of the objectives of the policy is a relieving of economic inequality. However, there clearly maybe objections from higher waged workers. These might perceive their position as weakened because of their relatively adverse treatment by the combined tax and subsidy package. Indeed, in some simulations reported in Table 2 increased employment in low income groups occurs partly at the expense of lower employment and real wages for higher-wage sectors of the labour force. At the very least, policy makers should be aware of these possible distributional implications.

6. CONCLUSIONS

The results of the purely analytical and simulation results reviewed here is that the government can influence employment by introducing an appropriate tax and benefit system, even where the economy is working in a perfectly competitive way. It must be stressed that

the analysis is of a long-run nature: that such policies would change the long-run equilibrium toward which the economy is being pulled. The analysis makes no predictions concerning the short-run dynamics, though some of the short-run implications have been identified here and in practice these might be politically problematic. There is at present an increased faith in "market forces" and a general desire to reduce subsidies that artificially maintain inefficient or inappropriate industries. However, where there are apparently high levels of structural unemployment amongst primarily low skilled workers, and where these unemployed are supported by welfare payments which lower the real income of workers and reduce their incentive to work, the possibility of long-term persistent labour subsidies should be considered. If such subsidies can be packaged as tax rebates the possibility occurs of a simultaneous fall in taxation and increase in employment.

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FOOTNOTES

1. In fact there is a more complex version still in Johnson. This is where the wage in the youth market is fixed as the weighted sum of the market clearing wage in that sector and some socially determined "minimum" wage (where the "minimum" wage is above the market clearing wage). This formulation has both youth employment and real wages changing as the demand for labour in this segment of the labour market varies.

2 The superscript c is used here to make the notation consistent with that used for wages where the post-tax/subsidy wage is labelled the consumption wage. The notion of the producer price of capital is not the cost of purchasing capital goods, but rather the producer's cost of using the capital goods - interest, depreciation and tax.