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Tax-tariff reform with costs of tax administration*

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Abstract

As is broadly recognized, the straightforward application of the Diamond-Mirrlees (1971) production efficiency theorem implies that when lump-sum taxation is not available, then it is optimal for the government in a small open economy to rely on taxes on the net demand of households rather than on border taxes to finance its resource requirements. However, the theorem does not hold when taxation is associated with administrative costs. The present paper explores the implications for optimal taxation and for desirable directions of tax-tariff reform in countries at different levels of economic development taking into account the costs of tax administration. The paper lends support to and clarifies the reasons for the criticism by Emran and Stiglitz (2003, 2005) of the IMF and the World Bank's recommendation to developing countries to adopt VAT to replace border taxes.

Keywords: Optimal taxation, optimal trade policy, VAT, tax-tariff reform, costs of tax administration, informal sector, developing countries
JEL classification codes: F11, F13, H21

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1. Introduction

In a seminal paper, Diamond and Mirrlees (1971) established that even when lump-sum taxation is not available production efficiency is desirable. However, as Stiglitz and Dasgupta (1971) pointed out at the outset, the Diamond-Mirrlees efficiency theorem is not very robust considering that production efficiency will not necessarily be desirable if certain tax instruments cannot be used.

Under the assumption that all market transactions and profit can be taxed, the conditions for a tax-tariff system to be optimal are fairly well understood. It is corollary to the Diamond-Mirrlees (1971) production efficiency theorem that in a small open economy it is optimal for the government to rely on taxes on the net demand of households rather than to use border taxes (see Dixit and Norman 1980, Dixit 1985), but equally it follows from the Stiglitz and Dasgupta analysis that if all tax instruments cannot costlessly be set at their optimal level, free trade is in general not desirable. This latter implication has been explored by Dasgupta and Stiglitz (1974) and by Heady and Mitra (1982, 1987), but until the papers by Eman and Stiglitz (2003, 2005) created a resurgence of interest, little research has been done in the area. The assumption of exogenous given tax restrictions in the original contributions (Stiglitz and Dasgupta 1971 and Munk 1980) is unattractive. Already in 1982 this made Heady and Mitra identify the development of a theory of costly administration which would permit an endogenous choice of tax restrictions as a priority for future research, but although the importance of administrative costs has been widely recognised, little progress has been made to incorporate administrative costs into the theory of optimal taxation.

On the other hand, there is a considerable literature on desirable directions of tariff reform. Hatta (1977) analysed the welfare effects of tariff reform when changes in government tax revenue are balanced by changes in lump-sum transfers. Although important in opening up the area for theoretical investigation, the assumption that the government's revenue requirement is financed by lump-sum taxes clearly limited the policy relevance of the results. Subsequent contributions (see for example Diewert, Turunen-Red, and Woodland 1989) have taken into account that the revenue forgone by tariff reductions has to be replaced by tax revenue generated by other distortionary taxes. But in general this work has been done within a framework where free trade would be the ultimate aim of such reform. As Keen and Ligthart (2002) have pointed out, this literature is thus of limited relevance for identifying desirable directions of tax-tariff reforms when the set of feasible tax instruments are restricted and free trade therefore in general is not desirable. In the same vein, Emran and Stiglitz (2003, 2005) have argued that traditional theory - with its implication that free trade is always desirable - cannot be used as the basis for providing policy advice on tax-tariff reform in developing and transition countries. In particular, they have criticised the IMF and the World Bank recommendation to reduce trade taxes and increase consumption taxes, such as VAT, as this is likely to decrease rather than increase welfare in developing countries with large informal sectors.

The present paper addresses the challenge of developing a theory of optimal taxation which permits an endogenous choice of tax restrictions. This is done by exploiting the simplifying assumption that different tax structures are associated with different administrative costs. This provides a framework for gaining insight into how the optimal tax-tariff system in the course of economic development

changes in response to reduction in the relative cost of tax administration. [1] This in turn provides a basis for evaluating tax-tariff reform in general, and more specifically the Emran and Stiglitz criticism of the IMF and World Bank recommendation with respect to tax-tariff reform in developing countries. Emran and Stiglitz (2003, 2005) emphasise the importance of administrative costs, but employ a model without the representation of these costs. The present analysis may be seen as an articulation of assumptions on which their analysis is based.

The paper is structured as follows. In Section 2, we formulate simplifying assumptions about the costs of tax administration and review briefly the empirical evidence. In Section 3 we formulate the government's maximisation problem taking administrative costs into account, and in Section 4 we derive and characterise the optimal tax systems for four different tax structures. On this basis in Section 5 we identify desirable directions of coordinated tax-tariff reforms in response to improvement in administrative infrastructure in the process of economic development, and discuss policy implications. Section 6 summarises and concludes.

2. Administrative costs of tax administration

Defining a *tax-tariff system*, $\boldsymbol{\tau}$, as the values of all tax instruments, and a *tax-tariff structure j,* Ξ^j, as the set of tax-tariff systems, $\boldsymbol{\tau} \in \Xi^j$, where the same restrictions are imposed on the set of tax instruments, we provide a framework for incorporating administrative costs into the standard theory of optimal taxation. Governments may consider a large number of different tax structures, however, to simplify the exposition we assume that only four different tax structures are being considered:

Ξ^1 : no tax-tariff restrictions;
Ξ^2 : only primary factor tax at a uniform rate and border taxes are feasible [2];
Ξ^3 : only border taxes are feasible; and
Ξ^4 : only border taxes at a uniform rate are feasible.

We make the following simplifying assumptions about the costs of tax administration:

A1: The costs of tax administration associated with a given tax-tariff system at a given level of economic development are equal to $B(\Xi, d)$, where $\Xi = \Xi(\boldsymbol{\tau})$ is the tax-tariff structure to which the tax-tariff system $\boldsymbol{\tau}$ belongs, and d the level of economic development.

A2: The costs of tax administration decrease in relative importance with increasing levels of economic development.

A3: The costs of tax administration are increasing with the differentiation of the tax-tariff structure and with the number of transactions which is subject to taxation.

[1] The paper thus responds to the challenge to develop optimal tax theory of greater relevance for developing countries addressed to the profession by Joe Stiglitz at the IIPF conference in Prague 2003 where he presented the Emran and Stiglitz paper (2003).

[2] Notice that within the standard framework of optimal tax models, a tax on the market supply of the primary factor is equivalent to a uniform tax on the final consumption of the commodities produced in the formal sector, i.e. a VAT.

Empirical research on the existence and impact of tax operating costs has flourished in recent years. The World Bank has investigated the role of public finance in development and has established that the costs of tax administration are of relatively greater importance in developing countries than in developed countries (see World Bank Report 1988). The OECD (2004) has undertaken a major study of the costs of tax administration in the OECD countries. Evans (2003) has reviewed a large number of studies, including studies on the tax system in many transitional and developing countries. He divides the costs of tax administration into two components, government costs of tax collection and tax enforcement and private costs of compliance, and reports private and government costs in the order of 1% and private costs of 3%-10% of the tax revenue, respectively. Furthermore, he states that the costs are of relatively greater importance in developing countries than in developed countries. Since for a given commodity there are more domestic transactions than foreign transactions taxing domestic transactions is generally more costly than taxing foreign transactions. Bird (2005) has reviewed the lessons from the experience with VAT in transition and developing countries. Although he finds that there is surprisingly little solid empirical knowledge of some critical factors, and that the relevant economic theory also remains rather sketchy[3], he identifies a number of particular problems of VAT design and administration facing developing countries based on case studies.

Assumptions A2 and A3 therefore seem consistent with the empirical evidence. Assumption A1 would also be realistic if, as in general assumed in optimal tax theory, households would pay taxes according to the provisions in the tax code. However, considering that governments also incur administrative costs to combat tax evasion, the assumption that administrative costs depend only on the tax structure is problematic, as differences in tax rates may also influence the incentive to cheat and thus decisions by governments to use resources to discourage cheating. In Section 5, where we discuss the policy implications of our theoretical results, we therefore consider how taking tax evasion into account will modify our conclusions.

3. The model

Adopting a simplified version of the theoretical framework of Dasgupta and Stiglitz (1974) and Heady and Mitra (1982, 1987) we consider the problem of optimal taxation in a small open economy. The economy comprises one representative household, three perfectly competitive production sectors, and a government. There is one primary factor, indexed *0*, and three tradable commodities, indexed (*1,2,3*). The government imposes border taxes, $\mathbf{t}^{\mathrm{W}} \equiv \left(t_1^W, t_2^W, t_3^W\right)$, and household taxes $\mathbf{t} = \left(t_0, t_1, t_2, t_3\right)$. World market prices are $\mathbf{p}^W \equiv \left(p_1^W, p_2^W, p_3^W\right)$, producer prices are $\mathbf{p} \equiv \left(p_0, p_1, p_2, p_3\right) = \left(p_0, p_1^W + t_1^W, p_2^W + t_2^W, p_3^W + t_3^W\right)$, and household prices are $\mathbf{q} \equiv \left(q_0, q_1, q_2, q_3\right) = \left(p_0 + t_0, p_1 + t_1, p_2 + t_2, p_3 + t_3\right)$.

The economy has the potential to produce any of the three commodities using only the primary factor as input. The production structure exhibits constant returns to scale, hence, the economy will specialise in the production of one commodity, which thus becomes the export good, while the two

[3] Bird (2005) quotes Laffont (2004) for having made similar observations with respect to public utility regulation in developing and transition countries.

other commodities become the import goods.[4] The output of the export sector is y_1, and the use of the primary factor for its production is y_0.[5] The production function for the export sector is

$$y_1 = -a_0 y_0 \tag{1}$$

and by the zero profit condition the producer price of the primary factor is

$$p_0 = a_0 p_1 \tag{2}$$

The household's endowment of the primary factor is ω_0, and its net demand vector is (x_0, x_1, x_2, x_3). The household's untaxed consumption of the primary factor, representing the use of resources in the informal sector of the economy, is thus $\omega_0 + x_0$.[6] The preferences of the household are represented by the expenditure function, $E(\mathbf{q}, u)$, defined over household prices, $\mathbf{q}$, and utility, u. The household's net demands are given by[7]

$$x_i = E_i(\mathbf{q}, u) \qquad i = 0,1,2,3 \tag{3}$$

Foreign trade is (y_1^W, y_2^W, y_3^W). The balance of trade constraint is thus

$$\sum_{i\in(1,2,3)} p_i^W y_i^W = 0 \tag{4}$$

The government's choice of tax- and tariff rates is subject to *tax-tariff restrictions*. We express restrictions on domestic tax rates as[8]

$$T_i \equiv (t_i + p_i)/p_i = \overline{T}_i\ , \qquad i = 0,1,2,3$$

and on tariffs as

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[4] In Dasgupta and Stiglitz (1974) and Heady and Mitra (1982, 1987) more than one primary factor is considered. However, when it comes to gaining insight into the implications for the optimal tax system of the choice of alternative tax structures the convenience of assuming only one primary factor and thus fixed producer prices outweighs the inconvenience, allowing us to draw on well-established results of the theory of optimal taxation.

[5] The sign conventions are: $y_0 < 0$ and $y_1 > 0$; $x_0 < 0$ and $x_i > 0$ $(i=1,2,3)$; $y_1^W < 0$ and $y_i^W > 0$, $(i = 2,3)$. Thus for the primary factor tax and the export tax, respectively, to generate a positive tax revenue the tax rates must be negative.

[6] We disregard the possibility of intermediate consumption, in particular that the goods produced in the informal sector are used as input in the formal sector.

[7] We utilize the derivative notation writing $E_i \equiv \dfrac{\partial E}{\partial q_i}$, $i = 0,1,2,3$, and $E_{ij} \equiv \dfrac{\partial^2 E}{\partial q_i\, \partial q_j}$, $i, j = 0,1,2,3$

[8] For example $\overline{T}_0 = 1$ indicates that it is not possible to tax the primary factor, $\{\overline{T}_i = 1,\ i = 0,1,2,3\}$ indicates that domestic commodity taxes are not feasible, and $\{\overline{T}_i^W = 1,\ i = 1,2,3\}$ that border taxes cannot be used.

$$T_i^W \equiv \left(t_i^w + p_i^w\right) / \, p_i^w = \overline{T}_i^W, \qquad i = 1,2,3$$

Since the administrative costs associated with tax-tariff systems belonging to the tax-tariff structure, Ξ^j, is $B\left(\Xi^j, d\right)$, and, as we assume the government's resource requirement other than for tax administration to be exogenously given, for the tax-tariff structure *j,* the government's total resource requirement is

$$x_i^G = x_i^G\left(\Xi^j, d\right) \qquad i = 0,1,2,3 \tag{5}$$

For a *tax-tariff system,* $\left(\mathbf{t}, \mathbf{t}^W\right) \in \Xi^j$, the government's budget constraint is

$$\sum_{\text{i=0,1,2,3}} t_i \, x_i \; + \sum_{\text{i=1,2,3)}} t_i^W x_i^W - \sum_{\text{i=0,1,2,3}} p_i \, x_i^G\left(\Xi^j, d\right) = 0 \tag{6}$$

Material balance requires

$$y_0 \; = \; x_0 + x_0^G \tag{7}$$

$$y_1 + \, y_1^W \; = \; x_1 \quad + x_1^G \tag{8}$$

$$y_i^W \; = \; x_i \; + x_i^G \qquad i = 2,3 \tag{9}$$

Substituting by (1) in (8), and by (3) and (5) in (7),(8) and (9), and subsequently substituting for y_0 by (7) in (8), we obtain

$$y_1^W \; = \; a_0 \left[E_0\left(\mathbf{q}, u\right) + x_0^G\left(\Xi^j, d\right)\right] + E_1\left(\mathbf{q}, u\right) + x_1^G\left(\Xi^j, d\right) \tag{10}$$

$$y_i^W \; = \; E_i\left(\mathbf{q}, u\right) + x_i^G\left(\Xi^j, d\right) \qquad i = 2,3 \tag{11}$$

As a matter of normalisation, we assume that the producer price of the primary factor, p_0, is fixed, and that the world market prices, $\mathbf{p}^W \equiv \left(p_1^W, p_2^W, p_3^W\right)$, are exogenously determined.

Finally, we substitute (10) and (11) into the balance of trade constraint, (4), and into the government's budget constraint, (6). Using the approach adopted in Dixit and Munk (1977)[9] the following conditions for a tax system, $\left(\mathbf{t}, \mathbf{t}^W\right) \in \Xi^j$, to be feasible may then be expressed as follows

$$\mathrm{E}(\mathbf{q}, u) \le 0 \tag{12}$$

$$p_1^{\mathrm{W}}\left[a_0\left[E_0\left(\mathbf{q}, u\right) + x_0^G\left(\Xi^j, d\right)\right] + \; E_1\left(\mathbf{q}, u\right) + \; x_1^G\left(\Xi^j, d\right)\right] + \sum_{i \in 2,3} p_i^{\mathrm{W}}\left[\; E_i\left(\mathbf{q}, u\right) + \; x_i^G\left(\Xi^j, d\right)\right] \ge 0 \tag{13}$$

[9] The first equation (12) assures that the value of compensated demand is consistent with the household's lump-sum income, the second equation (13) that international trade is balanced, and the third (14) that the government's expenditures are financed by the tax revenue. The conditions for utility maximisation, profit maximisation and material balance are represented by these three equations (see also Diamond and McFadden 1974).

$$\sum_{\mathrm{i}=0,1,2,3} t_i E_{\mathrm{i}}\left(\mathbf{q},u\right)+t_1^{\mathrm{W}}\left[a_0\left(E_0\left(\mathbf{q},u\right)+x_0^G\left(\Xi^j,d\right)\right)+E_1\left(\mathbf{q},u\right)+x_1^G\left(\Xi^j,d\right)\right]\geq 0$$
$$+\sum_{i=2,3} t_{\mathrm{i}}^{\mathrm{W}}\left[E_i\left(\mathbf{q},u\right)+x_i^G\left(\Xi^j,d\right)\right]-p_0 x_0^G\left(\Xi^j,d\right)-\sum_{i=1,2,3} p_i x_i^G\left(\Xi^j,d\right)\geq 0 \qquad (14)$$

where $p_{\mathrm{i}}=p_{\mathrm{i}}^W+t_{\mathrm{i}}^W$, (i=1,2,3) and $\mathbf{q}\equiv\left(q_0,q_1,q_2,q_3\right)=\left(p_0+t_0,p_1+t_1,p_2+t_2,p_3+t_3\right)$.

By Walras' law an equilibrium solution can be found disregarding either (13) or (14). Expressing the condition for equilibrium by (12) and (13), we see that under Ξ^2 and Ξ^3, we can without loss of generality assume that exports are untaxed, and under Ξ^1, we can in addition assume that the domestic consumption of the export good is untaxed.[10]

The government is assumed to maximise social welfare, u, subject to the general equilibrium conditions as expressed by (12) and (14). The maximisation takes place in a two-step procedure: First, the government calculates the optimal tax system for each tax structure; then, in the second step, based on the results of the first step, it chooses the optimal tax structure, Ξ^*, i.e. the tax structure which allows the highest level of social welfare to be attained, and concomitantly the overall optimal tax system, $\left(\mathbf{t}^*,\mathbf{t}^{W*}\right)$. Administrative costs are thus exogenous to the choice of the optimal solution for a given tax-tariff structure, but endogenous to the government's choice of tax system so that the optimal tax structure may change in the course of economic development in response to changes in administrative infrastructure and other structural changes of the economy.

4. Characterisation of the optimal tax-tariff system for different tax structures

No restrictions

We first characterise the optimal tax-tariff system under the unconstrained tax-tariff structure, Ξ^1, i.e. the situation analysed by Dixit (1985). Assuming, as a matter of normalisation, that both the domestic consumption and the export of commodity *1* are untaxed, i.e. $t_1=0$ and $t_1^{\mathrm{W}}=0$, the Lagrangian expression corresponding to the government's problem of finding the optimal solution may (leaving out arguments of functions for readability) be expressed as

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[10] Substituting by $q_0=a_0T_0T_1^Wp_1^W$ and $q_i=T_iT_i^Wp_i^W,\left(i=1,2,3\right)$, (12) and (13) may be rewritten

$$E\left(a_0T_0T_1^Wp_1^W,\left\{T_iT_i^Wp_i^W,i\in(1,2,3)\right\},u\right)=0$$
$$p_1^W\left[a_0\left[E_0\left(a_0T_0T_1^Wp_1^W,\left\{T_iT_i^Wp_i^W,i\in(1,2,3)\right\},u\right)+x_0^G\left(\Xi^j\right)\right]+E_1\left(a_0T_0T_1^Wp_1^W,\left\{T_iT_i^Wp_i^W,i\in(1,2,3)\right\},u\right)+x_1^G\left(\Xi^j\right)\right]$$
$$+\sum_{\mathrm{i}=2,3} p_i^W\left[E_i\left(a_0T_0T_1^Wp_1^W,\left\{T_iT_i^Wp_i^W,i\in(1,2,3)\right\},u\right)+x_i^G\left(\Xi^j\right)\right]=0$$

Multiplying T_i, i=0,1,2,3 by the same constant and similarly multiplying T_1^W, i=1,2,3 by the same constant will not change demands and will thus leave the equilibrium conditions unaffected.

$$L = u + \mu(-E) + \lambda\left(\sum_{i=0,2,3} t_i E_i + \sum_{i=2,3} t_i^W \left(E_i + x_i^G\right) - p_0 x_0^G - \sum_{i=1,2,3} \left(p_i^W + t_i^W\right) x_i^G \right) \quad (15)$$

The first order conditions with respect to domestic taxes, t_k, are

$$-\mu E_k + \lambda\left(\sum_{i=0,2,3} t_i E_{ik} + E_k + \sum_{i=2,3} t_i^W E_{ik} \right) = 0 \qquad k = 0,2,3 \quad (16)$$

and with respect to tariff rates, t_k^w,

$$-\mu E_k + \lambda\left(\sum_{i=0,2,3} t_i E_{ik} + E_k + \sum_{i=2,3} t_i^W E_{ik} \right) = 0 \qquad k = 2,3 \quad (17)$$

If $t_i^w = 0,\ i = 2,3$, and if domestic taxes are set optimally so that (16) is satisfied, then also (17) is satisfied. The optimal solution may thus be achieved using only domestic taxes, as may indeed be deduced directly from the Diamond and Mirrlees production efficiency theorem, interpreting the foreign sector as a production sector.

Compared with the first-best allocation, any tax system including the optimal tax system implies that the household's (untaxed) consumption of the primary factor is encouraged, or in other words a discouragement of the household's supply of the primary factor to the market. This implies that starting with a proportional tax system in terms of the produced goods it is possible, in general, to alleviate the discouragement of the supply of the primary factor by differentiating the tax rates for the produced commodities. The optimal tax system may thus be interpreted as representing a trade-off[11] between two objectives:

Objective 1*:* To maintain the first-best pattern of consumption of the produced commodities.

Objective 2: To discourage the untaxed consumption of the primary factor.

The optimal tax system will therefore, generally speaking, be characterised by (see Corlett and Hague 1953, Harberger 1974)

1) High tax rates on the commodities which are the most complementary with the untaxed use of the primary factor.

[11] To avoid confusion it is preferable to use the term the "untaxed use of the primary factor" rather than "leisure" or "labour". The implications of assuming "labour" untaxed have not always been clearly appreciated in the literature. Whereas the assumption that labour, in the meaning "leisure", cannot be taxed is a restriction, the assumption that the supply of labour to the market cannot be taxed is just a normalisation rule. The interpretation of the Corlett and Hague result that the optimal tax system involves higher taxes on those commodities which are complementary with leisure is thus not (as for example suggested by Myles 1995) a consequence of the normalisation rule adopted, that labour cannot be taxed, but a consequence of the fact that "leisure" cannot be taxed.

2) Greater departure from proportionality, a) the greater the complementarity with the untaxed use of the primary factor; and b) the more the degree of complementarity differs between produced commodities.

Distorting producer prices by using border taxes does not contribute to either of these two objectives, as household prices can be determined by the choice of domestic taxes irrespective of the level of border taxes. This provides the intuitive explanations for why border taxes are not relevant to the solution of the government's maximization problem even as lump-sum taxes are not feasible.

From a purely allocative point of view, i.e. disregarding administrative costs, the tax structure, Ξ^1, is clearly the optimal tax structure, as the optimal tax system associated with this tax structure is subject to fewer constraints than the other tax structures. However, the tax structure Ξ^1 requires monitoring of the domestic market transactions for each commodity separately. The administrative costs associated with the unconstrained tax-tariff structure are therefore likely to be significantly larger than for the other tax structures, in particular in countries with a weak administrative infrastructure. Thus Ξ^1 may not be the optimal tax structure when both administrative and distortionary costs are taken into account.

Only border taxes and VAT

We now characterise the optimal tax-tariff system when the government's revenue requirement can only be financed by tariffs and by a tax on the market supply of the primary factor (corresponding to a VAT), i.e. when the tax-tariff system belongs to Ξ^2 where $\overline{T}_i = 1, i = 1,2,3$ [12]. This problem is similar to that by Heady and Mitra (1982).

As in the case of unconstrained taxation, Ξ^1, we assume, as a matter of normalisation, that the export of commodity 1 is untaxed, i.e. $t_1^W = 0$. The first order conditions for $\left(\mathbf{t}, \mathbf{t}^W\right)$ to be an optimal solution to the government's maximisation problem under Ξ^2, are

$$-\mu E_0 + \lambda\left(t_0 E_{00} + E_0 + \sum_{i\in(2,3)} t_i^W E_{i0}\right) = 0 \tag{18}$$

$$-\mu E_j + \lambda\left(t_0 E_{0j} + E_j + \sum_{i\in(2,3)} t_i^W E_{ij}\right) = 0 \qquad j = 2,3 \tag{19}$$

Although it is feasible for the government to finance its resource requirements using only the domestic tax and thus maintaining production efficiency, this is not the optimal solution. The government can increase welfare by using tariffs to discourage the untaxed use of the primary factor in the informal sector.[13] The optimal tariff structure will thus be determined as a compromise

[12] Notice that within the model framework, a tax on the market supply of the primary factor is equivalent to a uniform tax on the final consumption of the commodities produced in the formal sector, i.e. a VAT.

[13] As long as the output from the informal sector is consumed only in the household sector the untaxed use of the primary factor is equivalent to "leisure" in standard optimal tax models.

between the same two objectives, which in the previous case determine the optimal commodity tax structure. As the domestic taxes under Ξ^2 cannot be manipulated to discourage the use of the primary factor in the formal sector, tariffs are instead used to achieve this objective, however potentially at a higher cost because also production decisions may be distorted. In countries with a relatively large informal sector and where there are relative large differences in the complementarity of different commodities with the use of the primary factor in the informal sector the benefits from using tariffs are therefore relatively more important than in countries where this is not the case.

With the imposition of the optimal tariffs, production will take place in the same sector as under the previous tax-tariff structure or it will switch to another sector. In the first case, consumption will also remain unchanged as the same consumer prices will be sustained by tariffs instead of by domestic taxes. However, in the second case there will be a loss of allocative efficiency.

The use of tariffs involves monitoring far fewer market transactions than the use of differentiated consumer taxes. The administrative costs associated with the tax-tariff structure, Ξ^2, are therefore smaller than those associated with the unconstrained tax-tariff structure, Ξ^1. However, the optimal tax system associated with Ξ^2 may involve a loss in allocative efficiency compared with that associated with Ξ^1. If the economy specialises in the production of different goods under the two different tax structures, then choosing between Ξ^1 and Ξ^2 involves a trade-off between administrative costs and allocative efficiency. In this case, which tax structure is the optimal cannot be determined a priori on theoretical grounds.

Only tariffs

We now consider the optimal solution when the government's revenue requirement has to be financed only by tariffs, i.e. under the tax structure, Ξ^3 with $\overline{T}_i = 1, i = 0,1,2,3$. This corresponds to the situation analysed by for example Hatta and Ogawa (2003), however based on a somewhat different model.

A proportional tariff structure

$$T_i^W \equiv \left(t_i^w + p_i^w\right) / p_i^w = T^W , \qquad i = 1,2,3$$

generates no revenue. We may therefore, as a matter of normalisation, assume that exports are untaxed. With the tariff structure, Ξ^3, both the non-market use of the primary factor and the domestic consumption of the export good[14] will thus be encouraged compared with the first-best allocation. In the absence of domestic taxes, the government uses tariffs not only to generate tax revenue, but also to discourage the consumption of the export good and the use of the primary factor in the informal sector. The optimal tariff system may thus be interpreted as a compromise between the following three objectives:

[14] As pointed out by Hatta and Ogawa (2003), there is an analogy to the rationale to tax commodities at a higher rate the more they are complementary to leisure.

Objective 1: To maintain the first-best pattern of consumption of the import goods.

Objective 2*:* To discourage the untaxed consumption of the primary factors.

Objective 3*:* To discourage the untaxed consumption of the export good.

In other words, in addition to the two objectives considered in the previous cases, also *Objective 3* needs to be taken into account.

Transforming the first order conditions, we may derive tax formulae which clearly bring out these trade-offs.

The first order conditions for an optimal tax-tariff system now become

$$-\mu E_j + \lambda\left(E_j + \sum_{i=2,3} t_i^W E_{ij}^h\right) = 0 \qquad j = 2,3 \tag{20}$$

Solving for the optimal tariffs using the symmetry of the Slutsky matrix we have

$$t_2^W = \theta\frac{\left(-E_{33}E_2 + E_{23}E_3\right)}{D} \tag{21}$$

$$t_3^W = \theta\frac{\left(-E_{22}E_3 + E_{32}E_3\right)}{D} \tag{22}$$

where $D = E_{22}E_{33} - E_{32}E_{23}$, and $\theta = \dfrac{\lambda - \mu}{\lambda}$

Defining compensated price elasticities as $\varepsilon_{ij} \equiv E_{ij}\Big/\dfrac{x_i}{q_j}$, $(i, j = 0,1,2,3)$, (21) and (22) may be transformed into

$$\frac{t_2^W}{q_2} = \theta\frac{\left(\varepsilon_{23} - \varepsilon_{33}\right)}{\varepsilon_{22}\varepsilon_{33} - \varepsilon_{32}\varepsilon_{23}} \tag{23}$$

$$\frac{t_3^W}{q_3} = \theta\frac{\left(\varepsilon_{32} - \varepsilon_{22}\right)}{\varepsilon_{22}\varepsilon_{33} - \varepsilon_{32}\varepsilon_{23}} \tag{24}$$

By homogeneity of degree zero of the compensated demand functions, $E_i(\mathbf{q}, u)$, $(i = 0,1,2,3)$, we have that $\sum_{j=0,1,2,3} \varepsilon_{ij} = 0$,$(i = 0,1,2,3)$, and therefore that $\varepsilon_{12} = -\varepsilon_{11} - \varepsilon_{10}$ and $\varepsilon_{21} = -\varepsilon_{22} - \varepsilon_{20}$. The optimal tariff system may therefore also be expressed as (see Munk and Rasmussen 2003)

$$\frac{t_2^W / q_2}{t_3^W / q_3} = \frac{-\varepsilon_{22} - \varepsilon_{33} - \varepsilon_{21} - \varepsilon_{20}}{-\varepsilon_{22} - \varepsilon_{33} - \varepsilon_{31} - \varepsilon_{30}} \tag{25}$$

or since $\varepsilon_{ij} = s_j \sigma_{ij}$ where σ_{ij} is the Allen elasticity of substitution, and s_j the share of the consumption of j in full income, as

$$\frac{t_2^W / q_2}{t_3^W / q_3} = \frac{(s_2 + s_3)\sigma_{23} + s_1\sigma_{31} + s_0\sigma_{30}}{(s_2 + s_3)\sigma_{23} + s_1\sigma_{21} + s_0\sigma_{20}} \tag{26}$$

The optimal tariff system reflects the desire to discourage both the untaxed consumption of the primary factor and the untaxed domestic consumption of the export good. Which commodity will be taxed at the highest rate depends entirely on the sign of $(s_1\sigma_{31} + s_0\sigma_{30})$ - $(s_1\sigma_{21} + s_0\sigma_{20})$ (Objectives 2 and 3). For a given value of σ_{23}, the difference in the tax rates will be greater, the greater the numerical value of $(s_1\sigma_{31} - s_1\sigma_{21}) + (s_0\sigma_{30} - s_0\sigma_{20})$; and for a given value of $s_1(\sigma_{31} - \sigma_{21}) + s_0(\sigma_{30} - \sigma_{20})$ the difference will be the smaller the greater σ_{23} is (Objective 1) (see Munk and Rasmussen 2003). Objectives 2 and 3 may be conflicting, but if the consumption of the same import good is more complementary to both the untaxed consumption of the export good and to the untaxed consumption of the primary factor, then it will be taxed at a higher rate than the other import good. Countries with a relatively large informal sector (as measured by s_0) and where the difference in the complementarity of the imported commodities with the use of the primary factor in the informal sector is relatively large (as measured by $(\sigma_{30} - \sigma_{20})$), are therefore likely to derive relatively large benefits from a differentiated tariff structure.

Compared with the optimal tax-tariff system obtained under the two previous tax structures, the optimal solution for this tax structure represents increased distortionary costs because domestic taxes cannot be used to discourage the domestic consumption of the export good and the untaxed consumption of the primary factor. On the other hand, the administrative costs of raising government revenue only by tariffs are likely to be significantly smaller than for the two other tax-tariff structures, because under Ξ^3 domestic market transactions are not taxed. Therefore, on theoretical grounds alone it cannot be ruled out that a tax system belonging to Ξ^3 is the overall optimal tax system.

Only uniform tariff

Finally, under Ξ^4, where $\overline{T}_i = 1, i = 0,1,2,3, T_1^W = 1$, $T_i^W = \overline{T}_i^W$, $i = 2,3$, assuming as a matter of normalisation that exports are untaxed, only one tax-tariff system is feasible. This tax-tariff structure implies greater distortionary costs than the other tax-tariff structures, and in particular than a differentiated tariff system. However, by the same token this tax-tariff structure is likely to be

associated with the smallest administrative costs since only foreign transactions are taxed, and at the same rate.

The trade-off between allocative efficiency and administrative costs in the choice of tax-tariff systems

Writing $W\left(\Xi^j, d\right)$ as the maximum social welfare at the level of economic development d associated with the tax-tariff structure j disregarding administrative costs, we have

$$\text{T1: } W\left(\Xi^1, d\right) \geq W\left(\Xi^2, d\right) \geq W\left(\Xi^3, d\right) \geq W\left(\Xi^4, d\right)$$

since $W\left(\Xi^j, d\right)$ is by general rules of optimisation non-decreasing in the number of tax-tariff instruments available to the government.

Since by assumption A3 the costs of tax administration are increasing with the differentiation of the tax-tariff structure and with the number of transactions which is subject to taxation the tax-tariff structures may be ranked in terms of administrative costs as follows

$$\text{T2: } B\left(\Xi^1, d\right) \geq B\left(\Xi^2, d\right) \geq B\left(\Xi^3, d\right) \geq B\left(\Xi^4, d\right)$$

This ranking is thus the opposite of the social ranking according only to allocative considerations. There is therefore a trade-off between allocative efficiency and administrative costs which in a given country does not allow the optimal tax-tariff structure to be identified without empirical information about both the structure of the economy and the costs of tax administration.

5. The evolution of optimal tax-tariff structure and tax-tariff reform in the process of economic development

In this section we consider the implications of our analysis for the evolution of the optimal tax structure in the process of economic development, as well as the policy implications for tax design and tax-tariff reform in developing countries. As basis for the analysis we make one further assumption supported by amble evidence (see for example Schneider and Enste 2002).

A4: The size of the informal sector measured by the share in full income of the consumption of the primary factor in the informal sector, s_0.

This assumption implies that the benefit of a differentiated tax-tariff structure will decrease with increasing economic development (see the interpretation of the various tax-tariff structures in Section 4).

As we have also assumed that the costs of tax administration decrease in relative importance with increasing levels of economic development (assumption A2), the implication of T1 and T2 is that in the process of economic development the optimal tax structures and the objectives which determine the optimal tariff structure will change, as summarised in Table 1.[15]

Table 1: Level of development and optimal tax-tariff system

Optimal tax-tariff structure	**Level of economic development**	**Objective determining the optimal tariffs following from the government's maximisation problem**
Uniform tariff rate: Ξ^4	Low	None. (The level of the uniform tariff is determined only by the government's resource requirement)
Border taxes: Ξ^3	Lower-middle	Reduce the use of resources in informal sector Reduce the consumption of the export commodity
Border taxes +VAT: Ξ^2	Upper-middle	Reduce the use of resources in informal sector
Differentiated domestic taxes: Ξ^1	High	None. (The objective of reducing the untaxed use of primary factors is achieved through the domestic tax system)

Our analysis thus provides insight into what constitutes desirable directions of tax-tariff reform at different levels of economic development. The first transition from Ξ^4 to Ξ^3 corresponds to the situation where the administrative infrastructure has improved to the point where the differentiation of the tariff rates becomes preferable to a uniform tax structure in order to discourage the consumption of those commodities which are complementary with the use of resources in the informal sector and the domestic consumption of the export good. The second transition from Ξ^3 to Ξ^2 corresponds to the situation where it has become desirable to finance government expenditures by a uniform domestic tax, maintaining border taxes only to discourage the use of resources in the informal sector. Finally, the third transition from Ξ^2 to Ξ^1 involves the adoption of free trade as it

[15] One may also consider a tax structure which combines elements from Ξ^2 and Ξ^1, i.e. a tax structure where the government's revenue requirement is covered only by a VAT. The adoption of such a tax structure cannot be linked to the process of economic development which, on the one hand, decreases the value of being able to use border taxes because the relative importance of the informal sector is likely to decrease with economic development, and which, on the other hand, decreases the costs of using border taxes as the administrative costs of using border taxes will also decline.

becomes desirable to differentiate domestic tax rates to balance the objective of maintaining the pattern of first best consumption of produced commodities with the objective of discouraging the use of resources in the informal sector.

An important implication of our assumptions is that although the process of economic development is likely to be continuous the development of the tax system is not. Due to the associated fixed costs the tax structure will change only after the trade-off between administrative costs and distortionary costs has changed sufficiently to justify the transition. However, when the tax structure changes the tax system will undergo a substantial transformation because all tax rates, not only those which have previously been constrained, will change as the objectives to be achieved through the tax system have changed. Consider for example the situation of a government in a lower-middle income country (see Table 1) which considers replacing the tax structure Ξ^3 with the tax structure Ξ^2. For a government in this situation it is necessary to assess the implication of such a tax reform not only in terms of the administrative and distortionary costs of implementing a VAT system, but also in terms of the adjustment of the border taxes to reflect the smaller requirement for tariff revenue, and the fact that tariffs no longer should be used to discourage the consumption of the export commodity but only the use of resources in the informal sector. During these transitional phases there will therefore be a particularly strong need for technical advice on how to implement an appropriate tax-tariff reform.

The IMF and the World Bank have advocated that developing countries, in fact even the least developed countries, should abolish border taxes in favour of broad-based taxes like VAT. These recommendations have been supported by Keen and Ligthart (2002), but have been strongly criticised by Emran and Stiglitz (2003, 2005). They point out that Keen and Ligthart's analytical results critically depend on their (implicit) assumption that there is no informal sector in the economy, where developing countries in fact are characterised by having relatively large informal sectors.

As the present analysis illustrates, taking administrative costs into account may justify diversions from free trade and explain why many developed countries have resisted the pressure to eliminate border taxes. The results of our analysis are thus largely consistent with Emran and Stiglitz's criticism. First, the least developed countries may not benefit from the introduction of domestic taxes as the administrative costs may outweigh the allocational benefits. Second, it may not be in the interest of developing and transition countries to give up the use of border taxes entirely even if they adopt a VAT regime. However, the analysis also suggests that a developing country at a certain stage of its development is likely to benefit from tax-tariff reform that reduces border taxes and introduces a broad-based tax system, such as a VAT. If, however, the degree of complementarity between the import goods and the untaxed use of the primary factors in the informal sector differs, it may still be desirable to levy tariffs to tax the use of resources in the informal sector indirectly, thus alleviating the distortion implied by the partial coverage of the VAT.

A recent paper by Baunsgaard and Keen (2005) implicitly provides support to these conclusions. Based on convincing empirical evidence, the paper states that whereas for high income countries the replacement of border taxes with a VAT has resulted in increased government revenue, the opposite has been the case for low income countries. They consider the revenue effect itself as troubling. However, from the perspective of the analysis undertaken in this paper, what is really a reason for concern is that the substitution of a VAT system for border taxes for the least developed countries may have increased the opportunity costs of raising government revenue, and thus

resulted in a decrease in social welfare, as suggested by Emran and Stiglitz. This is not least problematic considering the massive pressure these countries have been subjected to by the international community to undertake this policy change. Our analysis has thus also important implications for the discussion of the fairness of symmetric commitments in international trade negotiations. Even if free trade enhances social welfare for highly developed countries obliging countries in transition, and in particular the least developed countries, to adopt free trade may result in a significant loss of social welfare for these countries.

However, when attempting to draw policy conclusions it is important to consider the fact that our analysis has been based of simplifying assumptions which imply that the effects of the choice of tax structure on the possibilities for income redistribution, tax evasion and rent seeking are disregarded. These are important considerations which may clearly influence the choice of the optimal tax-tariff structure. Policy recommendations in this respect should therefore also reflect these considerations.

First, taking into account distributional considerations that we have disregarded in our formal analysis, as also Keen and Ligthart (2002) and Emran and Stiglitz (2003, 2005) have done, seems further to reinforce the rationale for using border taxes instead of or to supplement a VAT system, as border taxes make it possible to achieve distributional objectives that cannot be achieved by a VAT at a standard rate. When industries, such as agriculture, coal, steel, and textile, come under pressure in the process of economic development, or because of opening up to international markets, it creates important income distributional problems. In general, highly developed countries are well equipped to deal with these problems. It is precisely due to their higher level of development that they are able to put in place and enforce tax and transfer systems which are typically far more efficient in achieving distributional objectives than border taxes. However, for less developed countries, not being able to use border taxes may imply that they will not be able to achieve tax revenue and distributional objectives which could have been achieved using border taxes.

Another important consideration for the choice of tax structure is, as mentioned in Section 2, the scope it creates for tax evasion. The effect of tax evasion on the administrative costs and the distortionary effect of taxation have been considered in the tradition started by Allingham and Sandmo (1972) and recently summarised in Andreoni et al. (1998). For example, taking tax evasion into account the scope for substitution between the consumption of different commodities and the use of resources in the informal sector, σ_{i0}, would increase creating a greater allocative benefit of a differentiated tax-tariff structure. High administrative costs prevent the implementation of a differentiated domestic tax system. Taking tax evasion into account seem therefore to provide an additional reason for developing countries to use tariffs to raise revenue. However, a full assessment of the implication of taking tax evasion into account for the choice of tax-tariff structure is beyond the scope of this article.

A final concern is the importance of political economy considerations for recommendations on the choice of tax-tariff structure in developing countries. Nobody doubts that rent seeking behaviour and corruption are major problems in many developing countries. This, however, does not automatically imply a preference for domestic taxes over border taxes. Firstly, tariffs can as domestic taxes be levied at the same rate, and, as pointed out by Bird (2005), in developing countries the lobbying pressure for exemptions from VAT is no less acute than for differentiated tariff rates. Another question is to what extend such differences, if they exist, are sufficiently important to justify significant modifications to the recommendations with respect to the choice of

tax structure in developing countries. It is understandable if those behind the so-called 'Washington consensus', given their belief that a proportional domestic tax system would be the best tax system for developing countries as well as for developed countries, based on theoretical considerations have interpreted the widespread use of tariffs in developing countries as a result of rent seeking and corruption. However, in poor countries with large informal sectors and difficulties in monitoring activities for tax purposes, imposing high tariff rates is a rational response to the problem of raising government revenue at minimum economic costs. The question is therefore if the distortion of the resource allocation due to rent seeking activities is not much smaller than has previously been thought. This is the conclusion reached by Gordon and Li (2005 a,b) who have recently undertaken a quantitative analysis of this question. They show that a political economy model in the tradition of Grossman and Helpman (1994) poorly reconciles many aspects of the data on tax-tariff structures in developing countries compared with their own model based on assumptions similar to those made in this paper.[16] Their results therefore seem to suggest that although remaining important for explaining tax rates within a given tax structure, political economy considerations are not sufficiently important to undermine the policy conclusions reached within a public economics framework with respect to what constitutes the desirable tax-tariff structure, or more specifically the criticism by Emran and Stiglitz of the IMF and the World Bank's recommendation to developing countries to adopt VAT to replace border taxes.

6. Concluding remarks

In this paper we have developed a simple theory of optimal taxation which permits an endogenous choice of tax restrictions representing a trade-off between the objectives of limiting distortionary costs and of limiting the administrative costs of taxation. We have used the theory to gain insight into how the optimal tax-tariff systems evolve in the process of economic development suggesting that the optimal tax-tariff system will evolve through transitional phases characterised by significant changes in tax rates and in the objectives determining the optimal tariff rates. Using this theory we have also been able to throw light on the recent controversy regarding whether or not the substitution of VAT for border taxes in developing countries is likely to be welfare improving. Although reality is clearly more complex than has been assumed, the theory serves to highlight that disregarding the costs of tax administration may result in misguided recommendation with respect to the design of tax systems and tax-tariff reform in developing countries.

The analysis has also demonstrated that recommendations on tax design and tax-tariff reform cannot be made based only on theoretical considerations. A priority for future research must therefore be to gather further empirical evidence on the administrative costs to supplement the information provided by Evans 2003, Bird 2005 and others, and on their consequences along the lines suggested by the empirical work of Gordon and Li (2005b). There is also clearly a need to expand the micro foundation for explaining how the choice of tax structure and tax system

[16] Gordon and Li (2005a,b) assume that due to insufficient administrative infrastructure governments in poor countries are not able to tax activities of firms which do not use financial intermediation, that firms differ in their needs to use financial intermediation and that the incentive for firms to opt out of the use of the formal sector in general is greater than in developed countries. In terms of our model this means that the size of the informal sector, s_0, is large and that the elasticities of substitution σ_{i0} are large and of different size for different commodities, which, as we have seen, justifies the use of differentiated domestic taxes and when this is not possible, differentiated tariff rates, in order indirectly to tax the informal sector.

influences the administrative costs, the costs of tax evasion, and the incentive for rent seeking going beyond the simple framework established in this paper.

References

Allingham, M. and A. Sandmo (1972), "Income tax evasion: a theoretical analysis", *Journal of Public Economics,* **1**, 323-338.

Andreoni, J., B. Erard, and J. Feinstein (1998), "Tax compliance", *Journal of Economic Literature*, **96**, 818-860.

Baunsgaard, T. and M. Keen (2005), "Tax revenue and (or) trade liberalisation, *Working Paper, IMF.*

Bird, R.M. (2005), "Value added taxes in developing and transitional countries", *Working Paper 05-05, Andrew Young School of Policy Studies, Georgia State University.*

Corlett, W.J. and D.C. Hague (1953), "Complementarity and excess burden of taxation"*, Review of Economic Studies*, **21**, 21-30.

Dasgupta, P. and J. E. Stiglitz (1974), "Benefit-cost analysis and trade policies", *Journal of Political Economy*, **82**, 1-33.

Diamond, P.A. and D.L. McFadden (1974), "Some uses of the expenditure function in public finance", *Journal of Public Economics*, **3**, 3-21.

Diewert, W. E., A.H. Turunen-Red, and A.D. Woodland (1989), "Productivity and Pareto-improving changes in taxes and tariffs" , *Review of Economic Studies*, **56**, 199-216.

Dixit, A. K. (1985), "Tax policy in open economies," in *Handbook of Public Economics*, Vol. I, eds. A.J. Auerbach and M. Feldstein (Amsterdam: North-Holland).

Dixit, A.K. and V. Norman (1980), *The theory of international trade*, (Cambridge: Cambridge University Press).

Dixit, A and K. J. Munk (1977), "Welfare effects of tax and price changes. Correction", *Journal of Public Economics,* **8**, 103-107.

Evans, C. (2003) , "Studying the studies: An overview of recent research into taxation operating costs, *eJournal of Tax Research*, **1**, 64-92.

Emran, M. S. and J. Stiglitz (2003), "Price-neutral tax reform with an informal economy", *Working Paper, George Washington University.*

Emran, M. S. and J. Stiglitz (2005), "On selective indirect tax reform in developing countries", *Journal of Public Economics,* **89**, 599-623.

Gordon, G. and We Li (2005a), "Tax structures in developing countries: many Puzzles and a possible explanation", *NBER Working Paper No. 11267.*

Gordon, G. and We Li (2005b), "Puzzling tax structures in developing countries: A comparison of two alternative explanation", *NBER Working Paper N0. 11661.*

Grossman, G. and E. Helpman (1994), "Protection for sale", *American Economic Review*, **84**, 833-50.

Harberger, A. C. (1974), *"Taxation and welfare"*, (Chicago: Chicago University Press).

Hatta, T. (1977), "A recommendation for a better tariff structure", *Econometrica*, **45**, 1869-69.

Hatta, T. and Y. Ogawa (2003), "A theory of optimal tariffs under a revenue constraint", *CSIS Discussion Paper no. 55.*

Heady, C. and P. Mitra (1982*)*, "Restricted redistributive taxation, shadow prices and trade policy", *Journal of Public Economics,* **17***,* 1-22.

Heady, C. and P. Mitra (1987)*,* "Distributional and revenue raising arguments for tariffs"*, Journal of Development Economics,* **26***,* 77-101.

Keen, M. and J. E. Ligthart (2002), "Coordinating tariff reduction and domestic tax reform", *Journal of International Economics,* **56**, 489-507.

Laffont, J. J. (2004), "Management of public utilities in China", *Annals of Economics and Finance*, **5**, 185-210.

Mirrlees, J.A. (1971), "On producer taxation", *Review of Economic Studies*, **39**, 105-11.

Munk, K. J. (1980), "Optimal taxation with some none-taxable commodities"*, Review of Economic Studies,* **47***,* 755-765.

Munk, K. J. and B. Rasmussen (2005), "On the determinants of optimal border taxes for a small open economy", *Discussion Paper, University of Aarhus.*

Myles, G. D. (1995), *Public Economics,* (Cambridge: Cambridge University Press).

OECD (2004), Tax administration in OECD countries: *Comparative Information Series.*

Schneider, F. and Dominik H. Enste (2002), "Shadow economies: Size causes, and consequences", *Journal of Economic Literature*, **38**, pp 77-114.

Stiglitz, J. E. and P.S. Dasgupta (1971), "Differential taxation. public goods and economic efficiency", *Review of Economic Studies*, **38**, 151-174.

World Development Report 1988, published for the World Bank by Oxford University Press.

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