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THEORY AND AN APPLICATION TO INDIA

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THEORY AND AN APPLICATION TO INDIA*

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PROTECTIVE AND REVENUE-RAISING TRADE TAXES: THEORY AND AN APPLICATION TO INDIA

Pradeep K. Mitra

ABSTRACT

This paper lays out an analytical framework which is general enough to encompass two prominent approaches to trade policy analysis in developing countries. These are (1) the Ramsey-Samuelson-Diamond-Mirrlees public finance tradition as applied to open economies and (2) the effective protection tradition stemming from the work of Balassa and Corden. Such a unified perspective emphasizes the critical role of assumptions about domestic fiscal instruments in the appropriateness of trade policy advice. The paper obtains analytical characterizations of desirable protective and revenue-raising trade taxes in various circumstances and, inter alia, identifies directions of reform. The quantitative significance of these ideas is illustrated by calculating such tariffs in a general equilibrium model of the Indian economy.
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1. INTRODUCTION

The Setting

The reform of trade taxes, i.e., import tariffs and export subsidies is an integral part of the process of structural adjustment in developing countries. Such reform is constrained by the need to (1) provide a limited degree of timebound protection for domestic and export production in selected sectors of the economy; (2) maintain the public revenue base in as much as trade taxes are a significant source of revenue, especially in low-income countries, and (3) pay due attention to administrative capacity. Balancing these considerations as part of a best feasible policy package is a difficult but inescapable task.

The purpose of this paper is (1) to obtain a precise analytical characterization of optimal protective and revenue-raising trade taxes in small open developing economies under different assumptions about domestic tax possibilities and (2) to explore the quantitative significance of those results in an applied general equilibrium model of India. First, it lays out a framework which is general enough to encompass two prominent and potentially conflicting

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1/ This paper does not deal explicitly with quantitative restrictions. However, import tariffs can be understood to cover the tariff equivalent of such restrictions.
approaches to trade policy analysis which have influenced advice in
developing countries. These are (1) the Ramsey-Samuelson-Diamond-
Mirrlees tradition elaborated by Dasgupta and Stiglitz (1974) and
Dixit and Norman (1980) and synthesized in Dixit's (1985) survey of
open economy public finance; and (2) the effective protection
tradition associated with Balassa (1977) and Corden (1974) and
formalized in Bertrand (1972), which uses that concept as an
organizing device to underpin trade policy reform. In effecting such
a synthesis, the paper identifies circumstances under which widely
used rules of thumb on effective rates of protection are valid.
Second, such a unified perspective emphasizes the critical role of
assumptions about domestic fiscal instruments in the appropriateness
of trade policy advice, a theme systematically explored in Heady and
Mitra (1985b), but extended here to include protection as well as
revenue-raising as an objective of trade policy. Finally, it provides
a numerical feel for the importance of these various considerations by
calculating optimal protective and revenue-raising tariffs in a
modestly disaggregated applied general equilibrium model for India.
It is hoped that this will help evolve a search for practically
applicable rules of thumb for trade taxation on broad categories of
goods that are consistent with administrative capacity in developing
countries.

Plan of the Paper

Section 2, immediately following this introduction, lays out
basic concepts and notation. Section 3 characterizes protective trade
taxes in general and derives conditions under which equal effective
rates of protection are desirable, in particular. The analysis of constrained-optimal trade tax structures also helps characterize directions of reform, starting from a distorted initial position, both in Section 3 and subsequently in the paper. Section 4 obtains the form of purely revenue-raising trade taxes with and without domestic taxes and highlights the interaction between domestic fiscal and trade policy instruments. Section 5 combines the themes of Section 3 and 4 by considering protective and revenue-raising tariffs together. Section 6 uses the approach of the earlier sections to calculate protective and revenue-raising tariffs using a modestly disaggregated general equilibrium model for India. Section 7 concludes by summarizing the main propositions of the paper.

2. PRELIMINARIES

Notation

\[ p^* = \text{international prices} \]
\[ t = \text{trade taxes (import tariffs or export subsidies)} \]
\[ \alpha = \text{domestic consumer taxes} \]
\[ \beta = \text{domestic producer subsidies} \]

where vectors without a transpose ' are column vectors.

Thus

\[ p^c = p^* + t + \alpha = (1 + \tau^c)p^* \]  \hspace{1cm} (2.1)
\[ p^p = p^* + t + \beta = (1 + \tau^p)p^* \]  \hspace{1cm} (2.2)

2/ The paper follows the notation in Dixit and Norman (1980) as far as possible.
where the right hand sides of (2.1) and (2.2) define the vectors \( \tau^c \) and \( \tau^p \) respectively and \( (1+\tau) \) is a diagonal matrix with \((1+\tau)\) elements along the diagonal.

Hence

\[
p^c = \text{domestic consumer prices}
\]

\[
p^p = \text{domestic producer prices}
\]

Let

\[
A = \text{input output matrix}
\]

Value added per unit of gross output is

\[
\pi = (I-A')p^p
\]

(2.3)

where inputs and outputs are valued at producer prices; and

\[
\pi^* = (I-A')p^*
\]

(2.4)

where inputs and outputs are valued at international prices.

Also define \( \epsilon \) by the relation

\[
\pi = (1^\wedge \epsilon) \pi^*
\]

(2.5)
Hence \( \tau P \) and \( \epsilon \) are the nominal and effective rates of protection respectively.

From (2.2) - (2.5),

\[
\tau + \beta = (I - A')^{-1}(\pi - \pi^*) \quad (2.6)
\]

\[
\tau P^* = (I - A')^{-1}\epsilon \pi^* \quad (2.7)
\]

where (2.7) links nominal and effective rates of protection.

**Revenue Functions**

Define the revenue function

\[
\rho(\pi, \nu) = \max_{\zeta} (\pi', \zeta) \quad (\zeta, \nu) \text{ feasible} \quad (2.8)
\]

where

\[
\zeta = \text{ gross output}
\]

\[
\nu = \text{ factor endowment}
\]

\( \rho \) is value added at producer prices. It has the appealing property that

\[
\rho_{\pi} = \zeta \quad (2.9)
\]

\( \rho_{\pi\pi} \), the matrix of cross partials of gross outputs with respect to value added, is symmetric and, when the numeraire rows and columns are deleted, positive semi-definite.

Next define

\[
R(pP, \nu) = \max_{X} (pP'x) \quad (x, \nu) \text{ feasible} \quad (2.10)
\]

\[
= pp' x (p, \nu)
\]
where

\[ x = \text{net output} \]

As before,

\[ R_p = x \quad (2.11) \]

\( R_{pp} \), the matrix of cross partials of net outputs with respect to prices, is symmetric and, when the numeraire rows and columns are deleted, positive semi-definite.

Clearly,

\[ R(p^P,v) = \rho [(I - A')p^P,v] \quad (2.12) \]

Differentiation yields

\[ (I - A)^{-1} R_p = \rho \pi \quad (2.13) \]

This expresses the familiar relationship between net and gross output, i.e., substitution from (2.9) and (2.11) into (2.13) yields

\[ (I - A)^{-1} x = \xi \quad (2.14) \]

\[ (I - A)^{-1} R_{pp} = \rho \pi \pi (I - A') \quad (2.15) \]

**Expenditure Function**

Next, define the expenditure function

\[ E(p^c,u) = \min \{ p^c'c \mid f(c) \geq u \} \]
This is minimum income necessary to attain utility level $u$, with prices $p$ and utility function $u = f(c)$. Again

$$E_p = c,$$  

(2.16)

the compensated demand function.

$E_{pp}$, the matrix of cross partials of compensated demands with respect to prices, is symmetric and, when the numeraire rows and columns are deleted, negative semi-definite.

From (2.1) - (2.3),

$$p^c = p^P + \alpha - \beta = (I - A')^{-1} \pi + \alpha - \beta$$

so that, for given $\alpha$ and $\beta$

$$E(p^c,u) = E[(I - A')^{-1} \pi + \alpha - \beta, u] = \phi(\pi,u)$$  

(2.17)

Differentiation of (2.17) yields (as with (2.13) and (2.15)),

$$(I - A)^{-1}E_p = \phi_\pi$$  

(2.18)

$$(I - A)^{-1}E_{pp} = \phi_{\pi\pi}(I - A')$$  

(2.19)

Revenue

Net imports, $M$, may be written

$$M = E_p - R_p = (I - A) (\phi_\pi - \rho_\pi)$$

Thus,

Trade tax revenue is $t'(E_p - R_p) = [(\pi - \pi^*)' - \beta' (I - A)] (\phi_\pi - \rho_\pi)$  

(2.20)

Domestic Revenue is $\alpha' E_p - \beta' R_p = \alpha' (I - A) (\phi_\pi - \beta' (I - A) \rho_\pi)$  

(2.21)
Constant returns to scale implies that the price vectors $p^P$ and $p^C$ can be independently normalized while the absence of transfers between the home country and the rest of the world imply that the prices $p^*$ can be normalized independently of the domestic prices as well. Lack of attention to this point has sometimes led to confusion and error. In what follows, domestic and international prices are normalized in whatever way is most convenient in particular situations.

3. PROTECTIVE TRADE TAXES

The Problem

Protection in developing countries is typically recommended on infant industry grounds. It is argued that the volume of gross output confers "learning-by-doing" type benefits. These eventually lower costs of production and allow the industry to become competitive in the future. The argument is therefore intertemporal: society incurs the costs of production today in return for benefits in terms of higher productivity tomorrow.

However, as was pointed out by Baldwin (1969), among others, a long time ago, this does not necessarily translate into an argument for government intervention. Thus, if private firms can invest in high cost production in the early years and appropriate the benefits of higher productivity in later years, no intervention is necessary. Institutional

3/ "Protection" is used to refer to tariffs for import-substituting industries and to export subsidies for exporting industries.
restrictions on appropriability and capital market imperfections may however preclude the coincidence of private and social benefits implicit in the above. The Bhagwati-Johnson principle of targeting would then argue for intervention in labor and capital markets to correct those distortions, without restricting trade in any way. However, the administrative capacity to identify and extend the appropriate domestic subsidies may be lacking, especially in low-income countries. Hence the ensuing analysis is applicable to countries where the entire manufacturing sector is going through a common learning process and where incentives to such a process can be provided principally through tariff-cum-export subsidies.⁴

This raises two questions: what should be protected and to what extent? First, although the infant industry argument can only have validity for a selected subset of sectors at any given time, it is in practice the case that many developing countries extend protection to all manufacturing. However, in such a case it is important to argue for preannounced and timebound assistance to ensure that targeted industries eventually become competitive without need for further tariffs and export subsidies. Second, the extent and timing of trade intervention, although derivable in principle from an intertemporal assessment of costs and benefits, will in practice be decided on a priori grounds, using a combination of country-specific factors and the historical experience of more advanced countries (say, Korea, Taiwan, etc.) when the latter were at a stage of development comparable to the present-day condition of the country being considered.

⁴/ Such an argument is to be found in the writings of Balassa (1977) and Corden (1980).
Prompted by these considerations, the literature on effective protection [cf. Bertrand (1972)] suggests the following proximate way of stating the objective of protection: to require that the sum of value added (at international prices) in a subset of priority sectors (labelled "T") account for no less than some prespecified proportion, \( \eta \) of total value added (again at international prices).

\[
\pi^* (\hat{\delta} \rho_{\pi}) \geq \eta \pi^* \rho_{\pi}
\]

(3.1)

where \( \hat{\delta} \) is a diagonal matrix with unit entries in the diagonal position corresponding to the industries in "T" and zeroes elsewhere. Hence \( \pi^* \) is a (row) vector with zeroes in non-"T" columns. \( \eta \) is a constant (0<\( \eta \)<1) selected a priori. This condition aims at protecting all industries in "T" (manufacturing, say) uniformly vis-a-vis those outside "T", allowing the market to determine the pattern of industry. The extent of protection is summarized by \( \eta \). (3.1) may be written, on substituting from (2.4) and (2.13), as

\[
p^* (I - A) (\hat{\delta} - \eta I)(I - A)^{-1} R_p \geq 0
\]

(3.2)

**The Argument**

Armed with the constraint on policy given by (3.2), it is possible to derive the appropriate structure of import tariffs and export subsidies. To answer this question, recognize that trade taxes on any good (1) affect government revenue, (2) impose a tax on the user of that good and (3) provide a subsidy to domestic production of a competing good. It is the simultaneous interaction of these three considerations that makes the
analysis of trade taxes potentially complex. To see the issues clearly, therefore, it is useful to begin by controlling for these effects.

No Revenue Constraint

First, remove the importance of trade taxes as a source of revenue by assuming that the proceeds of tariff revenue (export subsidies) are returned to (raised from) the private sector in lump sum fashion. Note that this assumption, which is made in much of standard trade theory, sits uneasily with the postulate of limited capacity to administer domestic interventions. It is made for pedagogic purposes and will be relaxed in Sections 4 and 5. Then the national income identity states that expenditure equals the sum of value added and trade tax-cum-domestic tax revenue, i.e.,

\[
E(p^* + t + \alpha, u) - R(p^* + t + \beta, v) - (t' + \alpha')E_p - (t' + \beta')R_p = 0 \quad (3.3)
\]

This ensures that trade taxes have no adverse effects on private sector incomes. Consider the effects of changing trad. taxes \( t \), with constant \( \alpha \) and \( \beta \). To that end, differentiate (3.3) totally to get

\[
[E_u - (t' + \alpha')E_{pu}] \, du = [(t' + \alpha')E_{pp} - (t' + \beta')R_{pp}] \, dt
\]

Homegeneity of \( E_u \) of degree one in prices \( p^c \) implies that

\[
E_u = (p^* + t + \alpha)' \, E_{pu} \quad (3.4)
\]

Substitution in the above yields

\[
5/ \quad \text{There is only one consumer, so that distributional considerations are ignored.}
\]
\[ p^*E_{pu} \, du = [(t + \alpha)'E_{pp} - (t + \beta)'R_{pp}] \, dt \] (3.5)

An appeal to stability (Hatta (1977)) may be used to argue that \( p^*E_{pu} > 0 \).
Thus, (3.5) shows that the effect on utility of a change in the trade tax on any commodity is directly proportional to the term in square brackets on the right hand side: this is the compensated reduction in demand less that in domestic production consequent upon the change. In the special case when \( \alpha = \beta (= 0 \) in the case of no domestic taxes) the term in square brackets is the compensated reduction in net import demands.

Optimal protection requires that \( t \) be set to maximize \( u \) subject to (3.2), where (3.3) [or, in differentiated form, (3.5)] provides a relationship between \( u \) and \( t \). The Lagrangean is

\[ L = u + \lambda p^*(I - A) (\hat{\delta} - \eta I) (I - A)^{-1}R_p \]

The first order conditions are

\[ du = - \lambda p^*(I - A) (\hat{\delta} - \eta I) (I - A)^{-1}R_{pp} \, dt \] (3.6)

The coefficient of \( dt \) on the right hand side of (3.6) measures the effect of changing trade taxes on value added in targeted industries vis-a-vis the stipulated proportion, \( \eta \), of total value added: the effect on net output is shown by \( R_{pp} \), which is then converted into the effect on gross output by the \((I - A)\) matrix.

Substitute for \( du \) from (3.5) in (3.6) and equate the coefficients of \( dt \) to get
(p^*E_{pu})^{-1}[(t + \alpha)'E_{pp} - (t + \beta)'R_{pp}] = -\lambda p^*E_{pu} (I - A)(\delta - \eta I)(I - A)^{-1}R_{pp} (3.7)

This equates the marginal cost of trade taxes on utility to their marginal benefit in targeted activities, thus characterizing the optimal structure of protective trade taxes. While this, by definition, is the ultimately desirable goal of policy, there are various practical considerations which limit the extent to which an existing trade tax structure can be altered. However, (3.7) also provides a rule for welfare-improving "protection-neutral" trade tax reform, starting from any arbitrary initial position. It examines the losses suffered by the economy per unit of protection conferred by different trade tax instruments: if these are unequal, it is always possible to effect an improvement, while continuing to respect the country's protection objectives as given by (3.2). In practice, policy advisors frequently question whether the scope of protection in many developing countries is not too extensive: the reduction of the extent of protection then urged upon such countries, in conjunction with the above rules, should make even further welfare gains possible.

The equation (3.7) may be rewritten as

(t + \alpha)'E_{pp} - (t + \beta)'R_{pp} = -\lambda p^*E_{pu} p^* (I - A)(\delta - \eta I)(I - A)^{-1}R_{pp} (3.8)

\[ \hat{6}/ \text{ A reform is protection-neutral if it does not violate (3.2).} \]
Equation (3.8) provides a general characterization of optimal protective trade taxes in a small open economy. It shows that such taxes have two effects. First, they discourage net imports by influencing both consumption and production. Second, they assist value added in targeted sectors. An optimal structure balances both sets of considerations: the discouragement to net imports must, at the margin, offset the encouragement to value added for every trade tax that the authorities can set. Thus we have

**Proposition 1**: With (1) no constraint on public revenue and (2) an objective of equal encouragement to a subset of domestic sectors, the compensated reduction in demand less that in production arising from a change in trade taxes must be proportional to the increase in value added made possible in sectors targeted for protection in relation to the entire economy. 7

This proposition implies that the structure of trade taxes depends in an essential way on the responses of producers and consumers to tariff changes (i.e., on economywide own- and cross-price elasticities of supply and demand), as well as the input-output relationships of the economy. This is inescapable, as the effects of trade taxes on the economy are pervasive. The above considerations do not readily suggest simple rules of thumb for setting those taxes. However, in as much as (3.8) provides a precise characterization of the way in which different effects interact, it is possible to calculate approximately optimal protective trade taxes for the many developing economies where substantial data on the above items has been put together. This is done with Indian data in Section 6.

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7/ The correct statement of the rule, as (3.8) makes clear, is in terms of the discouragement of compensated net imports, in order to focus on the distortionary substitution effect of a change in trade taxes.
Tariff-Offsetting User Subsidies

It will be recalled that the analysis of optimal protective trade taxes abstracted from the revenue aspects by assuming that lump sum adjustments were possible. That assumption, while maintaining private sector incomes, nevertheless allows losses to be inflicted on users of protection-ridden goods since those users are unable to transact at world prices. To control for this, assume that the country has a well functioning domestic consumption tax system which subsidizes users of protection-ridden products to the point where they can continue to transact at world prices. This assumption nullifies the consumption losses of trade taxes completely. Together with the assumption of no revenue constraint, this implies that it is possible to administer subsidies to domestic production.

Hence set $\alpha = -t$, so that domestic user subsidies are implemented to offset the consumption losses from tariffs. Then, from (2.1), $p^c = p^*$, so that consumers face world prices.

Then (3.8) becomes [using (3.4)].

$$(t + \beta)'R_{pp} = \lambda E_{up^*}(I - A) (\delta - \eta I) (I - A)^{-1}R_{pp}$$  (3.9)

Substitution from (2.6) and (2.15) yields

$$(\pi - \pi^*)R_{\pi\pi} = \lambda E_{up^*}(\delta - \eta I)R_{\pi\pi}$$  (3.10)

Assume that (3.2) is binding at an optimum: otherwise, $\lambda = 0$. Choose a domestic vis-a-vis international normalization such that for one of the sectors which is targeted for protection, $i$, 

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\[ \pi_i = [1 + \lambda E_u (1-\eta)] \pi_i^* \]

Then since \( \varepsilon = \frac{\pi_i - \pi_i^*}{\pi_i^*} \), it is easily checked that (3.10) has the solution

\[
\begin{align*}
\varepsilon_i &= 0, \quad i \in T \\
\varepsilon_i &= -\lambda E_u \eta, \quad i \notin T
\end{align*}
\]

(3.11)

i.e., a uniform effective rate of protection (ERP) in "T" (the priority sectors) and a different but uniform ERP outside "T". With a positive marginal cost of protection (\( \lambda > 0 \)), the optimum is characterized by zero ERP's to the priority industries and negative ERP's to the others.

It is important to note that protection to "T" industries in accordance with the constraint (3.2) requires two sets of ERP's; their absolute levels depend on the particular domestic vis-a-vis international normalization chosen.\(^8\) Needless to say, the resource pulls implied by those ERP's do not depend on the normalization adopted.

The assumptions used to arrive at (3.11) are to be recommended on pedagogic grounds rather than realism. They imply that trade taxes are used solely to subsidize domestic production, with the user losses of such taxes perfectly neutralized and such revenue as the economy may need to raise or dispose of being handled by lump sum instruments. With the role of protection so confined, the objective of providing equal encouragement to value added in a subset of priority activities is best achieved by raising the price of unit value added in those activities by equiproporportionate amounts, at the expense of the other activities. This is

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\(^8\) With the above normalization, (3.11) is the only solution if the matrix \( \rho_{\pi \pi} \) has maximal rank, which is \( n \).
Proposition 2: With (1) no constraint on public revenue (2) the domestic fiscal system being developed to the point where the user losses from protection can be perfectly neutralized and (3) an objective of equal encouragement to a subset of domestic sectors, the optimal trade tax structure is one which confers equal effective protection to that subset of sectors and a lower but common rate of effective protection to the remaining ones.  

It is clear that the objective of equal protection for certain industries, [as in (3.2)] inasmuch as it implies unequal ERP's between targeted and other sectors in [as in (3.1)] cannot be achieved by equal nominal tariffs, the latter being the policy instruments actually available to governments. This is obvious from (2.4). It arises because while net output is assisted by nominal tariffs, gross outputs which enter the constraint (3.1) are assisted by effective tariffs, i.e., nominal tariffs on output adjusted for those on inputs. Indeed, this is the essential insight of the effective protection literature.

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9/ This is the special case for which the uniform ERP results of Bertrand (1972) are valid.
Implications

Proposition 2 establishes that the circumstances under which an objective of equal encouragement to a subset of the economy (e.g., manufacturing) translates into a common ERP for the priority sectors and lower but common ERP for the others are very restrictive even within a model which has fixed input-output coefficients, i.e., fixed $a_{ij}$. If the reader wonders why so much is being made of this special case, it is because the doctrine of uniform ERPs has evidently exerted a powerful hold on those offering policy advice to developing countries. There are four problems here.

First, the conditions under which ERPs are to be equalized are those where trade taxes as normally understood are redundant, and for the following reason. Recall from Proposition 2 that the results require the fiscal system to be developed to the point where assistance to targeted industries is being offered via lump sum-financed production subsidies, as classical economic theory argues it ideally should. Proposition 2 then shows that equal protection requires effective subsidies to be equalized. But then it is somewhat misleading to refer to trade taxes as instruments of industrial assistance when the job is actually being done solely by production subsidies.

---

10/ This model is chosen because a lot of empirical work in LDCs is based on input-output tables with fixed coefficients. A crisp account of the difficulties raised for the ERP concept by the presence of substitution is provided by Ethier (1977). An assessment of what difference those difficulties cause in practice is contained in Balassa (1982).
Second, it is patently obvious that many LDCs, especially the low-income countries, do not have adequately functioning consumption tax systems. Much of their revenue comes from taxes on international trade, on domestic production in the form of excises levied ex factory and on intermediate goods. Administrative considerations preclude the major part of revenue from being raised through taxes levied at the final point of sales to consumers. In fact, much of the work on tax reform in those countries is concerned with the problems of moving towards consumption-based taxes; and it is generally recognized that this is a long-term process. Thus, the assignment of instruments to targets implicit in the writings of the effective protection school, viz., that production subsidies can be used for protection and (modestly) distortionary broad-based consumption taxes for revenue and distributional purposes is unlikely to be applicable to many developing countries.

Third, the results are obviously sensitive to the particular form of the protection constraint used. The market failure implicit in the need for intervention is ideally handled through an intertemporal balancing of the costs and benefits of protection, and summarized in a set of shadow prices. In the absence of such a model which, given the uncertainties of the learning process, would, in practice, be difficult to calibrate, equation (3.1), is to be seen as one possible formulation of a "non-economic" objective.

Finally, the entire approach treats tariffs on imports and export subsidies, both of which are protective devices, in a completely symmetric way. Thus, for example, Proposition 2 would ensure equal ERP's for domestic and export sales. In practice, however, the widespread use of
export subsidies would almost certainly be subject to countervailing measures, thus introducing a bias in favor of domestic sales. This observation could be accommodated in the derivation of equation (3.8) underlying the more general Proposition 1 by setting \( t = 0 \) for exportables (relative to some choice of numeraire).

4. **REVENUE RAISING TRADE TAXES**

The assumption of there not being a revenue constraint was made in Section 3 to focus exclusively on the characterization of protective tariffs. Since trade taxes are a significant source of revenue, especially in low-income countries, it is necessary to characterize optimal revenue-raising trade taxes as well. This is done here for the case where protection is not an objective of policy. Section 5 will bring together protective and revenue-raising trade taxes.

**Fixed Domestic Taxes**

When domestic-cum-trade-tax revenue is not returned to the consumer, the income-expenditure equality (3.3) becomes

\[
E(p^* + t + \alpha, u) - R(p^* + t + \beta, v) = 0
\]  

(4.1)

Now consider the effects of changing trade taxes, \( t \), with constant \( \alpha \) and \( \beta \). Differentiate (4.1) totally to get

\[
E_u du = -(E_p - R_p)' dt
\]  

(4.2)
where \((E_p - R_p)\) signifies net imports. (4.2) is the familiar condition that the effect on utility of changing protection on any commodity is (negatively) proportional to net imports of that commodity.

The revenue constraint may be written, using (2.20) and (2.21), as

\[
(t + \alpha)'E_p - (t + \beta)'R_p = G \tag{4.3}
\]

where \(G\) is an exogenously specified revenue requirement.

Optimal revenue-raising requires that \(t\) be set to maximize \(u\) subject to (4.3), where (4.1) [or, in differentiated form (4.2)] provides a relationship between \(u\) and \(t\). The Lagrangean is

\[
L = u + \mu[(t + \alpha)'E_p - (t + \beta)'R_p - G]
\]

The first-order conditions are

\[
[1 + \mu(t + \alpha)'E_{pu} du + \mu[(t + \alpha)'E_{pp} - (t + \beta)'R_{pp} + (E_p - R_p)'] dt = 0
\]

Substitution for \(du\) from (4.2) and simplification yields

\[
(t + \alpha)'E_{pp} - (t + \beta)'R_{pp} = - \theta (E_p - R_p)' \tag{4.4}
\]

where \(\theta = 1 - [(t + \alpha)' \frac{E_{pu}}{E_u} + \frac{1}{\mu E_u}]\)

The term in square brackets has the usual interpretation of the net social marginal value of income, expressed in terms of government revenue [cf. Atkinson and Stiglitz (1980)].
This forms the basis of

**Proposition 3:** With (1) no protection objective and (2) fixed domestic taxes and subsidies, the compensated reduction in demand less that in production of any commodity arising from a change in trade taxes is proportional to the net imports of that commodity.

**Optimal Domestic Taxes**

Since the economy without a protection objective reduces to a Diamond-Mirrlees (1971) economy, it follows (see, for example, Dixit (1985)), that an optimum where the domestic taxes \( \alpha \) and \( \beta \) may be optimally chosen is characterized by (1) equality of relative producer prices with world prices, i.e., \( p^P = \lambda p^*, \) for all \( \lambda > 0 \) (production efficiency); (2) a wedge between relative producer prices \( (p^P) \) and consumer prices \( (p^C) \) so as to equate the proportional reduction in the compensated demands for all commodities (Ramsey taxation).

This argument is the basis for

**Proposition 4:** With (1) optimally chosen domestic consumption taxes-cum-subsidies and (2) the absence of a protection constraint, the optimum in an open economy with a given revenue requirement may be characterized by (a) zero taxation of intermediate goods and (b) taxation of final goods alone, satisfying, from (4.4), the equation

\[
\alpha' E^p = \theta E'_p \tag{4.5}
\]
or the standard form of Ramsey-optimal taxation at constant producer prices.11,12

Thus, there is an interesting analogy between the economy described in Proposition 2 of Section 3 above and the present one. With purely protective tariffs and consumers trading at world prices, the framework of this paper reduces to the uniform ERP model of Bertrand (1972). By contrast, with purely revenue-raising tariffs and producers trading at world prices, the present framework reduces to the Ramsey-consumption-taxes-at-constant-producer-prices model underlying the applied work of Ahmad and Stern (1984).

11/ As is well-known, θ can be shown to have the same sign as G, the government revenue requirement. [Cf. Atkinson and Stiglitz (1980)].

12/ Since λ is arbitrary, this solution may be thought of as one involving uniform nominal tariffs-cum-export-subsidies at a rate (λ-1). From (2.4) this is equivalent to a uniform effective rate of protection of (λ-1). With ERP's being equalized for all sectors, the incentive structure offers no protection to domestic industries. Thus, formally speaking, the open economy Ramsey optimum is decentralizable via uniform ERP's and standard Ramsey taxation. However, since the level at which that uniform ERP rate is set (possibly zero) is purely a question of the relative levels at which the vectors pP and p* are independently normalized, and has no real consequences, such statements are best avoided to prevent confusion and error.
No Domestic Taxes

With $\alpha = \beta = 0$, (4.4) becomes

$$t' (E_{pp} - R_{pp}) = -\theta (E_p - R_p)'$$

(4.6)

This yields

**Proposition 5**: With no domestic tax instruments, the proportional reduction in compensated net import demands arising from a change in revenue-raising tariffs must be equal for all commodities.

Equation (4.6), which is the Ramsey rule for optimal revenue raising tariffs with zero domestic taxes, urges uniformity in terms of consequences (changes in net imports) and not instruments (i.e., tariff rates). 13 Equation (4.4) may be seen as its obvious generalization in the presence of nonzero but fixed domestic taxes.

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13/ These rules have been analyzed by Bliss (1980), for which reference I thank Avinash Dixit, by Heady and Mitra (1985b), who explicitly model domestic tax restrictions, derive optimal policies to explore sensitivity to underlying parameters, and also present numerical examples, and by Dahl, Devarajan and van Wijnbergen (1986) who apply the theory to a general equilibrium model of Cameroon. Since the rule (4.4) applies to all commodities, it does not extend to intermediates the favorable treatment accorded to them by Proposition 4, thus highlighting the interaction between domestic fiscal and trade instruments.
Partially Restricted Taxation

A (more realistic) case which lies between the two extremes analyzed above is one where only part of the domestic economy is taxable. This arises frequently in developing economies where taxes may not be levied on trades internal to certain sectors (e.g., agriculture); the authorities may only tax their net transactions with the rest of the economy. In such a case, the "taxable" sector behaves as in Proposition 3 while the "untaxable" sector behaves as in Proposition 4. It is then possible to establish [cf. Heady and Mitra (1985a)]

**Proposition 6:** With untaxability of trades internal to certain sectors of the economy, (henceforth the "untaxable" sector), production in the taxable sector and international trade taken together should be productively efficient, i.e., there should be no divergence between relative world prices and relative producer prices in that sector.

**Proposition 7:** Trade taxes (tariffs and export subsidies) on goods transacted with the untaxable sector should be set so as to equalize the reductions in compensated net import demands for all such goods.

Such a system of trade taxes introduces a distortion in production. However, the marginal cost of that distortion equals the marginal benefit from being able to use trade taxes to manipulate consumer prices in the untaxable sector of the economy.
5. TRADE TAXES FOR PROTECTION AND REVENUE

In practice, countries with relatively undeveloped domestic systems use trade taxes both to protect domestic import-substituting industries as well as to raise revenue. The section therefore brings together the considerations of Sections 3 and 4 simultaneously.

It is assumed for convenience that $\alpha = \beta = 0$. Then, $t$ must be set to maximize $u$ subject to

$$p^*(I - A) (\hat{\delta} - \eta I) (I - A)^{-1} R_p \geq 0$$  \hspace{1cm} (5.1)

$$t' (E_p - R_p) = G$$  \hspace{1cm} (5.2)

with the relationship between $u$ and $t$ given by

$$E_u du = -(E_p - R_p)' dt$$  \hspace{1cm} (4.2)

The Lagrangean is

$$L = u + \lambda [p^*(I - A) (\hat{\delta} - \eta I) (I - A)^{-1} R_p] + \mu [t' (E_p - R_p) - G]$$

The first order conditions are

$$du = -(\lambda p^*(I - A) (\hat{\delta} - \eta I) (I - A)^{-1} R_{pp} + \mu [t' (E_{pp} - R_{pp}) + (E_p - R_p)']) \ dt$$

Substitute for $du$ from (4.2) and equate the coefficients of $dt$ to get

$$E_u^{-1} (E_p - R_p)' = \lambda p^*(I - A) (\hat{\delta} - \eta I) (I - A)^{-1} R_{pp} + \mu [t' (E_{pp} - R_{pp}) + (E_p - R_p)']$$  \hspace{1cm} (5.3)
This equates the marginal cost of protection on utility to its marginal benefit on government revenue as well as value added in targeted industries. (5.3) may be simplified to yield

\[ t'(E_{pp} - R_{pp}) = -\theta (E_p - R_p)' - \frac{\lambda_p x'}{\mu} (I-A) (\delta - \eta I) (I-A)^{-1} R_{pp} \]  

(5.4)

where \[ \theta = 1 - \left[ \frac{t' E_{pu}}{E_u} + \frac{1}{\mu E_u} \right] \]

The second term in (5.4) is the deviation from Ramsey optimal tariffs induced by protection. This yields

**Proposition 8:** With no domestic tax instruments and an objective of equal encouragement to a subset of domestic sectors, the reduction in compensated net import demands arising from a change in trade taxes deviates from the proportionality established in Proposition 5 by the amount of encouragement afforded to sectors targeted for protection.

6. **AN APPLICATION TO INDIA**

A six sector general equilibrium model of India is used to give numerical expression to these ideas. A heuristic description of the model is as follows. \(^{14}\)

\(^{14/}\) See Mitra and Tendulkar (1986) for a detailed and formal description of the model and the data base used for calibration.
Production

The production side of the model distinguishes six sectors: (1) Agriculture, (2) Consumer goods, (3) Capital goods (including construction), (4) Intermediates, (5) Public Infrastructure, and (6) Services. The sectoring follows agriculture-industry-services lines. Industry is disaggregated into use-based categories (2), (3) and (4), to capture the differential impact of policies on different parts of the industrial sector.

By contrast, with the analytical model of earlier sections, the production structure allows considerable substitution. In sector 1 (agriculture), the production structure is represented by a nested CES tree as follows:
Output, $X$ is a function of $H$ (land), $L_S$ (self-employed labor), $L_M$ (hired labor), $N_D$ (domestically produced intermediate goods from all sectors other than 5 into the sector in question), $N_M$ (imported intermediates goods from all sectors other than 5 into the sector in question), and $G$ (the flow of infrastructure, i.e., output of sector 5 going into the sector in question). The particular tree structure chosen imposes some separability on the production function. Much, although not all land, is owner-cultivated to some extent: the resulting sub-aggregate $S$ is combined with hired labor ($L_M$) to produce value added ($V$). $N_D$ is a fixed-proportions bundle of domestically produced intermediates excluding sector 5; similarly, $N_M$ is a fixed-proportions bundle of imported intermediates, again excluding sector 5. Some substitution is allowed between $N_D$ and $N_M$; their aggregate, $N$ combines with value added to produce $Z$. Infrastructural services, $G$, which are publicly provided in most countries, are identified separately and combined with $Z$ to produce output, $X$. Since $G$ is an integral part of the tree structure, the formulation captures the contribution of infrastructure to the production process.

In sectors 2 to 6, the portion of the CES tree below value added is as follows:

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15/ In empirical implementation, $H$ includes both land and capital in agriculture.
Capital and the two categories of labour continue directly to produce value added in these sectors.

In sectors with significant quantities of almost-finished imports, there is an extra layer at the top of the tree as follows:
Thus imported final goods (M) are less than perfect substitutes for the domestically produced variety (X): final output (CX) is considered to be a CES aggregate of the two. This formulation holds in sectors 3.

**Income Generation**

The production system distinguishes four categories of income, viz., (1) income from self-employment, (2) wage income, (3) land/capital income, and (4) income from implicit government subsidies on publicly provided infrastructure. To this must be added nonproduction-related income, comprising such items as (a) interest on national debt, (b) domestic current transfers, (c) net factor income from abroad and (d) net current transfers from the rest of the world. The model maps those income according to fixed rules into a single rural and a single urban household.

**Final Demands**

Final demands comprise private consumption, public consumption, exports and investment. Household incomes are mapped into private consumption via a savings function. Private consumption demand for the output of the six production sectors is generated by separate rural and urban linear expenditure systems. Public consumption of each sector’s output is exogenous. Export demand is a function of income in the rest of the world as well as the ratio of export prices to those of substitutes in international markets. Investment demand is almost entirely directed at sector 3 (capital goods, including construction).
Trade

It is worth noting that the trade side incorporates price-responsive export and import relationships. The derived demand for both intermediate and final imports depends on the level of output and the import price to the user relative to that of the domestically produced variety, where appropriate.\textsuperscript{16} Final imports in sectors, 1, 2 and 5 are policy-determined rather than price-responsive. These are principally food, edible oils and petroleum imports. Import prices are given, so that the country is small in the relevant market. Exports depend on the state of demand in the rest of the world (world income) and export prices relative to that of substitutes. Thus, the country is assumed to be able to vary its export sales by changing its export prices. Export elasticities are set at a value of 5 across the board - higher than that suggested by available econometric estimates [Lucas (1986)]. This implies that export taxes will be levied at an optimum. However, since export taxes are negligible in India, these are set to zero. For this reason, the optimal import tariffs in the experiments below will at least partially attempt to mimic the incidence of export taxes.

Market Clearance Goods

Gross output in each of the six sectors must equal the sum of final demands, intermediate demands and changes in stocks, less imports. Since each of these components is either exogenous or price-responsive, the market clearance conditions determine prices.

\textsuperscript{16} For imported goods which have no domestically produced substitute, import demand depends only on the level of production of output.
The allocation of public infrastructural flows for intermediate use in each of the production sectors is fixed by policy, while production and final demand are price-responsive. Intermediate users are typically not charged the market price for infrastructure. This can allow an exploration of the effects of changing the rates of cost recovery on public infrastructure as well as of the policy-determined allocations to intermediate users.

Factors

The operation of factor markets is as follows. The wage of hired labor in sectors 2 to 6 is indexed to the consumer price index, hence determining the demand for them. This leads to rationing of jobs: those who are unable to find employment swell the ranks of the low productivity self-employed whose returns must be depressed to clear the market. In this sense, there is no open urban unemployment. In sector 1 (agriculture), wages of hired labor are fixed as well. But since much self-employment is on own land, the stock of self-employed is postulated to be fixed with returns varying to clear the market. Those unable to find jobs at the fixed agricultural wage become openly unemployed. On grounds of its quantitative insignificance in India, there is no rural-urban migration, so that the rural and urban labor markets are not linked on the supply side.

The amount of land in sector 1 and the stock of capital in each of sectors 2 to 6 is fixed within periods but augmented across periods as investment takes place.
Investment and Savings

The relation between household incomes and consumption determines household savings. Government savings are the difference between government income and expenditure. In the so-called "savings-driven" version of the model, foreign savings are exogenously specified. The sum of these three sources of savings equals investment, which is therefore residually determined. Alternatively, in the "investment-driven" version, investment is exogenously specified, and foreign savings must adjust residually to satisfy the savings investment equality. The model is run in either mode depending on the question at hand. But it needs to be stressed that these different specifications can make a substantial difference to qualitative behavior, a feature worth bearing in mind when interpreting the numerical results.

Government

The sum of tax and tariff revenue, the return on public infrastructure net of subsidies and other income, less the value of government consumption equals government savings. This is the government's budget constraint but it does not need separate formulation, since it may be derived from the other equations of the system.

Dynamics

The breakdown of investment by sector of origin is given by base year input output data; it typically comes entirely from sector 3. Its breakdown by sector of destination is taken from national accounts data, when available. Otherwise, it is chosen to reproduce base year proportions or to move in response to differences in sectoral rates of return to capital, or a combination of both.
Debt

The model incorporates a debt module which keeps track of the effect of foreign borrowing on the stock of debt and debt service payments (amortization and interest) corresponding to medium- and long-term (official and private) and short-term debt.

Data

The model is calibrated on a consistent data set for 1973-74, details of which are provided in Mitra and Tendulkar (1986). The data appendix to the present paper is confined to describing how the data on indirect taxes on intermediate inputs and final demands were put together.

The Base Solution

Table A.2 displays the structure of tariffs in the base period solution of the model. The variable TNM refers to import duties on intermediate goods. Since domestically produced and imported intermediates are (imperfect) substitutes, changes in TNM directly affect protection. TFM signifies import duties on "final" goods. The latter requires some clarification. Since final imports in sectors 1, 2 and 5 (food, edible oils and petroleum respectively) are policy-determined, with the government releasing such imports in the domestic market at domestic prices, it is clear that these tariffs have no direct impact on protection. This is not the case with sector 3 (capital goods) where the imported good can substitute for the domestically produced variety(with an elasticity of 0.9).

It is necessary to draw attention to a particular feature of the economy that is relevant for the subsequent discussion. The relatively closed nature of the Indian economy has implied that the contribution of
imported sector 2 and sector 3 intermediates to domestic production extremely is low. This implies that very large changes in tariffs on those intermediates (i.e., TKNM2 and TNM3) are consistent with little change in final goods prices. Thus, in the absence of any further constraints, attempts to optimize the tariff structure can lead to seemingly unreasonable values for TKNM1 and TKNM2. The way in which this problem is handled in the experiments is described below.

The Protection Constraint

It is assumed that sectors 2, 3 and 4, which mainly comprise tradeable manufacturing, are covered by a protection constraint of the type (3.1). The constant \( \eta \) is calibrated as follows.

First, remove all trade taxes in the base solution, but scale all domestic taxes to ensure that, with investment and foreign savings fixed at base run values, the government can meet its expenditure commitments. The value added prices in each sector in such an "expenditure-neutral" free trade run, denoted \( P^*_V \) below, are taken to be the international prices at which value added quantities are to be evaluated.

Second, the sum of value added in sectors 2, 3 and 4 in the base period,

\[
\sum_{i=2,3,4} P^*_i V_i
\]

is compared with total value added, \( \sum_{i=1}^{5} P^*_i V_i \), where everything is evaluated at the international prices derived above. This yields the parameter \( \eta \) (equalling 0.165).

Third, for all subsequent experiments, the protection constraint is written:
\[ \sum_{i=2,3,4} P_{V_i}^* V_i = \eta \sum_{i=1}^{6} P_{V_i}^* V_i \] (6.1)

where \( P_{V_i}^* \) : international (value-added) price for sector \( i \)

\( V_i \) : value added quantities in any experiment.

Revenue-Raising Tariffs

This experiment drops the protection constraint (6.1) in order to focus solely on tariffs for revenue-raising. The uniform nominal tariff which meets the government’s expenditure requirement is 26%. (see Table 1)

Turning to optimal tariffs, the tariffs on sector 2 and 3 intermediate imports (i.e., TNM\(_2\) and TNM\(_3\)) are maintained for reasons mentioned above at the levels corresponding to the uniform level (of 26%). The other tariffs are variable. The welfare losses from uniform tariffs vis-a-vis the optimum are measured as follows. We ask by how much the economy’s endowments (labour, capital and foreign savings) and exogenous requirements, (e.g., government consumption) would have to contract such that the optimum tariff structure in the contracted economy yields the same welfare, taken to be the sum of rural and urban utilities, as the uniform
Table 1  India: 1973-74: Tariffs and Coefficient of Resource Utilization

<table>
<thead>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TFM</td>
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<td>0.38</td>
<td>-</td>
<td>0</td>
<td>0.9993 (^a/)</td>
</tr>
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<td>TNM</td>
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<td>0.16</td>
<td>0.42</td>
<td>0.28</td>
<td>-</td>
<td></td>
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<tr>
<td><strong>II. Pure Revenue-Raising Tariffs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Optimal TFM</td>
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<td>0</td>
<td>0.32</td>
<td>-</td>
<td>0.02</td>
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<td>Optimal TNM</td>
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<td>0.11</td>
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<td>Uniform Tariff</td>
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<td>0.26</td>
<td>0.26</td>
<td>0.26</td>
<td>-</td>
<td>0.9995</td>
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<td><strong>III. Pure Protective Tariffs</strong></td>
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<td></td>
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<td>0.33</td>
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<td>0.31</td>
<td>0.29</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Uniform Tariff</td>
<td>0.31</td>
<td>0.31</td>
<td>0.31</td>
<td>0.31</td>
<td>-</td>
<td>0.9999</td>
</tr>
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<td><strong>IV. Protective-Cum-Revenue-Raising Tariffs</strong></td>
<td></td>
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<tr>
<td>Optimal TFM</td>
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<td>0.55</td>
<td>-</td>
<td>0.03</td>
<td></td>
</tr>
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<td>Optimal TNM</td>
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<td>0.31</td>
<td>0.14</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Uniform Tariff</td>
<td>0.31</td>
<td>0.31</td>
<td>0.31</td>
<td>0.31</td>
<td>-</td>
<td>0.9993</td>
</tr>
<tr>
<td><strong>V. Pure Protective Tariffs and Rates to Exports</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Optimal TFM</td>
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<td>-</td>
<td>0.08</td>
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</tr>
<tr>
<td>Optimal TNM</td>
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<td>0.36</td>
<td>0.31</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Uniform Tariff</td>
<td>0.36</td>
<td>0.36</td>
<td>0.36</td>
<td>0.36</td>
<td>-</td>
<td>0.9999</td>
</tr>
</tbody>
</table>

\(^a/\) This is calculated relative to Case IV, i.e., the optimal protective-cum-revenue-raising tariff.
tariff structure in the original economy. This yields a commodity measure of the welfare losses.\(^{17}\)

It is readily seen that the uniform tariff solution is virtually identical from the point of view of welfare to the base period and that the losses from uniform tariffs vis-a-vis the optimum are low as well. This result, which recurs in the subsequent experiments, is due to the low share of trade in the Indian economy. Exports and imports respectively accounted for 4% and 6% of GDP in 1973-74 and tariffs brought in 7% of total revenue in that year.

**Protective Tariffs**

In this experiment, we examine uniform and optimal tariffs when protection alone is the objective of policy, i.e., when we do not postulate a revenue constraint. This latter notion is not easily interpreted in general equilibrium, for the following reason. Since government expenditures -- consumption and transfers -- are fixed in real terms, they must, therefore, be met by any solution. Hence, a postulate of revenue-neutrality does not add very much to the analysis.

Revenue-neutrality is formally modelled by postulating that tax and tariff revenue in the experiment must equal that in the base run, with the difference being adjusted via lump sum transfers to the private sector.

\(^{17}\) This is the coefficient of resource utilization [Debreu (1951)] applied to an economy with a social welfare function. The latter is the sum of rural and urban utilities corresponding to the linear expenditure system, cardinalized in the form, \(\sum_{i=1}^{6} \beta_i\).
The uniform protective tariff (e.g., the tariff which provides the required degree of protection to sectors 2, 3, and 4) is 31%. This is the same as the uniform protective-cum-revenue-raising tariff reported subsequently. The experiment therefore supports the view that, with expenditure neutrality, revenue neutrality is superfluous - this is confirmed by a low shadow price on the corresponding constraint. Table 1 also presents the structure of optimal protective tariffs whose magnitudes are, however, affected by the postulate of revenue-neutrality. Once again, it is seen that the welfare losses from uniformity, as measured by the coefficient of resource utilization, are very low.

**Protective-Cum-Revenue-Raising Tariffs**

In this case, the uniform tariff is again 31%. Notice that, as in the purely revenue-raising case, the tariff on intermediate good inputs falls, as does the tariff on sector 1 intermediate imports which is converted into an import subsidy.

**Duty Drawback on Exports**

Finally, the discrimination against exports caused by import tariffs is partially offset by a scheme by rebating taxes on domestic intermediates and import duties on imported intermediates entering into export production. The results are presented for purely protective tariffs with no revenue constant; the revenue losses from the drawback scheme is adjusted via lump sum taxes. The uniform tariff is, predictably, higher and rises to 36%. While the levels of the optimal tariffs differ from their values in the no duty drawback case, it will be seen that their structure is extremely similar to that of the purely protective case.
These experiments highlight the limited impact of tariff reform on welfare. This finding is consistent with those, for example, of Srinivasan and Whalley (1986), who report that in a number of trade models, small welfare gains accrued from trade liberalization experiments which were typically much less constrained than the protection and revenue neutral exercises considered in this paper. The extent to which our results would be modified by the exploitation of scale economies and change in rents sought by lobbyists as a result of tariff rationalization must await further empirical work on these matters in the Indian economy.

7. CONCLUSIONS

This section lists the principal propositions of the paper.

Proposition 1: With (1) no constraint on public revenue and (2) an objective of equal encouragement to a subset of domestic sectors, the compensated reduction in demand less that in production arising from a change in trade taxes must be proportional to the increase in value added made possible in sectors targeted for protection in relation to the entire economy.

Proposition 2: With (1) no constraint on public revenue (2) the domestic fiscal system being developed to the point where the user losses from protection can be perfectly neutralized and (3) an objective of equal encouragement to a subset of domestic sectors, the optimal trade tax structure is one which confers equal effective protective to that subset of sectors and a lower but common rate of effective protection to the remaining ones.
Proposition 3: With (1) no protection objective and (2) fixed domestic taxes and subsidies, the compensated reduction in demand less that in production of any commodity arising from a change in trade taxes is proportional to the net imports of that commodity.

Proposition 4: With (1) optimally chosen domestic consumption taxes-cum-subsidies and (2) the absence of a protection constraint, the optimum in an open economy with a given revenue requirement may be characterized by (a) zero taxation of intermediate goods and (b) taxation of final goods alone, so as to equalize the proportionate compensated reduction in their net import demands.

Proposition 5: With no domestic tax instruments, the proportional reduction in compensated net import demands arising from a change in revenue-raising tariffs must be equal for all commodities.

Proposition 6: With untaxability of trades internal to certain sectors of the economy, (henceforth the "untaxable" sector), production in the taxable sector and international trade taken together should be productively efficient, i.e., there should be no divergence between relative world prices and relative producer prices in that sector.

Proposition 7: Trade taxes (tariffs and export subsidies) on goods transacted with the untaxable sector should be set so as to equalize the reductions in compensated net import demands for all such goods.
Proposition 8: With no domestic tax instruments and an objective of equal encouragement to a subset of domestic sectors, the reduction in compensated net import demands arising from a change in trade taxes deviates from the proportionality established in Proposition 5 by the amount of encouragement afforded to sectors targeted for protection.

Illustrative calculations of protective and revenue-raising tariffs in a modestly disaggregated general equilibrium model of India indicate that the welfare gains from tariff rationalization are limited and, correspondingly, that the welfare losses from following administratively simple rules of thumb are low.

DATA APPENDIX: INDIRECT TAXES ON INTERMEDIATE INPUTS AND FINAL DEMANDS

E. Ahmad and N. Stern\textsuperscript{18} provided the sectoral breakdown of import duties, excise duties, other indirect taxes and subsidies according to the 115 sector classification in CSO-NAS-IOTT (1981) for the year 1973-74. Aggregating this breakdown to six sectors and relating import duties to imports, excise duties to domestic gross output, other taxes to domestic gross output plus imports and subsidies to domestic gross output, we obtained the following tax rates.

\textsuperscript{18}/ Private communication
Table A.1: Sector-Specific Rates of Indirect Taxes by Types of Taxes

<table>
<thead>
<tr>
<th>Sectors</th>
<th>Import Duties</th>
<th>Excise Duties</th>
<th>Other indirect Taxes</th>
<th>Subsidies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.0458</td>
<td>0.0048</td>
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<td>0.0138</td>
<td>0.0232</td>
<td>0.0</td>
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<tr>
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</table>

For getting the indirect tax rates on domestic and imported intermediate inputs, we applied the excise tax rates to the domestic flow matrix and import duty rates to the import-flow matrix. The resulting matrices were column-wise prorated to add to the total indirect taxes available from CSO-NAS-IOTT. Adding the resulting matrices row-wise and relating them to the intermediate inputs - domestic and imported separately - the average tax rates on domestic and imported intermediates were obtained. A similar procedure was applied to each component vector of final demand - domestic and imported - to arrive at indirect tax rates for final demand assuming that other indirect taxes and subsidies were applicable to final demand. The resulting tax rates are given below.
<table>
<thead>
<tr>
<th>Sector</th>
<th>Indirect Tax Rate on Intermediate Inputs</th>
<th>Indirect Tax Rate on Final Demand</th>
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<tr>
<td></td>
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<td>Imported</td>
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<td>6</td>
<td>0.1056</td>
<td>0.6715</td>
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</table>
REFERENCES


Lucas, R. E. B. (1986), "Demand for India's Manufactured Exports", (Boston University, April, processed).
