On the Use of Border Taxes in Developing Countries

Knud J. Munk†

Université catholique de Louvain and University of Aarhus

Version: January 2008

Abstract

With reference to the size of the informal sector, Stiglitz (2003) has argued, contrary to what is implied by the “Washington consensus”, that in the least developed countries, border taxes are superior to VAT. However, supported by much respectable research, the IMF and World Bank’s recommend that developing countries substitute VAT for border taxes, maintaining that with a VAT there is no justification for the use of border taxes. The present paper provides a simple general equilibrium framework which may be used as the basis for empirical research to settle the dispute. The framework allows for the fact that different tax structures are associated with different administrative costs and represent the informal sector as a parameterisation of household behaviour by a utility function with explicit representation of the use of time, the CES-UT. It illustrates by means of a quantitative example on the one hand, that a large informal sector in itself does not justify the use of border taxes, but on the other hand when administrative costs of taxation are taken into account, that the size of the informal sector is indeed important for whether the use of border taxes is desirable or not.

Keywords: Optimal trade policy, VAT, tax-tariff reform, costs of tax administration, informal sector, developing countries

JEL classification codes: F11, F13, H21

Acknowledgements

This is a revised version of University of Aarhus Discussion Paper 2006-12. Michael Keen of the IMF have been particular generous in providing detailed and constructive comments on that and other drafts of the paper. The paper has been presented at the IIPF 2007 and EEA 2007. Comments from Robin Boadway, and other participants in these events, and from Inger Munk and Hylke Vandenbussche have also been helpful. Thanks are also due to Ane-Kathrine Christensen for efficient research assistance. During work on the paper I have benefitted from resources made available both at the University of Aarhus and at Université catholique de Louvain, for which I am grateful.

†Visiting Professor at Université catholique de Louvain, and Adjunct Associate Professor at the School of Economics and Management at the University of Aarhus. He is also Research Professor at Deutsche Institute für Weltwirtschaft, and Associated Senior Research Fellow at the Danish Technical University. Correspondence by E-mail to knud.munk@uclouvain.be
1. Introduction

How to tackle underdevelopment in poor parts of the world is one of the most pressing challenges in economics today. In this context, in recent years the desirability of free trade, a treasured tenet of many economists, has come under attack. Prominently Stiglitz (2003) has implied, that substituting VAT for border taxes is likely to reduce rather than improve social welfare because developing countries have large informal sectors. However, a highly influential body of research, including work by Keen, has provided academic support for the IMF and World Bank recommendations for developing countries to use VAT rather than border taxes to raise government revenue. Yet the basis for the disagreement has remained elusive. Emran and Stiglitz’ (2005) contribution suggests that the key problem with the literature supporting the use of VAT in developing countries is that it neglects that these countries have large informal sectors. Keen (2007a) posits based on a partial equilibrium analysis that given an optimal VAT system a large informal sector in itself provides no justification for diversions from free trade. He further argues that the reason Emran and Stiglitz (2005) reach another conclusion, is that they misrepresented VAT by not allowing for the fact that under a VAT system the informal sector is not reimbursed for VAT paid on its purchase of intermediate inputs. Keen (2007b), however, recognises that in devising recommendations with respect to taxation in developing countries it is important to take into account administrative costs.

Governments in developing countries tend to finance a great part of their expenditures by border taxes. Whether developing countries benefit from the use of border taxes is thus an important policy issue with obvious relevance for policy makers in these countries, but also for policy makers in developed countries who in the context of international and bilateral negotiations on trade and assistance tend to put pressure on developing countries to liberalise their economies in return for market access. It is thus a question of considerable importance whether policy-makers should be guided by the recommendations of Emran and Stiglitz or by those of the Bretton-Woods sister organisations.

The contribution of this paper is firstly to clarify why Emran and Stiglitz (2005) and Keen (2007a,b), while relying on what is essentially the same theory, reach different conclusions, and secondly to contribute a relatively easy to implement parameterised theoretical model, which can be used as the basis for empirical research required to reach a consensus opinion on the issue. In the process, we point out that for the application of the Diamond and Stiglitz Production Efficiency Theorem, the presence of untaxed profit in the informal sector is irrelevant, and provide insight into why, due to problematic separability assumptions, simulations results based on the use of standard CGE models have misrepresented the cost of a differentiated tax and tariff structure in developing countries.

The paper is organized as follows. In Section 2, we set up a general equilibrium model which by the assumption of intermediate consumption allows the representation of a VAT tax system to be
different from a system of consumer taxes, and by the use of a utility function with the explicit presentation of the use of time to represent household production as the informal sector, and which also allows the representation of different tax structures to be associated with different administrative costs. In Section 3, we address from a theoretical point of view the issue at hand under alternative assumptions about administrative costs associated with taxation. In Section 4, we specify a stylized CGE model, which uses the CES-UT parameterisation of a household utility functions to represent the informal sector in a prototype developing country; present simulation results on the differences in administrative costs associated with a VAT and other tax structures; and identify under what conditions within the framework of the stylised model diversions from free trade is justified. A final section summaries and concludes the paper.

2. The general equilibrium setting with the representation of VAT and the informal sector

Extending the theoretical framework used in Munk (2004) with the representation of intermediate consumption (without which a VAT is equivalent to a system of consumer taxes), we specify a general equilibrium model of a small open economy with three perfectly competitive production sectors, one representative household, and a government. In the economy there is one domestically traded primary factor, indexed 0, and three internationally traded commodities, indexed 1, 2 and 3. The government imposes border taxes, \( t^W = (t_1^W, t_2^W, t_3^W) \), household taxes \( t = (t_0, t_1, t_2, t_3) \), and sector specific taxes on intermediate inputs, \( t^i = (t_1^i, t_2^i, t_3^i) \), \( i = 1, 2, 3 \). World market prices are \( p^w = (p_1^w, p_2^w, p_3^w) \), market prices are \( p = (p_0, p_1, p_2, p_3) = (p_0 + t_1, p_1 + t_1, p_2 + t_2, p_3 + t_3) \), household prices are \( q = (q_0, q_1, q_2, q_3) = (p_0 + t_0, p_1 + t_1, p_2 + t_2, p_3 + t_3) \) and sector specific producer prices for intermediate inputs are \( p^i = (p_1^i, p_2^i, p_3^i) = (p_1 + t_1^i, p_2 + t_2^i, p_3 + t_3^i) \). The economy is assumed to have the potential to produce any of the three commodities using the primary factor and intermediate inputs of produced commodities. The production in the formal sector exhibits constant returns to scale with \( c'(p_0, p_1, p_2, p_3) \) representing the unit cost of producing commodity \( i \). Hence, the economy will specialise in the production of one commodity, which thus becomes the export good, while the two other commodities become import goods. The output of the export sector is \( y_k \),
the use of the primary factor for its production is \( v_i \), and the use of intermediate inputs \( v_i, i = 1, 2, 3 \). By the zero profit condition, the producer price of the export good is \( p_k = e^k \left( p_0, p_1^k, p_2^k, p_3^k \right) \).

The household's endowment of the primary factor is \( \omega_0 \), and its net demand vector is \((x_0, x_1, x_2, x_3)\).

The household's untaxed consumption of the primary factor is thus \( \omega_0 + x_0 \). The government's resource requirement is \( x_i^G, i = 0, 1, 2, 3 \).

The condition of profit maximisation is for the export sector, sector \( k \), is that

\[
\frac{\partial c^k}{\partial p_i}(p_0, p_1^k, p_2^k, p_3^k) y_k = 0, \quad i = 0, 1, 2, 3
\] 

\[
p_k = e^k \left( p_0, p_1^k, p_2^k, p_3^k \right)
\] 

and for other sectors, that

\[
p_i < e^i \left( p_0, p_i^i, p_1^i, p_2^i, p_3^i \right) \quad i \neq k = 1, 2, 3
\] 

The balance of trade constraint is

\[
\sum_{i=1}^{3} p_i^W y_i^W = 0
\] 

The government's budget constraint is

\[
\sum_{i=0}^{3} x_i + \sum_{i=1}^{3} t_i x_i + \sum_{i=1}^{3} t_i^W y_i^W - \sum_{i=0}^{3} p_i x_i^G = 0
\] 

Material balance requires

\[
0 = v_0 + x_0 + x_o^G
\] 

\[
y_k + y_k^W = v_1 + x_k + x_k^G
\] 

\[
y_i^W = v_i + x_i + x_i^G \quad i \neq k = 1, 2, 3
\] 

If we had represented household preferences by a standard utility function, \( u(x_0, x_1, x_2, x_3) \), the condition for \((x_0, x_1, x_2, x_3)\) to be consistent with the utility maximising condition for general equilibrium, we would have expressed by

\[
E(q, u) = 0
\] 

\[
x_i = E_i(q, u) \quad i = 0, 1, 2, 3
\] 

However we add structure to the model by expressing this condition based on a utility function with explicit representation of time, \( U \left( c_0^0, c_1 \left( x_1, c_0^1 \right), c_2 \left( x_2, c_0^2 \right), c_3 \left( x_3, c_0^3 \right) \right) \). We assume that the purchase of produced commodities by the household sector, \( x_i, i = 1, 2, 3 \) is combined with use of

---

1 The sign conventions are: \( y_i > 0 \) and \( v_i > 0, (i = 0, 1, 2, 3) \); \( x_k < 0 \) and \( x_i > 0 \) \((i=1,2,3)\); \( y_i^W < 0 \) and \( y_i^W > 0 \) \((i = k = 1, 2, 3)\). Thus for the primary factor tax and the export tax, respectively, to generate a positive tax revenue, the tax rates must be negative.
time, \(c_i^0, i=1,2,3\), producing goods \(C_i, i=1,2,3\), which are traded and consumed only within the household sector. \(C_i = C_i(x_i, c_i^0)\), \(i=1,2,3\) are concave functions, which represent how the amounts purchased of the commodities by the household are combined with the time used for their consumption. \(U(c_i^0, C_1, C_2, C_3)\) defined on consumption of the three composite commodities and pure leisure, \(c_0^0\), which is the amount of time used on activities that do not involve the consumption of purchased commodities, is a household utility function with standard properties. The total time used for the consumption of purchased commodities is \(\sum_{i=1,2,3} c_i^0\), therefore \(c_0^0 = \omega_0 - \sum_{i=1,2,3} c_i^0 - x_0\). We define the informal sector as the production and consumption of goods \(C_i, i=1,2,3\). Informality thus involves that production and consumption, as well as transactions within the household sector, is not subject to taxation\(^2\). The profit in the informal sector is \(\Pi(q_0, q_1, q_2, q_3) = \max_{x_{q_i}, i=1,2,3} \{\sum_i Q_i C_i - \sum_i G_i(q_0, q_i, C_i)\}, i=1,2,3\), where costs functions \(G_i(q_0, q_i, C_i), i=1,2,3\) indicate the costs associated with the production of commodities within the informal sector.

The conditions for \((x_0, x_1, x_2, x_3)\) to be consistent with the utility maximising condition for general equilibrium may thus be express by (cf. Munk 2008)

\[
E(q_0, Q_1, Q_2, Q_3, u) - q_0 \omega_0 = \Pi(q_0, q_1, q_2, q_3)
\]

\(i=1,2,3\)

\[
Q_i = G_i^C(q_0, q_i, C_i)
\]

\(i=1,2,3\)

\[
x_i = G_i^q(q_0, q_i, C_i)
\]

\(i=1,2,3\)

\[
c_i^0 = G_i^c(q_0, q_i, C_i)
\]

\(i=1,2,3\)

\[
x_0 = c_0^0 + \sum_{i=1,2,3} c_i^0 - \omega_0
\]

where \(G_i^C(q_0, q_i, C_i) \equiv \frac{\partial G_i}{\partial q_0}\), \(G_i^q(q_0, q_i, C_i) \equiv \frac{\partial G_i}{\partial q_i}\), and where marginal costs are \(G_i^C(q_0, q_i, C_i) \equiv \frac{\partial G_i}{\partial C_i}\) and \(Q_i\) is the informal sector price of the commodity \(i=1,2,3\).

It is easy to verify that the whole system of general equilibrium conditions (1) to (14) is homogenous of degree zero both in consumer prices, \(q \equiv (q_0, q_1, q_2, q_3)\), and producer prices, \(p \equiv (p_0, p_1, p_2, p_3)\).

Domestic consumption and the border transaction of one commodity can thus be assumed untaxed without loss of generality (cf. Munk 2004). World market prices, \(p^w \equiv (p_0^w, p_1^w, p_2^w, p_3^w)\), are

---

\(^2\) Our notion of informality is thus different than the notion of a black economy where agents evade taxation. As pointed out by Pierre Pestieau at the IIPF 2007, where Boadway and Sato (2007) and Dreher, Méon and Schneider (2007) were also presented, the agricultural sector, representing up to 50% of national income, was exempt from taxation on income and market transactions in many European countries at the middle of the 20th century. This notion of informality is therefore presumable also of appropriate to describe the situation in many developing countries today.
exogenously determined, and as a matter normalisation and without loss of generality, we assume
that the export good is untaxed at the border, and that the supply of labour to the market is untaxed,
i.e. \( t_k^w = 0 \) and \( t_0 = 0 \) (cf. Munk (2004)).

As the informal sector is represented by adding structure to a standard utility function, the model is
consistent with the traditional Diamond and Mirrlees framework for optimal tax analysis, as spelt out

However, at one important point yet to be specified, we differ from this framework, however in a
way which it in general is considered to be important to represent\(^3\); we assume that different tax
structures are associated with different administrative costs\(^4\). We assume that the government’s
resource requirement depends on the tax system, \( \tau \equiv (t, t', i=1,2,3) \), rather than being
exogenously given. To make precise this notion we assume, as in Munk (2004), that the
government’s choice of a tax-tariff system, \( \tau^* \equiv (t^*, t^{*'}, i=1,2,3) \), is constrained to be an element
in the set of tax-tariff structures, \( \Xi^j, j \in \mathbb{F} \), where each tax structure \( j \) is defined by restrictions
imposed on the tax instruments available to the government, and where the administrative costs for
all tax-tariff systems belonging to a given tax-tariff structure \( j \) are \( B(j) \). Since we assume the
government’s resource requirement for other expenditures than for tax administration is exogenously
given, the government’s total resource requirement is thus

\[
x_i^G = x_i^G (j) \quad i = 0,1,2,3 \tag{15}
\]

3. The solution to the government’s problem

In this section, we consider the implication for the government’s problems of maximising social
welfare under the alternative assumptions that taxation is, and is not associated with administrative
costs (cf. Munk 2004).

- **when taxation is not associated with administrative costs**

The Diamond and Mirrlees’ Production Efficiency Theorem says that although lump-sum taxation is
not feasible, optimal taxation requires production efficiency to be maintained; it will therefore not in
the model specified in Section 2 be desirable to tax neither intermediate inputs nor border
transactions. When taxation is assumed not to be associated with administrative cost, the general
equilibrium model specified in Section 2 is a special case of the general theoretical model from

\(^3\) For example Emran and Stiglitz (2005) emphasise the importance of administrative costs, but do not explicitly represent
such costs in their model.

\(^4\) Administrative includes both the costs of tax collections and the cost of tax compliance.
which the Diamond and Mirrlees’ Production Efficiency Theorem is derived. It thus follows directly from the application of this theorem, that when all market transactions can be taxed at no costs, that production efficiency, and thus free trade is desirable. If VAT is interpreted as the taxation of household consumption (including consumption used as inputs for informal sector production) at different rates, and as exemption from taxation of intermediate inputs used in the informal sector, i.e.

\[ \tau = (t, t', i=1,2,3, t^W) \] where \( t' = 0, i=1,2,3 \), then Keen (2007a,b) is right, that with a VAT there is no justification for the use of border taxes. It is indeed an illustration of the benefits of the representation of household production as embedded in the general utility function, rather than as a separate production sector, that we are able to reach the same conclusion as Keen (2007b) without complex derivations and interpretations of conditions for a constrained maximization.

when taxation is associated with administrative costs

The development of the Diamond and Mirrlees framework for the analysis of optimal taxation was motivated by the observation, that it is administratively infeasible to achieve government objectives of income distribution and revenue generation by the use of lump sum taxes. It is however equally unrealistic to assume that systems of commodity taxation are not associated with administrative costs. Nevertheless, during the last 30 years this assumption has been the maintained assumption in almost all optimal tax analyses. However, as noted from the outset by Stiglitz and Dasgupta (1971) and elaborated using a dual approach in Munk (1980), but largely neglected, presumably as analytically and ideologically inconvenient, if commodity taxes cannot be taxed at their optimal level at no costs, the Diamond and Mirrlees (1971) Production Efficiency Theorem is not valid and production efficiency and free trade thus not necessarily desirable.

The consensus opinion in the profession with respect to taxation in developed countries is that a progressive income tax combined with a VAT at uniform rate without the use of border taxes, is the best system of taxation. This position finds its justification mainly based on two arguments. The first is that with a progressive income tax the scope for increasing social welfare by a differentiated system of commodity taxation is small compared with the administrative costs involved; and the second that the use of border taxes will introduce production inefficiency. The first argument is often justified with reference to Atkinson and Stiglitz (1978) who show that with an optimal income tax there is no need for differentiated commodity taxation; and the second argument with reference to the Diamond and Mirrlees (1971) Production Efficiency Theorem as mentioned above.

However, there is also a consensus opinion in the profession, supported by substantial research by the World Bank and the IMF, that taxation in developing countries is associated with high
administrative costs, which effectively makes it impossible to raise tax revenue by income taxation and also makes it very costly to differentiate VAT rates.

The IMF and World Bank recommendations with respect to taxation in developing countries to implement a VAT at uniform rate without the use of border taxes may therefore be seen as the application to developing countries of what is generally considered a reasonable system of taxation for developed countries. But, as pointed out by Stiglitz (2003), there are important differences between developed and less developed countries which need to be taken into account in providing advice on taxation. As emphasised by Emran and Stiglitz (2007), the fact, that developing countries cannot raise a significant amount of tax revenue by income taxation, means that the insight by Atkinson and Stiglitz (1978) cannot be used to provide a rationale for the application in developing countries of a VAT at uniform rate; and with a VAT at uniform rate, the Diamond-Mirslees Production Efficiency Theorem provides no justification for arguing that it is desirable to suppress border taxes. Furthermore, if a VAT at uniform rate is assumed superior to a VAT at differentiated rates due to the administrative costs involved, then, as Emran and Stiglitz (2005) point out and as supported by the analysis in Munk (2004), the size of the formal sector plays an important role for whether the use of border taxes is justified or not. It seems therefore that there is a inconsistency between the World Bank and the IMF's position with respect to the importance of administrative costs, and their position on the use of border taxes by developing countries.

4. The CES-UT parameterisation of household preferences and a quantitative illustration

It is one thing theoretically to establish that administrative costs may justify diversions from free trade; it is another matter whether such costs do in fact justify the use of border taxes. There is still relative little empirical evidence available on the administrative costs associated with different tax systems in developing countries, and the data required to fully specify general equilibrium models to represent developing country economies, are not readily available. There seems therefore not yet to be sufficient empirical evidence to conclusively settle the dispute on whether it is desirable or not for developing countries to use border taxes.

However, we want here by a quantitative example involving the use of a stylized CGE model\(^5\), to approach an answer to this question. To fix ideas we assume, that in the prototype developing country that the informal sector is large, as is manifestly the case in most developing countries, and that in the formal part of the economy involve transaction in three produced commodities: Manufacturing (1), Cash crop (2) and Food (Formal sector) (3), that the three commodities are

\(^5\) A detailed documentation of the model may be obtained from the author.
traded both domestically and internationally, and that at world market prices the economy is competitive in the production of Food (Formal sector), but not in Cash crop and in particular not in Manufacturing. Furthermore, we assume that Food (Informal sector), a close substitute to Food (Formal sector) in the informal sector. Food (Formal sector) is represented by the CES unit cost function \( c^3 \left( p_0, p_i; s^3 \right) \), where \( s^3 \) is the elasticity of substitution between inputs of Labour and Manufacturing, whereas Food (Informal sector) is produced according to the CES cost function, \( G^i \left( q_0, q_i, C_i; \sigma^{i1} \right) \), mainly by the use of time, but also with an input of Manufacturing.

**Figure 1: The structure of household preferences imbedding the formal sector**

We represent household behaviour, and thus the behaviour of the informal sector as the result of maximisation subject to the budget constraint, \( \sum_{i=0,1,2,3} q_i x_i \), of a simplified version of the CES-UT utility function, \( U \left( c_0^0, C_i \left( x_i, c_0^i, \sigma^{i1} \right), x_2, x_3; \sigma^2 \right); \sigma^3 \)\), where \( C_i \left( x_i, c_0^i, \sigma^{i1} \right), \quad C \left( C_i, x_2, x_3; \sigma^2 \right) \) and \( U \left( C, c_0^0; \sigma^3 \right) \) are CES functions characterised by elasticities of substitution \( \sigma^{i1}, \sigma^2 \) and \( \sigma^3 \), respectively. We incorporate the CES-UT parameterisation of household behaviour in stylized CGE model just to put numbers to the theoretical results reviewed in Section 3, rather than at this stage to attempt to reach conclusive answers based on empirically evidence which very difficult, if not
impossible to obtain. A graphical illustration of the CES-UT utility function used is provided in Figure 1.

As a matter of normalisation without loss of generality, we assume, as in the general model, the export of Food (Formal sector) and the supply of Labour to the market to be untaxed.

The partial equilibrium model specified by Keen (2007b) may be interpreted as a special case of this model and thus of the general equilibrium model formulated in Section 2. The parameters used for the fully specified model are provided in Table 1.

**Table 1: Parameter values of the parameterised model**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elasticity of substitution between pure leisure and consumption, $$\sigma^3$$</td>
<td>0.8</td>
</tr>
<tr>
<td>Elasticity of substitution between composite commodities, $$\sigma^2$$</td>
<td>1</td>
</tr>
<tr>
<td>Elasticity of substitution within the production of food in the informal sector: $$\sigma^{11}$$</td>
<td>0.1</td>
</tr>
<tr>
<td>The primary factor costs as a share of the purchase of input to produce Food (informal sector)</td>
<td>3</td>
</tr>
<tr>
<td>Elasticity of substitution within the production of food in the informal sector: $$\sigma^3$$</td>
<td>1</td>
</tr>
</tbody>
</table>

The benchmark data set representing the hypothetical situation, where the government’s revenue requirement is financed by a lump-sum tax, is provided in Table 2 in the form of supply utilisation accounts for the formal part of the economy.

**Table 2: Supply utilisation accounts for the formal economy**

<table>
<thead>
<tr>
<th>Output</th>
<th>Intermediate consumption in the formal sector</th>
<th>Net trade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Produced commodities</td>
<td>Manu.</td>
<td>0</td>
</tr>
<tr>
<td>Cash c.</td>
<td>0</td>
<td>0,00</td>
</tr>
<tr>
<td>Food</td>
<td>20,00</td>
<td>0,00</td>
</tr>
<tr>
<td>Primary factor</td>
<td>Labour</td>
<td>0</td>
</tr>
</tbody>
</table>

The total time endowment is assumed to be 138 of which 24 is used for production of Food (Informal Sector) and 91 for non-productive purposes, leaving 23 to be supplied to the market in the form of Labour. Defining National Income as the value added in the production of Food (Formal sector) and Food (Informal sector), and the Government’s use of Labour, the share of the informal sector in terms of National Income in the benchmark is thus 46%.

The corresponding matrix of consolidated, compensated demand elasticities, which to the extent they are available may be compared with elasticities obtained from the estimation of complete demand systems using flexible functional forms, is provided in Table 3 (for how to calculate these elasticities, see Munk 2008).

---

6 See Annex for a more detailed argumentation for this assertion.

7 In the benchmark, the value of time is assume to be three times the value of the input of Manufacturing in the production of Food (Informal sector) (see Table 1)
Table 3: Consolidated compensated price elasticities for the parameterised utility function for the chosen parameter values

<table>
<thead>
<tr>
<th></th>
<th>Manufacturing</th>
<th>Cash crop</th>
<th>Food (Formal sector)</th>
<th>Labour</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \varepsilon_{ij} )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td>-0.239</td>
<td>0.032</td>
<td>0.075</td>
<td>0.131</td>
</tr>
<tr>
<td>Cash crop</td>
<td>0.086</td>
<td>-0.968</td>
<td>0.075</td>
<td>0.806</td>
</tr>
<tr>
<td>Food</td>
<td>0.086</td>
<td>0.032</td>
<td>-0.925</td>
<td>0.806</td>
</tr>
<tr>
<td>Labour</td>
<td>-0.046</td>
<td>-0.105</td>
<td>-0.245</td>
<td>0.396</td>
</tr>
</tbody>
</table>

Note: The elasticities have been calculated based on the parameters specified in Table 1 and the benchmark dataset specified in Table 2.

For further reference, we notice that the compensated price elasticity of the untaxed use of the primary factor in the household sector with respect to the demand for Manufacturing (0.131) is smaller than with respect to the demand for Cash crop and Food (both 0.806); furthermore that the compensated elasticities of demand for Manufacturing and Cash crop with respect to the price of the export good, Food (Formal sector), are the same (both 0.075).

We assume that the government considers four different tax structures:
- \( \Xi^1 \): Only VAT at uniform rate,
- \( \Xi^2 \): No restrictions on the set of feasible tax instruments,
- \( \Xi^3 \): VAT at uniform rate and border taxes, and
- \( \Xi^4 \): Only border taxes;

The corresponding optimal tax systems, \( \tau^j \), \( j = 1,2,3,4 \) (for the reason of exposition based on the assumption that taxation does not involve administrative costs) are provided in Table 4.

For \( \Xi^2 \), where there are no restrictions on the government’s use of commodity tax instruments, the optimal tax system involves production efficiency and hence \( t^w = 0 \). The optimal differentiation of commodity tax rates represents a trade-off between the objective of encouraging the supply of labour to the formal sector and the objective of not distorting the consumer prices of produced commodities (cf. Munk 2008). As Manufacturing is complementary with the (untaxed) use of the primary factor in the informal sector (see Table 3), the optimal tax on the consumption of Manufacturing is thus taxed at a relatively high rate of 45%, whereas the consumption of Cash crop and Food (Formal sector) is only taxed at 15%.

For \( \Xi^3 \), where the government’s revenue requirement is financed by a VAT at a uniform rate supplemented by border taxes, production efficiency is in general not desirable. We can here as for \( \Xi^2 \) as a matter of normalisation without loss of generality assume the export of Food (Formal sector) untaxed. The optimal tax system now involves a three way trade-off between the same two objectives as in the case of \( \Xi^3 \), and in addition the objective of limiting the distortion of the input price of
Manufacturing in the production of Food (Formal sector). The optimal solution involves a VAT at a uniform rate of 19% supplemented by a tariff on the imports of Manufacturing of 18%. Because of the objective of limiting the distortion of inputs in the production of Food the price wedge between the consumer price and the world market prices, reflecting the combined effect of the VAT at uniform rate and the tariff, is at 40% lower than the VAT rate for Manufacturing for $\tau^2$ at 45%.

Table 4: Optimal tax-tariff systems and administrative costs

<table>
<thead>
<tr>
<th>Optimal tax-tariff system</th>
<th>$\tau^1 \in \Xi^1$</th>
<th>$\tau^2 \in \Xi^2$</th>
<th>$\tau^3 \in \Xi^3$</th>
<th>$\tau^4 \in \Xi^4$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic tax rates</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td>$t_1$</td>
<td>0,32</td>
<td>0,45</td>
<td>0,19</td>
</tr>
<tr>
<td>Cash crop</td>
<td>$t_2$</td>
<td>0,32</td>
<td>0,15</td>
<td>0,19</td>
</tr>
<tr>
<td>Food (Formal sector)</td>
<td>$t_3$</td>
<td>0,32</td>
<td>0,15</td>
<td>0,19</td>
</tr>
<tr>
<td>Labour</td>
<td>$t_0$</td>
<td>0,00</td>
<td>0,00</td>
<td>0,00</td>
</tr>
<tr>
<td>Border tax rates</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturing good</td>
<td>$t_1^W$</td>
<td>0,00</td>
<td>0,00</td>
<td>0,18</td>
</tr>
<tr>
<td>Cash crop</td>
<td>$t_2^W$</td>
<td>0,00</td>
<td>0,00</td>
<td>0,00</td>
</tr>
<tr>
<td>Food (Formal sector)</td>
<td>$t_3^W$</td>
<td>0,00</td>
<td>0,00</td>
<td>0,00</td>
</tr>
<tr>
<td>Factor income (formal sector)</td>
<td></td>
<td>20,67</td>
<td>21,48</td>
<td>20,80</td>
</tr>
<tr>
<td>EV compared with $\tau^1 \in \Xi^1$ (as share of benchmark factor income in the formal sector)</td>
<td></td>
<td>0</td>
<td>0,58%</td>
<td>0,43%</td>
</tr>
</tbody>
</table>

For $\Xi^4$, where the government’s revenue requirement is financed only by border taxes, we can as for $\Xi^2$ and $\Xi^3$, as a matter of normalisation without loss of generality, assume the exports of Food (Formal Sector) as untaxed. The optimal solution involves differentiation of tariff rates motivated by the following objectives (cf. Munk 2004 and Munk and Rasmussen 2005: the two objective which determine the optimal tax system in a closed economy

- to encourage the supply of labour to the formal sector (Objective 1), and
- not to distort the consumer prices of produced commodities (Objective 2)

and in addition the objective

- to encourage the export of Food (Objective 3)\(^8\)

Objective 2 draws, as in the case of $\Xi^1$, in the direction of a relatively high tariff on the imports of Manufacturing. Objective 3 suggests on the one hand, that it is desirable to strive for a relatively high

---

8For border taxes to raise revenue to the government the tax system $\tau^4$ must discouraged the exports of Food (Formal sector). Objective 3 does not apply in the case of $\Xi^1$ since under this tax structure the justification for the use of border taxes is not to raise government revenue directly, but to encourage the supply of labour to the market.
tariff on the imports of commodities which in household consumption is complementary with the consumption of *Food (Formal sector)*, the export good, and on the other hand, that a relatively low tariff on *Manufacturing* is desirable as it is used as intermediate inputs in the production of *Food* in the formal sector. With the current parameterisation we have assumed additive separability in consumption between the three produced commodities. This implies that that *Manufacturing* and *Food (Formal sector)* are equally complementary with the consumption of *Food (Formal sector)* (see Table 3). It is thus not possible by differentiation of tariff rates to discourage the household consumption of *Food (Formal sector)*, however this of an artefact due to the parameterisation of the model. A relative low tariff on *Manufacturing* will thus encourage the production, and thus the export of *Food (Formal sector)*. *Objective 2* of encouraging the supply of labour to the market dominates *Objective 3* of encouraging the exports of *Food (Formal sector)* with the result that the optimal tariff on the imports of *Manufacturing* at 52% is considerably higher than the tariff on *Cash Crop* at 19%.

This result contrasts with results calculated using of standard CGE models, as for example Dahl et al. (1994) and Mitra (1992), where the welfare loss caused by imposing a uniform tariff rather than the optimal tariff is negligible. This difference in results may be explained by the fact that standard CGE models impose separability between household consumption of produced commodities and sometimes even that the supply of labour is fixed, whereas the CES-UT specification used in the present model allows for differences in the degree of complementarity with the use of the primary factor in the informal sector. It seems hardly realistic, in particular in developing countries, to assume additive separability between consumption of different commodities and the use of the primary factor in the informal sector. One would therefore expect a non-proportional tariff structure to represent the optimal solution in practise even based only on efficiency considerations. Our simulation results are consistent with this insight. We therefore at this point for the reasons elaborated in Munk and Rasmussen 2005 reach a different conclusion than Hatta and Ogawa (2007) who suggest that in practice the optimal tariff structure will be close to proportionality.

To give an idea of the size of administrative costs required to balance the allocative benefits of different tax structures, we calculate the savings in administrative costs required to make the optimal tax systems \( \tau_j^* \), \( j = 2, 3, 4 \) equivalent in welfare terms to \( \tau^1 \). These results are reported in Table 5.

*Table 5: Administrative costs making \( \tau_j^* \sim \tau^1 \, 11\)*

---

9 We are in the process of modifying the parameterised model to be able to represent this possibility.

10 Based, as here, solely on efficiency considerations it thus does not seem realistic that a proportional tax system should be optimal. Taking distributional aspects into account naturally provides an additional reason for non-proportionality. For more detailed arguments with respect to this point, see Emran and Stiglitz (2007).

11 The figures of course differ from the EVs reported in Table 4 due to as they have been calculated taking the administrative costs of taxation into account.
The increase in administrative costs associated with $\Xi^2$ compared with $\Xi^1$ which makes $\tau^2$ equivalent to $\tau^1$ in welfare terms, is 0.48% of the factor income in the formal sector. The increase in administrative costs associated with $\Xi^3$ which makes $\tau^3$ equivalent to $\tau^1$ is 0.29%, whereas the administrative costs associated with $\Xi^4$ need to be at least 0.35% lower to make $\tau^4$ equivalent to $\tau^1$. Therefore, if compared with the administrative costs associated with $\Xi^1$ the administrative costs associated with $\Xi^2$ are more than 0.58% greater, and either those associated with $\Xi^3$ less than 0.37% more costly, or those associated with $\Xi^4$ at least 0.47% less costly, then border taxes are desirable as an alternative or as a supplement to a VAT system.\footnote{This figure increases progressively with the government’s revenue requirements. If for example the share of the government’s requirement increases from 5 to 10 (see Table 2) the saving in administrative costs required for financing the government’s revenue requirement solely by border taxes rather than by a VAT at uniform rate increases more than three fold from 0.35% to 1.15% of the factor income in the formal sector. With reference to increases in the efficiency of tax administration and the increasing size of the government’s share of consumption of National Income, Kimbrough and Gardner (1992) explain why the importance of tariff revenue in the US has diminished over time. The present model may thus also be used to illustrate this insight.}

The model simulations thus highlights that one cannot a priori exclude that border taxes are desirable, and the important role for this to be the case played by 1) the size of the informal sector, 2) the differences in complementarity with the untaxed use of primary factors in the informal sector of different commodities, and 3) the costs associated with tax administration. As knowledge about these aspects are largely insufficient to settled the dispute between Stiglitz and the Bretton-Woods sister organisations, there is clearly a need for empirical research on the administrative costs associated with different tax structures and on the structure of the economy (in our model represented by the benchmark data set and the value of the elasticities of substitution) and in order to determine whether the use of border taxes is indeed desirable in developing countries.

5. Summary and Concluding Remarks

We have investigated Stiglitz’ (2003) claim that in developing countries border taxes are a better instrument to raise government revenue than a VAT. We have for this purpose specified a parameterised model where the informal sector is represented by a simplified CES-UT utility function, where production in the informal sector is assumed to generate an untaxed profit to the household, and where different tax structures are associated with different administrative costs. We
have shown that Keen’s partial equilibrium model essentially is a special case of this model. His analysis therefore amounts to restating the Diamond-Mirrlees efficiency theorem for this special case. Keen is thus right that an informal sector in itself does not provide an argument against free trade.

Using the parameterised model and a set of data and parameter values resulting in a plausible matrix of compensated demand elasticities to represent a prototype developing country with a large informal sector, we have produced simulation results which illustrate that when taxation is associated with administrative costs whether border taxes are desirable or not depends critically on the size of informal sector and thus lent support to the position taken by Emran and Stiglitz (2005, 2007). Where a VAT at uniform rates is the only source of domestic taxation, the complementarity between the consumption of the traded goods and the use of the primary factor in the informal sector plays an import role for whether based on efficiency considerations it is desirable to supplement the VAT with border taxes. In the case where border taxes are the only source of government revenue the discouragement of the consumption of the export good and the encouragement of its production also influence the optimal tax structure. Contrary to what has been suggested in the literature a proportional tariff structure is unlikely to be optimal in practice, in particular when distributional considerations, which we for reasons of exposition we have ignored in this paper, are taken into account.

The simulation results have highlighted that the question of whether border taxes are desirable or not can only can be settled on the basis of solid empirical evidence. Evidence on the distortionary and administrative costs of various tax arrangements remains essential in order to identify the optimal tax-tariff system for a given country at a given point in time. Claims of the opposite are likely to represent expressions of ideology, rather than being based on scientific insight.
References


Munk, K. J. (2008), “Welfare effects of tax and price changes revisited, Manuscript, Université catholique de Louvain, and University of Aarhus.


Annex: The partial equilibrium model employed by Keen

The purpose of this Annex is to detail the assertion in the main text that the partial equilibrium model employed by Keen (2007b), which underpins his 2006 presidential address to the IIPF congress (Keen 2007a), may be seen as a special case of the model specified in Section 2. Keen considers an economy with an informal and formal sector, but as his analysis is conducted within a partial equilibrium framework, he does not explicitly represent the use of the primary factor in either the informal sector or the formal sector. Furthermore, he explicitly represents only two commodities. However, assuming that the first commodity corresponds to Manufacturing and the second to Food (Formal sector), Keen’s model, as our model, explicitly represents Manufacturing imports and the domestic production of Food (Formal sector), as well as the competing production of Food (Informal sector). Keen (2007b) assumes the production of Food (Informal sector), \( C_i \) in our notation and \( Y \) in Keen’s notation, to be a perfect substitute for Food (Formal sector), \( y_3 \) in our notation and \( y \) in Keen’s notation, whereas in our model Food (Formal sector) and Food (Informal sector) are imperfect substitutes. However, this is not an important difference as Keen’s model at this point may be interpreted as a limiting case of our model.

The consumer price of manufacturing, \( q_i \) in our notation, is in Keen’s notation \( \rho = \frac{P + T_M + T_W}{1 - T_v} \) with \( P \) being the world market price of Manufacturing, \( T_M \) and \( T_W \) the tariff rate and the VAT rate, respectively, applied to Manufacturing imports (the latter, \( T_W \), by Keen called a withholding tax), and \( T_v \) the VAT rate applied to sales of domestically produced goods. When \( \rho T_v = T_W \), such that the tax-inclusive import price of Manufacturing faced by informal producers is \( \rho = P + T_M \), this corresponds to a VAT at uniform rate, in our notation to a consumer tax vector, \( (t_1, t_2, t_3) \), where \( (t_i + p_i) / p_i = T \) \((i = 1, 2, 3)\).

In Keen’s model the unit cost of Food (Formal sector), \( Q \) in his notation plus the VAT rate is equal to the (shadow) price of Food (Informal sector), in our notation \( Q_i = G_i(C) \left( q_0, q_i, C_i \right) \). The cost function for the production of Food (Formal sector), in Keen’s notation \( C(\rho, Y) \), is in our notation \( c^3(p_0, p_i; s^3) y_3 \). Notice than both in the model employed in Munk (2004) and in this paper, the consumption in the informal sector of commodities produced in the formal sector are purchased at consumer prices\(^{13} \). This is in contrast to what is assumed in Stiglitz and Emran (2005).

---

\(^{13}\) It is thus not correct, as Keen (2007a,b) seems to suggest, that the use imports in the informal sector are not assumed subject to VAT in Munk (2004). However, in the model used in that paper, contrary to in the present one, there is assumed not to be any use of intermediate inputs in formal sector production. A VAT is therefore in Munk (2004) similar to a consumption tax system, as indeed in Emran and Stiglitz (2005).