A Static Analysis of Domestic Production Loss in the Presence of Negative Value-Added:

The Case of Iranian Automobile Industry *

Basudeb Biswas**
and
Ahmad Shahrokni***

I. Introduction

It is well-recognized in the empirical literature of effective protection that the protective structure of tariffs in many developing countries results in the domestic production in some sectors with negative value-added. Of course, value-added is always positive when measured at domestic prices, otherwise there would not be any domestic production. But the sector which makes positive production under a set of tariffs may experience negative value-added when the output and the input used to produce the output are evaluated at world prices. In an open economy, evaluation of traded goods is to be made at world prices because for any output mix produced domestically the country's consumption possibility frontier is determined by trade at world prices. Basically, this is the rationale behind measuring the value of traded goods at world prices. In many developing countries it has been estimated that negative value-added occurs in industries established under a set of tariffs.[1] To explain the

* Competent research assistance was rendered by Hamid Beladi, currently serving as an Assistant Professor in the Economics Department at Central Michigan University. A special acknowledgement is accorded to Gopal Tribedy whose editorial assistance was of considerable help.

** Associate Professor, Economics Department, Utah State University
*** Assistant Professor, Economics Department, Free University of Iran

[1] See Soligo and Stern (1965), Bhagwati and Desai (1970), Power (1966), Guisinger (1969) and Tan (1970) for examples of negative value-added, found empirically in some countries.

phenomenon of negative value-added, Corden has given an example of the automobile industry and has provided some possible reasons why it "costs more to import the components of a motor-car than finished motor-car." This may be due to higher transport and packaging cost components, or there may be inefficiency and waste in the use of inputs at home. It is well known that if there is no other domestic distortion, then a tariff on an imported good by a small country results in consumption loss and production loss. In the presence of negative value-added in a protected industry production loss can be divided into two elements. One element can be designated as foreign exchange loss (FEL) that results from the excess of the cost of inputs over the cost of output — both costs measured at world market prices. The country could get the same amount of output at less cost by buying at the world market. Hence, the term foreign exchange loss is used to identify this part of the production loss. The second element of production loss can be designated as domestic resource loss (DRL). It is so called because primary factors which are transferred from other sectors to the protected sector add nothing to national income and, hence, are sheer waste. The purpose of this paper is to measure total production loss in terms of foreign exchange loss and domestic resource loss in the production of automobiles of five different models in the Iranian Automobile Industry in the early 1970s.

Michaely (1975) has suggested a method of estimating the foreign exchange loss (FEL) and the domestic resource loss (DRL). We use the framework of Michaely with some minor modification for its empirical application to the case of Iranian Automobile Industry where the national content requirement for the producers in the industry calls for the calculation of the tariff equivalent of the content program.[2]

The plan of the paper is as follows: Section II presents the theoretical model in a partial equilibrium framework. Section III

[2] Under a national content program, the domestic producers of a final product, who are protected by a tariff, are obliged to allocate a specified proportion of the unit cost of their output to domestically supplied inputs as substitutes for imports. In the case of the Iranian Automobile Industry, national content requirements specifically mention the particular material inputs that must be procured locally. Since the locally produced inputs cost more than the imported ones of the same quality, the local manufacturers of the final product are implicitly taxed, and this can be regarded as equivalent to a tariff on inputs.

develops the formula in a measurable way and Section IV gives a brief summary of the empirical results.

II. Theoretical Framework

The final economic activity in the automobile industry is the production of car which is an importable of the country. Production of car needs both intermediate inputs and primary factors. The intermediate inputs are also importable to the country, while the primary factors are supplied domestically. The country is a price-taker both for the final product and for the intermediate inputs in the world market. It is the primary factors that contribute to value-added in the final activity. So, the primary factors taken together may be called the "value-added" factor which has a positively sloped domestic supply curve. The production function is of the fixed coefficient type. The units of the intermediate input and the "value-added" factor are so chosen that one unit of each of them goes with one unit of a car.

Beacause the country is a price-taker in the world market, the supply curves of car and intermediate input are horizontal at the respective international prices. Due to the inefficiency in domestic production, the unit price of the intermediate input is higher than the unit price of car.[3] The domestic supply curve of the final product is the vertical sum of the horizontal intermediate input supply curve and the positively sloped "value-added" supply curve. Initially, there is no tariff protection. So, the domestic supply price of a car exceeds its world price. As a result, the entire domestic consumption of car is imported, and there is no domestic production.

When tariff protection is accorded to the domestic automobile industry, the tariff-inclusive domestic car price is higher than the world price. But at the same time, the protection to the domestic car industry is conditional upon the purchase of certain local components at higher prices. The higher price of

[3] Corden (1971) mentions four possible explanations for a negative effective price under free trade in the home country: (a) higher transport cost for the components than for the finished product, (b) difference in production functions, (c) lower input price to producers in the supplying country than its export price, and (d) deliberate higher pricing by monopolist producers in the supplying country to discourage processing abroad.

local components raises the domestic price of the intermediate input above its world price and the difference is equivalent to the tariff on the purchased input. Now the domestic supply price of a car is the sum of the supply price of the "value-added" factor and the domestic price of the intermediate input. Domestic production of car is determined at the point of equality between its domestic supply price and its tariff-inclusive domestic price.

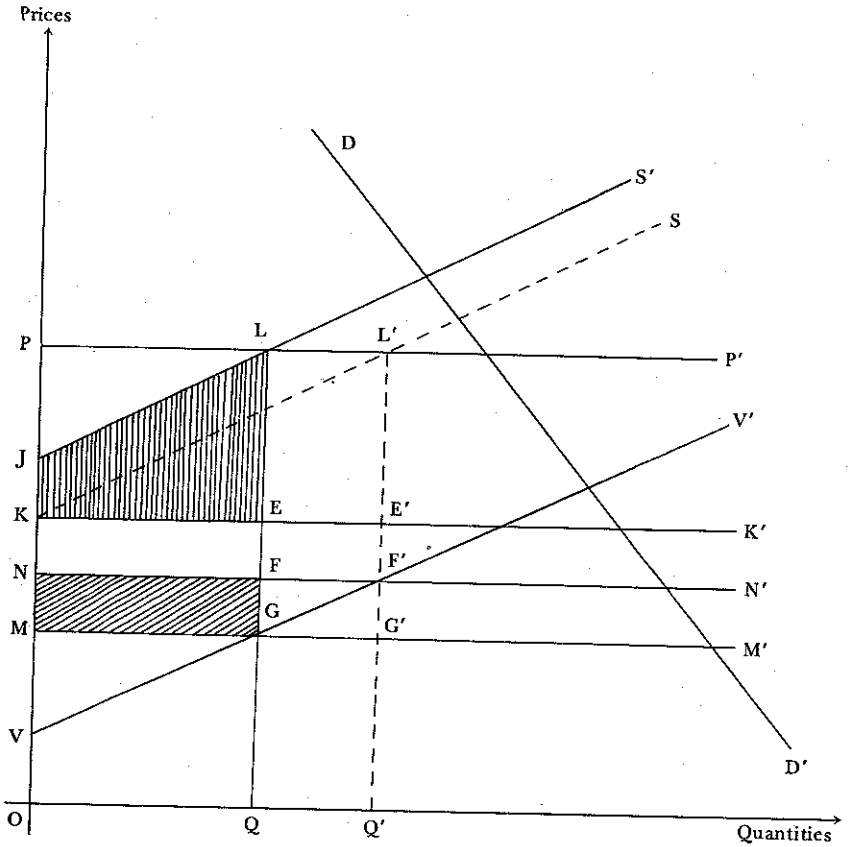
When there is some production under this protection scheme, the value of the final product at international price is less than the value of the intermediate input used, and this difference constitutes the amount of negative value-added in the final activity. The foreign exchange used to buy the intermediate input is greater than what it would cost to buy the final product to replace the protected domestic production. That is why this part of the loss due to protection is called the foreign exchange loss (FEL). In addition to the FEL, there is another loss. The primary factors used in domestic production have been transferred from other final activities and so, their entire supply price is the domestic resource loss (DRL). The total production loss is the sum of the FEL and the DRL.

Figure 1 demonstrates the theory stated above. OM is the world price of the final product; DD′ is its domestic demand curve. ON is the unit price of the intermediate input, when the domestic requirement per unit of the final product is valued at the world price. VV′ is the "value-added" supply curve. Before any tariff protection is accorded to the car industry, KS is the domestic supply curve (the vertical sum of VV′ and NN′) which lies above the international price line MM′ for the final product. Then there is no domestic production. Now tariff protection to the car industry raises the tariff-inclusive domestic producers now face the PP′ price line. The national content program associated with the protection scheme raises the unit price of the intermediate input to OK, when NK is the tariff equivalent of the content requirement. Now the domestic supply curve of the final product is JS′ (the vertical sum of VV′ and KK′), which determines the domestic production at OQ.

The intermediate input cost of the domestic production of OQ quantity at world price is represented by the area ONFQ, whereas the same quantity of the final product would have a cost equal to the area OMGQ at world price. Thus the magnitude of

Figure 1

PRODUCTION LOSS OF PROTECTION IN THE PRESENCE OF NEGATIVE VALUE-ADDED



negative value-added is given by the area ONFQ minus the area OMGQ, which is equal to the area MNFG. This area is the measure of foreign exchange loss. The OQ quantity of domestic production uses primary factors, the supply prices of the which is represented by the area KJLE (which is the same as the area OVGQ). Since the supply price of the primary factors is equal to the value of output lost elsewhere in the economy, the area KJLE stands for the domestic resource loss resulting from the domestic

production. The total production loss is, therefore, the sum of the area MNFG and KJLE.

III. Estimation Procedure

If the data relating to the world price of the final product (i.e., OM in Figure 1) and the unit price of the intermediate input used in domestic production valued at world price (i.e., ON in Figure 1) were available, one could easily estimate the FEL by taking the product of the domestic production and the difference between the two prices. But data are available for the tariff-inclusive domestic price of the final product, domestic price of the local components and c.i.f. value of the imported components. Once the nominal tariff rate on the final product is known, one can, however, estimate its free trade price by using the following equation:

$$(1) \quad P_j = P'_j/(1+t_j)$$

where P_j is the free trade price of the final product, P'_j is the domestic price and t_j is the rate of nominal tariff expressed as a percentage of the world price.

Because of the national content requirement, the intermediate input used in domestic production is divided into two categories — the locally purchased ones and the imported ones. One is to know the unit price of a lumped intermediate input used in domestic production, valued at the world price. Since the duties paid on imported components and their c.i.f. value are known, one can add them together to obtain the domestic price of the imported components. When the value of local components used in one unit of the final product at domestic price is also known, the equivalent free trade price of the intermediate input can be estimated in a roundabout way. Let m_{ij} be the value of the i-th input used in one unit of the final product j at free trade price, m'_{ij} its corresponding value at domestic price and t_i the nominal rate of tariff on the input i expressed as a percentage of the free trade price. Then the relation between the free trade price and the domestic price is given by

$$(2) \quad m'_{ij} = (1 + t_i)m_{ij}$$

The average nominal rate of tariff on the intermediate input can be defined as

$$(3) \quad t_e = \sum_i m_{ij} t_i / \sum_i m_{ij}$$

Using (2) and (3), one directly arrives at the result

$$(4) \quad \sum_i m_{ij} = \frac{\sum_i m'_{ij}}{1 + t_e}$$

where $\sum_i m_{ij}$ is the free trade price of a unit of the intermediate input. Now value-added in the final activity j at free trade prices is

$$(5) \quad V_j = P_j - \sum_i m_{ij} = \frac{P'_j}{1+t_j} - \frac{\sum_j m'_{ij}}{1+t_e}$$

The unit value of the intermediate input at domestic price, $\Sigma m'_{ij}$, have two components: the value of local components, m'_{1j}, and the value of imported components, m'_{2j}. Data are available for both of them. But the average nominal rate of tariff on the intermediate input, t_e, is not known directly. For the calculation of the effective rate of protection, it has been estimated in Biswas and Shahrokni (1982) in an indirect way.[4] Those estimates of t_e can be used to calculate the FEL given in equation (5).

With reference to Figure 1, the DRL is estimated by deducting the area JPL from the area KPLE. The area KPLE is given by the product of the quantity of domestic production and the difference between P'_j and $\Sigma m'_{ij}$. The area of the triangle JPL is estimated in the following way suggested in Michaely (1975). Let P_v be the price of domestic "value-added" at the post-tariff equilibrium position. Then

[4] Based on interviews with dealers of automobiles and auto parts in the USA and Iran, the ratio of domestic price to world price of the locally produced components was found to be about 1.5. This ratio has been used to estimate the free trade price of the locally produced parts from their domestic price. Then the c.i.f. value of the imported components has been added to the estimated free trade price of the local components to obtain the free trade price of the lumped intermediate input. This could be directly used to estimate the negative value-added. However, the ratio of the free trade price of the locally produced part in the lumped component to the free trade price of the lumped component has been used to estimate the ratio of its domestic price to its world price. This last ratio minus unity gives the average rate of nominal tariff on the intermediate input.

$$(6) \quad P_v = P'_j - \Sigma m'_{ij}$$

The elasticity of supply of the "value-added" factor is defined as

$$(7) \quad \varepsilon = \frac{\Delta q}{q} \Big/ \frac{\Delta p_v}{P_v}$$

where q is the quantity of domestic production and Δ stands for the change in a variable. Since in the absence of protection there will be no domestic production, $\Delta q = q$, and hence

$$(8) \quad \varepsilon = 1 \Big/ \frac{\Delta P_v}{P_v}$$

from which it follows that

$$(9) \quad \Delta P_v = \frac{P_v}{\varepsilon} = \frac{P'_j - \Sigma m'_{ij}}{\varepsilon}$$

Now using (6) and (9), one can estimate the domestic resource loss with the help of the following result:

$$(10) \quad DRL = q \cdot P_v - \tfrac{1}{2} q \cdot \Delta P_v = q[P'_j - \Sigma m'_{ij}] \left[1 - \frac{1}{2\varepsilon}\right]$$

IV. Empirical Results

The theoretical framework and the estimation procedure suggested above are now applied to the Iranian Automobile Industry to estimate the FEL and the DRL resulting from the protectionist policy in the industry in the presence of negative value added. In this study, the FEL and the DRL have been calculated for five different models of automobile. They accounted for more than 95 percent of domestic production of passenger cars which were made by three major automobile manufacturing companies in the early 1970s.[5].

The results of the empirical study are summarized in Tables

[5] See Amuzegar (1977).

Table 1

ESTIMATES OF VALUE-ADDED PER UNIT OF OUTPUT AT FREE TRADE PRICES IN IRANIAN AUTOMOBILE INDUSTRY, 1971

1. Automobile	Peykan Deluxe (Hunter Deluxe)	Peykan GT (Hunter Super)	Jiyan (Citroen "AY")	Jeep CJ-5 (Hardtop)	Shaheen (Rambler 220)
2. Domestic retail price of an automobile (in rials) P'_j	252,350	303,250	181,125	343,686	344,750
3. Value of local components used in an automobile at domestic price (in rials) m'_{1j}	30,000	35,000	18,000	30,000	35,000
4. Value of imported components used in an automobile at domestic price (in rials) m'_{2j}	102,858	114,389	74,000	165,000	153,000
5. Total value of intermediate inputs used in an automobile at domestic price (in rials) $\sum_i m'_{ij}$	132,858	149,389	92,000	195,000	188,000
6. Average rate of tariff on intermediate inputs in the presence of content requirement t_e	0.421	0.423	0.278	0.221	0.225
7. Rate of nominal tariff on an automobile t_j	2.15	2.15	2.15	2.15	2.15
8. Free trade price of an automobile (in rials) $P_j = \frac{P'_j}{1+t_j}$	80,111	96,270	57,500	109,107	109,444
9. Free trade price of intermediate inputs used in an automobile (in rials) $\sum_i m_{ij} = \frac{\sum_i m'_{ij}}{1+t_e}$	93,496	104,982	71,987	159,705	153,469
10. Value-added per unit of automobile at free trade price (in rials) $V_j = P_j - \sum_i m_{ij}$	-13,385	-8,712	-14,487	-50,598	-44,025

Sources: Computed from data supplied in (1) Ministry of Commerce *General Regulations on Export and Import* (Tehran, Iran, March 1968) and (2) U.N. Industrial Development Organization, Metro Group, *A Study of Automobile Market and Industry in Iran*, October 1972.

1-3. The last row of Table 1 shows the negative value-added per car of each model, while the total FEL of each model is shown in row 4 of Table 3. The total FEL amounted to about 680 million rials. The DRL per unit has been estimated for $\varepsilon = 1$, $\varepsilon = 1.5$ and $\varepsilon = 2.0$; these are shown in row 3, 4 and 5 of Table 2. The total DRL shown in row 6 of Table 3 amounted to more than 3,200 million rails at $\varepsilon = 1.5$; the total production loss shown in the last column of Table 3 amounted to about 3,880 million rails.

Table 2

ESTIMATES OF DOMESTIC RESOURCE LOSS PER UNIT OF OUTPUT IN IRANIAN AUTOMOBILE INDUSTRY, 1971

1. Automobile	Peykan Deluxe (Hunter Deluxe)	Peykan GT (Hunter Super)	Jiyan (Citroen "AY")	Jeep CJ-5 (Hardtop)	Sahheen (Rambler 220)
2. Difference between the domestic price of an automobile and the cost of intermediate inputs used in it at domestic price (in rials) $P'_j - \sum_i m'_{ij}$	119,492	153,861	89,125	148,686	156,750
Domestic resource loss per unit of output (in rials) $[P'_j - \sum_i m'_{ij}]\ [1\text{-}1/2\ \varepsilon]$					
3. $\varepsilon = 1$	59,746	76,931	44,563	74,343	78,375
4. $\varepsilon = 1.5$	79,661	102,574	59,417	99,124	104,500
5. $\varepsilon = 2.0$	89,619	115,396	66,844	111,515	117,563

Sources: Computed from data supplied in (1) Ministry of Commerce, *General Regulations on Export and Import* (*Tehran, Iran, March 1968*), and (2) U.N. Industrial Development Organization, Metro Group, *A Study of Automobile Market and Industry in Iran*, October 1972.

Table 3

TOTAL PRODUCTION LOSS IN IRANIAN AUTOMOBILE INDUSTRY, 1971

1. Automobile	Peykan Deluxe (Hunter Deluxe)	Peykan GT (Hunter Super)	Jiyan (Citroen "AY")	Jeep CJ-5 (Hardtop)	Shaheen (Rambler 220)
2. Number of automobiles produced q	22,631	5,658	3,344	1,932	4,101
3. Foriegn exchange loss per unit (in rials) v_j	13,385	8,712	14,487	50,598	44,025
4. Total foreign exchange loss (in million rials) $q \cdot v_j$	302.9	49.3	48.4	97.8	180.5
5. Domestic resource loss per unit at $\varepsilon = 1.5$ (in rials) $(P'_j - \Sigma m'_{ij}) \cdot (1\text{-}1/2\ \varepsilon)$	79,661	102,574	59,417	99,124	104,500
6. Total domestic resource loss (in million rials) $q(P'_j - \Sigma m'_{ij}) \cdot (1\text{-}1/2\ \varepsilon)$	1,802.8	580.4	198.7	191.5	428.6
7. Production loss per unit (in rials)[a] $(P'_j - \Sigma m'_{ij}) \cdot (1\text{-}1/2\ \varepsilon) + v_j$	93,046	111,286	73,904	149,722	148,525
8. Total production loss (FEL & DRL) (in million rials)[b] $q\, v_j + q(P'_j - \Sigma m'_{ij}) \cdot (1\text{-}1/2\ \varepsilon)$	2,105.7	629.7	247.1	289.3	609.1

[a]Row 7 is the sum of row 3 and row 5.
[b]Row 8 is the sum of row 4 and row 6.

Sources: Computed from data supplied in (1) Ministry of Commerce, *General Regulations on Export and Import* (Tehran, Iran, March 1968), and (2) U.N. Industrial Development Organization, Metro Group, *A Study of Automobile Market and Industry in Iran,* October 1972, and (3) Ministry of Industries and Mines, *A Report on the Automotive Industry's Situation* (In Farsi), (Tehran, Iran, September 1975).

One striking result of this study is to discover the existence of value subtraction at international prices for all models of car in the Iranian Automobile Industry. The phenomenon of value subtraction leads to domestic resource loss also due to the transfer of primary resources from other activities. The amount of total production loss in the industry gives a measure of the extent of resource misallocation caused by the protection accorded to the domestic industry.

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