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PUBLIC GOODS AND OPTIMAL TAX POLICIES IN LDCs

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A b s t r a c t

We build a general equilibrium model of a small open economy characterized by unemployment, and producing two private traded goods and one non-traded public consumption good. The provision of public good is financed with tariffs, or income taxes or (and) consumption taxes. Within this framework, the paper examines the effects of such policies on the country's unemployment ratio and welfare. It derives the efficiency rules for public good provision and the optimal rate for each policy instrument. It shows, among other things, that the private marginal cost of the public good always overstate its social marginal cost in the case of income taxes, and may overstate it in the case of a consumption tax or a tariff even if the taxed good and the public good are substitutes in consumption.

Key words: Unemployment**,** taxes, efficiency rules for public goods,

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Public Goods and Optimal Tax Policies in LDCs

1. Introduction

Traditionally, an analytically convenient and widely used assumption in the international trade and development economics literature has been that of lump-sum distribution of direct (*e.g.*, income) or indirect (*e.g.*, consumption, tariff) tax revenue when various policy implications of such instruments (*e.g.*, terms of trade or welfare effects) were to be examined. This analytical shortcut, however, hardly ever constitutes a real world practice either in rich developed or in poorer developing economies.

On the other hand, another extensive branch of economics, the public finance literature, has adopted a more realistic approach regarding the economic activity of a government. A government is viewed, among other things, as a provider of public (collective) consumption goods and/or of public inputs that enhance the productive capacity of the private sector. Being so, it can use revenues from non-distrtionary (*e.g.*, lump-sum) taxes or distortionary (*e.g.*, consumption) taxes to finance the provision of such goods and services. Within this public finance context, a long standing proposition states that when non-distortionary taxes are used to finance the provision of a public good, the, first-best, efficiency rule requires that the sum of the marginal rates of substitution (*i.e.*, the social marginal benefit) must equal the marginal rate of transformation (*i.e.*, the social, marginal cost) (*e.g.*, see Samuelson 1954). On the other hand, the first-best efficiency rule for the provision of a public input requires that its marginal revenue product (*i.e.*, the sum of the marginal benefits to private productions) equals its marginal cost. [1] When distortionary taxes are used to finance the provision of the public good, Pigou (1947) argued that the social marginal cost exceeds the private marginal cost because of the induced indirect cost from raising tax revenue through distortionary taxation. Stiglitz and Dasgupta (1971) Atkinson and Stern (1974), and Wildasin (1984), among others, demonstrate that in certain cases (e,g,., when the taxed and the public good are complements in

[1] Manning *et al* (1985) show that in a competitive economy with fixed factor supplies when Lindhal pricing cannot be applied to public inputs (i.e., firms paying in proportion to the marginal benefit of this good to their profits), then a proportional income tax on factor incomes is non-distortionary and reproduces the first-best efficiency rule for the provision of the public input.

consumption) Pigou`s argument fails to hold and the social cost may fall short of the private marginal cost.[2]

Because of its more realistic appeal, this public finance approach to the use of tax revenue has been subsequently adopted by the relevant international trade and development economics literature. Recently, the efficiency rule for public good provision has been examined in the context of a small open economy by, among others, Feehan (1988) when tariff revenue finances the provision of the public good, in an economy producing two traded goods and a non-traded public consumption good. Feehan (1992) and Matsumoto (1996) consider the use of tariff revenue to finance the provision of a public input, in an economy producing two private traded goods and a non-traded public input. Michael and Hatzipanayotou (1995) examine this issue and derive the formulae for the optimal tax rates on traded or non-traded goods in an economy producing also many traded and non-traded goods, and where consumption tax revenue finances the provision of the public good. Michael and Hatzipanayotou (1997) demonstrate the failure of the first-best efficiency rule when lump-sum taxes are used to finance the provision of a public good in a small open economy, in the presence of trade restrictions (*i.e.*, a tariff or a VER). Finally, Feehan (1998) derives the first-best and second-best efficiency rules for the provision of a Hicksian public input, alternatively financed through lump-sum, consumption or production tax revenue, or through tariff revenue. His analysis elegantly decomposes the beneficial impact of this Hicksian public input on private productions, and its marginal social cost under the alternative financing schemes.

Two features in the above reviewed studies of the international trade/development economics, and public finance literature, motivate the present paper. First, all these studies derive the efficiency rule for public good provision in the context of a small open or closed economy with full employment. Unemployment, however, to a lesser or to a larger extent, remains a structural feature of many developed or developing economies. From an analytical standpoint, the existence of such a distortion may alter both the optimal tax formulae, and the efficiency rule for public good provision. Second, the above reviewed literature considers the case where a government uses a single policy instrument (*e.g.*, lump-sum taxes, or consumption

[2] Michael and Hatzipanayotou (1995) for the case of a consumption tax and Michael (1997) for the case of an import tariff, show that the social cost of the public good may understate its private marginal cost when the public good and the taxed good are general equilibrium complements.

taxes, or tariffs) to finance the provision of the public good. More than often, however, governments may have at their disposal several tax instruments that they can simultaneously use in order to raise revenue for financing the provision of public consumption goods or inputs.

Capitalizing on these two realizations, the present paper constructs a general equilibrium trade model of a small open, developing, economy characterized by Harris-Todaro type of unemployment, and producing two private traded --an exported and an imported-- goods, and a non-traded public consumption good. We assume that in order to finance the provision of a public good, the government raises tax revenue through the imposition of (i) separately an income tax, a consumption tax, or an import tariff, and (ii) jointly an income and consumption tax. Within this context, we examine the effects of each policy scheme on welfare**.** We derive the optimal policy rate for each case and state the sufficient, but not necessary, conditions, under which the welfare-maximizing instrument can be explicitly determined. Finally, we derive the efficiency rule for public good provision under each policy. We show that in the presence of unemployment when income tax or lump-sum tax revenue is used to finance the provision of the public good the private marginal cost always overstates its social marginal cost. When consumption taxes or tariffs are used the private marginal cost of public good provision may overstate its social marginal cost even if the taxed and public goods are substitutes.

2. The Model

In this section we develop a two sector --an urban and a rural-- general equilibrium trade model of a small developing economy with identical consumers characterized by (HT) unemployment. In the urban sector two goods are produced, an import competing manufacturing good (M), and a non-tradable, public consumption good (g). An exported agricultural good (A) is produced in the rural sector, which is also chosen as the *numeraire* commodity. The exported good (A) is freely traded, while a tariff may be imposed on the imports of the manufactured good (M)**.** All commodity markets are assumed competitive and both goods are assumed normal in consumption**.** Taxes on income from production of all goods at a rate (r), on consumption at a rate (t), and on imports at a rate (t) are levied by the government to finance the provision of the public good.

2.1 *The Structure of Production*

Labor is the intersectorally mobile factor, capital (K) is sector-specific in the production of the manufacturing good (M), and land (E) is sector-specific in the production of the agricultural good (A). Production technologies of the two private goods exhibit constant returns to scale with positive and diminishing marginal products of factors, and positive cross-partials. The production functions of the two private goods are gives by:

$$M = M(L^M, \overline{K}) \text{, and} \tag{1}$$

$$A = A(L^A, \overline{E}) \text{,} \tag{2}$$

where L^i, i=*M*, *A* denotes, respectively, the amounts of labor employed in the production of the two private traded goods, $\overline{K}$ and $\overline{E}$, respectively, are the fixed endowments of the sector specific capital and land.

For simplicity we assume that labor is the only factor in the production of the public good, and that the labor input per unit of output is one. Thus,

$$g = L^g \text{,} \tag{3}$$

is the amount of the public good produced, and L^g is the amount of labor used in its production.[3]

We define $R(q, l, \overline{K}, \overline{E})$ to be the gross national product (GNP) function, representing the maximum attainable revenue from production of the private and public goods, given: (i) the producer domestic relative price for (M) $q(= p^*)$ in the case of only income or consumption taxation, and $q(= p^* + t)$ in the case of an import tariff, where p^* is the constant world price for the manufacturing, (ii) the urban unemployment ratio $l(= L^u / (L^M + L^g))$, where L^u is the number of urban unemployed workers, and (iii) the endowments of the sector specific capital ($\overline{K}$) and

[3] In part, the results depend on the assumed linear production function for the public good. For expositional purposes, however, we think that this approach is reasonable.

land ($\overline{E}$).[4] For the rest of the analysis $\overline{K}$ and $\overline{E}$ are omitted from the GNP function since they do not affect the results of the paper**.** The variable $l\,(= l\,(r\,,t\,,t)$**,** see the Appendix for derivations) enters as an argument into the GNP function to capture the loss to the economy due to unemployment, measured by the shadow wage of labor (*e.g.,* see Beladi and Chao, 1993). Since $l\,(= L^u\,/\,(L^M + L^g))$, the loss to the economy due to a one-unit increase in l is $R_l = -w^A(L^M + L^g)$. The partial derivative of the GNP function with respect to $q(i.e., R_q(q, l))$ is the supply function of the manufacturing good. Because $l = l\,(r\,,t\,,t)$ and p^* is assumed constant, the supply function for the manufacturing good can be written as $R_q(q(t), l\,(t)) = \widetilde{R}_q(q(t))$ for the case where only import tariff is used.[5] The $R(q, l)$ function is assumed to be strictly convex in $q(i.e., \widetilde{R}_{qq} > 0)$. For the rest of the analysis, subscripts denote partial derivatives.

2.2 The Wage-setting and Labor Market Equilibrium

According to the (HT) paradigm, the rural wage (w^A) is competitively determined ensuring full employment in that sector. In the urban sector, the existence of an institutionally fixed minimum wage ($\overline{w}$) above the market clearing level results in sectoral unemployment.[6] Assuming that each worker has the same chance of been hired, the probability of finding urban employment equals the ratio of employed labor $(i.e., L^m = L^M + L^g)$ to the labor force in that sector $(i.e., L^m + L^u)$. Then, the expected urban wage (w^e) equals the minimum wage ($\overline{w}$) multiplied by the probability of finding employment (*i.e.,* $L^m\,/\,(L^m + L^u)$).

Inter-sectoral labor migration, which is the factor connecting the rural-urban areas, ensures the equalization of expected wages in the two sectors, and labor market equilibrium. That is,

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[4] It can be shown that the comparative static's analysis using $R(q, l\,, \overline{K}, \overline{E})$ as the GNP function, are the same as those using a more conventional writing, *e.g.,* $R(q, L^M, L^g, L^A, \overline{K}, \overline{E})$.

[5] Note that in the case of a consumption tax $\widetilde{R}_{qt} = (\partial M\,/\,\partial L^M)(\partial L^M\,/\,\partial t) = 0$. Similarly in the case of an income tax $\widetilde{R}_{qr} = 0$ (see the Appendix).

[6] Alternatively, the urban wage rate can be indexed in terms of consumer prices. The essence of the results, however, remains the same.

$$w^A = w^e = [L^m / (L^m + L^u)]\overline{w} . \qquad (4)$$

Using the definition of the urban unemployment ratio $l\,(= L^u / L^m)$, the labor market equilibrium condition in (4) can be rewritten as:

$$\overline{w} = (1 + l)w^A . \qquad (5)$$

Labor is assumed homogeneous, and because perfect competition exists in product markets, it is paid the value of its marginal product in each sector. That is:

$$\overline{w} = qM_L(L^M, \overline{K}), \quad \text{and} \quad w^A = A_L(L^A, \overline{E}), \qquad (6)$$

where $M_L(= \partial M / \partial L^M)$ and $A_L(= \partial A / \partial L^A)$, respectively are the sectoral marginal products of labor. Since labor is free to move throughout the economy, the fixed labor endowment ($\overline{L}$) must equal the sum of employment in the urban sector (manufacturing employment plus employment in the production of the public good) and agriculture plus the number of urban unemployed. Using the definition of l, the economy's labor endowment constraint can be written as:

$$(1 + l)L^m + L^A = \overline{L} . \qquad (7)$$

2.3 Demand Conditions, and the Government

We assume identical consumers whose utility depends positively on the consumption of the two traded goods (*i.e.*, M and A), and the public consumption good (g). Demand conditions are described by the expenditure function $E(p, g, u)$ denoting the minimum private spending on consumption required to achieve a level of utility u, given the consumer domestic relative price of the manufacturing good $p(= p^* + t + t)$, and the level of public good provision (g). The partial derivative of the expenditure function with respect to $p(i.e., E_p)$ denotes the compensated demand function of the manufacturing good, which is assumed strictly concave in p (*i.e.*, $E_{pp} < 0$). Moreover, E_g is negative denoting that an increase in the consumption of the public good reduces expenditure on the private goods required to achieve the level of utility u. In the public economics literature (*i.e.,* King 1986), $-E_g$ is called the *consumer's marginal willingness to pay for the public good*.

It is assumed, as noted earlier, that the government collects revenue from (i) taxes on income from the production of the private and public consumption goods, (ii) taxes on consumption, and (iii) tariffs. These tax revenues are used to finance the cost of providing the public good. The government net tax revenue *(i.e., B*) is written as follows:

$$B = rR(q,l) + tE_p(p,g,u) + t\tilde{Z}_p(p,g,u) - \overline{w}\ L^g, \qquad (8)$$

where $rR(q,l)$ is the income tax revenue, $tE_p(p,g,u)$ is the consumption tax revenue, $t\tilde{Z}_p(p,g,u)$ is the tariff revenue, $\tilde{Z}_p = E_p - \tilde{R}_p$, and $\overline{w}\ L^g$ is the cost of the public good. For the case where the government collects only tariff revenue to finance the provision of the public good we have $p = q(= p^* + t)$. We assume that the government maintains a balanced budget, so that B=0.

Totally differentiating equation (8), recalling the properties of the GNP function, and rearranging terms we obtain:

$$dB = (t+t)E_{pu}du - (\overline{w} - tE_{pg} - tE_{pg})dL^g - rw^A L^m dl + [E_p + (t+t)E_{pp}]dt$$
$$+ (\tilde{Z}_p + t\tilde{Z}_{pp} + r\tilde{R}_q + tE_{pp})dt + Rdr, \qquad (9)$$

where $\tilde{Z}_{pp}(= E_{pp} - \tilde{R}_{pp})$, by the properties of the expenditure and GNP functions, is strictly concave in p.

Equation (9) reveals that government net tax revenue, *ceteris paribus*, increases with a decrease in the unemployment ratio $(i.e., (\P B / \P l) = -rw^A L^m < 0)$, and an increase in the income tax rate $(i.e., (\P B / \P r) = R > 0)$. Either with a consumption tax or a tariff, changes in L^g, *i.e.,* in *g*, have an ambiguous effect on B, depending on whether the manufacturing and public goods are complements $(i.e., E_{pg} > 0)$ or substitutes $(i.e., E_{pg} < 0)$ in consumption. If $E_{pg} < 0$, then

$(\P B/\P L_g) < 0$, while if $E_{pg} > 0$ then $(\P B/\P L_g)$ may be positive or negative.[7] A small consumption tax, assuming no use of other policy instrument, on the manufacturing good increases government net tax revenue, while a larger one may decrease it.

For the case of the tariff equation (9) gives that $(\P B/\P t) = (\tilde{Z}_p + t\tilde{Z}_{pp})$. Thus a small tariff, assuming no use of other policy instrument, increases government net tax revenue while a larger one may decrease it.[8]

2.4 Some Benchmark Results

The country's income-expenditure identity (budget constraint) requires that total private spending must equal net, after tax, income from production of all goods. That is:

$$E(p, g, u) = (1 - r)R(q, l)\ . \tag{10}$$

A partial welfare analysis can be conducted after total differentiation of equation (10). That is:

$$du = [-E_p - E_g L_t^g + (1-r)R_l\, l_t]dt + [-\overline{Z}_p - E_g L_t^g + (1-r)R_l\, l_t]dt$$
$$+ [-R - E_g L_r^g + (1-r)R_l\, l_r]dr\ , \tag{11}$$

where $E_u = 1$ by choice of units, $\overline{Z}_p = \tilde{Z}_p + rR_p > 0$, L_i^g and l_i, $i = r, t$, t are the total differentials of L^g and l with respect to the policy parameters r, t and t (see the Appendix for the detailed derivations). Equation (11) indicates that changes in any of the three policy instruments affect welfare directly, and indirectly through changes in the level of public good provision (*i.e.*, $L^g = g$), which we call the *public-good-effect*, and through changes in the unemployment ratio (*i.e.*, l), which we call the *employment-effect*.

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[7] Assuming that $E_{pg} = 0$, *i.e.*, assuming that the private and public goods are separable in consumption, then unambiguously $(\partial B/\partial L^g) = -\overline{w} < 0$.

[8] It does not add much to the results of the paper to consider the other taxes as non-zero constants.

Observing equations (A.3) to (A.5) the following proposition can summarize straightforwardly the policy effects on public good provision (*i.e.*, $g = L^g$).

Proposition 1: *Assume a small open economy characterized by HT type of unemployment, and by local provision of a public consumption good. Then, a small income or consumption tax, or a small tariff unambiguously raises the provision of the public good. But, a higher rate of any tax instrument may decrease it.*[9]

Observing equations (A.6) to (A.8) the following proposition can summarize the policy effects on the unemployment ratio:

Proposition 2*: Assume that in a small open economy characterized by HT type of unemployment, the government provided public good is financed through income taxes, or consumption taxes or tariffs. An increase in the income tax rate always increases government net tax revenue and reduces the unemployment ratio. Similar effects are induced by a small consumption tax or a small tariff, while a larger rate of either instrument may reduce the government net tax revenue and increase the unemployment ratio.*

3. Income Tax Policy and Welfare

Now we assume that the government's policy instrument is a tax on incomes from production of the private and public consumption goods, and that it uses revenue to finance the provision of the public good.

Setting $dt = t = dt = 0$, but t>0 in equation (11), and using equations (A.3) and (A.6) of the Appendix, after some algebraic manipulations, we obtain:

$$(\Delta R^{-1})(du/dr) = d_2(\overline{w} + E_g) + d_1 R_l - td_2\, E_{pg} \tag{12}$$

When $t = 0$, equation (12) indicates that a higher income tax affects welfare through an induced (i) *public-good-effect* (*i.e.*, $\Delta^{-1} R d_2(\overline{w} + E_g)$), and (ii)

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[9] The result that for a small $(t), (dL^g / dt) > 0$, holds regardless of whether initially $r \geq 0$ (see equation (A.5)).

employment-effect (*i.e.,* $\Delta^{-1}Rd_1R_l$).[10] Through the *public-good-effect*, the higher r, which raises government net tax revenue and public good provision, affects welfare positively if the public good is under-supplied, and negatively, in the unlikely case where, it is over-supplied.[11] Through the *employment-effect*, the higher r exerts a positive effect on welfare since by increasing the public good provision, (*i.e.,* L^g), it reduces the unemployment ratio (see equations (A.3) and (A.6)), and thus it increases income. Thus, the higher income tax rate improves welfare if the public good is under-supplied, and it reduces it, in the unlikely case, when it is over-supplied and $\left|d_2(\overline{w}+E_g)\right| > \left|d_1R_l\right|$. When $\overline{w}=E_g$, then a higher income tax rate unambiguously improves welfare through a reduction in the unemployment ratio.

In the presence of a consumption tax, an increase in the income tax has an additional effect on welfare through its effect on consumption tax revenue. That is, through this effect, an increase in the income tax, increases revenue, the public good provision increases causing consumption tax revenue to increase (decrease) if the public good and the taxed good are complements (substitutes) in consumption. The increase (decrease) in consumption taxes revenue affects positively (negatively) welfare.

Setting $(du/dr)=0$ in equation (12), reveals that the optimal income tax rate (r^*) cannot be explicitly determined, but only implicitly since r is included in $g(=L^g)$, $E_g(p,g,u)$, $R_l(=-w^A(L^M+L^g))$ etc**.**

4. Consumption Tax Policy and Welfare

We examine the welfare effects of a consumption tax $(i.e., dt>0)$ and its optimal rate, when revenue is used by the government to finance the provision of the public good.

Letting in equation (11) $r>0$ and $dr=t=dt=0$, and using equations (A.4) and (A.7) of the Appendix, after some algebraic manipulations, we obtain:

$$\Delta(du/dt)=d_2(\overline{w}+E_g)E_p+d_1R_lE_p-t[d_2(E_pE_{pp}^{-1}E_{pg}-E_g)-d_1(1-r)R_l]E_{pp}. \quad (13)$$

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[10] Identical results emerge when $t=0$ and lump-sum taxes are used to finance the provision of the public good**.**

Equation (13) indicates that a higher consumption tax affects welfare through (i) the direct effect of changes in the level of public good provision (*i.e.*, $d_2(\overline{w}+E_g)E_p$), which we call the *public-good-effect*, (ii) changes in income due to changes in the unemployment ratio (*i.e.*, $d_1 R_l E_p = -d_1 w^A L^m E_p$), which we call the *employment-effect* and (iii) changes in government net tax revenue, due to changes in consumer prices, the level of public good provision, and the unemployment ratio (*i.e.*, -$t[d_2(E_p E_{pp}^{-1} E_{pg} - E_g) - d_1(1-r)R_l]E_{pp}$), which we call the *tax-revenue-effect*.

Through the *public-good-effect*, the impact of the higher t on welfare, by and large follows that of the previous case of the income tax. Through the *employment-effect*, the higher t, which raises government revenue, affects positively L^g, reduces l (see equations (A.4) and (A.7)) and increases incomes, thus exerting a positive impact on welfare. When consumption taxes are the only source of financing the provision of the public good, and the consumption tax rate is small (*i.e.*, $t \approx 0$), it is expected that the public good is under-supplied (*i.e.*, $-E_g > \overline{w}$). In this case, an increase in t raises welfare through the induced *public-good-effect* and *employment-effect*. For a larger tax (*i.e.*, $t > 0$) a further increase in its rate may exert, through the *tax-revenue-effect*, a positive or negative impact on welfare, in part, depending on whether the manufacturing and public consumption goods are substitutes (complements) in consumption ($i.e., E_{pg} < 0 (> 0)$). For example, if $E_{pg} < 0$, then this revenue effect of a higher t on welfare is negative. In this case, if also t is large, then a further increase in the consumption tax reduces welfare if the *tax-revenue-effect* dominates the *public-good-effect and employment-effect*. If t is small it is expected that the latter two effects dominate the *tax-revenue-effect*, thus, a higher consumption tax is expected to improve welfare.

Setting $(du/dt) = 0$ in equation (13), and solving for t, we obtain the optimal consumption tax rate ($i.e., t^*$) to be:

$$t^* = [(\overline{w}+E_g)d_2 + d_1 R_l]E_p / [d_2(E_p E_{pp}^{-1} E_{pg} - E_g) - d_1(1-r)R_l]E_{pp}. \qquad (14)$$

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[11] In the following analysis when $-E_g >(<)\ \overline{w}$ we say that the public good is under-supplied (over-

Equation (14) can be used to assess the optimal consumption tax policy in several different cases emerging within the present context of unemployment and public good provision. When consumption taxes are used to finance the provision of the public good, the sufficient condition for the government's optimal policy to be a consumption tax is that the public good is under-supplied ($i.e., (\overline{w} + E_g) < 0$), regardless of whether a given income tax rate exists (*i.e.*, $r \geq 0$). If, however, $r > 0$, then the corresponding optimal consumption tax rate is greater to that when $r = 0$, assuming everything else is the same. In the unlikely case that the public good is provided at its first optimal level ($i.e., (\overline{w} + E_g) = 0$), then again the optimal policy is $t^* > 0$. Assuming that the three cases noted above are evaluated at the same initial conditions, we get:

$$t^*\big|_{r>0} > t^*\big|_{r=0} > t^*\big|_{(\overline{w}=-E_g)} > 0 . \tag{15}$$

Lastly, if $(\overline{w} + E_g) < 0$, then the optimal policy is $t^* > 0$ also in the case of full employment (*i.e.*, $R_l = 0$). But, with full employment, the optimal policy is $t^* = 0$ when the public good is provided at its first best level.

When $E_{pg} > 0$ it is possible for the denominator of equation (14) to be positive. In this case one could conclude that the optimum consumption tax is negative. This, however, is wrong. The negative consumption tax is the one that minimizes welfare. When the denominator of (14) is positive, that is the third term on the right hand side of equation (13) is negative, it means that as the consumption tax increases, welfare increases at an increasing rate and in this case we may have a corner solution or implicit determination of the optimum tax rate. When $E_{pg} < 0$ this possibility does not exists.

5. Import Tariff and Welfare

Most LDCs are frequently constrained by revenue considerations when needed to finance government activities, *e.g.*, the provision of public goods. For this, an import tariff, despite its known heavier dead-weight losses compared to other policy

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supplied). When $-E_g = \overline{w}$, we say that the public good is supplied at its first best level.

instruments (*e.g*, income taxes), is a relatively effective and administratively low cost policy choice for generating government revenue and financing public sector activities. Within the present context, we assume the absence of income taxes, and the use of only tariff revenue to finance the provision of the public good. Using equation (11) and (A.5), the welfare effect of raising the tariff rate is given as follows:

$$\Delta(du/dt) = d_2(\overline{w} + E_g)\tilde{Z}_p + d_1[\tilde{Z}_p - (qM_{LL})^{-1}M_L\overline{w}]R_l$$
$$- t[d_2(\tilde{Z}_p\tilde{Z}_{pp}^{-1}E_{pg} - E_g) - d_1R_l(1+x)]\tilde{Z}_{pp}, \qquad (16)$$

where $x = (qM_{LL}\tilde{Z}_{pp})^{-1}M_LE_{pg} > (<)0$ depending on whether $E_{pg} > (<)0$. Equation (16) shows that the higher tariff rate affects welfare through an induced (i) *public-good-effect* (*i.e.,* $\Delta^{-1}d_2(\overline{w} + E_g)\tilde{Z}_p$), (ii) *employment-effect* (*i.e.,* $\Delta^{-1}d_1[\tilde{Z}_p - (qM_{LL})^{-1}M_L\overline{w}]R_l$), and (iii) *tariff-revenue-effect* (*i.e.,* $-\Delta^{-1}t[d_2(\tilde{Z}_p\tilde{Z}_{pp}^{-1}E_{pg} - E_g) - d_1R_l(1+x)]\tilde{Z}_{pp}$).[12]

Through the *public-good-effect*, a higher tariff, which raises government revenue, affects welfare positively if the public good is under-supplied, and negatively if it is over-supplied. Through the *employment-effect*, the higher tariff entails a positive effect on domestic employment, thus incomes and welfare. First, as in the case of a consumption or an income tax, the higher tariff raises government revenue, which affects positively L^g, reduces l and raises incomes and welfare (*i.e.,* $\Delta^{-1}d_1R_l\tilde{Z}_p$). Second, a tariff, which acts as a subsidy to manufacturing production raises employment in that sector, thus further reducing l, increasing urban incomes, and overall welfare (*i.e.,* $-\Delta^{-1}d_1(qM_{LL})^{-1}M_L\overline{w}R_l$).

Like in the case of a consumption tax, when the tariff is the only policy instrument and $t \approx 0$, an increase in its rate affects welfare through the induced *public-good-effect* and *employment-effect*. The *public-good-effect* exerts a positive impact on welfare when the public good is under-provided, while the impact of the *employment-effect* on welfare is unambiguously positive. Thus, a small tariff is welfare improving.

[12] The analytical interpretation of equation (19) does not change despite the presence of additional terms when ? is not zero. To simplify the exposition of the results, however, we set ? =0.

For a larger tariff (*i.e.*, $t > 0$) a further increase in its rate has an ambiguous effect on welfare, through the induced *tariff-revenue-effect*, which can be negative or positive. Contrary to a consumption tax, however, the *tariff-revenue-effect* can be positive even if E_{pg} is negative.

Setting $(du/dt) = 0$ in equation (16), the optimal tariff rate (*i.e.*, t^*) is given by:

$$t^* = \{d_2(\overline{w} + E_g)\tilde{Z}_p + d_1[\tilde{Z}_p - (qM_{LL})^{-1} M_L \overline{w}]R_l\} / \Omega \,, \qquad (17)$$

where $\Omega = [d_2(\tilde{Z}_p \tilde{Z}_{pp}^{-1} E_{pg} - E_g) - d_1 R_l (1+x)]\tilde{Z}_{pp}$ is the induced *tariff-revenue-effect*.

Equation (17) can be used to assess the optimal tariff policy in several cases emerging within the present context of unemployment and public good provision. First, it indicates that when only tariffs are used to finance the provision of the public good, the sufficient condition under which the optimal policy is an import tariff is that the public good is under-supplied. Second, in the unlikely case where the public good is provided at its first best level, then again the optimal policy is a tariff. The optimal policy unambiguously is $t^* > 0$ given by (17) if the public good is under-supplied and the public and manufacturing goods are neutral in consumption (*i.e.*, $E_{pg} = 0$).[13] Lastly, like in the case of an optimal consumption tax rate, when the public good is under-supplied, the optimum policy is a tariff even in the in the case of full employment (*i.e.*, $R_l = 0$).

A negative tariff being the optimal policy is not acceptable in the present framework, since it is the one minimizing not maximizing welfare (see the relevant discussion of equation (14)).

Assuming that the cases noted above are evaluated at the same initial conditions, we get:

$$t^*\big|_{(\overline{w}+E_g)<0} > t^*\big|_{(\overline{w}+E_g)=0} > 0 \,. \qquad (18)$$

The following proposition summarizes some of the findings:

Proposition 3*: Assume that the government provided public good is financed through income taxes, consumption taxes or tariffs and is under-supplied. The sufficient, but not necessary, condition for the optimal consumption tax to be explicitly determined is that the public good is a substitute to the manufacturing good in consumption. The sufficient, but not necessary condition for the optimal import tariff to be explicitly determined is that the public and the imported good are neutral in consumption. The optimal income tax is determined only implicitly.*

6. Efficiency Rules for Public Good Provision.

When non-distortionary taxes (*e.g.*, lump-sum taxes) are used to finance the public good, then the first-best efficiency rule for its provision requires that the social marginal benefit must equal the social marginal cost. When distortionary taxes (*e.g.*, consumption taxes) are used to finance the provision of the public good, then Pigou argued that the private marginal cost understates the social marginal cost. This, however, as subsequent authors have shown is not always true. For example, when the taxed and the public goods are complements in consumption, or when we have a backward bending labor supply, then the private marginal cost may overstate the social marginal cost. In this section we derive the efficiency rules for public good provision in the presence of unemployment when the government uses income taxes, or consumption taxes, or tariffs to finance its provision.

Setting $(du/dr) = 0$, in equation (12), when the government's policy instrument is an income tax and revenue is used to finance the public good, we get the efficiency rule for its provision as follows:

$$-E_g = \overline{w} + (d_1/d_2)R_l - tE_{pg}. \tag{19}$$

The left-hand side of equation (18) is the social marginal benefit of public good provision while the right hand side is its social marginal cost. The second right hand side term of equation (18) is negative. Thus, in the absence of consumption taxes, we conclude that the private marginal cost of public good provision always overstates its

[13] In this case, the denominator of equation (21) reduces to $\Omega = (-d_2 E_g - d_1 R_l)\tilde{Z}_{pp} < 0$.

true social marginal cost.[14] Intuitively, the social marginal cost of the public good is less than the private marginal cost in this case since an increase in the income tax rate to finance the provision of public good decreases the unemployment rate and increases income and welfare. When full employment exists then the private marginal cost equals the social marginal cost. In the presence of consumption taxes, the private marginal cost overstates its social marginal cost when the taxed and the public goods are complements in consumption. If, however, they are substitutes, then the private marginal cost may understate its social marginal cost.

Setting $(du/dt) = 0$, in equation (13), when the government's policy instrument is a consumption tax and revenue is used to finance the public good, we get the efficiency rule for its provision as follows:

$$-E_g = \overline{w} + (d_1/d_2)R_l - t[(E_p E_{pp}^{-1} E_{pg} - E_g) - (d_1/d_2)(1-r)R_l]E_{pp}E_p^{-1}. \quad (20)$$

When we have full employment (*i.e.*, R?=0), we get the well-known result. That is, when the public and the taxed goods are substitutes in consumption (*i.e.*, $E_{pg} < 0$), then the private marginal cost understates its social marginal cost. When, however, they are complements, then the private marginal cost may overstate its social marginal cost. But, in the present framework, with (HT) unemployment, the private marginal cost may overstate the social marginal cost even if the public and the taxed goods are substitutes in consumption.

Concluding the discussion of equations (19) and (20), we note the following point. When an income tax is chosen as a policy instrument, the existence of a consumption tax may alter the efficiency rule for public good provision. In case that the selected policy instrument is a consumption tax, the presence of an income tax has no bearing on the respective efficiency rule.

Setting $(du/dt) = 0$ in equation (16), we get the efficiency rule for public good provision when the government uses tariff revenue to finance its provision as follows:

[14] In the present context of unemployment, the identical efficiency rule applies when the public good is financed through lump-sum taxes (see footnote 7).

$$-E_g = \overline{w} + (d_1/d_2)\tilde{Z}_p^{-1}[\tilde{Z}_p - (qM_{LL})^{-1}M_L\overline{w}]R_l$$

$$-t[(\tilde{Z}_p\tilde{Z}_{pp}^{-1}E_{pg} - E_g) - (d_1/d_2)R_l(1+x)]\tilde{Z}_{pp}\tilde{Z}_p^{-1}. \qquad (21)$$

Careful examination of equation (21) reveals again that the private marginal cost of the public good may overstate its social marginal cost even if the taxed and the public good are substitutes in consumption. When full employment exists (*i.e.,* R?=0), we get the well-known result. That is, when the public and the taxed goods are substitutes in consumption (*i.e.,* $E_{pg} < 0$), then the private marginal cost understates its social marginal cost.

Proposition 4: *Assume an economy with unemployment described by the Harris-Todaro model. The private marginal cost of the public good always overstates its social marginal cost when the public good is financed only with income or lump-sum taxes. When consumption taxes or tariffs are used to financed the public good, then the private marginal cost of the public good may overstate its social marginal cost even if the public and the taxed good are substitutes in consumption.*[15]

7. Joint Consumption and Income Taxes

In this section we assume that the government has at its disposal two policy instruments, a consumption tax and an income tax, which it uses to finance the provision of the public good. Setting in equation (12) $(du/dr) = 0$ and then substituting the result, that is substituting equation (19) into equation (13), we get the following:

$$\Delta(du/dt) = t[d_2E_g + d_1(1-r)R_l]E_{pp} < 0. \qquad (22)$$

[15] With distortionary taxation, the marginal cost of public funds (MCF) is usually greater than one. When, however, the private taxed good and the public good are complements in consumption then the MCF could be less than one (Atkinson and Stern 1974). Sandmo (1998) shows that MCF can be less than one in a model with heterogeneous consumers and redistribution from high-wage to low-wage workers. In the present model with unemployment, the MCF is always less than one with income or lump-sum taxes and can be less than one with consumption taxes or tariffs even if the taxed good and the public good are substitutes in consumption. For the definition of MCF see for example Sandmo (1998).

Thus, when the government has at its disposal the income taxes and can choose the optimal income tax rate, then any increase in the consumption tax rate decreases welfare. Therefore, the consumption tax rate should be zero when the government can apply the optimal income tax rate.

9. Concluding Remarks

By now it is broadly accepted in the literature of international trade and economic development that governments seldom lump-sum distribute to domestic households revenues generated from the imposition of taxes (*e.g.,* income, consumption), or tariffs. Instead, such tax revenues, by and large, are used to finance the provision of public goods and public inputs. As a result, recent serge in this literature has evolved around this premise.

Within this existing trade literature of public good provision, the paper notes and incorporates two issues. The first is that of the existence of unemployment, an assumption particularly relevant in the context of a LDC. The second recognizes that, more than often, governments may use policies jointly (*e.g.,* income and consumption tax policies) to finance the provision of the public good or input. Either issue, when accounted for alters non-trivially existing analytical results, and provides some newer ones. For this, we construct a general equilibrium trade model of a small open economy characterized by Harris-Todaro type of unemployment, producing two private traded goods and a non-traded public consumption good. For the provision of the later commodity, the government generates the required revenue through the imposition of an income and/or consumption tax, or of an import tariff. The paper then, examines the effect of such tax policies on the unemployment ratio and level of welfare, and derives the efficiency rules for public good provision and the optimal rate for each policy.

Among other findings we note the following. First, with or without unemployment and the presence of an income tax, the sufficient, but not necessary condition, for a government’s optimal policy to be a consumption tax or an import tariff is that the public good is under-supplied. Second, because of unemployment, our analysis shows that when the public good is provided at its first-best level, and consumption tax or tariff revenue is used to finance its provision, then the optimal tax rate of such a policy instrument is positive. On the other hand, with full employment and provision of the public good at its first-best level, the optimal consumption tax or tariff rate is zero. Moreover, under either policy regime, because of unemployment, even if the taxed and public goods are substitutes in consumption, it is possible for the private marginal cost of the public good to overstate its social marginal cost. In the case of full employment such a possibility does not exist when the two goods are substitutes in consumption. Third, with income taxes alone, the private marginal cost of the public good always overstates its social marginal cost with unemployment, but the two are equal with full employment. If also a consumption tax exists, and the taxed and public goods are substitutes (complements) in consumption, the private marginal cost of the public good may understate (always overstates) its social marginal cost.

Lastly, when an income and a consumption tax are used to finance the provision of the public good, the analysis shows that when the government can apply the optimal income tax rate to raise revenue, then the optimal consumption tax rate is zero.

Appendix:

Equations (5), (6), (7), (9), and (11) constitute a system of six equations in the endogenous variables u, L^M, L^g, L^A, l, and w^A, solved as functions of the policy parameters r, t and t. Total differentiation of equations (5), (6), (7), using (9) and rewriting (11) as:

$$du + E_g dg - (1 - r)R_l dl = -E_p dt - \overline{Z}_p dt - R dr \text{ ,} \qquad \text{(A.1)}$$

produces the following matrix system:

$$\begin{bmatrix} 1 & 0 & 0 & E_g & -(1-r)R_l & 0 \\ 0 & qM_{LL} & 0 & 0 & 0 & 0 \\ 0 & 0 & A_{LL} & 0 & 0 & -1 \\ 0 & 0 & 0 & 0 & w^A & (1+l) \\ 0 & (1+l) & 1 & (1+l) & L^m & 0 \\ -tE_{pu} & 0 & 0 & -(\P B/\P L^g) & -rR_l & 0 \end{bmatrix} \begin{bmatrix} du \\ dL^M \\ dL^A \\ dL^g \\ dl \\ dw^A \end{bmatrix} =$$

$$\begin{bmatrix} -R \\ 0 \\ 0 \\ 0 \\ 0 \\ R \end{bmatrix} dr + \begin{bmatrix} -E_p \\ 0 \\ 0 \\ 0 \\ 0 \\ (\partial B/\partial t) \end{bmatrix} dt + \begin{bmatrix} -\overline{Z}_p \\ -M_L \\ 0 \\ 0 \\ 0 \\ (\partial B/\partial t) \end{bmatrix} dt . \qquad \text{(A.2)}$$

Recall that when r is non-zero, then $\overline{Z}_p = \tilde{Z}_p + rR_p$, and $(\partial B/\partial t) = \overline{Z}_p + t\tilde{Z}_{pp}$. For stability, the determinant $\Delta = -d_1[r + (1-r)tE_{pu}]R_l - d_2[\overline{w} - t(E_{pg} - E_g E_{pu})]$, must be negative; $d_1 = qM_{LL}A_{LL}(1+l)^2 > 0$ and $d_2 = qM_{LL}[(1+l)L^m A_{LL} - w^A] > 0$. The following results are obtained:

Policy Effects on Public Good Provision.

Income tax: $(dL^g/dr) = L_r^g = -\Delta^{-1}d_2(1-tE_{pu})R > 0$, (A.3)

Consumption tax: $(dL^g/dt) = L_t^g = -\Delta^{-1}d_2[(1-tE_{pu})E_p + tE_{pp}]$. (A.4)

Import tariff:

$(dL^g/dt) = -\Delta^{-1}\{d_2[(1-tE_{pu})\tilde{Z}_p + t\tilde{Z}_{pp}] + d_1(pM_{LL})^{-1}M_L[r + (1-r)tE_{pu}]R_l\}$.(A.5)

Policy Effects on the Unemployment Ratio

Income tax: $\Delta(dl/dr) = d_1(1-tE_{pu})R < 0$, (A.6)

Consumption tax: $\Delta(dl/dt) = d_1[(1-tE_{pu})E_p + tE_{pp}]$, (A.7)

Import tariff:

$\Delta(dl/dt) = d_1\{(1-tE_{pu})\tilde{Z}_p + t\tilde{Z}_{pp} - (pM_{LL})^{-1}M_L[\overline{w} - t(E_{pg} - E_g E_{pu})]\}$. (A.8)

Note that $(1-tE_{pu}) > 0$ and $(1-tE_{pu}) > 0$ since both goods are normal in consumption.

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