DISCUSSION PAPER

A GENERAL EQUILIBRIUM ESTIMATION OF THE EFFECTS
OF REDUCTIONS IN TARIFFS AND QUANTITATIVE RESTRICTIONS
IN TURKEY IN 1978

by

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September, 1984

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Abstract

This paper presents general equilibrium estimates of the effects of removing quantitative restrictions and reducing tariff protection across-the-board by 50% for Turkey in 1978. The paper presents a number of extensions over previous estimates of the gains from reducing foreign trade restrictions. The most important extensions include a correct modelling of quantitative restrictions in general equilibrium and an approach to the endogenous determination of rent-seeking activity levels in the presence of quantitative restrictions. The results suggest that substantial costs in terms of foregone GDP resulted from import quotas in the presence of rent-seeking. Finally, for reasons explained in the paper, the additional gain (measured in terms of real GDP) from a further 50% across-the-board reduction in tariff barriers would have been negligible.

OUTLINE

I. INTRODUCTION

A number of recent Computable General Equilibrium models at the World Bank have been used for numerical analysis of changes in the degree of trade restrictions in the economy (Dervis and Robinson, 1978; de Melo and Robinson, 1981; Lewis and Urata, 1983; Amranand and Grais, 1984; Michel and Noel, 1984). Usually these models have attempted in several ways to incorporate not only the traditional tariff distortions but also quantitative restrictions (QRs) and rent-seeking activities that have been observed in economies ridden with quantitative controls. This paper presents a model which draws upon and extends these studies. The approach is based on the methodology presented in Drud, Grais and Pyatt (1983a,b) which enables us to compare directly the effects of reducing tariff barriers with the alternative of relaxing quantitative controls. Because of the variety of mechanisms at work under the different scenarios, we have sacrificed some sectoral detail to facilitate the presentation of results. The application is carried out with an eight-sector model of Turkey for 1978, a year when tariffs and quantitative barriers were important.

The paper is organized as follows. Section II gives an overview of the model and its relationship to other general equilibrium trade models. Section III describes how we introduce QRs and rent-seeking activities in the model. Base year data, calibration, and solution procedures are described in Section IV. The results from a relaxation of QRs followed by a 50% tariff reduction are described in Section V. Conclusions follow in Section VI.

II. A GENERAL EQUILIBRIUM MODEL TO ANALYZE FOREIGN TRADE RESTRICTIONS

2.1 Relationship to Other Models

The model is closely related to previous CGE models built at the World Bank. The model is Walrasian in the sense that it determines relative prices that clear their respective markets. Demands and supplies in each market come from the independent optimizing decision of the various agents subject to their budget constraints. The domestic price of agriculture is taken as numeraire.

The model departs from CGE models in the Scarf-Shoven-Whalley tradition in that it explicitly features expenditure flows arising from government behaviour and the activities of investors. Although government and investors' behaviour is modelled in a rudimentary fashion, their inclusion is needed to capture their activities in the economy. By introducing two agents, welfare analysis requires assumptions on the weights attached to each agent. To minimize the effects of distributional shifts between agents, we fix real government expenditure and use consumption expenditure by the (single) representative household as our welfare indicator. These departures are motivated by concerns at the World Bank on the growth and resource balance effects of alternative policies.

The model departs from previous CGEs in the following respects. First, the model introduces a symmetry between the treatment of exports and imports in a single country model by departing from the assumption of perfect substitutability between commodities produced for the domestic market and for exports. Second, the model does not impose identical marginal rates of substitution between imports and domestic goods across agents, nor does it always adopt two-stage budgeting decision-making. Third, a distinction is made between the short-run (sectoral specificity of capital stocks) and the long-

run (capital mobile across sectors). Fourth quantitative restrictions are modelled by deriving notional demands at virtual prices which are equivalent to effective demands at market prices. Finally, we introduce rent-seeking activities which induce producers to divert resources away from production activities. Because of the emphasis on the role of quantitative trade restrictions, we call the model the TQR model (Tariff Quantitative Restriction).

2.2 Overview of the Model

The structure of the model is outlined in Table 1. The complete set of equations of the TQR model is contained in the appendix. The model is calibrated to 1978 Turkish data. Calibration is around a disaggregated version of the social accounting matrix (SAM) given in Table 3. With a few exceptions discussed below, functional forms are fairly close to those of other CGEs. Note that the sectoral composition of government and investment demand is in fixed proportions and that there is a fixed (in foreign currency units) capital inflow.

In most previous applications, the introduction of product differentiation has entailed adopting the Armington assumption, that is the introduction of two-stage budgeting which means that the utility function generating behaviour is weakly separable over sub-groups. 1/ As way of example, the elasticity of substitution between domestic and foreign cars is independent of the consumption of food. In single country models, the separability is not carried over to similar goods originating from different suppliers. Besides two-stage budgeting, it is also usually assumed that marginal rates of substitution between domestic and foreign produced goods are the same for all sources of demand. Since at fairly aggregated sectoral levels (2-3 digit), data indicate that there are several categories of demanders for the same

Table 1: Main Features of the TQR Model

1. Model Dimensions:

Eight sectors (one non-traded: construction); one consumer; two primary factors labor and capital with labor mobile and capital mobile or immobile across sectors.

2. Production:

Cost-minimizing producers using CES functions for value-added; intermediate requirements involve fixed coefficients across intermediates in different sectors but allow for substitution between domestic and foreign intermediates within a sector (see Table 2(b)).

3. Foreign Trade:

Imports and domestically produced goods are imperfect substitutes with different marginal rates of substitution by end use; capital inflows fixed in terms of foreign currency; the real exchange rate defined as the relative price of foreign produced goods in terms of the numeraire clears the market for domestically produced goods. Domestic production is supplied for domestic market and for export sales according to a CET transformation function. Small country assumption for import supplies and foreign export demand.

4. Final Demand

Linear expenditure system for single household. Fixed coefficient investment demand by origin. Fixed coefficient demand by the Government. Fixed real government consumption. Government savings determined residually.

"goods" -- government, private consumption, intermediate demand, investment demand -- .it seems desirable to relax this assumption and allow for different degrees of responsiveness across demanders. 2/

Table 2(a) shows the assumptions we have adopted with respect to substitution possibilities between imports and domestically produced goods across different users. For private consumption, an LES demand system is specified which allows for non-unitary income elasticities of demand. The selection of parameter values for minimum requirements allows for cross-price substitution effects between similar domestic and imported goods. Government and investment demands for different goods are assumed to be in fixed proportions while two-level budgeting is introduced for intermediate demand. The model therefore assumes that within the period of analysis different users have different price and income elasticities and different marginal rates of substitution between commodities.

Analogously with consumer decision-making, producers take a two-step supply decision. First they produce a composite good at the point of inter-section of their marginal cost and marginal revenue schedules where the marginal revenue schedule is the dual to the (CET) aggregation function described below. In the second step, producers allocate their sales so as to equate the marginal rate of transformation between export and domestic supply with the exogenously given relative price of exports to domestic sales. In both markets, producers are price takers.

The composite price for the output follows a constant elasticity of transformation (CET) function [Powell and Gruen (1967)]. This specification for exports thus introduces a symmetrical treatment of imports and exports, a treatment usually absent in previous single-country models (see the discussion on the treatment of exports in Dervis, de Melo and Robinson, 1982, chapter 7).

Table 2(a): Final Demand Structure

Private Consumption	Government Consumption	Investment Demand	Intermediate Demand
LES	Leontief	Leontief	Two-Level budgeting Armington assumption See Table 2(b)
/ \	/ \	/ \	
Domestic Imported	Domestic Imported	Domestic Imported	
See minimum requirements in Table 3			
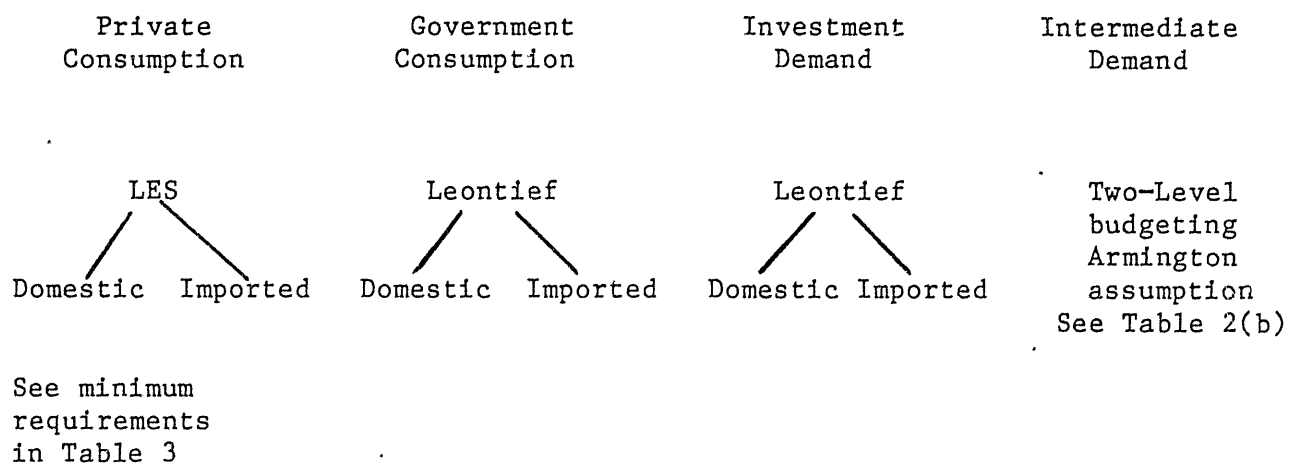
Table 2 (b): Substitution Possibilities in Production and Demand

Gross Output (X_i)

Leontief   (Level 1)

Value Added (VA_i)   Intermediate (I_i)   (Level 2)

CES   Leontief

Capital   Labor   Composite . . . Composite   (Level 3)
                           Intermediate   Intermediate

Domestic   Imported   (Level 4)
Intermediate   Intermediate
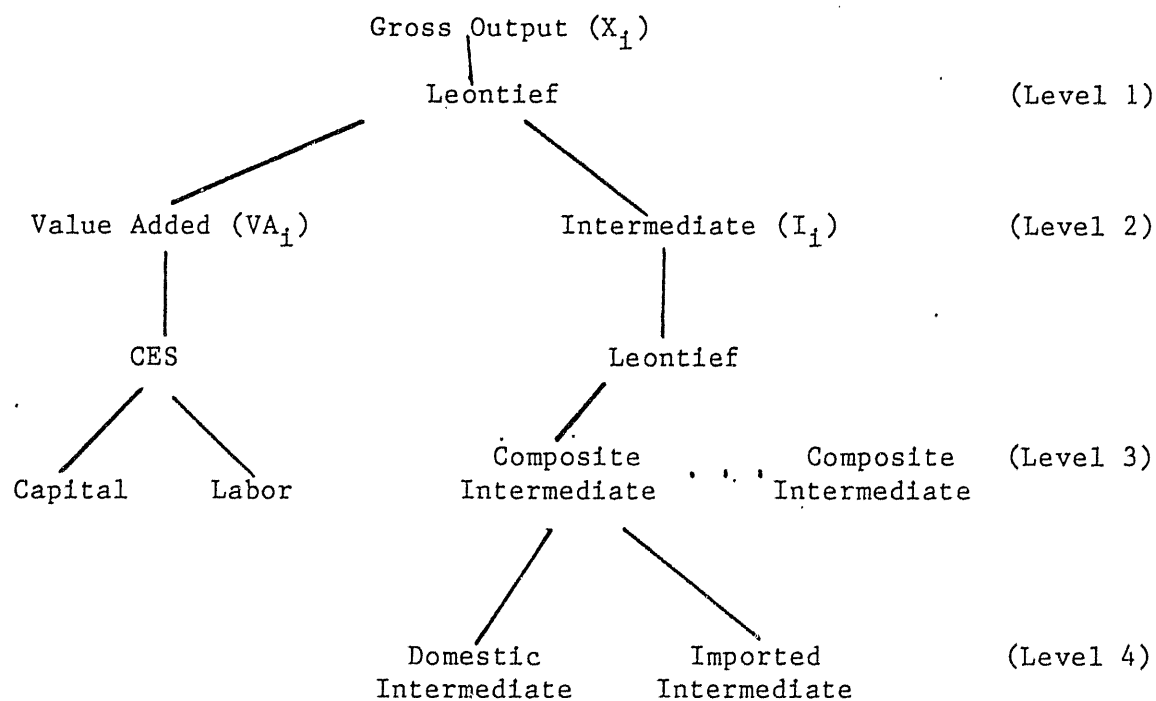
As a result, the model incorporates product differentiation symmetrically for both imports and exports while keeping the small country assumption by maintaining infinite supply elasticities for imports of non-rationed goods and infinite demand elasticities for exports.

Substitution possibilities in production are described in Table 2(b). A Leontief aggregation function is specified between value-added and intermediate demand with value-added a CES aggregation of capital and labor. Intermediate substitution is limited by a fixed intermediate requirement technology across sectors, i.e. there is no scope for substitution between the textiles sector intermediate demand for machinery and for light intermediates. However, there is some scope for substitution within an intermediate category via the CES aggregation functions between domestic and foreign goods falling in that category (level 4 in Table 2b). Thus, a reduction in tariffs on imported machinery would induce domestic textile producers to substitute imported machinery for domestically produced machinery. 3/

III. MODELLING TRADE DISTORTION POLICIES

Since the end of the 1950s protection in Turkey has been achieved by the combination of tariffs, import quotas, and a system of import licensing. 4/ Annual import programs have itemized commodities under different lists (described below) and, in 1978, the Central Bank determined the amount of foreign exchange available for each category of imports, thus in effect directly controlling the allocation of foreign exchange. Typically import programs have been issued semi-annually with imported commodities classified under three main lists: a liberalization list consisting essentially of raw materials and spare parts not competing with domestic production for which importation remained free; a restricted list consisting of interme-

diary and final goods mostly manufactured in Turkey, for which an import license was required; and a quota list, both commodity-specific and user-specific with commodity-specific quotas further allocated between industrialists and importers. 5/ In many respects, the Turkish foreign exchange trade regime was typical of that encountered among many developing countries that have followed an import-substitution-led industrialization strategy for an extended period of time.

No precise information is available about the distribution of the value of imports under the above categories for 1978, but an approximate distribution can be obtained on the basis of information for 1981, a year during which licensing and quotas were less stringent than in 1978. In 1981, 70% of the value of imports of goods (including crude oil) was subjected to licensing, while 17% was on the liberalization list and 8% on the quota list. Furthermore, durable and non-durable consumer goods including cars, washing machines, and television sets did not appear on either list. Importing these goods was de facto prohibited unless a specific authorization was issued by the government.

To model realistically the quantitative impact of a reduction in the degree of restrictiveness of the Turkish foreign trade regime in an economy-wide framework is a difficult task. To begin with, it is likely that in the presence of licensing and rationing a reduction in tariffs would have no effect on the volume of imports for many products. It is also difficult to imagine how one could effectively quantify the effects of new imported products following a removal of quotas. Furthermore, it is likely that the prevailing non-price distortions induced illegal foreign trade transactions and rent-seeking activities. To model comprehensively these various features of the foreign trade regime is beyond our scope. We have therefore decided to

concentrate only on two aspects of Turkey's foreign trade regime in 1978: rationing and rent-seeking. Since the manner in which these aspects of the trade regime is modelled is distinctive and determines the numerical results presented in Section V, a discussion of QR and rent-seeking follows below. Also numerical analysis of reductions in QRs and rent-seeking is undertaken separately from the tariff reduction experiment.

3.1 Quantitative Restrictions

From the above presentation of Turkey's foreign trade regime, it should be obvious that it is extremely difficult to model realistically rationing and rent-seeking activities. To simplify the presentation of the model and to help in the interpretation of results, we have decided to simplify the representation of rationing and rent-seeking activities by sharply dividing imports in the following three categories: imports which are only subjected to tariffs (investment goods and government imports); imports which are subjected to tariffs and rationing and give rise to rent-seeking activities (intermediates); imports which are subjected to tariffs and rationing but which do not give rise to rent-seeking (consumer goods). This categorization of imports is of course only an approximation and the modelling of QRs for consumer goods ignores the fact that commodity-specific quotas for consumer goods were mostly allocated to importers, but this sharp dichotomy helps greatly in keeping clarity of formulation and in interpreting the results.

To model rationing, we draw on the concept of "virtual" prices used by Neary and Roberts (1980), i.e. those prices which would induce an unrationed household to behave in the same manner as when faced with a given vector of ration constraints. 6/ For both import categories which are rationed (intermediates and consumer goods), denote their virtual price

Figure 1
Household Import Demand Under Import Rationing
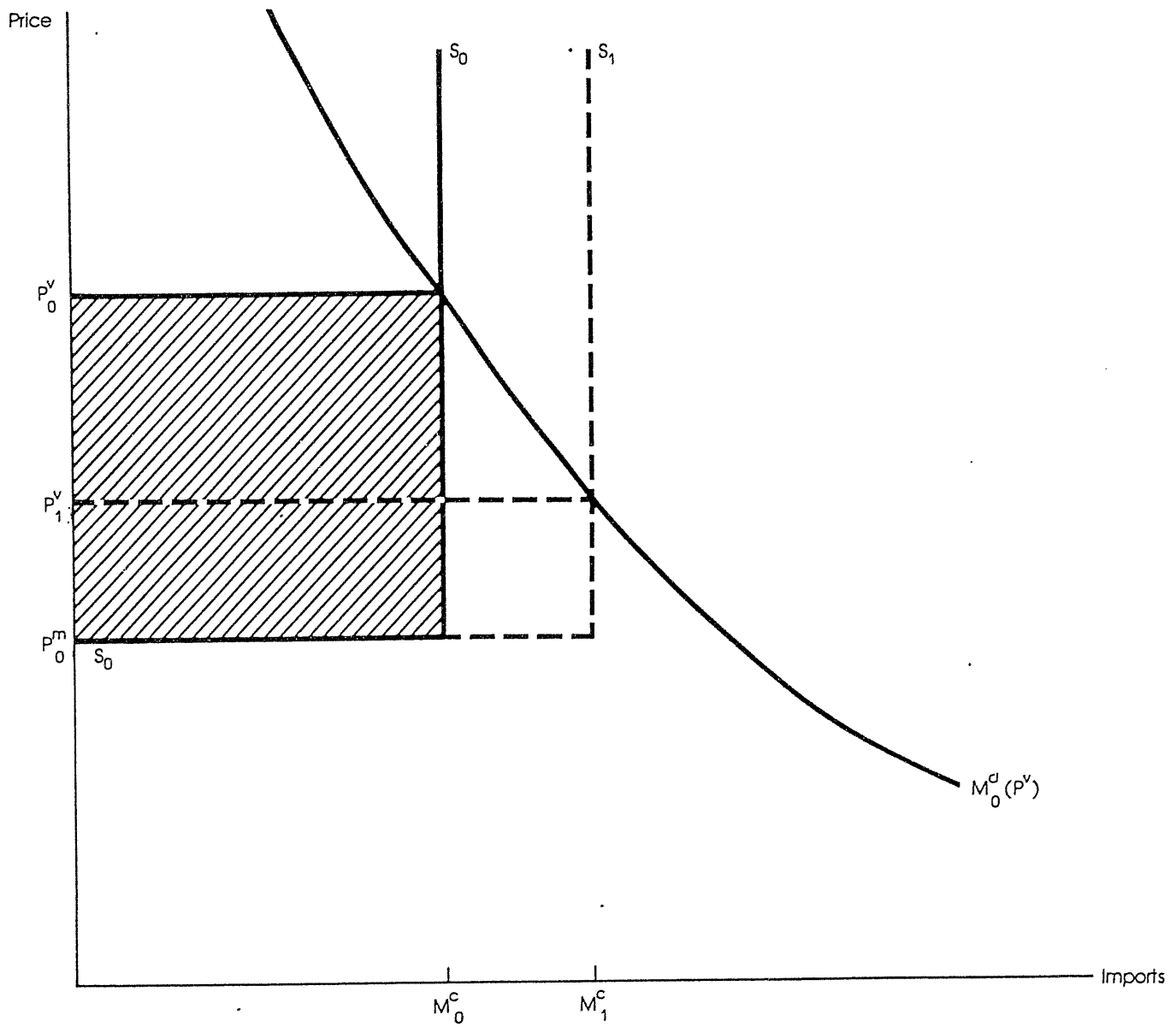
by P^v. Rationing of consumer goods purchased by the household is illustrated in Figure 1. The household is unconstrained in its purchase of domestic goods, but its consumption of imported goods is limited to M_o^c. What Neary and Roberts (1980) demonstrate is that effective demands at market prices and notional demands at virtual prices are equivalent. As shown in Figure 1, though the household only purchases M_o^c at the domestic currency price P_o^m, this is equivalent to the household purchasing the same quantity along the notional import demand curve M_o^d evaluated at virtual prices, P_o^v. This approach to modelling QRs allows us to take fully into account that the household re-optimizes subject to rationing, as the income associated with rationing (the shaded are in Figure 1) is being channelled back to disposable income and reallocated between the unrationed domestic substitutes and savings. 7/ The benefit to the household from a small increase in the amount of consumption of M_o^c is expressed as a reduction in the expenditure required to attain the same utility level and is given by $(P_o^v - P_o^m)$.

Figure 1 also illustrates how a relaxation in the level of rationing affects import demand. An increase in the permitted import level (M_o^c to M_1^c) shifts the import supply curve (S_0S_0 to S_0S_1). The effect is a new virtual price, P_1^v, corresponding to the new situation.

3.2 Rent-Seeking

Recall that producers received directly commodity-specific import licenses for intermediates which they were usually not allowed to resell. We therefore assume that producers engage in rent-seeking activities in order to capture the rents associated with licenses for purchases of imported inter-mediates. In the absence of any specific information, we assume that rent-seeking activity takes place in each sector. For Turkey this is a rough approximation of what actually happened in 1978 since commodity specific

imports on the restricted list were imported with a license that was allocated directly to producers.

Our approach to implementing rent-seeking behaviour is to assume that the production function for rent-seeking is the same as the production function of what we refer to as "traditional" output. The producer, however, must purchase both the "traditional" commodity and rent-seeking. Furthermore, we assume that the entire value of the rents, R, is spent on the production of the rent-seeking activity. Dropping sector subscripts, at equilibrium the following will hold:

(1) $$X_T^D \text{ (PD)} + X_R^D \text{ (PD)} = X^S \text{ (PD, PV; } \overline{K})$$

and

(2) $$X_R^D \cdot \text{PD} = M \text{ (PV} - \text{PM)} = R$$

where PD, PV, and PM are respectively the domestic, virtual and import prices, M is the volume of rationed intermediate imports and X_T^D, X_R^D, are the demand for "traditional" and rent-seeking output and X^S is short-run output supply given capital stock. Thus the effect of rent-seeking is to reduce the supply of the "traditional" output and to raise the price to the final user. 8/ In the spirit of the literature on directly unproductive activities, rent-seeking creates incomes since more output is produced but at the same time the output generated by rent-seeking, X_R^D, does not enter the utility function since it does not appear as an element of final demand.

The loss to the economy from rationing and rent-seeking is summarized in Figure 2 where the economy is conveniently aggregated into one sector. Because producers purchase imported intermediates, any rationing of these

Figure 2
Welfare Cost of Rationing and Rent-Seeking
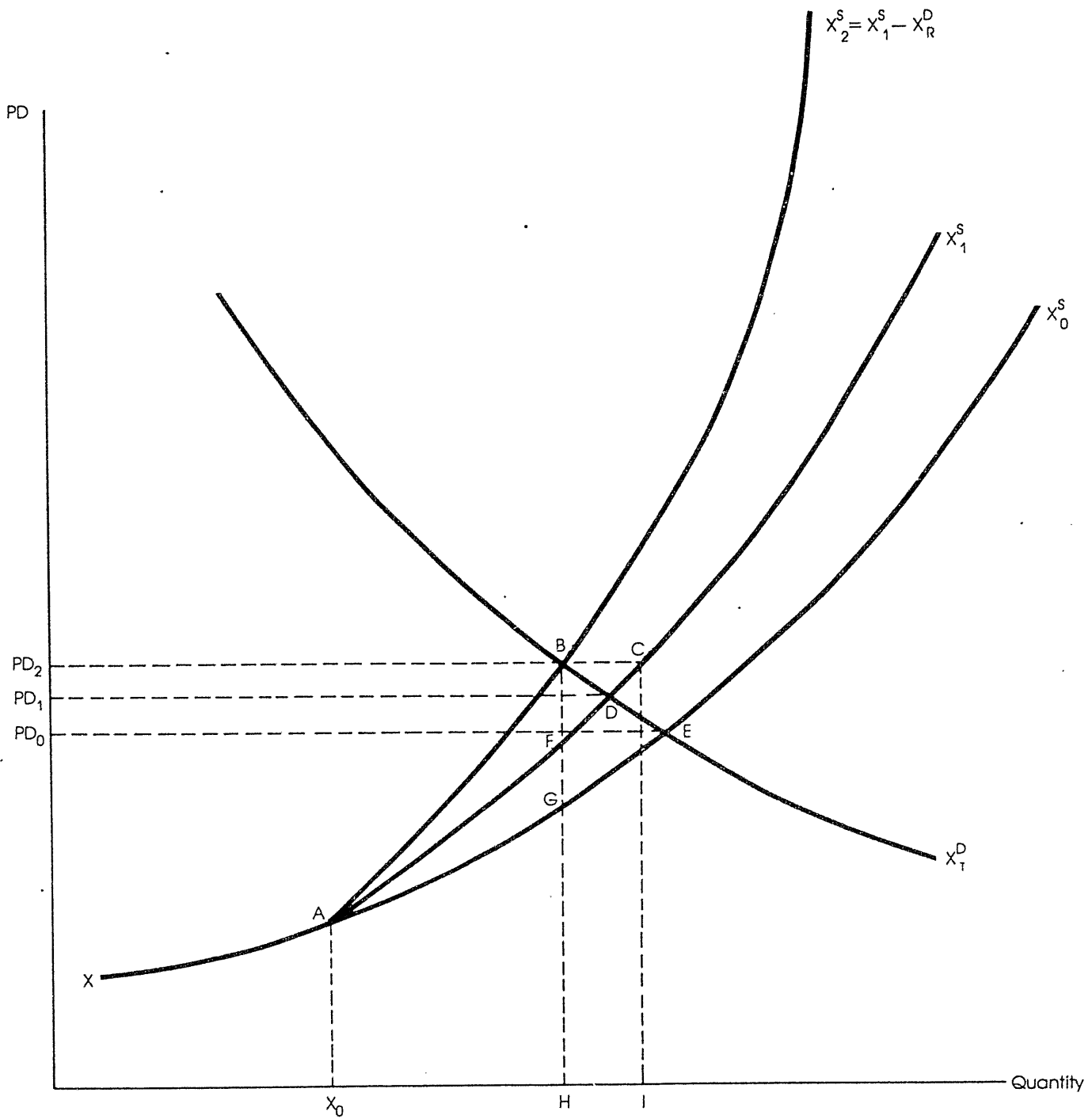
intermediates will raise marginal costs of production. This is shown in Figure 2 by the leftward shift of $X X_0^S$ to $X X_1^S$ beyond X_0, the point at which rationing becomes effective. As a result of rationing, there is a deadweight loss, ADE. The effect of rent-seeking is to further push up the supply curve to $X_2^S = X_1^S - X_R^D$ because of the diversion of output towards rent-seeking. The result is to raise the price (in terms of the numeraire) to PD_2. The area HBCI is equal to the value of the rents and the horizontal distance between X_1^S and X_2^S shows the output of rent-seeking activity. The extra deadweight loss from rent-seeking is given by ABD. At the new equilibrium, FG and BF are additional costs due to rationing and rent-seeking respectively.

Several characteristics of this approach to rent-seeking activity should be noted. 9/ First there is the issue of what is an appropriate form for the production function that underlies this activity. In the absence of any estimation of such activities we have assumed that the production function is similar to the production function of the corresponding sector to which the import license is issued. Second there is the issue of how we recognize that this activity, while being profitable, is not directly productive in the sense that the output generated does not enter directly the utility function. 10/ As modelled here the unproductive nature of rent-seeking results from an increase in intermediate demand per unit of output which is equivalent to an inward shift of the net production possibility frontier. In interpreting the results below one must keep in mind that this approach is only one among a number of possible alternatives. For instance, one could assume that the technology of rent-seeking is similar across sectors and that a single sector, say commerce, engages in rent-seeking.

IV. CALIBRATION AND SOLUTION PROCEDURE

Two steps are involved in the calibration procedure. First, exogenous parameters in supply and demand equations are provided. Second, a consistent social accounting matrix (SAM) is constructed. Before describing these two procedures, we briefly present the SAM underlying the TQR model. The SAM helps understanding the structure of the model and the figures in the SAM give a sense of the magnitudes involved.

4.1 A One Sector SAM for the TQR Model

Table 3 shows a one-sector version of the Turkey SAM. As all SAMs it has the same number of rows and columns, which respectively represent receipts and expenditures associated with each account. As in all accounting, total expenditure has to be equal to total receipts for each account and thus each row sum has to be equal to the corresponding column sum. One particular feature of the SAM used in this model is that only transactions with the same valuation belong to the same row. 11/ Two examples from the Turkey SAM illustrate this feature. The first example considers the treatment of different assumptions regarding the mobility of factors of production. If capital is assumed to be perfectly mobile across sectors so that only one rental rate is determined in the economy, then only one account is needed in the SAM. However, if capital is assumed to be immobile across sectors (i.e. sector specific capital), one needs as many capital factor accounts as there are sectors because rental rates will differ across sectors. The second example illustrates the treatment of import quotas. Since the value of imports to purchasers varies with the virtual price associated with the amount of imports allowed under the quota system, accounts representing import quotas are introduced in the Turkey SAM. It is thus clear that a different price is associated with each account in the SAM.

Table 3: **Social Accounting Matrix for the TQR Model (million TL)**

	#	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
FACTORS OF PRODUCTION																										
Labor	1												597													597
Capital	2												590														590
Consolidated Cap	3		590																								590
HOUSEHOLD																										
Revenue	4	597		590								22						7								1216
Disp Income	5				999																					999
Total Exp	6					845																				845
Discret. Exp	7						419																			419
GOVERNMENT																										
Revenue	8				217									47					8			24			8	304
Expenditure	9								169																	169
CAPITAL ACCOUNT	10					154			135			24														313
REST OF THE WORLD	11																		25			71			25	121
ACTIVITIES																										
Value Added	12													1187												1187
Output	13														2053	75										2128
DOMESTIC SUPPLY	14																805			733	66			449		2053
EXPORTS	15											75														75
COMMODITIES																										
Consumption																										
Domestic	16						443	362																		805
Rationed Imp	17						-17	57																		40
Imports	18																	33								33
Intermediates																										
Domestic	19																						733			733
Rationed Imp.	20																						161			161
Imports	21																				95					95
Composite	22													894												894
Others																										
Domestic	23									165	284															449
Imports	24									4	29															33
TOTAL	25	597	590	590	1216	999	845	419	304	169	313	121	1187	2128	2053	75	805	40	33	733	161	95	894	449	33	

The Turkey SAM presented in Table 3 has twenty-four accounts which can be grouped into six broad categories: (a) factors of production (accounts 1-3); (b) current accounts of institutions (4-9); (c) capital account (10); (d) rest of the world (11); (e) production activities (12 and 13); (f) commodities (14-24). The entries in the SAM indicate that the single (representative) household receives payments from factors of production and from the rest of the world in the form of workers' remittances while it spends its revenue on income taxes, savings and consumption. Household consumption is split into committed and discretionary components since a linear expenditure system is assumed to represent household consumption behaviour. Also note that taxation is not restricted to tariffs only: the government also receives tax revenues from households and from domestic production. Since government expenditures are assumed fixed in real terms, expenditure shifts between consumption and investment will be induced by changes in protection levels.

The SAM indicates the composition of imports in the base year and highlights the treatment of imports by end use. In particular notice the presence of import rationing in consumption and intermediate goods (columns 17 and 20). The premia attached to quota on consumer goods imports are allocated to the household account and the premia from quota on intermediate goods imports are allocated to the importing sector.

4.2 Elasticity Specification

Four sets of elasticities are necessary to implement the model: household income elasticities of consumption goods, elasticities of substitution between domestic and imported intermediate goods in production, elasticities of substitution between labor and capital in production, and elasticities of transformation between domestic and exported goods in

· production. In addition to income elasticities, a value for the Frisch

parameter (set to -2) has to be provided to derive the remaining parameters of

the linear expenditure system.

The values for the income elasticities are shown in Table 4. In

deriving income elasticities it was assumed that elasticities are higher for

non-primary goods and imports compared to those for primary goods and domestic

goods. Compensated own price elasticities also reflect our assumption that

the presence of quantitative restrictions is likely to have given rise to a

pent-up demand for imports captured by high income and price elasticities for

imported goods. Values for the elasticities of substitution between capital

and labor in value-added and values for the elasticities of transformation

between domestic and imported goods (as intermediates) and between domestic

sales and exported goods appear in Table 5. The values of the first two sets

of elasticities are taken from Lewis and Urata (1983) and those of the

elasticities of transformation between exports and domestic sales are inspired

from Powell and Gruen (1967).

To complete the calibration to the base year data we had to make some

"guesstimates" about the premia generated by import quotas. The estimation of

premium rates is based on the quantity rationing rate reported in Lewis and

Urata (1983). Given the ratio of the actual import volume to the desired

import volume and the implied price elasticity of demand for intermediates in

Table 4, the premium rate is approximated by the following formula:

$$(3) \qquad \frac{\Delta Pm}{Pm} = -\frac{1}{\mu}\frac{\Delta M}{M^*}$$

where Pm is the price of imports under free trade (assumed to be unity),

ΔPm is the premium, M^* is the desired level of imports at price Pm, ΔM is the

Table 4:

Household Consumption and Intermediate Demand Elasticities

| | HOUSEHOLD CONSUMPTION | | | | INTERMEDIATES | |
| | Income | | Own Price (Compensated) | | Price a/ | |
	D	M	D	M	D	M
Agriculture	0.6	2.5	-0.2	-1.2	----	----
Mining	0.6	2.5	-0.3	-1.2	-0.5	-1.0
Food Processing	0.8	2.5	-0.4	-1.2	----	----
Textiles	1.1	2.9	-0.5	-1.4		----
Intermediates	1.1	2.9	-0.5	-1.4	-0.1	-0.3
Machinery	1.1	2.9	-0.5	-1.4	-0.1	-0.3
Construction	----	----	----	----	----	----
Services	1.1	2.9	-0.3	-1.4	-0.1	-0.8

D and M indicate domestic and imported goods respectively.

a/ For derivation see Dervis, de Melo, and Robinson (1982), p. 238.

Table 5:

Elasticities of Substitution and Transformation
in Production and Foreign Trade

| | Elasticity of Substitution | | Elasticity of Transformation |
	Value Added (Capital/Labor)	(Domestic/ Imported Goods)	(Domestic/ Exported Goods)
Agriculture	1.2	----	1.5
Mining	0.8	1.5	1.5
Food Processing	0.4	----	1.5
Textiles	0.4	----	0.5
Intermediates	0.4	0.4	0.5
Machinery	0.4	0.4	0.5
Construction	0.4	----	----
Services	0.4	0.8	0.5

difference between desired and actual import volume and $\mu(<0)$ is the price elasticity of import demand. The resulting premium rates appear in Table 6. Premium rates on consumption goods range between 13% and 32%, and premium rates on intermediate goods are much higher due to low demand elasticities for intermediates. These premium rates are then used to compute the premia allocated to households and to the services sector which appear in Table 3. The premia on consumption goods imports amount to 7 million TL and the premia on intermediates amount to 66 million TL.

Before turning to a discussion of the solution procedure, it should be noted that the calibration of the model to the benchmark data incorporated in the SAM implies that, other than the distortions described above, we have assumed that the economy was in long-run equilibrium in 1978. In particular, wage and rental rates are equated across sectors.

4.3 Solution Procedure 12/

The solution procedure involves three steps. The first step generates the logical structure of the model by incorporating the information from the SAM and the functional specification and behavioural equations outlined in the previous sections and specified in the appendix. The second step performs a block decomposition of the model and partitions the simultaneous blocks into a recursive part and a spike or loop part. The third step solves the model numerically by utilizing a Newton-type algorithm on a system which consists mainly of spike variables and equations since everything else can be substituted out numerically. A particularly attractive feature of this solution procedure is that a solution algorithm is designed for each model structure endogenously before turning to the numerical solution of the model. As a result, the solution procedure can handle a wide variety of

Table 6:

Tariff Rates, Quantity Rationing Rates and Premium Rates (%)

Sector	Tariff Rate [a]	Quantity Rationing Rate (M_o^C/M_o^*) [b]	Premium Rate (%)	
			Consumption Goods $(P_v-P_m)/P_m$	Intermediate Goods $(P_v-P_m)/P_m$
Agriculture	20	70	23.9	-----
Mining	3C	60	32.0	40.0
Food Processing	24	60	32.0	-----
Textiles	49	80	13.7	-----
Intermediates	41	70	20.7	94.6
Machinery	35	70	21.0	101.4
Construction	--	--	-----	-----
Services	9	80	13.7	25.4

[a] Aggregated from Lewis and Urata (1983), Table 2.6.

[b] M_o^C and M_o^* are respectively the actual and the desired import volumes.

models.. For further description of the approach and solution procedure see Drud, Grais, and Pyatt (1983a).

V. ESTIMATES FROM REDUCTIONS IN QUANTITATIVE AND TARIFF BARRIERS

5.1 Macroeconomic Results

Because of the prevailing import quotas in Turkey in 1978 it would be pointless to proceed with a reduction in tariffs for commodities subjected to a quota. We could of course reduce tariffs on those commodities not subjected to quotas. However, we have decided to proceed differently in three steps. As a logical first step towards liberalization of the foreign trade regime, we remove quotas on intermediate imports. This is consistent with experiences observed in many developing countries undertaking a liberalization of their foreign trade regime. In a second step, we remove the remaining quota on consumer goods imports. Finally in a third step when all quotas have been removed, we reduce the ad-valorem tariff rates reported in Table 6 by 50% across-the-board. For all experiments we contrast the results obtained under sectoral capital specificity (short-run) with the results obtained when both labor and capital are mobile across sectors (long-run). This gives the following set of experiments:

E-1A : Removal of quotas on imports of intermediate goods with fixed sectoral capital.

E-1B : Same as E-1A but with capital mobile across sectors.

E-2A : Removal of import quotas on consumer and intermediate goods with fixed sectoral capital.

E-2B : Same as E-2A but with capital mobile across sectors.

E-3A : E-2A + 50% tariff reduction across the board.

E-3B : E-2B + 50% tariff reduction across the board.

The rationing-induced rents are estimated at 6 percent of GDP with rents concentrated in intermediates. Starting with the effect of removing quotas on imports of intermediates (E-1A; E-1B), the net effect is to raise the volume of other imports (investment goods and government imports) in spite of a real exchange rate depreciation. The reason for this effect lies in the combined effect on investment of a greater value of foreign savings caused by the real exchange rate depreciation (i.e. an increase in the domestic currency price of foreign exchange in terms of the numeraire) and of the increased value of government tariff collection which is also channelled into savings because of the assumption of fixed real government expenditures. 13/ Since investment demand has a high import content, this results in an increase in the volume of other imports in spite of an increase in their relative price. 14/

The greatest welfare gains from trade liberalization come from the removal of quotas on intermediates. This is so both because of their large share in total imports and because they give rise to rent-seeking. As a result of the removal of quotas on imports of intermediates, real GDP increases by 4.6 or 5.2 percent depending upon the assumption about capital mobility. Taking real household consumption as a welfare indicator, the corresponding increases in real household consumption are 3.5 and 3.8 percent. It should be noted, however, that this measure understates the total welfare gain since there is also an increse in real investment of between 9.7 and 11.2 percent which would induce higher levels of future consumption.

The net incremental gains from removing quotas on imports of consumer goods are not very large both because consumption goods imports have a lower share in total imports (coupled with a lower rationing rate) and because they do not give rise to rent-seeking. In the case of mobile capital the net gain

Table 7: Macroeconomic Results

Experiment: Ratio to Base year Value

	Base	E-1A	E-1B	E-2A	E-2B	E-3A	E-3B
Real Exchange Rate [a]	1.0	1.011	1.045	1.073	1.099	1.124	1.145
Volume of Imports [b]							
Consumer	25	1.000	1.000	1.232	1.227	1.372	1.393
Intermediate	71	0.995	1.035	0.979	1.018	0.995	1.037
Other	25	1.085	1.098	1.085	1.096	1.064	1.062
Total	121	1.014	1.040	1.054	1.078	1.088	1.117
Export volume [c]	75	1.024	1.065	1.086	1.126	1.142	1.189
Real GDP: [c]	1281	1.046	1.052	1.048	1.054	1.049	1.055
Rationing-induced rents (as % of nominal GDP)							
Consumer goods	0.6	0.7	0.6	0.0	0.0	0.0	0.0
Intermediates	5.4	0.0	0.0	0.0	0.0	0.0	0.0
Real Household Consumption [c]	845	1.035	1.038	1.038	1.042	1.048	1.057
Real Investment [c]	313	1.097	1.112	1.097	1.110	1.073	1.071
Real Import/Real GDP	9.4	9.2	9.3	9.5	9.7	9.8	10.0
Real Export/Real GDP	5.9	5.7	6.2	6.1	6.3	6.4	6.6

[a] The real exchange rate is defined in terms of the domestic price of agricultural goods.
[b] Million TL exclusive of tariffs.
[c] Million TL.

Note: Unless otherwise noted all experiment values are ratios to base value.

in real household consumption is 0.4 percent. Finally, the result of reducing tariffs by 50% across-the-board is to further increase real household consumption by 1%, but this is due mostly to a fall in real investment. The reduction in investment comes from the reduction in government savings which is due to a lower tariff revenue caused by the tariff reduction. In terms of real GDP, almost all the gains come fom the removal of the rent-seeking associated with quotas on imports of intermediates.

Finally, note that the assumption of sectoral fixity of capital does not affect much the magnitude of the results. These results are in contrast with earlier comparisons of the role of capital specificity in models where perfect substitution was assumed between domestic and foreign goods (de Melo, 1978). In the TQR model, the curvature of the net production possibility set is thus mostly determined by the assumption of imperfect substitution between domestic and foreign produced intermediates.

5.2 The Price Mechanism and Sectoral Resource Allocation

The macroeconomic results discussed above are the outcome of resource shifts at the sectoral level. Tables 8 and 9 show the implications of two distinguishing characteristics of the TQR model: the treatment of quantitative restrictions and the distinction of import demand by end use. Table 8 indicates resources shifts resulting from the removal of import quotas on intermediates and consumer goods. Table 9 takes as a point of departure the results in Table 8 and reports resource shifts resulting from a further 50% across-the-board tariff reduction.

Table 8 is useful to evaluate differences between the usual tariff-equivalent approach to estimating the impact of a removal of quantitative restrictions and the notional demand approach used in this paper. The traditional approach might proceed along the following line: extraneous

Table 8: Resource Shifts from Removal of Import Quotas of Consumer and Intermediate Goods

(Mobile Capital)

	Consumer Goods Imports			Intermediate Imports				Gross Output
	Virtual Price	Volume		Virtual Price	Volume			
Experiment Sector	(% change) (E-2B)	(Ratio to Base) (E-2B)	(a)	(% change) (E-2B)	(Ratio to Base) (E-2B)	(a)	(E-1B)	(E-2B)
1 Agriculture	−11.3	1.24	(1.23)	---	---		-----	1.04
2 Mining	−16.8	1.34	(1.29)	−21.5	0.94	(1.24)	0.96	0.68
3 Food	−16.8	1.34	(1.29)	---	---		-----	1.05
4 Textiles	−3.4	1.14	(1.17)	---	---		-----	1.04
5 Intermediates	−9.0	1.24	(1.24)	−43.5	1.07	(1.15)	1.08	0.79
6 Machinery	−9.2	1.24	(1.24)	−45.4	1.12	(1.15)	1.13	0.98
7 Construction	---	---	(----)	---	---		-----	1.11
8 Services	−3.4	1.14	(1.17)	−12.4	1.07	(1.16)	1.11	1.03

Notes: Partial Equilibrium Estimates in parentheses.

(a): Computed as $\Delta M/M = -\mu \frac{P_v}{1 + P_v}$ where μ is the price elasticity of demand in Table 4 and P_v is the premium rate in Table 6.

information drawn from price comparisons would lead to an estimate of the gap
between the world price of the imported good and its domestic currency price,
i.e. the premium rates in Table 6. The sectoral premium rates would then be
added to the sectoral tariff rates reported in the first column of Table 6.
This approach might be termed the naive approach since it does not take into
account the exchange rate adjustment that would accompany the removal of the
tariff equivalent of quantitative controls -- 9.9% for the mobile capital case
(E-2B) reported in Table 8. A comparison of the virtual price changes
reported in Table 8, columns 1 and 3 with the premium rates reported in the
last two columns of Table 6 give an approximation of the general equilibrium
effects. By way of example consider textiles (consumer goods) which have a
premium rate of 13.7%: assuming that an accurate back-of-the-envelope
calculation is made of the real exchange rate adjustment, the tariff-
equivalent partial equilibrium estimate would yield 9.9% - 13.7% = - 3.8%
increase in the imported price which is higher than the model generated
equilibrium estimate (-3.4%). Similar approximations can be made for imported
intermediates.

One can further estimate the likely import response using partial
equilibrium formulae with the exogenously computed premia in Table 6. Such
calculations are close to those generated by the general equilibrium model and
are reported in parentheses in Table 8. The predictions are fairly close for
consumer good imports but are quite off the mark for intermediates because of
the neglected effects of changes in net prices via inter-industry linkages.
Finally, the last column in Table 8 gives the estimated gross output resource
shift from removing import quotas of consumer goods and intermediates.

To provide a direct comparison with other estimates which focus on
the implications of resource shifts resulting from an across-the-board 50%

Table 9:   Sectoral Resource Shifts from 50% Tariff Reduction

(mobile capital; ratios to quota free solution; (E-3B)/(E-2B))

	Gross Output	Consumer Imports	Intermediate Imports	Other Imports
Agriculture	1.01	1.08	---	---
Mining	0.97	1.12	1.03	1.00
Food	1.02	1.09	---	---
Textiles	1.01	1.24	---	---
Intermediates	0.98	1.19	1.01	0.97
Machinery	0.98	1.17	1.01	0.97
Construction	0.97	---	---	---
Services	1.00	1.02	1.00	0.96

tariff reduction, Table 9 indicates the output and import responses starting from a quota-free situation. As expected, tariff reduction leads to a resource shift out of non-tradables (construction) towards export-oriented tradable sectors (food and textiles). Finally, the machinery sector contracts owing to the fall in real investment demand. Finally, the last three columns in Table 9 show the differential impact across import categories of an identical tariff reduction. Consumer imports expand most because of the high income elasticity of demand while other imports fall because of the decline in investment demand for imports.

VI. CONCLUSIONS

This paper has provided a general equilibrium model capable of incorporating directly some of the most important mechanisms and by-products of foreign trade controls found in developing countries: quotas and rent-seeking (directly unproductive) activities. The model has also extended the traditional product differentiation between imports and domestic goods to product differentiation between exports and domestic sales. Finally the model makes a distinction between imports by categories of final demand.

Numerical analysis suggests that a removal of quotas on consumer and intermediate goods in Turkey in 1978 would have led to large gains in terms of real GDP. The results also suggest that this result would be robust with respect to assumptions about sectoral capital mobility. However, the additional gain from a further across-the-board 50% tariff reduction would be small. This result is similar to other general equilibrium estimates of the gains from across-the-board reductions in tariffs.

FOOTNOTES

1/ In most applications the specifications adopted imply strong separability. The assumption of weak separability is however sufficient.

2/ This specification has also been followed in Auranand and Grais (1983).

3/ The two stage budgeting procedure could be relaxed if an import matrix were available.

4/ The summary volume by Bhagwati (1978) and the country study on Turkey by Krueger (1974a) provide detailed descriptions and analyses of the functioning of foreign trade regimes with quantitative restrictions.

5/ For further detail see World Bank (1982), chapter 2. The lists correspond respectively to liberalization lists I and II and to the quota list.

6/ Since the utility function of the LES can be written in closed form, one could proceed directly from the constrained primal problem instead of using duality and virtual prices.

7/ Dervis, de Melo, and Robinson (1981) also introduced rationing but constrained users to spend the income under the shaded area entirely on the domestic substitute good i competing with imported good i thereby ruling out spillovers across markets.

8/ See Dervis, de Melo, and Robinson (1983), Chapter 9 for an alternative approach to rent-seeking.

9/ See Tullock (1967), Krueger (1974b) and Bhagwati and Srinivasan (1980) for theoretical treatments of rent-seeking and Bhagwati and Srinivasan (1983, ch. 30) for a review of the literature.

10/ Dervis, de Melo, and Robinson (1982, chapter 9) model rent-seeking activities as an inward shift (negative disembodied technical change) in the production function which also amounts to an upward shift of the marginal cost curve. However, in their formulation, the level of resources extended towards rent-seeking activity is allowed to vary exogenously whereas here resources equivalent to the full value of rents are expended on rent-seeking as suggested by Bhagwati and Srinivasan (1980).

11/ The model is formulated according to the transactions value (TV) approach presented in Drud, Grais, and Pyatt (1983a and b).

12/ See Drud, Grais and Pyatt (1983b) for a more detailed description.

13/ The effect of the increased domestic currency value of the exogenously fixed foreign currency value of the foreign capital inflows was first noted by Hirschman (1948).

14/ In the case of fixed sectoral capital stocks, intermediate imports fall in spite of the removal of quotas. This is due to the contractionary effect on production of abandoning rent-seeking activities.

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Appendix to:

A GENEREAL EQUILIBRIUM ESTIMATION OF THE EFFECTS OF REDUCTIONS

IN TARIFFS AND QUANTITATIVE RESTRICTIONS IN TURKEY IN 1978

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September, 1984

The Equations of the TQR Model

This appendix presents the complete set of equations describing the model. Exogenous variables and parameters are denoted by Roman letters with a bar or Greek letters; superscripts are used to distinguish commodities by end use and subscripts refer to sectors. Table A.1 lists the sets of equations in the model and Table A.2 defines commodity prices in the model.

Table A.1: Equations of the TQR Model

1. ### Factor Markets

$$L_i^d = \alpha_i^{\sigma_i} (PN_i / W)^{\sigma_i} X_i$$

Labor demand (σ is the elasticity of substitution between capital and labor)

$$\sum_i L_i^d = \overline{L}$$

Equilibrium condition for the labor market

$$K_i^d = (1 - \alpha_i)^{\sigma_i} (PN_i / r)^{\sigma_i} X_i ,$$

Demand for capital services

$$\sum K_i^d = \overline{K}$$

Equilibrium condition for capital services (capital mobile across sectors). If capital is fixed, rental rates, r_i, are determined residually.

2. __Demands for Intermediate Inputs (V)__

$$V_i^c = \sum_j a_{ij} \cdot X_j$$

Demands for composite intermediates, where X_j is total output

$$V_j^d = \xi_j^{n_j} [pc_j^i / pd_j^i]^{n_j} V_j^c$$

Notional demands for domestic intermediates, $n_j > 0$, $0 < \xi_j < 1$

$$V_j^m = (1 - \xi_j)^{n_j} [pc_j^i / pv_j^i]^{n_j} V_j^c$$

Notional demands for imported intermediates, $n_i > 0$, $0 < \xi_j < 1$

3. __Supplies to Domestic (S^d) and Foreign (S^e) Markets__

$$S_j^d = \beta_j^{\theta_i} [PD_j / PD_j^d]^{\theta_j} X_j$$

Supplies to domestic markets, $\theta_j < 0$, where X_j is total output;

$$S_j^e = (1 - \beta_j)^{\theta_i} [PD_j / PD_j^e]^{\theta_j} X_j$$

Supplies to foreign markets, $\theta_j < 0$; where X_j is total otput;

4. __Relations Between Prices__ (variables starting with "τ" refer to corresponding ad-valorem tax rates)

$$pd_j^c = (1 + \tau c_j^d) PD_j^d$$

Market prices of domestic consumer goods

$$pd_j^i = (1 + \tau i_j^d) PD_j^d$$

Market prices of domestic intermediates

$$pd_j^o = (1 + \tau o_j^d) PD_j^d$$

Market prices of other domestic goods

$$pd_j^e = (1 + \tau e_j) PD_j^e$$

Export prices inclusive of taxes or subsidies

with $pd_j^e = \overline{\pi e_j} \cdot ER$

$$pm_j^c = (1 + \tau c_j^m) \overline{\pi c_j^m} \, ER$$

Landed prices of consumer imports

$$pm_j^i = (1 + \tau i_j^m) \overline{\pi i_j^m} \, ER$$

Landed prices of intermediate goods

$$pm_j^\theta = (1 + \tau o_j^m) \; \overline{\pi o}_j^m \; ER$$

Landed prices of other imports

$$pc_j^i = \{\xi_j^{n_j} \, (pd_j^i)^{1-n_j} + (1 - \xi_j)^{n_j} \, (pv_j^i)^{1-n_j}\}^{1/1-n_j}$$

Composite prices of intermediates

$$PD_j = \{\beta_j^{\theta_j}(PD_j^d)^{1-\theta_j} + (1 - \beta_j)^{\theta_j} (PD_j^e)^{1-\theta_j}\}^{1/1-\theta_j}$$

Marginal revenues

$$PD_j = \sum_i a_{ij} \, (pc_i^i) + a_{VA,j} \cdot PN_j$$

Gross output prices, marginal costs of gross output

$$PN_j = \{\alpha_j^{\sigma_j} \, W^{1-\sigma_i} + (1 - \alpha_j)^{\sigma_i} \, r_j^{1-\sigma_j}\}^{1/1-\sigma_j}$$

Net prices/marginal costs of primary factors

5.   Market-Clearing Conditions

$$C_j^d + G_j^d + I_j^d + v_j^d = S_j^d$$

Domestic goods

$$C_j^m = \overline{C}_j^m$$

Rationed Consumer imports

$$V_j^m = \overline{V}_j^m$$

Rationed Intermediate imports

Perfectly elastic supplies   Other imports

Perfectly elastic demands   Exports

$$\sum_j \overline{\pi c}_j^m \, C_j^m + \sum_j \overline{\pi i}_j^m \, V_j^m + \sum_j \overline{\pi o}_j^m \, (G_j^m + I_j^m) - \sum_j \overline{\pi e}_j \, S_j^e = \overline{FS}$$

Balance of payments

6. <u>Definition of Rents</u>

$$CR = \sum_j (pv_j^c - pm_j^c) \, \overline{C}_j^m \qquad\qquad \text{Rents to consumers}$$

$$PR = \sum_j (pv_j^i - pm_j^i) \, \overline{V}_j^m \qquad\qquad \text{Rents to Producers}$$

7. <u>Government Revenues, Expenditures and Savings</u>

$$GREV = DTAX + NIT \qquad\qquad \text{Government revenue}$$

$$GEXP = \overline{TG} \qquad\qquad \text{Government expenditures}$$

$$G_i^d = \delta_i^d \, \overline{TG}$$

Government demand for domestic goods

$$\left. \right\} \; \sum (\delta_i^d + \delta_i^m) = 1$$

$$G_i^m = \delta_i^m \, \overline{TG}$$

Government demand for imported goods

$$GSAV = GREV - GEXP \qquad\qquad \text{Government savings}$$

$$NIT = \sum_j [\tau c_j^d \, C_j^d + \tau i_j^d \, V_j^d + \tau o_j^d \, (G_j^d + I_j^d)] \, PD_j^d +$$

$$+ \, [\sum_j \tau c_j^m \, \overline{\pi c}_j^m \, C_j^m + \sum_j \tau i_j^m \, \pi i_j^m \, (V_j^m)$$

$$+ \sum_j \tau o_j^m \, \overline{\pi o}_j^m \, (G_j^m + I_j^m)] \, ER$$

Net indirect taxes

8. <u>Savings and Investment</u>

$$SAV = HS + GSAV + ER . \overline{FS}$$

Total savings ($\overline{FS}$ is foreign capital inflow)

$$TINV = SAV \qquad\qquad \text{Total investments}$$

$$I_i^d = \gamma_i^d \, (TINV/PI)$$

Demands for domestic capital goods

$$\left. \right\} \; \sum (\gamma_i^d + \gamma_i^m) = 1,$$

$$I_i^m = \gamma_i^m \, (TINV/PI)$$

Demand for imported capital goods

9. <u>National Income and its Allocation</u>

$$Y = \sum_i W L_i^d + \sum_i r_i K_i^d + ER \overline{FS} + CR$$

GNP at factor cost; CR is the total rent generated by the rationing of consumer imports

$$HDI = (1 - t) Y,$$

Disposable income

$$DTAX = tY,$$

Direct taxes

$$\overline{TC} = \mu HDI$$

Private consumption

$$\left. \begin{array}{l} \\ HS = (1 - \mu) HDI \end{array} \right\} o < \mu < 1$$

Private savings

$$C_i^d = \gamma_i^d + (b_d^i/pd_i^c) [\overline{TC} - \sum_j \gamma_j^d (pd_j^e) - \sum_j \gamma_j^m (pv_j^c)]$$

Notional private demands of domestic goods

$$C_i^m = \gamma_i^m + (b_i^m/pv_i^c) [(\overline{TC} - \sum_j \gamma_j^d (pd_j^c) - \sum \gamma_j^m (pv_j^c)]$$

Notional private demands of import goods

Table A.2: Prices in the TQR Model

PN_j, $j = 1, 2, \ldots, N$ — Net prices

PD_j, $j = 1, 2, \ldots, N$ — Gross output prices, inclusive of production taxes

PD_j^d, $j = 1, 2, \ldots, N$ — Supply prices of domestic goods to domestic markets exclusive of commodity taxes or subsidies

PD_j^e, $j = 1, 2, \ldots, N$ — Supply prices of domestic goods to export markets exclusive of commodity taxes or subsidies

pd_j^k, $j = 1, 2, \ldots, N$
$k = c, i, o, e$

Prices of domestic goods inclusive of commodity taxes or subsidies where c, i, o, e refer to consumer, intermediate, other goods and exports

pm_j^k, $j = 1, 2, \ldots, N$
$k = c, i, o$

Tariff inclusive landed prices of imports

pv_j^k, $j = 1, 2, \ldots, N$
$k = c, i$

Virtual prices of consumer and intermediate imports

pc_j^i, $j = 1, 2, \ldots, N$

Composite prices of intermediates

$\left. \begin{array}{l} \pi c_j \\ \bar{\pi}i_j^m \\ \bar{\pi}o_j^m \end{array} \right\}$ $j = 1, 2 \ldots N$

World prices of imports

$\bar{\pi}e_j$

World prices of exports

W

Wage rate

r_i, $i = 1, 2, \ldots, N$

Sectoral rates of returns; $r_i = r_j$ where capital is mobile

P

Consumer price index (numeraire)

PI

Investment price index

PG

Government price index

ER

Exchange rate