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SIZE OF TARIFF REDUCTIONS AND STATIC WELFARE GAINS : A SENSITIVITY TEST

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In this paper, an attempt is made to look at the nature of the relationship between the size of tariff reductions and static welfare gains. For this purpose, an empirical economy-wide optimization model is applied to the Turkish economy, and the sensitivity of static welfare gains is examined as different solutions obtained under simulated tariff cuts of differing sizes.

1. Introduction

How would the static resource reallocation gains, resulting from uniform accross-the-board tariff reductions, compare when tariff rates are subjected to different rates of reduction? This is the question that we attempt to answer in this study. A multisector optimization model is applied to the Turkish economy, and solutions are obtained for alternative scenarios of tariff liberalization. In generating quantitative answers to the above question, simulation solutions of the model will enable investigation of some issues of theoretical and practical importance.

Bruno (1972) argued that "if the technology is (strictly) convex and producers maximize their profits at given market prices, any AB[1] cut in the distance between the market prices (P) and the independently given shadow prices ($\bar{P}$) of all goods constitutes a potential improvement in welfare in the sense that net output, evaluated at shadow prices, must (strictly) increase"[2]. As it is pointed out by Bruno, one of the cases to which his theorem

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1. Meant to be 'accross-the-board'.
2. Bruno (1972), p. 374.

applies is the case of a 'smal' open economy facing given international prices for its tradable goods. Latter prices constitute the 'independently given shadow prices', whereas the tariff-inclusive domestic prices are to be the 'market prices' mentioned in the theorem. Thus, differences between the market prices and given international prices reflect tariffs. In the same study, Bruno developed a (somewhat) generalized version of the above theorem so as to incorporate non-traded goods. He derived a condition, underwhich his first theorem would hold in the presence of non-traded goods.[3]

Solutions of our model for accross-the-board (AB for short) tariff cuts will provide a test of Bruno's theorems. Not all of the conditions stated in Bruno's more general theorem are included in the model. Therefore we will be testing his conclusions under more relaxed conditions.[4]

A second issue that interests us here is related to the static welfare **costs** (**gains** from the removal) of trade barriers. Several attempts[5] have been made since late 1950s for estimating welfare costs of trade barriers, and estimates tend to indicate that for industrialized countries, losses from trade barriers are about 1 percent or less of GNP[6]. Whereas, for some developing countries

3. Bruno, **op cit.** , pp. 378-9.
4. For example, our model incorporates production technologies that generate convex but kinked isoquants for (composite) commodities rather than smooth convex-to-origin isoquants that would be generated by a strictly convex production function. The model used in this study also includes more than one (composite) non-tradable commodity.
5. Some examples are: Harberger (1959), Johnson (1960), Wemelsfelder (1960), Stern (1964), Balassa and Kreinin (1967), Basevi (1968), Balassa (1971), Magee (1972).
6. It should be noted however that there are objections raised against the sizes of estimated losses. In most of these studies, the 'welfare triangles' approach has been utilized. Because of its partial equilibrium nature, this approach is based on highly aggregated commodity classes. This of course entails a downward bias in the estimation of stated losses. The cause of the bias is that the sensitivity of imports of individual importables (making up the composite aggregate commodity) to changes in tariff rates cannot be fully captured; the degree of commodity aggregation affects demand and supply elasticities to a great extent. On this issue, and for a thorough coverage of other causes of the stated underestimation, see Dixon (1976). Krueger's (1974) study is also relevant to this issue.

(those with relatively more diversified industrial structures), estimates show that losses (gains) from (the removal of) trade barriers constitute a larger percent of GNP (see, for example, Balassa (1971)). In this study, we will be able to test this result for the Turkish economy which has a fairly diversified manufacturing sector.

As it was stated above, one of the main concerns of this study is to look at the sensitivity of static welfare gains to the size of tariff reductions. To know about the possible pattern(s) of the relationship between static resource reallocation gains and size of tariff reductions will become important for a country that is about to initiate a policy of gradual liberalization in her trade policy. For such liberalization attempts, in addition to the qestion of optimum time-phase of tariff cuts, the size of initial AB tariff reduction may become an important practical issue. If the static gains are not rising in a linear or increasing fashion as the size of tariff reduction is increased, then it may be preferable for the country concerned to keep the initial tariff cut small. This is so because the dynamic adjustment costs of tariff liberalization, suh as labor displacement costs, cannot be expected to stay constant[7]. The latter costs will most probably be larger the larger the size of initial tariff cut.

This issue is particularly relevant for Turkey. In recent years (since January 1980), 'opening up the economy' gained importance as a trade strategy. This recent change in the trade policy may lead to, through direct and indirect steps undertaken by the government, reductions in tariff rates. Aside from these recent unilateral policy shifts in the government's approach to the foreign trade sector, Turkey, as an associate member of the EEC, has been gradually liberalizing trade relations with the member countries, a process that is expected to culminate in full membership[8].

7. De Melo and Derviş (1977), using a computable dynamic, non-linear Walrasian general equilibrium model, tried to analyze and compare possible static and dynamic welfare effects of alternative trade strategies under different specifications about the labor market. They have experimented with the extreme scenarios of protection and free trade.
8. A more detailed coverage of Turkey's relationship with the EEC can be found in Baysan (1974, Chapter 1).

The outline of the paper is as follows. The model is presented in Section 2. Section 3 contains information on data used for simulation solutions of the model. Results and their evaluation are presented in Section 4.

2. Methodology

We are interested in quantifying possible (static) welfare effects of assumed changes in Turkey's tariff structure. These effects, in turn, quantitatively depend on the resource allocation shifts that are to be induced by tariff changes. For this reason, in order to improve the reliability of estimates of welfare effects, simulation of resource reallocation effects of AB tariff changes must be based on a fairly detailed industrial structure. Therefore, choosing a model that is easily applicable to a system incorporating a large number of sectors is of utmost importance.[9] Otherwise, **intra**-industry resource-pull (and therefore the full extent of welfare) effects of trade policy changes cannot be captured.[10]

In order to simulate possible **static** resource reallocation and thereby welfare effects of the assumed tariff liberalization in Turkey's foreign trade policy, a static general equilibrium model is to be chosen for solutions. A Johansen-type multisector nonlinear model that incorporates price responsive Walrasian structure or a nonlinear programming model are possibilities. However, when such models are used for simulating resource reallocation effects of policy changes, researchers must restrict themselves to an economy that is subdivided into a fairly small number of sectors. As the number of industries is increased, the number of production and other parameters that must be estimated by econometric methods increases exponentially. De Melo (1977) solved a model with 15 sectors, but for our purposes, this system is far too aggregated. Linearization of such models, in order to incorporate larger number of sectors, will allow solutions only for 'local' deviations, whereas we want to experiment with 10, 20, 30, 50, and 100 percent tariff reductions.

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9. See Footnote 6.
10. There is ample evidence that tariff changes do affect intra-industry trade flows [for example, see Grubel and Lloyd (1975)].

In view of these considerations, a static linear programming model is used for estimating welfare effects of tariff changes. A large number of production activities and constraints on production can be incorporated into such models. Solutions yield shadow prices for these constraints, and in turn they provide extremely useful information about opportunity costs of constraints and of commodities when the whole economy is taken into account. Of course extreme care must be taken in interpreting any set of shadow prices and in analyzing solution results based on such prices (on this see, for example, Taylor (1975, pp. 59-83)).

The model is well suited, as an alternative to the 'welfare triangles' approach, for estimating the static resoure reallocation gain (or loss) from tariff changes. It is important, however, to note that failure to allow for input substitution raises doubts about reliability of results of studies dealing with resource reallocation effects of tariff changes. But, although LP models do not allow for substitution among inputs **within each** production activity, by allowing large number of activities for each sector, 'limited substitution' is easily incorporated into such models. As it is well known, the latter type of models generate 'kinked' isoquants, and these isoquants could be approximated to smooth, convex isoquants by increasing the number of activities in each sector.

In addition to fixed input-output coefficients, the model also incorporates the following basic assumptions. First, because of Turkey's extremely small production and trade volumes in relation to those of the world, international prices of traded goods are assumed to be exogenous in the system. Second, fixed proportions rather than substitution in consumption are assumed. In the presence of nontraded goods it is necessary to specify the pattern of final demand in order to have a deterministic model. The assumption of constant proportions serves this function and enables simultaneous determination of production and consumption equilibria. Furthermore, this approach to modeling consumption permits the objective function to be expressed in terms of one endogenous variable as explained below. (Implications of the assumption of fixed proportion in consumption are discussed further in Appendix B).

In the application, simulation is based on 1973 production

technologies and the input-output coefficients are obtained from the 1973 table for Turkey, the most recent available. Consequently the actual consumption proportions existing in 1973 are used in solutions.

Structure of the Model

The model is solved for 69 sectors, each producing a single homogeneous good. The first 54 sector produce internationally traded goods and the remaining sectors produce non-traded goods.

Physical units are defined such that one unit of the ith good equals the quantity of the i th good that could have been bought with one monetary unit (one million Turkish lira) at 1973 tariff-inclusive domestic prices. Consequently, tariff-inclusive domestic prices of all goods are normalized at unity.

Here, the structure of the model, in the form which is used to simulate resource allocation effects of the complete removal of tariffs, is presented and explained. Later, the particular form in which the model is solved for the case of tariff reductions is explained, together with the reinterpretation of some of the variables which appear below.

The model is constructed to maximize the international value of domestic final consumption[11] subject to a system of linear constraints. Thus, the primary problem[12] is to determine nonnegative values of final consumption quantities C_i, output levels X_i, exports E_i, and imports M_i as follows :

$$\text{Maximize } C = \bar{P}^w_1 C_1 + \ldots + \bar{P}^w_{54} C_{54} + P^d_{55} C_{55} + \ldots + P^d_{69} C_{69} \quad (1)$$

subject to

$$-X_i + \sum_{j=1}^{69} a_{ij} X_j + E_i - M_i + C_i \leq 0, \text{ for all } i =, \ldots ,69 \quad (2)$$

11. It is appropriate to lump components of final demand together as "final consumption" since we are concerned with possible static resource reallocation and welfare effects of tariff cuts on existing stocks of primary factors.
12. See Appendix A for the definition of variables. Information on the structure of the corresponding dual problem and dual variables can be found in Baysan (1980).

(where $E_i = 0$ and $M_i = 0$ for $i \geqq 55$)

$$\sum_{j=1}^{69} l_j X_j \leqq \bar{L} \tag{3}$$

$$\sum_{j=1}^{69} k_j X_j \leqq \bar{K} \tag{4}$$

$$\sum_{j=1}^{69} m_j X_j - \sum_{i=1}^{54} \bar{P}^w_i E_i + \sum_{i=1}^{54} \bar{P}^w_i M_i \leq \bar{B} \tag{5}$$

$$X_i \leqq \bar{X}^u_i, \text{ for } i=1, \ldots, 54 \tag{6}$$

$$-X_i \leqq -\bar{X}^L_i, \text{ for } i=1, \ldots, 54 \tag{7}$$

The objective function (1) can also be interpreted as the maximization of the international value of Turkish GDP since a constant trade deficit is assumed. Exogenous international prices of traded goods, $\bar{P}^w_i$ ($i=1, \ldots 54$), which Turkey would face under free trade (i.e. complete elimination of tariffs) are derived from unitary tariff-inclusive domestic prices and sectoral tariff rates adjusted for quantitative restrictions. Free trade prices of nontraded goods, P^d_i ($i=55, \ldots 69$), are endogenous in the system, and their equilibrium values are determined by domestic supply of and demand for these goods. In the initial solutions an arbitrary, nonzero set of prices is inserted for the nontraded goods. Free trade, equilibrium prices for these goods are then generated by an iterative procedure, which involves reinsertion of solution values of shadow prices of nontraded goods until the two sets of prices converge.

In order to accomodate the assumption of fixed consumption proportions, the objective function is expressed in different form. C_i is replaced by $\bar{C}_i \lambda$, where λ is a consumption scalar that gives the value of the ratio of the endogenously determined final consumption quantity of good i (i.e., C_i) under the simulated policy change to the actual quantity of that good consumed in 1973 (i.e., $\bar{C}_j$). The scalar λ has the same value for all goods and therefore satisfies the assumption of fixed proportions in consumption.[13] The modified objective function has the form

13. If $C_i = \bar{C}_i \lambda$ for all i (i = 1, ..., 69) then $C_i/C_j = \bar{C}_i\lambda/\bar{C}_j \lambda = c_{ij}$, hence the fixed consumption proportions assumption holds.

$$\text{Maximize } C = \left(\sum_{i=1}^{54} P^w_i \bar{C}_i + \sum_{i=55}^{69} P^d_i \bar{C}_i \right) \lambda$$

Since all P^d_i (i=55, ..., 69) are determined through an iterative procedure, λ is the only endogenous variable in the objective function.

Also, note that the value of the consumption scalar for actual final consumption quantities in 1973 equals **one** by definition, corresponding to Turkey's 1973 market conditions, which were affected not only by foreign trade distortions, but also by market distortions and structural rigidities. However, the model assumes perfectly competitive markets and excludes structural rigidities. Consequently the difference between the value of λ for the free trade solution and unity represents an estimate of Turkey's proportionate static gain (in terms of the international value of 1973 actual Turkish GDP) from removal of trade barriers **and** other domestic market distortions.

After solving the model for 100 percent tariff reduction (i.e., the free trade solution), the model is then solved, first for the protection case by holding the existing trade barriers intact but assuming that import quotas are removed.[14] Later, the model is solved under tariff reductions, again assuming that import quotas are absent. In all of these solutions absence of other domestic distortions is also assumed. For solving the model under protection and tariff reductions, tariff-ridden prices are entered in the objective function as well as in the balance of payments constraint. In this form, solutions would simulate competitive behavior of the economy under protection and tariff liberalization. The justification for expressing the balance of payments constraint in tariff-inclusive domestic relative prices in the latter set of solutions is that all real quantities will be generated on the basis of tariff-ridden relative prices under the stated conditions, including exports and imports. The right-hand constant in the balance of payments constraint can be interpreted, for this set of solutions, as a 'real resource transfer' from the government to the private sector as

14. Note that for this solution import quotas are assumed to be replaced by tariffs that also reflect 'rent' effects of quotas.

suggested by Taylor (1975, p. 75). The values of λ generated by solutions under protection and tariff reductions must of course be adjusted for net tariff revenues (i.e., tariff revenues minus export subsidies)[15] so that they could be comparable, first, among themselves, and second, with the free trade solution value of λ. Thus, for example, when the value of λ for the protection case, after adjustment for net tariff revenues, is deducted from the free trade value of λ, we obtain an estimate of the static resource reallocation gain attributable to the removal of trade barriers alone.

The following constraints are included in the system: The input-output material constraints (inequalities 2); demand for labor, and for capital cannot exceed their fixed endowments (ineq. 3 and 4, respectively); the difference between the international value of competitive plus noncompetitive imports[16] and the value of exports cannot exceed a fixed level of trade (ineq. 5); and output levels of the sectors producing tradables cannot differ from their 1973 actual levels by more than a specified percentage in either direction (ineq. 6 and 7). These output capacity constraints, apart from reflecting some real life limitations to factor mobility, serve a two-fold purpose. First, they eliminate the possibility of solutions that imply extreme cases of specialization.[17] Second, shadow prices corresponding to output constraints can be used to rank Turkish industries producing tradables according to their comparative advantage in the world markets given the technical coefficients existing in 1973[18]. However, in order to test for sensitivity of results to changes in output constraints three alternative trade solutions were computed for each of the trade

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15. Net tariff revenues are calculated separately.
16. Turkeys' 1973 input-output table does not distinguish between competitive and noncompetitive imports, and the latter category of imports are treated as if they are competitive. Therefore, in the application of the model, the non-competitive import coefficients that appear in the balance of payments constraint are given zero values in the solutions.
17. Alternative methods of overcoming the 'extreme specialization' problem have been discussed in the literature and other approaches have been used in empirical studies [for details see Taylor (1975, pp. 75-88)]
18. Such a ranking has already been obtained, and results were reported in Baysan (1980).

policy scenarios that we experimented with. These correspond to maximum allowable output variations above or below 1973 levels of 10 percent, 20 percent, and 50 percent.

3. Data :

The 1973 64-sector Turkish input-output table was the main source of data for the model. However, before obtaining solutions, the table was disaggregated into 69 sectors. The agricultural sector of the original table was disaggregated so as to separate traditional and nontraditional export goods. After the disaggregation the following sectors were distinguished : The **Industrial Crops, Cereals-Animal Feed-Pulses, Fruits, Citrus Fruits, Nuts,** and **Vegetables.**

The augmented 1973 input-output table supplied some of the data used in solving the model. However, further adjustments were necessary, after the disaggregation, in order to calculate values of coefficients and constants which entered solutions.

A major effort was devoted to the estimation of free trade prices (of traded goods) which appear as exogenous variables in the objective function and the balance of payments contraint of the free trade solution. These prices correspond to those that would have prevailed in Turkey had Turkey adapted free trade policy in 1973. Because the model is applied to a single country, it is appropriate to calculate these prices using the relationship $\bar{P}^d_j = (1+t_j)\ \bar{P}^w_j$, where $\bar{P}^w_j$ is the exogenous free trade price of the traded good produced by the jth sector, t_j is the 'average' tariff rate (adjusted for the 'rent' effects of quotas) for the jth sector, P^d_j is the domestic market price (inclusive of all import taxes and monopoly rent resulting from quantitative restrictions) of the jth good. Singe $\bar{P}^d_j$ is normalized at unity, the free trade price $\bar{P}^w_j$, equals $1/(1 + t_j)$.

The most difficult and time-consuming part of this exercise arose from the well-known problems associated with calculation of the t_js (Cooper, 1964; Basevi, 1971). If biases are to be minimized, this procedure requires detailed information on commodity tariff rates and information that will allow choice of

the appropriate weights to attach to component items comprising a sector. In this case further complications arose because Turkey's tax structure includes numerous indirect taxes on imports (stamp duty, municipality share, wharf duty, and production tax in addition to tariff duty), and export tax rebates have existed since 1964. Determination of average tariff rates for sectors, therefore, entailed calculation of commodity-specific tariff (at the six-digit commodity level), taking account of all the above taxes with different tax bases and subsidies, and the use of 1973 import and export proportions as weights. Some of the estimates of sectoral tariff rates had to be adjusted further to take account of downward biases resulting from relatively small weights for highly protected commodities and of monopoly rents generated by quantitative restrictions [for details of the procedure adapted, see Baysan (1983)].

4. Results, Their Evaluation, And Policy Implications

We have experimented with five different cases of tariff reductions : 10, 20, 30, 50, and 100 percent reductions. As pointed out, the 100 percent tariff reduction alternative corresponds to the free trade case. In addition, we have also solved the model for the protection case in order to simulate competitive behaviour of the economy under the existing tariff structure, but in the absence of quantitative restrictions and other domestic distortions.

Three simulation solutions, corresponding to the 10, 20, and 50 percent maximum allowable output deviations, were obtained for each of the trade policy scenarios mentioned above. Therefore, there are altogether 18 simulation solutions.

Solutions of the model generate diverse results, some of which have already been reported in Baysan (1980). But, in this paper we are mainly interested in the estimation of possible static resource reallocation gains from (simulated) AB tariff reductions. For this reason, only the solution values of the consumption scalar, λ, interest us here.

As it was explained above, λ gives the value of the ratio of endogenously determined final consumption quantity of good