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OPTIMAL FACTOR AND PRODUCTION SUBSIDIES
UNDER CLASSICAL UNEMPLOYMENT

BY

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Optimal Factor and Production Subsidies
Under Classical Unemployment

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ABSTRACT This paper appraises and compares the macroeconomic effects of three supply-side policies - namely employment, investment and production subsidies - within the context of a multisectoral two-period model of a small open economy with classical unemployment. Optimal subsidy levels are studied, a hierarchy of policies is derived, and policy rankings are shown to survive the introduction of common alternative specifications of the social welfare function.

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1. Introduction

It is widely agreed that "real wage gaps" have contributed to the unemployment problem of the last two decades, particularly for economies outside of North America¹. In the absence of government control over the level of real wages, policy makers are faced in this case with the problem of designing strategies to boost employment through enhanced profitability rather than simply through demand-expansion. Attention is shifted therefore to policies which affect aggregate supply, stimulating capital formation and employment by raising labour productivity relative to cost.

The purpose of the present paper is to study, within the context of an intertemporal model of a small open economy in which employment is cost- rather than demand-constrained, the macroeconomic effects of three of the most frequently encountered supply-side policies, i.e., the subsidisation of employment, investment and production. The optimal levels of these subsidies are analyzed, and a policy hierarchy is derived.

From standard welfare theory it is well known, of course, that the optimal intervention strategy is that which treats the distortion at source, implying the superiority of an employment subsidy or payroll tax reduction for an economy in which real wages are set at inappropriate levels. Employment subsidies have indeed been advocated to combat the current unemployment problem, notably by Layard and Nickell (1980), Blanchard, Dornbusch and

Layard (1986), and the more recent reports of the Centre for European Policy Studies. Other subsidies can also be welfare enhancing, however, as will be shown, since private returns and shadow values differ, both for production and for investment, in the presence of classical unemployment.

The importance of considering and of ranking instruments other than the first-best subsidy policy is that, as Corden (1974) points out, disbursement costs may make some forms of intervention excessively expensive. He specifically mentions the administrative difficulty of subsidising employment in less developed countries, while Neary (1978), in analysing the effects of capital subsidies, suggests that a possible explanation for their widespread use as a means of stimulating employment may be an administrative preference for grants paid out on a once and for all basis over ongoing labour subsidies. The choice between policy instruments therefore involves a trade-off between relative disbursement costs and relative welfare effects. (As a by-product of the present analysis it will be seen that the terms of this trade-off depend on the social objectives to be achieved by policymakers.) De Meza and Natale (1989) have recently proposed an alternative explanation for the widespread use of capital subsidies; their empirical investigations suggest that this policy may be more tax-efficient than labour-subsidisation².

Since the intertemporal as well as the intersectoral effects of investment subsidies are to be examined in this paper, so that

their full impact can be understood, the model adopted must allow for aggregate capital accumulation. This generalises the analyses of Borts (1966), Bhagwati and Srinivasan (1969), Ahluwalia (1973) and Neary (1978), all of whom employ the assumption of a fixed stock of intersectorally-mobile capital in order to explore aspects of one or other of the policies discussed here. The two-period model chosen as vehicle for the present analysis allows for these intertemporal effects while affording an analytical tractability not always found in multi-period dynamic models³. This framework, by directing attention towards the processes of saving and investment, also presents a perspective on the balance of payments that accords with recent work on the subject. The sectoral issues which are the main focus of concern of the industrial-policy literature are also fully taken into account in the present case.

To facilitate the comparison of policies, the paper begins by considering the benchmark case of an economy which is currently fully employed but in which second-period real wages, over which the government has no control, have been set in advance at a level which precludes full employment in the future. To offset this, fully-anticipated production or employment subsidies may be introduced in the second period, thereby increasing employment at that time while stimulating investment, through perfect foresight, in the earlier period. Alternatively, first-period investment could be subsidised, which, through its impact on labour productivity, would also have the effect of raising second-period employment. The results of the analysis are then

extended to deal with current unemployment.

The paper is organized as follows: the conditions for Pareto-efficiency in a multi-sectoral small open economy are outlined in the next section⁴. The following section studies the macroeconomic and efficiency effects of a wage shock. A comparison of the impact of various government policies, when subsidy levels are chosen optimally, is then made, and a policy hierarchy derived on this basis. The implications of some alternative social welfare functions are also discussed, and the paper concludes with a summary of the main results.

2. A Pareto-Efficient Macroeconomic Equilibrium

(a) Production:

It is assumed here, as in other two-period models, that capital must be purchased and installed one period in advance of its use, so that there is no new investment in the second period. Consider then the intertemporal decision problem of a firm in sector i which produces an internationally traded commodity whose price, determined on world markets, is held constant throughout the analysis and normalised at unity. The firm chooses labour inputs in each period, L_i^t and L_i^{t+1} , and a level of investment $I_i = K_i^{t+1} - K_i^t$, assuming no depreciation of capital, so as to maximize π_i , the discounted stream of net revenues:

$$(1) \quad \begin{aligned} \pi_i = & F_i(K_i^t, L_i^t) - I_i - bI_i^2/2 - w^t L_i^t \\ & + R[F_i(K_i^{t+1}, L_i^{t+1}) - w^{t+1} L_i^{t+1}] \end{aligned}$$

$F_i(\)$ is the firm's production function, which exhibits constant returns to scale; $bI_i^2/2$ is a capital-adjustment cost term, representing internal marginal adjustment costs which are an increasing function of investment, as is common in the theory of the firm⁵, and R is the interest factor, i.e., one over one plus the interest rate. The interest rate is assumed to be determined exogenously through perfect international financial capital mobility.

The first-order conditions for the solution of this optimisation problem are:

$$\begin{aligned}
 (2) \quad & F_{Li}^t = w^t \\
 & F_{Li}^{t+1} = w^{t+1} \\
 & 1 + bI_i = RF_{Ki}^{t+1}
 \end{aligned}$$

The first two equations represent the familiar condition that the value of the marginal product of labour be equated to the wage in each period. The third one requires equality between the marginal cost and marginal benefit of investment, and yields an investment function of the form:

$$I_i = (RF_{Ki}^{t+1} - 1)/b$$

(b) Consumption:

Consumers maximise an intertemporal utility function with four "goods" as arguments, i.e. each period's consumption and leisure, subject to an intertemporal budget constraint. If preferences are homothetically separable over time, the demand for each good depends only on relative prices, real interest rates, and

discounted disposable income⁶. As the first two effects are ambiguous a priori, and of limited relevance to the issues with which this paper is concerned, additional restrictions will be placed on the utility function in order to exclude them. Cuddington and Vinals (1986) and others have demonstrated the usefulness of the additive time-separable utility function of the log-linear form in this regard, particularly in the context of disequilibrium situations of the type analysed here.

The problem of the consumer is therefore to maximise

$$\begin{aligned}
 (3) \quad U &= [\alpha \ln C^t + (1-\alpha) \ln (H-L^t)] \\
 &+ B [\alpha \ln C^{t+1} + (1-\alpha) \ln (H-L^{t+1})] \\
 &\text{subject to} \\
 &C^t + RC^{t+1} = \\
 &\Sigma_i \pi_i + w^t L^t + R w^{t+1} L^{t+1}
 \end{aligned}$$

where C represents consumption, H the maximum amount of leisure per period, and B the time preference factor.

The solution is found by forming the Lagrangean and maximising with respect to the arguments of the utility function, to yield:

$$\begin{aligned}
 (4) \quad C^{t+1}/C^t &= w^{t+1}(H-L^{t+1})/w^t(H-L^t) = B/R \\
 \text{and} \quad w^t(H-L^t)/C^t &= w^{t+1}(H-L^{t+1})/C^{t+1} = (1-\alpha)/\alpha \\
 w^{t+1} &= B(1-\alpha)/R\Theta(H-L^{t+1})
 \end{aligned}$$

where Θ is the Lagrange multiplier on the budget constraint.

The first of these conditions expresses the relationship between

each period's consumption levels as a function of the ratio of the time preference to discount factors, the second depicts the ratio of the two goods consumed within a period as a function of the marginal rate of substitution between consumption and leisure, and the third gives us a precise value for the marginal utility of leisure, which will prove useful later.

The conditions for Pareto-efficiency are given by equation systems (2) and (4) together.

(c) The Balance of Payments:

Subsidies are the only government outlay in the model; assuming throughout that the government budget is balanced each period by the adjustment of lump-sum taxation to the level of these transfer payments, the current account surplus of the balance of payments each period, denoted NX^t and NX^{t+1} , is given by:

$$(5) \quad \begin{aligned} NX^t &= \sum_i (Y_i^t - C^t - I_i - bI_i^2/2) \\ \text{and } NX^{t+1} &= \sum_i (Y_i^{t+1} - C^{t+1}) \end{aligned}$$

where Y_i is the output of sector i . The intertemporal budget constraint specified in (3) above requires that the current account surpluses, discounted at the world interest rate, sum to zero.

(d) Stationary State Conditions:

It is assumed for ease of exposition that the economy is initially in a full-employment equilibrium, with an expected

future return to capital (equal across firms) such that no investment is taking place. If preferences are such that consumption is constant across periods (i.e. if $B = R$) the current account is also in equilibrium.

3. Classical Unemployment and the Impact of Subsidies

Now consider what happens if a wage-bargain struck this period raises the second-period wage above the market-clearing level⁷. In the absence of remedial government intervention, classical unemployment will prevail.

The impact of the wage shock on employment and investment is found from equation system (2) and the fact that $I = K^{t+1} - K^t$:

$$\begin{aligned}
 & dK_i^{t+1}/dw^{t+1} = -Re_i/b < 0 \\
 (6) \quad & dL_i^{t+1}/dw^{t+1} = e_i dK_i^{t+1}/dw^{t+1} - \sigma_i L_i^t / \delta_i w^t < 0
 \end{aligned}$$

where e_i is the labour-capital ratio, σ_i is the elasticity of substitution and δ_i is capital's share in output⁸.

The wage agreement leads to a fall in investment and future employment. The capital intensity of second period production is increased, as seen from the last term of the second equation in (6) above, while the effect on each firm's investment depends on the labour intensity of its production process (as would be apparent from a unit-cost curve diagram.⁹) Let us take as benchmark levels for the rest of the analysis the resulting

outcome for employment, investment and production.

The representative consumer now faces the added constraint that labour traded in the second period cannot exceed quantity demanded, and the individual's behaviour is therefore described by:

$$(7) \quad C^{t+1}/C^t = B/R$$

$$w^{t+1}(H-L^{t+1})/w^t(H-L^t) = B/R + \mu(H-L^{t+1})/R(1-\alpha)$$

$$w^t(H-L^t)/C^t = (1-\alpha)/\alpha$$

$$w^{t+1}(H-L^{t+1})/C^{t+1} = (1-\alpha)/\alpha + \mu(H-L^{t+1})/B\alpha$$

and
$$w^{t+1} = [B(1-\alpha) + \mu]/R\Theta(H-L^{t+1})$$

where μ is the Lagrange multiplier associated with the labour-market constraint. As (7) differs from (4), Pareto-efficiency is clearly seen to be violated.

The particular utility function adopted allows us write the demands for both periods' consumption and first-period leisure as linear functions of "restricted income", shown on the right-hand side of the budget constraint rewritten in the following form:

$$(8) \quad C^t + RC^{t+1} + w^t(H-L^t) = \\ \Sigma_i \pi_i + w^t H + R w^{t+1} L^{t+1}$$

If the labour market in period t is unconstrained, consumers respond to the expectation of a future employment constraint by increasing labour supply in the current period, i.e. by consuming less leisure.

It is assumed that the government cannot, ex post, change the wage agreement. The options available to affect investment and future employment include a subsidy m per future employee, a transfer to the firm today of a fraction g of the value of its proposed second-period capital stock, and a subsidy s for second-period production.¹⁰

The current value of these transfers to the firm in sector i amounts to

$$(9) \quad Rm_i L_i^{t+1} + g_i K_i^{t+1} + Rs_i Y_i^{t+1}$$

When added to the stream of revenues in equation (1) this yields the following first-order conditions:

$$(10) \quad \begin{aligned} F_{L_i}^t &= w^t \\ (1+s_i) F_{L_i}^{t+1} &= w^{t+1} - m_i \\ I_i &= [R(1+s_i)F_{K_i}^{t+1} + g_i - 1]/b \end{aligned}$$

From this system of equations with $m_i > 0$ and $g_i = s_i = 0$, it can be seen that the introduction of an employment subsidy causes production to become more labour-intensive in the second period, and increases investment by raising the anticipated marginal product of capital, with the size of the effect on the latter depending positively on labour intensity.

The impact on the capital stock and the level of employment in the second period is

$$(11) \quad \begin{aligned} dK_i^{t+1}/dm_i &= Re_i/b > 0 \\ dL_i^{t+1}/dm_i &= e_i dK_i^{t+1}/dm_i + \sigma_i L_i^t / \delta_i w^t > 0 \end{aligned}$$

These effects, of course, are simply the negative of the derivatives with respect to w^{t+1} seen in equation (6), as is obvious from the way in which m_i enters the model.

An investment subsidy, on the other hand, leaves the capital-labour ratio unchanged since the effective real product wage faced by the firm is not affected. The marginal cost of investment is driven down, however, so that both investment and second period employment are raised relative to their benchmark levels.

$$\begin{aligned} dK_i^{t+1}/dg_i &= 1/b > 0 \\ (12) \quad dL_i^{t+1}/dg_i &= e_i dK_i^{t+1}/dg_i > 0 \end{aligned}$$

The impact on the firm's investment is in this case independent of labour intensity¹¹.

A production subsidy is of course equivalent to an employment subsidy plus an investment subsidy, and its effects therefore lie between those of the other two. The capital-labour ratio is reduced in response to the decline in the effective product wage, and investment is stimulated by the increased profitability.

$$\begin{aligned} dK_i^{t+1}/ds_i &= RY_i^t/bK_i^t > 0 \\ (13) \quad dL_i^{t+1}/ds_i &= e_i dK_i^{t+1}/ds_i + \sigma_i L_i^t/\delta_i > 0 \end{aligned}$$

where Y represents output.

4. The Policy Hierarchy

When the labour market is in disequilibrium, the decision problem of the individual, the outcome of which was described in equation

(7), is more complex than that studied in section 2 of the paper because the constraint must be taken into account explicitly. For the government, however, the problem remains the same; i.e. to maximise social welfare, measured here by the utility function, subject to the intertemporal budget constraint written in the form appropriate to the social planner:

$$(14) \quad C^t + RC^{t+1} = \sum_i [F_i(K_i^t, L_i^t) + R F_i(K_i^{t+1}, L_i^{t+1}) - I_i - bI_i^2/2]$$

If a policy of labour subsidisation is to be used to combat classical unemployment, the optimal level of the subsidy is found by maximising utility with respect to m_i , subject to the budget constraint above and the private sector response embodied in equation system (10) for $m_i > 0$ and $g_i = s_i = 0$. This process reveals the optimal subsidy m_i^* as:

$$(15) \quad m_i^* = w^{t+1} - B(1-\alpha)/\theta R(H-L^{t+1})$$

The optimal subsidy therefore bridges the gap between the Walrasian and the rigid wage, as is seen by comparing (4) and (15), and completely offsets the effects on employment and investment of the wage increase; this is the standard type of result emerging from the theory of optimal intervention (when non-distortionary taxation is available). Furthermore, since m_i^* is the same for all i , a uniform rate of subsidy, m^* , is desirable.

The optimal level of investment subsidy, if this is the policy instrument used, is found by maximising (3) with respect to g_i ,

subject to equations (12) and (10) (with $g_i > 0$ and $m_i = s_i = 0$ in the latter). Its size may be related to the level of the wage distortion with the aid of equation (15) to reveal:

$$(16) \quad g_i^* = R e_i m^*$$

From (11) and (12) the optimal sector-specific investment subsidy, which depends positively on the labour intensity of the sector, is seen to replicate the effect of the optimal labour subsidy on each sector's investment, and thus also on aggregate investment. Less employment is stimulated, however, since this policy does not affect labour intensity.

If a uniformly-applied investment subsidy is instead adopted, the optimal setting is found in a similar fashion to be:

$$(17) \quad g^* = R(\Sigma_i L_i / \Sigma_i K_i) m^*$$

This policy replicates the effect of m^* on aggregate investment, but sector-specific and uniformly-applied subsidies have different effects on the sectoral structure of production, with the former providing a relatively greater stimulus to the more labour-intensive sectors. The effect of sector-specific capital subsidies on aggregate employment will therefore be greater¹².

The optimal level of production subsidy is found from (3) and (10) with $s_i > 0$, $m_i = g_i = 0$, and, again using equation (15), is given by:

$$(18) \quad s_i^* = [(RY_i e_i / bK_i) + (\sigma_i L_i / \delta_i)] m^* / [(RY_i^2 / bK_i^2) + (w\sigma_i L_i / \delta_i)]$$

From (11) and (13) this policy is seen to generate the same levels of sectoral and aggregate production as the optimal employment subsidy, while the latter causes a greater increase in each sector's labour intensity and thereby generates more employment.

A uniform production subsidy, optimally applied, would also generate the same level of aggregate output but growth would be less concentrated in the labour-intensive sectors so that less employment would be created than if sector-specific subsidies were used. The optimal size of the uniform subsidy is:

(19)

$$s^* = \Sigma_i [(RY_i e_i / bK_i) + (\sigma_i L_i / \delta_i)] m^* / \Sigma_i [(RY_i^2 / bK_i^2) + (w\sigma_i L_i / \delta_i)]$$

Since optimal production subsidies, whether uniform or sector-specific, generate more investment and a lower capital-labour ratio than does a uniform investment subsidy, it is clear that the latter policy, when applied optimally, generates the lowest level of employment of the policies studied.

As the last step in the construction of a complete hierarchy of employment effects it can be shown that the combined output and substitution effects on employment of a uniform production subsidy dominate the output effect (on employment) of a policy of sector-specific investment subsidies.¹³

In terms of the employment-effects of each subsidy programme, therefore, when each subsidy in turn is set at its optimal level,

the following policy hierarchy emerges:

- i) Uniform employment subsidies¹⁴
- ii) Sector-specific production subsidies
- iii) Uniform production subsidies
- iv) Sector-specific investment subsidies
- v) Uniform investment subsidies

It is easily shown that these policy rankings are maintained when we come to look at the relative effects of policies on social welfare rather than on aggregate employment. The impact on social welfare exerted by any policy instrument x , when set at its optimal level x^* , is measured by $U(x^*) - U_0$, where the subscript 0 denotes the outcome that would have prevailed in the absence of intervention.

Taking the total differential of the utility function and using the first-order conditions for the employment-constrained case, i.e. equation (7), yields:

$$dU = [dC^t - w^t dL^t + R dC^{t+1} - R w^{t+1} dL^{t+1}] \alpha / C^t + \mu dL^{t+1}$$

The budget constraint allows us write this as:

$$dU = \sum_i [dK_i^{t+1} \{R F_{K_i}^{t+1} - 1 - b I_i\} + R dL_i^{t+1} \{F_{L_i}^{t+1} - w^{t+1}\}] \alpha / C^t + \sum_i (dL_i^{t+1}) u$$

Since the optimal levels of each instrument are calculated taking

their distortionary side-effects into account, the relative welfare effects of the various subsidies can be approximated by linearising and evaluating the welfare effects around the base level of utility, U_0 , as described by equations (2) and (7). For any policy instrument x this process yields:

$$(20) \quad x^* [dU/dx] = x^* \sum_i [dL_i^{t+1}/dx] \mu$$

which has the strongly intuitive interpretation that the relative welfare effect of a subsidy policy, in the presence of a labour market distortion, is measured by the employment effect of that subsidy, when set at its optimal level, times the shadow value of employment in the absence of intervention (which is of course the Lagrange multiplier on the employment constraint.)

Equation (20) reveals that when policies are ranked in terms of their impact on social welfare, the hierarchy is the same as that constructed earlier for employment effects.

5. Interpretation and Assessment of Results:

(a) Interpretation:

From the standard theory of optimal intervention it is clear why labour subsidies should prove welfare-enhancing in the context of classical unemployment. Since a production subsidy is equivalent to a subsidy to both factors, it is also not surprising that it may prove useful, though the fact that it subsidises investment appears at first glance to be a failing since the wage distortion does not affect the Pareto-efficiency condition concerning investment. What sense then can be made of the result that a pure investment subsidy, which breaks this

marginal condition, can also succeed in raising welfare?

The answer is found by relating the value of the optimal investment subsidy derived above to the shadow value of capital derived by Marglin (1967), Srinivasan and Bhagwati (1978) and others, for use in project evaluation in labour-surplus LDC's¹⁵. They show the shadow value to be the discounted average product of capital while the private return to investment is the discounted marginal product, the difference between the two arising because of the extra employment (at zero opportunity cost, as they assume) generated by an increase in the capital stock at unchanged wages. The shadow value in the present case is the discounted average product less the utility cost of forgone leisure per unit of capital: $R[F_{K_i}^{t+1} + e_i F_{L_i}^{t+1} - e_i B(1-\alpha)/R\theta(H-L^{t+1})]$; cf. equation (4). The optimal investment subsidy derived in the present paper is therefore revealed as that which bridges the gap between this shadow value and the marginal private return to investment.

(b) Sensitivity of results to the unemployment assumption:

In order to compare the various subsidy programmes, the assumption has been made that unemployment emerges only in the second period. To what extent do the results depend on this modelling strategy?

Under the alternative assumption that unemployment occurs only in the first period, investment grants would have no beneficial effects; firstly, on the supply-side, because of the time it

takes for new capital to come on stream, and, secondly, because in the non-Keynesian context of the present model the demand effects of higher investment spending would affect the balance of payments rather than employment. Labour and production subsidies would have the positive effects identified in the paper, with the former continuing to dominate the latter.

We could alternatively consider a proportionate jump in first and second period wages, with unemployment being generated in both periods. Production and employment subsidies can improve employment prospects in each period, while the optimal investment grant, as in the text, would raise second period employment and total consumption, with the latter leading, through the income effect, to a fall in period t's labour supply. First period employment could therefore be affected, if at all, only in a negative direction (if the reduction in labour supply were more than sufficient to wipe out the initial excess supply), so that the hierarchy of policies would be unchanged.

(c) Taking the cost of taxation into account:

(i) There are two explicit sources of taxation available in the present model: capital and labour. Although financial capital is perfectly mobile internationally, implying that intersectoral and international rates of return must be equalised, physical capital is tied down by adjustment costs, so that actual returns, and hence the implicit values of capital, can differ across sectors. Thus capital presents itself as a

potential tax base.

If the programmes are provided on the margin, then labour also serves as a potential tax base, with income taxes on all workers providing revenue for the subsidisation of new jobs. It is perhaps unrealistic to assume in this case that wage demands would be unaffected by the various subsidy programmes. However, in the absence of an explicit bargaining model, any particular variant of which would stamp its own peculiarities on the results, it can be argued that the employment effects identified here serve as a measure of the extent to which employees would be able to reap wage increases in a fuller model. In such a model, smaller employment effects would occur alongside wage gains, leaving the policy hierarchy unaffected¹⁶.

(ii) Another issue concerning taxation and the policy hierarchy has been raised recently by de Meza and Natale (1989). They argue that taking the associated tax costs into account is empirically likely to reverse, for labour-abundant less developed countries, the relative positions of labour and capital subsidies. Production already occurring in the LDC's, they argue, is likely to be more labour-intensive than the processes attracted to locate there by cost-competitiveness-enhancing subsidy policies; labour subsidies therefore offer more to infra-marginal producers than capital subsidies do, so that the former's deadweight costs are greater. For a range of realistic parameter values they find that these differences in deadweight costs overturn the hierarchy derived above.

The tax costs of the programmes discussed in the present paper can easily be computed, and it indeed transpires that the relative size of these costs is ambiguous at the theoretical level. However, the infra-marginal effects focused upon by de Meza and Natale would be excluded if subsidies were restricted to new jobs or new investment projects. It is in order to minimise these deadweight costs that the authors mentioned in the introduction have advocated marginal employment subsidies, while, as noted for example by Ruane (1982), capital subsidies offered by governments are frequently directed specifically towards new investment projects.

If the subsidies offered are of this marginal type, then the tax-cost effects reinforce the hierarchy derived in the present paper. Switching to a single-sector model, for ease of exposition only, the proof, from Barry (1989), is as follows: consider levels of g and m that generate equal increases in second-period employment. The cost of the investment subsidy is g times the amount of investment stimulated, which in turn is $1/e$ times the amount of employment created. The discounted tax-cost of the labour subsidy, on the other hand, is Rm times this amount of employment. Is $g/e > Rm$? By the assumption that the subsidies are set such that equal increases in employment are generated, we have, after linearising, $g = m(dL^{t+1}/dm)/(dL^{t+1}/dg)$, so the proof requires that $dL^{t+1}/dm > R e dL^{t+1}/dg$. Inspection of equations (11) and (12) reveals that this is so, and that marginal employment subsidies are therefore more tax-efficient than investment subsidies, except when substitution effects are completely

absent, in which case the policies are equally effective.

A focus on marginal subsidies therefore rescues from de Meza and Natale's critique Corden's (1974, p.48) speculation that since "policies at the top of the hierarchy are those which are directed precisely to the point of the divergence, relevant subsidies will then cost rather little, less than when the subsidies are less discriminating".

6. Alternative Social Welfare Functions

The aim of this section of the paper is to study whether these policy rankings survive the introduction of some common alternative specifications of the social welfare function. An aggregate production function will be used from this point onwards since there are no further insights to be gained from sectoral considerations.

(i) Merit-Want Status for Foreign Exchange

Assuming for simplicity that consumption is constant across periods (i.e. $B=R$), the first-period current account deficit, from equation (5) is:

$$(21) \quad -NX^t = (R/1+R)[Y^{t+1} - Y^t + I + bI^2/2]$$

When investment is stimulated, second-period income rises relative to current income, and the current account deficit is increased¹⁷. All policies under discussion therefore worsen the deficit in the short run. It can easily be verified, however, that there is no relationship between the hierarchy derived

earlier and the relative effects of each subsidy (when applied optimally) on the current account. Since these effects are frequently of concern to policy makers, the question arises as to how optimal instrument levels are affected, and whether or not the hierarchy is changed, by taking this concern into account.

Results can be derived easily and intuitively by attaching a negative welfare weighting to the size of the current account deficit, which amounts to the assignment of merit want status to earnings of foreign exchange, a procedure suggested by Dasgupta, Sen and Marglin (1972) as a means of taking into account the strings attached to foreign capital inflows. This requires adding the Lagrange term $\Omega[F(K^{t+1}, L^{t+1}) - F(K^t, L^t) + I + bI^2/2]$ to the maximand in equation (3).

The optimal values of the various subsidies in this case - m' , g' , and s' - are given by:

$$(R\alpha/C^{t+1})(dL^{t+1}/dm)m' = (R\alpha/C^{t+1})(dL^{t+1}/dm)m^* \\ - \Omega[(p-1)F_L^{t+1}(dL^{t+1}/dm) - (1+R-p)F_K^{t+1}(dK^{t+1}/dm)]/J$$

$$(\Theta - \Omega/J)(dK^{t+1}/dg)g' = (R\alpha/C^{t+1})(dL^{t+1}/dg)m^* \\ - \Omega[(p-1)F_L^{t+1}(dL^{t+1}/dg) - (1+R-p)F_K^{t+1}(dK^{t+1}/dg)]/J$$

$$[(R\alpha/C^{t+1})F_L^{t+1}(dL^{t+1}/ds) + \Theta RF_K^{t+1}(dK^{t+1}/ds) - \Omega RF_K^{t+1}(dK^{t+1}/ds)/J]s' \\ = (R\alpha/C^{t+1})(dL^{t+1}/ds)m^* \\ - \Omega[(p-1)F_L^{t+1}(dL^{t+1}/ds) - (1+R-p)F_K^{t+1}(dK^{t+1}/ds)]/J$$

where $J = 1 - p/(1+R) > 0$,

and $p = F_{L^t} (1-\alpha)\alpha(H-L^t)/[(F_{L^t}\alpha^2(H-L^t) - \alpha(1-\alpha)C^t] < 0$

The effect of taking the balance of payments into account is to change the tradeoff between investment and employment, with the former now becoming less desirable because of its impact on the current account.

This has several important implications. Firstly, the optimal size of each subsidy is inversely related to the weight attached to foreign exchange in the social welfare function, as can be verified from the above equations. Secondly, the comparative advantage of instruments which stimulate employment whilst economising on investment is raised. Since this was the basis upon which the original hierarchy was constructed, the policy hierarchy is therefore unaffected. In this case, moreover, the optimal employment subsidy generates an increase in investment greater than that associated with the optimal investment subsidy, because of the change in the trade-off, and output is raised more than under the optimal production subsidy.

(ii) Full Employment as a Non-Economic Target

Employment heretofore has been treated not as a goal in itself but merely as a means to the objective of consumption. Now consider how the analysis is affected when full employment is adopted as a (distributive) goal to which consumption is subservient.¹⁸

Let x^{**} denote the level of subsidy x that yields full employment. These levels are found by imposing the full-employment condition $x^{**}dL/dx = m^*dL/dm$ to give:

$$\begin{aligned}
 m^{**} &= m^* \\
 (22) \quad g^{**} &= (Re + b\sigma K/\delta w)m^* \\
 s^{**} &= (Re^2\delta w + b\sigma L)m^*/(\delta ReY/K + b\sigma L)w
 \end{aligned}$$

Alternatively, the optimal levels of each policy instrument may be found by maximising (3) subject to the relevant private-sector behaviour and the full employment condition above. Equating the results of these two procedures yields explicit values for the Lagrange multiplier on the full employment constraint; these values in turn measure the price the economy must pay in the case of each policy instrument (in terms of the welfare lost through forgone leisure and consumption) for adopting full employment as a non-economic target.

For the case of employment subsidies this cost is zero (since full employment is the economic target in this case). For production subsidies the cost is:

$$(\alpha/C^t)m^* b\sigma F_K^2 R^2 L \delta / w [eRY\delta/K + b\sigma L]^2$$

and for investment subsidies:

$$(\alpha/C^t)m^* b\sigma K/\delta w e$$

It is easily seen that the cost of using investment subsidies to achieve full employment is greater than that associated with production subsidies, while there is no extra cost to using employment subsidies to achieve this end. It can therefore be

concluded that the difference between the welfare effects of any two policies in the hierarchy is magnified when full employment is the target of economic policy.

7. Concluding Comments

Labour subsidies have been shown in this paper to dominate investment subsidies as an instrument to tackle classical unemployment, while production subsidies occupy an intermediate position between the two. When the effects on the balance of payments are taken into account by policymakers, not only is the order of policies in the hierarchy unaffected but the relative benefits of choosing a policy higher up in the hierarchy increase. The reason is that the ranking of a policy depends negatively on the investment and thus foregone consumption that it requires per job created; since increased investment, *ceteris paribus*, causes a deterioration in the current account, it becomes even more important to adopt policy instruments that economise on the use of capital.

These conclusions also apply to the case where full employment is adopted as the target of government policy. The welfare ranking of a policy instrument was shown in the text to depend on the employment resulting when that subsidy is set at a level such that the discounted consumption and leisure stream is maximised. When full employment is to be achieved, each subsidy, except the first-best, must be expanded beyond its heretofore optimal level; the lower the ranking of the subsidy policy the

more that subsidy must be increased, so that the resource cost of achieving full employment is magnified as one moves down the policy hierarchy. This point is of significance because it shows that the terms of the trade-off between relative disbursement costs and relative resource costs that must be taken into account in choosing a policy instrument depend on the objective to be achieved and the importance attached to various endogenous effects of policies.

The use of firm or sector-specific subsidies as an alternative to policies applied uniformly across the economy has also been studied, and it has been shown that while a uniform employment subsidy is optimal, sector-specific investment or production subsidies which relate the size of the subsidy to the labour-intensity of the sector are preferable to their uniformly-applied counterparts. In practice, however, sector or firm-specificity may introduce a discretionary element into the granting of subsidies and thereby induce wasteful rent-seeking behaviour. This consideration lowers the position of all sector-specific subsidies in the hierarchy relative to those applied across the board.

To conclude, some mention should be made of the practical difficulties involved in attempting to distinguish between types of unemployment. A large part of what is frequently thought of as classical unemployment, for example, actually occurs not through increases in labour costs relative to productivity per se, but relative rather to productivity adjusted for terms of

trade changes [see e.g. Bruno and Sachs (1985)]. To the extent that these changes result from shifts in comparative advantage, a discussion of optimal policies must take account of the determinants of dynamic comparative advantage. While this issue lies at the heart of the "new approach" to international trade theory, that literature has had little to say as yet about unemployment.

REFERENCES

- Ahluwalia, M.S. (1973) "Taxes, Subsidies and Employment", Quarterly Journal of Economics, vol. 87; 393-409.
- Bailey, R. E. and W. M. Scarth (1980) "Adjustment Costs and Aggregate Demand Theory", Economica, 47, 423-431.
- Barry, F.G. (1989): "Payroll Taxes, Capital Grants and Irish Unemployment", Economic and Social Review, 21, 107-121.
- Barry, F., and J.P. Neary (1991) "Adjustment Costs, International Capital Mobility and Patterns of Specialization in the Open Economy", Centre for Economic Research Working Paper, University College Dublin, (forthcoming).
- Bean, C., P.R.G. Layard and S. Nickell (1986) "The Rise in Unemployment: A Multi-Country Study", Economica, (Supplement).
- Bhagwati, J.N. and T.N. Srinivasan (1969) "Optimal Intervention to achieve non-economic Objectives", Review of Economic Studies, Vol. 36, 27-38.
- Blanchard, O., R. Dornbusch, and R. Layard, eds. (1986) Restoring Europe's Prosperity: Macroeconomic Papers from the Centre for European Policy Studies, Cambridge, Mass.: MIT Press.
- Borts, G. H. (1966) "Criteria for the Evaluation of Regional Development Programs", in W. Z. Hirsch (ed.): Regional Accounts for Policy Decisions, Baltimore.
- Bruno, M. and J. Sachs (1985) Macroeconomics of Worldwide Stagflation, Cambridge, Mass.: Harvard University Press.
- Coen, R.M., and B.G. Hickman (1988) "Is European Unemployment Classical or Keynesian?", American Economic Review, Papers and Proceedings, pp. 188-193.
- Corden, W. M. (1974) Trade Policy and Economic Welfare, Oxford University Press
- Cuddington, J., and J. Vinals (1986) "Budget Deficits and the Current Account in the Presence of Classical Unemployment", Economic Journal, 96, 101-119.
- De Meza, D., and P. Natale (1989) "Efficient Job Creation in LDC's Requires a Tax on Employment", Economic Journal, 99, 1112-1122.
- Dasgupta, P., A. Sen and S. Marglin (1972), Guidelines for Project Evaluation, U.N.I.D.O, Vienna.
- Gould, J.P. (1968) "Adjustment Costs in the Theory of Investment of the Firm", Review of Economic Studies, 35, 47-56.

- Ford, R., and W. Suyker (1990) "Industrial Subsidies in the OECD Economies", Working Paper no. 74, OECD Department of Economics and Statistics.
- Johnson, G.E., and P.R.G. Layard (1986) "The Natural Rate of Unemployment: Explanation and Policy", Chpt. 16 in O. Ashenfelter and P.R.G. Layard (eds.) Handbook of Labor Economics, Amsterdam: North-Holland.
- Layard, R.R.G. and S.J. Nickell (1980) "The Case for Subsidising Extra Jobs", Economic Journal, 90, 51-73.
- Marglin, S.A. (1967) "The Rate of Interest and The Value of Capital with Unlimited Supplies of Labor", in Essays on the Theory of Optimal Economic Growth (ed. K. Shell), MIT Press, Cambridge.
- Neary, J.P. (1978) "Capital Subsidies and Employment in an Open Economy", Oxford Economic Papers, 30, 334-356.
- Nickell, S. (1990) "Unemployment: A Survey", Economic Journal, 100, 391-439.
- Persson, T., and L. Svensson (1985) "Current Account Dynamics and the Terms of Trade: Harberger-Laursen-Metzler two generations later", Journal of Political Economy, 93, 43-65.
- Razin, A. (1984) "Capital Movements, Intersectoral Resources Shifts and the Trade Balance", European Economic Review, 26, 135-152.
- Ruane, F.P. (1982) "Corporate Income Tax, Investment Grants and the Cost of Capital," Journal of Public Economics, 17, 103-109.
- Srinivasan, T.N. and J. N. Bhagwati (1978) "Shadow Prices for Project Selection in the Presence of Distortions: Effective Rates of Protection and Domestic Resource Costs", Journal of Political Economy, 86, 97-116.

1. See Bruno and Sachs (1985), Bean, Layard and Nickell (1986), Coen and Hickman (1988) and Nickell's (1990) survey, for example.

2. Whatever the reasons may be, it is clear that incentives directed towards production and investment are quite widespread, with employment-creation frequently in mind. Ford and Suyker (1990) provide a recent survey of the schemes in operation in OECD economies.

3. Razin (1984) includes an infinite-horizon extension of a two-period model similar to the one presented here to illustrate that the methods yield similar results.

4. The small open economy assumption is made for ease of exposition. With output determined at the point of intersection of the marginal cost curve and the flat marginal revenue curve assumed here (the SOE assumption), the various programmes discussed operate through their impact on marginal costs. If the marginal revenue curve were instead downward sloping, the pricing decision would become endogenous, but the conclusions would continue to depend on the differential impact of the policies on marginal costs, and so would not be affected.

5. The precise form of the adjustment cost term, which could represent factory floor disruption for example, is as in Gould (1968). See also Bailey and Scarth (1980).

6. See Persson and Svensson (1985, appendix), for example.

7. As the paper is concerned with real wage rigidity (and no nominal rigidities are assumed), it is irrelevant for the issues at hand whether exchange rates are fixed or flexible; a change in the exchange rate would induce equiproportionate changes in all nominal variables.

8. These derivations make use of the second-order Euler relations and the simple form taken by the elasticity of substitution in the constant returns case.

9. The unit cost curve analysis will show that the wage shock causes returns to capital to differ across sectors. This is consistent with equalised rates of return however, as the implicit values of installed capital also differ, leading to differential levels of sectoral investment. On this, see Bailey and Scarth (1980) and Barry and Neary (1991).

10. Alternatively the government could offer marginal subsidies for employment, investment or production above the benchmark levels. These would induce the same response as the programmes modelled while reducing deadweight costs. For this reason most advocates favour subsidies applied on the margin.

11. Under alternative assumptions concerning the production and investment processes a capital grant could induce substitution against labour. This would strengthen the case being made in this paper.

12. The aggregate employment effect of sector-specific capital grants is $Rm^* \sum E_i^2/b$ while that for uniform subsidies is $Rm^* \sum E_i L/Kb$. Unless all sectors have the same capital-labour ratio, $\sum E_i^2 > \sum E_i L/K$, which proves the assertion in the text.

13. From (12), (13), (16) and (19) this is seen to require that
$$\sum_i [(RY_{ie_i}/bK_i) + (g_i L_i/\delta_i)] \sum_i [(RY_{ie_i}/bK_i) + (\sigma_i L_i/\delta_i)] > \sum_i [(RY_{ie_i}^2/bK_i^2) + (w\sigma_i L_i/\delta_i)] \sum_i [\sigma_i/b] R_{e_i}$$
 This is easily proved since $\sum_i [(RY_{ie_i}/bK_i) + (\sigma_i L_i/\delta_i)] \sum_i [(RY_{ie_i}/bK_i)]$ is itself greater than the whole term on the right-hand side.

14. We have seen that there is no need for sector-specific employment subsidies.

15. It is in precisely such less developed economies that the administrative difficulty of subsidising employment may make it necessary to consider the use of other policy instruments.

16. This assertion can be checked by replacing the rigid real wage faced by employers by a simple Phillips curve relation, $w^{t+1} = w^{t+1}(L^{t+1})$, where the wage function has a positive first derivative. See also Johnson and Layard (1986) for a demonstration, within a broad class of wage determination models, of how marginal employment subsidies can yield positive employment effects while financed by labour taxation.

17. The policies under discussion actually reduce current income, through their effects on labour supply. When subsidies are set at their optimal levels consumption in each period rises, reducing labour supply through the consequent income effect, as seen from equation (8).

18. See Dasgupta, Sen and Marglin (1972, esp. Chapter 8) for a discussion of the social cost of labour, and of employment as an economic versus non-economic objective.