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Relative price and technology components of import liberalization in Turkey: 1973-1996*

Gülay Günlük-Şenesen

Istanbul University, Faculty of Political Sciences, Beyazıt 34116 İstanbul-Turkey

Ümit Şenesen

İstanbul Technical University, Faculty of Management, Maçka, Beşiktaş 34367 İstanbul-Turkey

Abstract

This paper studies the effects of Turkey's switch from import substitution to import liberalization in 1980 on intermediate imports. The underlying input-output methodology involves two novelties: Firstly, backward import linkages are disaggregated to capture both origin and destination sector information. Secondly, the intertemporal change is decomposed into relative price and technology components. Aggregated input-output tables for 1973 and 1996 constitute the database. Relative prices are far from being uniform, yet their effects in general are very small compared to the technology component. Production became more dependent on imported inputs in general, leading export sectors (Agriculture, Textiles-Clothing, and Food-Beverages) inclusive.

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"*Relative price movements have not received sufficient attention in the available empirical research on the Turkish economy.*"
(Celasun, 1983:80)

1. Introduction

Turkey switched from import substitution to import liberalization in early 1980's. The purpose of this paper is to assess the effects of this change on the intermediate import requirements of production. The paper introduces a new input-output methodology for intertemporal comparisons with respect to two components: relative prices and technology (structural change). We assume that the input-output table for 1973 represents the production structure of the pre-liberalization period and that for 1996 represents the end result of import liberalization.

The Turkish economy in the 1960's and 1970's is usually characterized by import substitution due to the implementation of development planning. The resolution for the severe stagflation and foreign exchange crisis of the late 1970's involved a radical shift in economic policy. The switch towards liberalization of the economy in 1980 included, among other measures, export promotion. Elimination of the wide range of inefficiencies of the previous period lay at the center of the new policy.[1]

Following the two decades of the implementation of sequential liberalization policies, the Turkish economy is characterized as a crisis economy in 2000's, with unresolved and deepened bottlenecks in current account balance and external debt (Celasun, 2002; Öniş and Riedel, 1993; Öniş and Rubin, 2003). The emphasis of assessments in general has been on macroeconomic performance, with little attention paid to the likely contribution of the underlying structure of production to these bottlenecks. For example, although exports boomed from early 1980's on, so did imports. Interestingly, trends in exports/imports ratios do not differ much between pre- and post-1980 eras. Their fluctuation around 65 % aggravates the already accumulated foreign liabilities. Furthermore, the ratio of intermediate imports to GNP displayed an increasing trend from 1980 onwards, fluctuating around 10-15 % in 1980's and 1990's, and exceeding 20 % in early 2000's, although it was at most 5 % during 1960-1977. Celasun (1994:471) already noted that "Turkey's export-led industrial

[1] See Celâsun and Rodrik (1989) for an overview of the economic policies and their consequences in the pre- and post-planning eras.)

expansion during 1983-8 was also connected with increased import intensity in manufacturing". Thus the opening-up of the economy has contributed towards intensifying the dependence of production on imports, which dates back to the import substitution era (Boratav, 1987; Şenesen and Günlük-Şenesen, 2003).

Although research on the impacts of liberalization on the production structure is rather limited, there are lessons to be learned from the similar liberalization experiences of Latin American countries and the resulting reflections on their production structures, which ultimately exert pressure on current account deficits. One common finding with variants of the input-output model by Albala-Bertrand (1999) for Chile, Guilhoto *et al.* (2002) for Brazil, Ruiz-Napoles (2001) for Mexico, and Sarma (1996) for India is that domestic production has become more dependent on intermediate imports, with a significant contribution by leading export sectors. This outcome is clearly a challenge to the expectations at the onset of trade liberalisation in Turkey, which aspired improving, among others, sustainability of foreign exchange availability (Şenesen and Günlük-Şenesen, 2005). This is the starting point of this paper, which assesses the overall change in import dependency of production and outlines the sectoral characteristics of the directions of this change.

The input-output methodology developed for the analysis is outlined in Section 2. General characteristics of sectoral patterns during 1973-1996 are presented in Section 3. An overall assessment is made in the final section.

2. Methodology and data

In the context of input-output modeling, direct intermediate import flows are defined with respect to their origin and destination sectors. Origin sectors are foreign suppliers (row sectors, $i = 1, 2,.., n$) and destination sectors are domestic buyers (column sectors, $j = 1, 2,.., n$). Indirect intermediate import demand is generated within the network of production sectors which are interconnected *via* domestic and imported input transactions.

Total intermediate input requirements (direct + indirect) are found by solving the simultaneous linear system with respect to final demand (policy) sectors ($k = 1, 2,.., n$). That is, generation of intermediate import requirements has three sectoral dimensions: origin, destination and policy (Günlük-Şenesen and Şenesen, 2001; Şenesen and Günlük-Şenesen, 2005). We will first outline the simultaneous solution for final demand induced imported intermediate

input demand with respect to sectors *k*, *i* and *j* for a certain point in time. Next, we will present the methodology for intertemporal comparison of production structures in the context of imported input requirements.

2.1. Intermediate imports with respect to origin, destination and policy sectors

For any point in time, basic matrix definitions of the subsequent methodology is as follows:

A^d : direct coefficients matrix (n, n) of domestic intermediate inputs

A^m : direct coefficients matrix (n, n) of imported intermediate inputs

$< T >$: diagonal matrix (n,n) of direct backward linkages for imports, i.e. $t_{jj} = \Sigma_i \; a^m{}_{ij}$ (column totals of A^m).

x : column vector (n,1) of sectoral outputs

y^d : column vector (n,1) of sectoral domestic final demands

m : column vector (n,1) of sectoral totals for intermediate imports by origin

u : column vector (n,1) of sectoral totals for imported intermediate inputs by destination.

Note that total intermediate imports in the economy is $\Sigma_i \, m_i = \Sigma_i \; u_i$.

The basic relationship between intermediate imports by origin and sectoral (domestic) outputs is given by

$$m = A^m x \tag{1}$$

The long known solution for total (direct + indirect) intermediate import requirements (m) in response to changes in the domestic final demand (y^d) involves

$$m = A^m (I\text{-}A^d)^{-1} y^d = A^m R y^d = S y^d \tag{2}$$

Here s_{ik} is the imported input requirement from the foreign sector i, induced by say, one unit increase in the final demand of sector k. Then $\Sigma_i \, s_{ik}$ shows the total imported input requirement in the economy generated by one unit increase in the final demand of sector k or in short "backward linkage of sector k for imports".[2] Note that

$$s_{ik} = \Sigma_j \, s_{ijk} \tag{3}$$

Hence, information on import requirements with respect to domestic buying sectors (that is destination sectors) is disguised in s_{ik},

[2] See Fujita and James (1991) for a relatively recent application.

which is the total of imports required from i by domestic sectors, $j = 1,\ldots, n$, in response to k^{th} final demand change.

On the other hand, intermediate imports by destination (domestic buying sectors) are related to sectoral outputs by

$$u = < T > x \quad (4)$$

and to sectoral final demands by

$$u = < T > (I\text{-}A^d)^{-1} y^d = < T > R y^d = V y^d \quad (5)$$

Here v_{jk} shows intermediate import demand of the j^{th} domestic sector in response to a unit change in k^{th} final demand, that is associating final demands with imports by destination.[3] The column totals $\Sigma_j v_{jk}$ here are identical to the corresponding $\Sigma_i s_{ik}$, as import backward linkages for sectors k.

With similar insight of Equation (3)

$$v_{jk} = \Sigma_i v_{ijk} \quad (6)$$

show the total of imports required by the domestic sector, j, from $i = 1, \ldots, n$, in response to k^{th} final demand change, but disguises information on the supplying foreign sector, i, or on the origin sector.

All three sectoral dimensions, that is i, j and k, of import requirements can be simultaneously captured in the following way: for any policy or final demand sector k, define

$$G^k = A^m < R^{*k} > \quad (7)$$

where $< R^{*k} >$ is a diagonal matrix (n, n), formed by the k^{th} column of R, that is $(I\text{-}A^d)^{-1}$ diagonalized for sector k.[4] A typical element of G^k, $g^k{}_{ij}$, then stands for imported intermediate input requirement (direct + indirect) by the j^{th} (domestic) sector from the i^{th} (foreign) sector induced by one unit increase in the k^{th} sector's final demand. Equation (7) reconciles Equations (2) and (5) for any k, and thus enhances the information content of backward import linkages as $s_{ik} = \Sigma_j g^k{}_{ij}$ and $v_{jk} = \Sigma_i g^k{}_{ij}$.

2.2. Structural change in intermediate imports requirements

As the accounting identities defined above in section 2.1 hold in current prices, intertemporal comparison of intermediate import requirements involves modeling of relative price and technology components of the change in current prices.[5] The technology component forms the basis of the assessment of structural change in

[3] See McDonald and Milner (1994) for an application.
[4] See Günlük-Şenesen and Şenesen (2001) for the underlying methodology.
[5] See Günlük-Şenesen and Küçükçifçi (1994) for the underlying methodology of this decomposition.

intermediate import demand. We first define the model in Equation (7) with respect to time:

$$G_0^k = A_0^m < R_0^{*k} > \qquad \text{for time } t_0 \tag{8}$$

$$G_1^k = A_1^m < R_1^{*k} > \qquad \text{for time } t_1 \tag{9}$$

Since structural or real changes can be captured with constant (or common) prices, we define G_0^k also in t_1 prices:

$$_1G_0^k = < P > G_0^k < P_k^{-1} > \tag{10}$$

where <*P*> is a diagonal matrix (*n*,*n*) of sectoral price indices at t_1, taking t_0 as the base year for prices. Note that elements of the post-multiplying diagonal price matrix are formed by the price index of the k^{th} final demand sector.[6] Then the total proportionate change in intermediate import requirements with respect to origin and destination sectors ($G_0^k \rightarrow G_1^k$) can be decomposed into two multiplicative components, in terms of individual non-zero elements of G_0^k .

$$\frac{g_{1,ij}^k}{g_{0,ij}^k} = \frac{{}_1g_{0,ij}^k}{g_{0,ij}^k} \times \frac{g_{1,ij}^k}{{}_1g_{0,ij}^k} \tag{11}$$

Therefore,

Total proportionate change in import requirements =

Proportionate change in relative prices ✕ Proportionate change in technology

$$\frac{g_{1,ij}^k}{g_{0,ij}^k} = \frac{P_i}{P_k} \times \frac{g_{1,ij}^k}{{}_1g_{0,ij}^k} \tag{12}$$

where P_i : price index of sector *i* in t_1, (change in P_i from t_0 to t_1 with $_0P_i = 1.0$)

The technology component corresponds to proportionate changes found with data expressed in constant prices. In the case of little variations in relative prices across sectors, the technology component is the main determinant of total change. Furthermore, note that P_i is identical to P_k for $i = k$, for which total proportionate change in import requirements is reduced to the proportionate change in technology:

[6] See the Appendix for the details of this derivation.

$$\frac{g^{k}_{1,ij}}{g^{k}_{0,ij}} = \frac{g^{k}_{1,ij}}{{}_{1}g^{k}_{0,ij}} \qquad (13)$$

The novelty of this approach is the decomposition of technology and relative price components of import requirements with respect to origin, destination and policy sectors. It provides insight to the change in the production structure in time by identifying the channels through which sectors induced intermediate import demand. It also reveals the channels through which demand for imported intermediate imports decreased in time.

2.3. The data

Input–output tables published by the Turkish State Institute of Statistics for 64 sectors (industries) for 1973 and for 97 sectors for 1996 (both in producers' prices) form the basis of calculations.[7] The data were aggregated to 24 sectors for both 1973 (t_0) and 1996 (t_1), since coherent sectoral wholesale price indices could be derived only for 24 aggregate sectors.

Accounting for only this one set of prices (P) and not distinguishing between domestic and import prices poses a conceptual challenge to the findings below as discussed in the Appendix. However, generalizations drawn below would still be expected to remain robust in the face of plausibility concerns for other alternatives to estimate different prices.

3. Components of change in intermediate import requirements

We outline leading characteristics of changes in import dependency of the production structure in Turkey in this section. Following the observations on relative price components, we discuss the patterns of technology component for several selected sectors.

3.1. Sectoral relative price components

The persistently high overall inflation rates of the whole period are reflected by sectoral P_{1996} / P_{1973} ratios, though with variations. For example, the price level of Banking and insurance sector products

[7] The recently available 1998 input-output data is compiled in basic prices, the first of its kind, in line with the *1995 European System of National Accounts.* Thus it is not readily compatible with the 1973 data. See Günlük-Şenesen (2005) for an assessment of the Turkish economy using the 1998 data set.

increased by more than 41,000 times in 23 years, in the lead by far (see Table 1). It is followed by Electricity-gas-water, Other manufacturing and Petroleum products sectors (in the range of 30,000 – 32,000 times). Prices for Glass and cement and Paper sectors increased around 25,000 – 27,000 times. On the other hand, price levels moved up comparatively less in some other sectors. For example this ratio is around 4,500 for Electrical machinery, 7,000 for Housing, 9,000 for Machinery and Metal products, 10,000 for Transport vehicles and Agriculture.

Table 1 presents the directions and magnitudes of relative price components for each pair of supplier and policy sectors. This coded table (adapted from Velleman and Hoaglin, 1981: 203-205), classifies actual data into symbols explained at the bottom of the table. For example "#" in the cell for $i = 6$, $k = 14$ shows that, for the policy sector Electrical machinery, intermediate imports requirements of every domestic (buyer) sector from the foreign Paper (supplier) sector increased by 5 – 10 times due to relative price movements.

The elements on the main diagonal are obviously 1 and the symmetrical cells above and below the main diagonal take inverse values (thus symbols) of each other. For example the actual value for the cell $i = 6$, $k = 4$ is 2.04 and that for the cell $i = 4$, $k = 6$ is 0.49 (= 1 / 2.04) (denoted by "‡" and "=" respectively in Table 1). If a supplier sector has a higher price increase than the policy sector from 1973 to 1996, its relative price effect is greater than 1, i.e. these supplier sectors create upwards price effects on every buyer sector's intermediate imports requirements, and *vice versa*.

In the case of policy sectors with relatively modest price increases during 1973-1996, relative price effects are high for all or most of the supplier sectors, as the columns for Electrical machinery, Housing, Machinery, Metal products, Transport vehicles and Agriculture indicate in Table 1. On the contrary, rows for low inflation suppliers in Table 1 have negative signs (i.e. actual values less than 1), implying that the price effects pull down the overall import dependency.

Table 1

Relative Price Components Matrix (P_i / P_k)

$i\downarrow$		P_{96} / P_{73}	$k\rightarrow$ 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	Agriculture	10961	1	–	–	–	–	=	–	=	–	=	–	+	+	‡	+	=	=	–	–	–	=	–	–	+
2	Mining	18347	+	1	+	+	+	–	+	–	+	–	+	‡	‡	‡	+	–	–	+	+	+	=	+	+	‡
3	Food	12658	+	–	1	+	–	–	–	=	+	=	–	+	+	‡	+	=	=	–	–	–	=	–	–	+
4	Textile	12089	+	–	–	1	–	=	–	=	+	=	–	+	+	‡	+	=	=	–	–	–	=	–	–	+
5	Wood	12841	+	–	+	+	1	–	–	=	+	=	–	+	+	‡	+	=	=	–	–	–	=	–	–	+
6	Paper	24653	‡	+	+	‡	+	1	+	–	‡	–	+	‡	‡	#	‡	–	–	+	+	+	–	+	+	‡
7	Chemicals	15172	+	–	+	+	+	–	1	=	+	–	+	+	+	‡	+	=	=	+	–	–	=	+	+	‡
8	Petroleum	30347	‡	+	‡	‡	‡	+	‡	1	‡	+	‡	‡	‡	#	‡	–	–	‡	+	+	–	‡	‡	‡
9	Rubber-plastics	11578	+	–	–	–	–	=	–	=	1	=	–	+	+	‡	+	=	=	–	–	–	=	–	–	+
10	Glass-cement	27066	‡	+	‡	‡	‡	+	+	–	‡	1	‡	‡	‡	#	‡	–	–	+	+	+	–	+	+	‡
11	Basic metals	12842	+	–	+	+	+	–	–	=	+	=	1	+	+	‡	+	=	=	–	–	–	=	–	–	+
12	Metal products	8964	–	=	–	–	–	=	–	=	–	=	–	1	+	‡	–	=	=	–	–	–	=	–	–	+
13	Machinery	8866	–	=	–	–	–	=	–	=	–	=	–	–	1	+	–	=	=	–	–	–	=	–	–	+
14	Electrical machinery	4467	=	=	=	=	=	≡	=	≡	=	≡	=	=	–	1	=	≡	≡	=	=	=	≡	=	=	–
15	Transport vehicles	10454	–	–	–	–	–	=	–	=	–	=	–	+	+	‡	1	=	=	–	–	–	=	–	–	+
16	Other manufacturing	32008	‡	+	‡	‡	‡	+	‡	+	‡	+	‡	‡	‡	#	‡	1	–	‡	‡	+	–	‡	‡	‡
17	Electricity-gas-water	32156	‡	+	‡	‡	‡	+	‡	+	‡	+	‡	‡	‡	#	‡	+	1	‡	‡	+	–	‡	‡	‡
18	Construction	14131	+	–	+	+	+	–	–	=	+	–	+	+	+	‡	+	=	=	1	–	–	=	–	+	‡
19	Trade	15866	+	–	+	+	+	–	+	–	+	–	+	+	+	‡	+	=	=	+	1	–	=	+	+	‡
20	Transportation-communication	16329	+	–	+	+	+	–	+	–	+	–	+	+	+	‡	+	–	–	+	+	1	=	+	+	‡
21	Banking-insurance	41124	‡	‡	‡	‡	‡	+	‡	+	‡	+	‡	‡	‡	#	‡	+	+	‡	‡	‡	1	‡	‡	#
22	Personal services	14648	+	–	+	+	+	–	–	=	+	–	+	+	+	‡	+	=	=	+	–	–	=	1	+	‡
23	Public services	13936	+	–	+	+	+	–	–	=	+	–	+	+	+	‡	+	=	=	–	–	–	=	–	1	‡
24	Housing	6955	–	=	–	–	–	=	=	=	–	=	–	–	–	+	–	=	=	=	=	=	≡	=	=	1

symbol	#	‡	+	1	–	=	≡
P_i / P_k	5 - 10	2 - 5	1 - 2	1	0.5 - 1	0.2 - 0.5	0.1 - 0.2

3.2. Sectoral characteristics of technology components

The real or structural change in intermediate import requirements induced by a policy sector is reflected by the technology component. Note that this component is defined in terms of all three (supplier, buyer, policy) sectors involved, thus a separate matrix (24, 24) is calculated for each of the 24 policy sectors. Due to space considerations, we will outline here general patterns and look closer to the specific patterns of three sectors.

One common finding for all of the policy sectors is that, technology component of import dependency is far more effective than the relative price component. While relative price components lie between 0.1 – 10, the range for technology components is 0.0001 – 10,000. It should also be noted that both effects are in the same direction in the overwhelming majority of the cases.

One of the most important, but not unexpected, finding is the significant increase in the dependency of the Turkish economy as a whole on imported energy during 1973-1996. The technology component indicates, irrespective of the policy sector, that intermediate import requirements of almost all buyer sectors from foreign Petroleum products sector increased considerably. Furthermore, import demand generation of the domestic Petroleum products sector from the foreign Mining sector increased for almost all policy sectors.

An interesting finding is the emergence of the overall dependency on intermediate consumption of imported Paper and paper products. For almost all policy sectors, this dependency increased enormously (above 100 times) for the domestic Trade, Transportation and communication, Banking and insurance sectors due to the technology component. At a lesser extent, but still quite high, similar effects (between 10 – 100 times) are observed for the destination sectors of Personal services and Textiles sectors. Most of this transformation could well be attributed to the so-called computer revolution.

We also note that intermediate imports demanded by the Glass and cement sector from the foreign Mining sector increased significantly for almost all policy sectors due to structural changes in the production process.

On the other hand, significant declines in the import dependency are observed for some sectors during 1973-1996. For almost all policy sectors, the technology component is dominant in the

outstanding decrease of dependency on intermediate imports by Agriculture from Textiles and Metal products; by Mining from Machinery and Electrical machinery, by Trade from Chemicals.

Having summed up the general observations, let us examine the specific cases of three policy sectors, Agriculture, Food and beverages and Textiles, traditionally leading sectors in Turkey's manufacturing exports, making up around one third of total exports in 1996.

3.2.1. Imports induced by final demand of agriculture (k = 1)

A summary of the outstanding sectors with respect to total changes in import requirements and its components for the policy sector Agriculture are presented in Figure 1. Note that these plotted changes (in both directions) follow Equation (12). The vertical axis for proportionate values is in logarithmic scale.

A common pattern is that both components affect total change in import requirements in the same direction. It is also clear that relative price effects are almost negligible as compared to technology effects. Significant proportionate decreases in total import requirements are observed for domestic Agriculture from foreign Textiles and Metal products, and for domestic Mining from all types of machinery products. Highest increases are observed for manufacturing (Textiles, Glass and cement, Electrical machinery) and services (Trade, Transportation and communication, Banking and insurance and Personal services) sectors.

The pattern of the technology component of import requirements for the policy sector Agriculture is presented in Table 2. Note that coded value ranges for symbols differ from those in Table 1. Also, a cell is left empty when the numerator and denominator values of the corresponding technology component $\left(g^{k}_{1996,ij} / {}_{1996}g^{k}_{1973,ij}\right)$ are both zero, implying no import transaction for those sectors in both years. In case a transaction did not exist in 1973 but it emerged in 1996, it is indicated by a "+" sign. In the opposite case, it is indicated by a "–" sign.

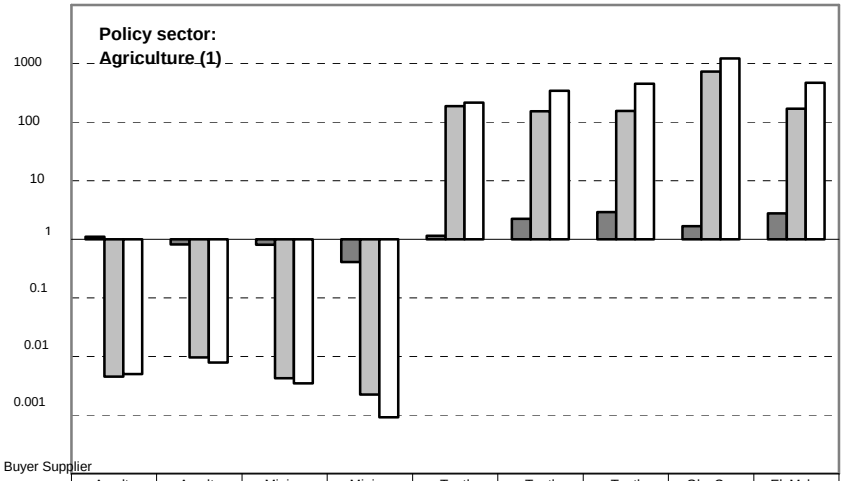
Table 2

Technology Components Matrix $\left(g^{k}_{1996,\,i\,j} / {}_{1996}g^{k}_{1973,\,i\,j}\right)$ for $k = 1$ (Agriculture)

$i\downarrow$		$j\rightarrow$	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	Agriculture		‡	=	‡	+	+	+	+		–							–			+	+				
2	Mining		+	+	‡	+	+	+	‡	+	+	#	+	+	+	+	+	+	+		+	+	+	+		
3	Food-beverages		‡		‡	#		+	‡												‡	+				
4	Textile		≡			‡	–	+	–		–							–			–			–		
5	Wood-furniture		+	+	+	+	‡	+	+	+	+	+	+	+	+	+	+	–	+		+	+		+		
6	Paper		+	+	+	#	+	‡	+	+	+	+	+	+	+	‡	+	–	+		#	#	#	‡		
7	Chemicals		–	+	+	+	–	+	+	+	+	+	+	+	+	‡	–	–	#		≡	+	–	+		
8	Petroleum		‡	‡	‡	‡	+	‡	‡	–	‡	‡	+	+	‡	#	+	+	‡		‡	‡	#	‡		
9	Rubber-plastics		–		+	–			–		‡			–	–	–	–	–				+				
10	Glass-cement		+		+	‡	+	+	+	+		‡	+	+	+	+	–	–			+	+				
11	Basic metals		+	–	+	+	‡	–	+	–	‡	+	+	+	+	+	–	+	+		+	+		+		
12	Metal products		≡	–	–	–	=	–	–	–	–	+	–	–	–	–	–	–	+		–	–	–	–		
13	Machinery		‡	≡	+	+	+	‡	‡	+	+	+	+	‡	+	‡	+	–	+		+	+	+	+		
14	Electrical machinery			≡	–	–		–				–	–	–	–	+	+		+			+		–		
15	Transport vehicles		+				+		+						+	+	–	+				+		+		
16	Other manufacturing		+	–	+	#	–	‡	+		+	‡		–	‡	+	‡	+	+		≡	#	–	+		
17	Electricity-gas-water																									
18	Construction																									
19	Trade																									
20	Transport'n-communic'n																									
21	Banking																									
22	Personal services																									
23	Public services																									
24	Housing																									

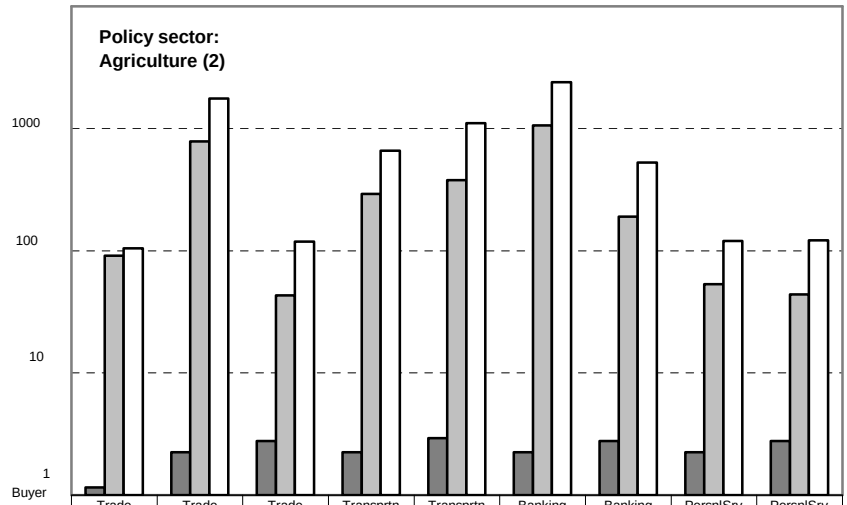
Symbol	#	‡	+	–	=	≡
$\left(g^{k}_{1996,\,i\,j} / {}_{1996}g^{k}_{1973,\,i\,j}\right)$	> 100	10-100	1-10	0.1-1	0.01-0.1	< 0.01

Figure 1
Policy Sector: Agriculture
Price and Technology Components for Total Change > 100 or < 0.01



Buyer Supplier

	Agrcltr Textl	Agrcltr MetlProd	Mining Machnry	Mining ElcMchnr	Textl Food	Textl Paper	Textl OthrMnf	GlasCm Mining	ElcMchn Petrlm
Price	1,103	0,818	0,809	0,408	1,2	2,2	2,9	1,7	2,8
Techn.	0,005	0,010	0,004	0,002	187,4	152,6	154,5	730,1	170,4
Total	0,005	0,008	0,003	0,001	216,4	343,2	451,2	1222,0	471,8



Buyer Supplier

	Trade Food	Trade Paper	Trade Petrlm	Transprtn Paper	Transprtn OthrMnf	Banking Paper	Banking Petrlm	PersnlSrv Paper	PersnlSrv Petrlm
Price	1,2	2,2	2,8	2,2	2,9	2,2	2,8	2,2	2,8
Techn.	90,8	782,8	43,0	292,5	378,0	1061,7	190,1	53,3	43,9
Total	104,9	1760,5	119,0	657,8	1103,9	2387,8	526,3	119,9	121,4

An increase in the final demand of the Agriculture sector induced more than 100 fold increase in imports requirements of domestic Textiles and some services sectors (Trade, Transportation and communication, Banking and insurance) from the foreign Paper sector. Similar proportionate increases are observed for imports by Textiles (from Food and beverages and Other manufacturing), by Glass and cement from Mining, by Electricity-gas-water from Chemicals, by Electrical machinery and Banking from Petroleum, and by Transportation and communication from Other manufacturing sectors.

In addition, import dependency increased, in response to an increase in the final demand of Agriculture, for almost all buyer sectors from foreign Petroleum, Mining, Wood and furniture, Paper, Chemicals, Glass and cement, Basic metals, Machinery and Other manufacturing sectors. In specific, the domestic Textiles sector as a buyer is distinguished from others with its increased import dependency on most of the supplier sectors. Note that this structural change is independent of relative price changes.

On the other hand, there are sharp declines in the technology component of imports requirements of domestic Agriculture from foreign Textiles and Metal Products, of Mining from Machinery and Electrical machinery, of Trade from Chemicals and Other manufacturing sectors.

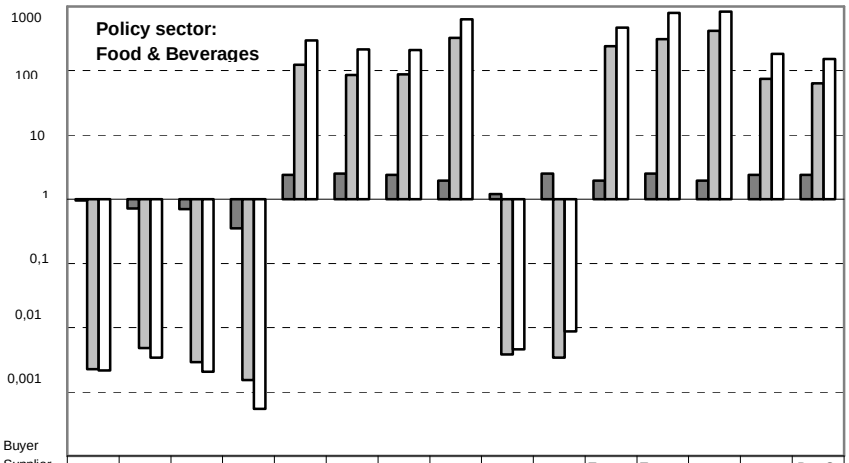
3.2.2. Imports induced by final demand of food and beverages (k = 3)

Figure 2 presents the outstanding destination sectors with respect to total proportionate changes in import requirements for the policy sector Food and beverages. The vertical axis for proportionate values is in logarithmic scale. Both components affect import dependency in the same direction in most of the cases. Again, price effects are relatively rather small.

Food and beverages induced less import demand of Agriculture (from Textiles, Metal Products), of Mining (from products of Machinery), and of Trade (from Chemicals and Other manufacturing). Note that relative price components in the last case move in opposite direction.

Significant increases are observed for manufacturing sectors like Machinery and Electrical machinery, and for services sectors (Trade, Transportation and communication, Banking and insurance and Personal services).

Figure 2
Policy Sector: Food and Beverages
Price and Technology Components for Total Change > 100 or < 0.01



Buyer / Supplier	Agrcltr Textl	Agrcltr MetPrd	Mining Machnt	Mining ElcMch	Machnr Petrlm	Machnr OthrMnf	ElcMch Petrlm	Trade Paper	Trade Chemcl	Trade OthrMnf	Transpr t Paper	Transpr t OthrMnf	Bankng Paper	Bankng Petrlm	PersSr v Petrlm
Price	0.955	0.708	0.700	0.353	2.4	2.5	2.4	1.9	1.199	2.529	1.9	2.5	1.9	2.4	2.4
Techn	0.002	0.005	0.003	0.002	123.0	85.3	88.3	326.1	0.004	0.003	240.5	310.9	422.7	75.7	63.8
Total	0.002	0.003	0.002	0.001	294.8	215.7	211.7	635.1	0.005	0.009	468.4	786.1	823.3	181.5	153.1

A comprehensive pattern for the technology component of import dependency for the policy sector Food and beverages is presented in Table 3. A striking characteristic is that technology components for induced Paper imports increased enormously in the case of domestic services sectors. Also, large increases are observed for induced imports by Glass and cement from Mining, by Machinery from Petroleum, by Transportation and communication from Other manufacturing sectors.

A more general observation is that the technology component increased for almost all buyer sectors from foreign Petroleum, Mining, Wood and furniture, Paper, Glass and cement, Basic metals, Machinery and Other manufacturing sectors.

Characteristics of decreased technology components of imports requirements induced by Food and beverages were already presented above, with reference to Figure 2.

Table 3

Technology Components Matrix $\left(g^{k}_{1996,ij} / {}_{1996}g^{k}_{1973,ij}\right)$ for $k = 3$ (Food and Beverages)

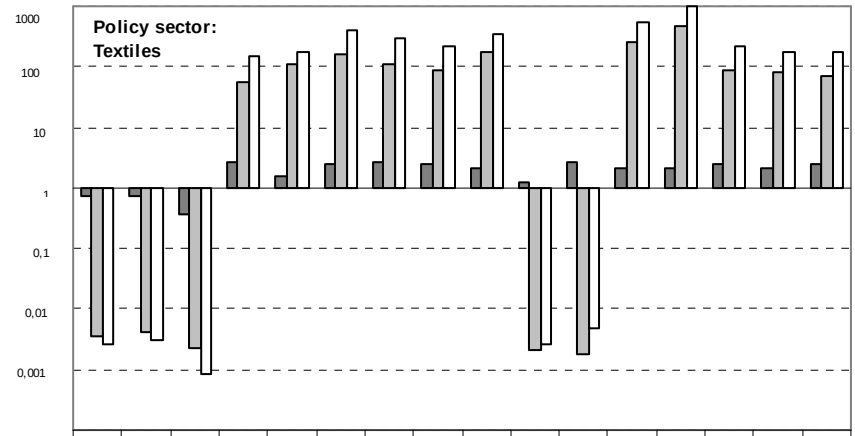
$i\downarrow$		$j\rightarrow$ 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	Agriculture	‡	=	‡	=	+	+	–		–							–			–	+				
2	Mining	+	+	‡	+	+	+	+	+	+	#	+	+	+	+	+	+	+		+	+	+	+		
3	Food-beverages	‡		‡	‡		+	+												‡	+				
4	Textile	≡			+	–	+	–		–							–			–			–		
5	Wood-furniture	+	+	+	=	+	+	+	+	+	+	+	+	+	+	+	–	+		+	+		+		
6	Paper	+	+	+	+	+	+	+	+	+	+	+	+	+	‡	+	–	+		#	#	#	‡		
7	Chemicals	–	–	+	–	–	–	+	–	+	+	+	+	‡	+	–	–	‡		≡	+	–	+		
8	Petroleum	‡	‡	‡	+	+	+	‡	–	‡	+	+	‡	#	‡	+	+	+		‡	‡	‡	‡		
9	Rubber-plastics	–		+	–			–		‡			–	–	–	–	–				+				
10	Glass-cement	+		+	–	+	+	+	+		+	+	+	‡	+	=	–			+	+				
11	Basic metals	+	–	–	–	‡	=	–	–	‡	+	–	+	‡	+	–	+	+		+	+		+		
12	Metal products	≡	–	=	=	=	–	–	–	–	–	–	–	–	–	–	–	+		–	–	–	–		
13	Machinery	‡	≡	–	–	+	‡	‡	+	+	+	+	‡	+	‡	+	–	+		+	+	+	+		
14	Electrical machinery		≡	–	–		–				–	–	–	+	+	+		–			+		–		
15	Transport vehicles	+				+		+						+	+	–	+				+		+		
16	Other manufacturing	+	–	+	+	=	+	–		+	+		–	‡	+	‡	+	+		≡	#	–	‡		
17	Electricity-gas-water																								
18	Construction																								
19	Trade																								
20	Transport'n-communic'n																								
21	Banking																								
22	Personal services																								
23	Public services																								
24	Housing																								

Symbol	#	‡	+	–	=	≡
$\left(g^{k}_{1996,ij} / {}_{1996}g^{k}_{1973,ij}\right)$	> 100	10-100	1-10	0.1-1	0.01-0.1	< 0.01

3.2.3. Imports induced by final demand of Textiles (k = 4)

The patterns and sectoral compositions of total change in import requirements induced by Textiles in Figure 3 are almost identical to those in Figure 2 for Food and beverages. Strikingly decreased import requirements of domestic Agriculture, Mining and Trade are similar in magnitudes and origin sectors. Note again the enormous increase in import requirements of domestic services sectors from Paper induced by Textiles final demand.

Figure 3
Policy Sector: Textiles
Price and Technology Components for Total Change > 100 or < 0.01



Buyer / Supplier	Agrcltr MetlPrd	Mining Machnr	Mining ElcMch	TextIs OthrMnf	GlasCm Mining	Machnr Petrlm	Machnr OthrMnf	ElcMch Petrlm	Trade Paper	Trade Chemcl	Trade OthrMn	Trnsprt Paper	Banking Paper	Banking Petrlm	PrsnSrv Paper	PrsnSrv Petrlm
Price	0,741	0,733	0,370	2,6	1,5	2,5	2,6	2,5	2,0	1,255	2,648	2,0	2,0	2,5	2,0	2,5
Techn	0,004	0,004	0,002	57,3	111,9	163,4	113,4	84,7	173,8	0,002	0,002	261,3	482,3	86,4	82,8	68,1
Total	0,003	0,003	0,001	151,6	169,8	410,2	300,2	212,6	354,3	0,003	0,005	532,8	983,6	216,8	168,9	171,0

Table 4 presents the sectoral composition of the technology component for the policy sector Textiles. Here too the special position of Paper sector as supplier is striking in the sense that import demand of Trade, Transportation and communication and Banking and insurance due to technology increased more than 100 times. Similar increases are observed again for imports by Glass and cement from Mining, by Machinery from Petroleum, by Machinery and Transportation and communication from Other manufacturing sectors.

Table 4

Technology Components Matrix $\left(g^{k}_{1996,ij} / {}_{1996}g^{k}_{1973,ij}\right)$ for $k = 4$ (Textiles)

$i\downarrow$		$j\rightarrow$1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	Agriculture	‡	=	‡	–	+	+	–		–							–			–	+				
2	Mining	+	+	‡	+	+	+	+	+	+	#	+	+	+	+	+	+	+		+	+	+	+		
3	Food-beverages	+		‡	‡		+	+												‡	+				
4	Textile	≡			‡	–	+	–		–							–			–			–		
5	Wood-furniture	+	+	+	–	‡	+	+	+	+	+	+	+	+	+	+	+	+		+	+		+		
6	Paper	+	+	+	‡	+	+	–	+	+	+	+	+	+	‡	+	+	+		#	#	#	‡		
7	Chemicals	–	+	+	+	–	+	+	+	+	+	+	+	‡	+	–	+	‡			+	–	+		
8	Petroleum	‡	‡	+	+	+	‡	+	–	+	+	‡	‡	#	‡	+	‡	+		+	‡	‡	‡		
9	Rubber-plastics	–		+	–			–		‡				–	–	–	–				+				
10	Glass-cement	+		+	+	+	+	–	+		+	+	+	‡	+	=	+			+	+		=		
11	Basic metals	+	–	–	+	‡	–	–	–	‡	+	+	+	‡	+	–	‡	+		+	+		+		
12	Metal products	≡	–	=	–	=	–	–	–	–	–	–	–	–	–	–	–	+		–	–	–	–		
13	Machinery	+	≡	–	+	+	‡	+	+	+	+	+	‡	+	‡	+	+	+		+	+	+	+		
14	Electrical machinery		≡	–	–		–				–	–	–	+	+	+		–			+		–		
15	Transport vehicles	+				+		+						+	+	–	+				+		+		
16	Other manufacturing	+	–	+	‡	–	+	–		+	+		–	#	+	‡	+	+		≡	#	–	‡		
17	Electricity-gas-water																								
18	Construction																								
19	Trade																								
20	Transport'n-communic'n		Symbol		#		‡		+		–		=		≡										
			$\left(g^{k}_{1996,ij} / {}_{1996}g^{k}_{1973,ij}\right)$		> 100		10-100		1-10		0.1-1		0.01-0.1		< 0.01										
21	Banking																								
22	Personal services																								
23	Public services																								
24	Housing																								

4. Conclusions

Both imports and exports increased significantly in Turkey in the last two decades of liberalization. However, export revenues were far from compensating for imports, hence persistent current account deficits and subsequent external indebtedness has increased the vulnerability of the Turkish economy. The contribution of the production structure towards increased import dependence has been an overlooked aspect of this vulnerability.

This paper has introduced a new methodology in input-output modeling with two novelties: The first novelty is decomposition of import requirements of production with respect to both origin and destination sectors. The second novelty is a further decomposition of these components with respect to relative price effects and technology effects.

We find that relative price effects are comparatively negligible, with a significantly overriding technology component of increased import dependency from 1973 to 1996. The proportionate increases in import dependency on imported energy and Paper products stand out as a significant character for almost all domestic buyer sectors. Note that the examination period of this paper ends with 1996. Since then SEKA, the state-owned paper manufacturing firm has been closed down and it can be safely claimed that the import intermediate requirements of domestic sectors must have been increased further in consequence. In case of any bottlenecks in current account deficits, the vulnerability of the economy in general and the sustainability of production in particular gain much more importance than before.

This crucial aspect is aggravated even more with the increased dependence of traditional export sectors on imported intermediate inputs, hence on imported technology in 1980's and 1990's. Besides, technology intensive sectors (e.g. chemicals, machinery and vehicles) have become increasingly dependent on imported inputs in the meantime. Celasun (1983: 48) noted that contrary to the experience of similar countries, the transformation of the economy during 1950-1980 did not lead to import substitution of primary products and energy by the manufacturing industry. We find that the liberalization period takes over this trend and foreign exchange earnings are put further at stake with the abandonment of import substitution. It then appears that impacts of macroeconomic remedies for imbalances will have limited success if their roots in the production structure are left unattended.

References

ALBALA-BERTRAND, J.M. (1999), "Industrial Interdependence Change in Chile: 1960-90, A Comparison with Taiwan and South Korea", *International Review of Applied Economics*, 13 (2), 161-191.

BORATAV, K. (1987), "İktisat Politikası Alternatifleri Üzerine bir Deneme", K.Boratav *et al*. (eds.), *Kriz, Gelir Dağılımı ve Türkiye'nin Alternatif Sorunu*, Kaynak, İstanbul, 70-109.

CELASUN, M. (1983), "Sources of Industrial Growth and Structural Change: The Case of Turkey", *World Bank Staff Working Papers*, No. 614.

————(1994), "Trade and Industrialization in Turkey: Initial Conditions, Policy and Performance in the 1980s", in G. K. Helleiner (ed.), *Trade, Policy and Industrialization in Turbulent Times* London: Routledge, 453-484.

————(2002), "Gelişen Ekonomilerin Dış Kaynak Kullanımı, Finansal Krizler ve Türkiye Örneği, 2001", *Doğu-Batı*, 17,161-180.

CELASUN, M. and RODRIK, D, (1989), "Debt, Adjustment and Growth: Turkey" in J. Sachs and S.M. Collins (eds.), *Developing Country Debt and Economic Performance*, Country Studies, The University of Chicago Press, 3, Book IV, 615-808.

FUJITA, N. and JAMES W. E. (1991), "Growth Patterns of the Japanese Economy in the 1980's: Before and After the Appreciation of the Yen", *Economic Systems Research***,** 3 (4), 399-412.

GUILHOTO, J. J. M. *et al*. (2002), "The Globalization Process and the Productive Structure of the Brazilian Economy in the 1990s: An Input-Output Approach", paper presented at the *14th International Conference on Input-Output Techniques*, Montreal, October 10-15, 2002.

GÜNLÜK-ŞENESEN, G. (2005), *Türkiye'nin Üretim Yapısı: Girdi-Çıktı Modeli ile Temel Bulgular*, TÜSİAD, İstanbul.

GÜNLÜK-ŞENESEN, G. and KÜÇÜKÇİFÇİ, S. (1994), "Decomposition of Structural Change into Technology and Price Components: Turkey, 1973-85", *Economic Systems Research*, 6 (2), 199-215.

GÜNLÜK-ŞENESEN, G., and ŞENESEN, Ü. (2001), "Reconsidering Import Dependency in Turkey: The Breakdown of Sectoral Demands with respect to Suppliers", *Economic Systems Research*, 13 (4), 417-428.

MCDONALD, S. and MILNER, C. (1994), "Specialization Gains from Trade in Intermediaries: An application of the VIS framework to the UK", *Economic Modelling*, 11 (3), 359-374.

ÖNİŞ, Z. and RIEDEL, J. (1993), *Economic Crises and Long-Term Growth in Turkey*, Washington D.C.: The World Bank.

ÖNİŞ, Z. and RUBIN, B. (2003), (eds.), *The Turkish Economy in Crisis*, Great Britain: Frank Cass.

RUIZ-NAPOLES, P. (2001) "Liberalisation, Exports and Growth in Mexico, 1978-94: A Structural Analysis", *International Review of Applied Economics*, 15 (2), 163-180.

SARMA, A. (1996), "Import Intensities of Indian Industries", in R.K. Koti *et al*. (eds.) *Studies in Indian Economy*, Bombay: Himalaya Publishing House, 128-144.

ŞENESEN, Ü. and GÜNLÜK-ŞENESEN, G. (2003), "Üretimde Dışalıma Bağımlılık: 1970'lerden 2000'lere ne Değişti?", A. H. Köse, F. Şenses ve E. Yeldan (eds.), *İktisadi Kalkınma, Kriz ve İstikrar*, İletişim, İstanbul, 533-558.

————(2005), "Impacts of Liberalisation on Imports for Production: Turkey, 1973-1996" (unpublished manuscript).

VELLEMAN, P. F., and HOAGLIN, D. C. (1981), *Applications, Basics and Computing of Exploratory Data Analysis*, Boston: Duxbury Press.

Appendix

Derivation of Equations (10)-(13) and model estimation are based on the assumption that sectoral prices for domestic and imported products are the same, i.e. $P^d = P^m = P$. We will present the generalized solution without these restrictions and justifications for simplification in section A.1 and derivation of Equation (10) in section A.2.

A.1. General case for updating the G matrix coefficients

The general procedure to update the value of intermediate input ($_0q_{ij}$) distinguishing between domestic (p_i^d) and import (p_i^m) prices would be as

$$p_i \ {}_0q_{ij} = p_i^d \ {}_0q_{ij}^d + p_i^m \ {}_0q_{ij}^m \qquad \text{(A1.1)}$$

Where

p_i : the composite price index of domestic and import prices, and

$$p_i^m = (p_i^{world} \times exchange\ rate)\,(1 + net\ tax\ rate)$$

Since $a_{0,ij} = \dfrac{{}_0q_{ij}}{{}_0q_j}$, then $a_{1,ij} = \dfrac{p_i^d}{p_j} a_{0,ij}^d + \dfrac{p_i^m}{p_j} a_{0,ij}^m$ (A1.2)

A_0^m in t_1 prices: $\quad {}_1A_0^m = < P^m > A_0^m < P^{-1} >$ (A1.3)

R_0 in t_1 prices: $\quad {}_1R_0 = < P^d > R_0 < P^{-1} >$ (A1.4)

$< R_0^{*k} >$ in t_1 prices: $\quad {}_1R_0^{*k} = < P^d >< R_0^{*k} >< P_k^{-1} >$ (A1.5)

Therefore

G_0^k in t_1 prices:

$${}_1G_0^k = \left(< P^m > A_0^m < P^{-1} >\right)\left(< P^d >< R_0^{*k} >< P_k^{-1} >\right) \qquad \text{(A1.6)}$$

Note that for each sectoral output, data on three different prices (p_i^d , p_i^m , p_i) are required for estimation with A1.6, which is obviously the realistic case. However, input-output data for both domestic and imported inputs are compiled in current domestic prices (all in Turkish Liras), and there is only one set of sectoral (wholesale) price index data available. In other words, overall price levels (P), domestic price levels (P^d) and imported price levels (P^m) are all compressed into one single price for each sector.

One solution for this drawback would be to assume $P^d = P^m = P$. Alternatively, P^m could be estimated on the basis of P^{world} and rates for exchange and tax, as defined above. Yet, P^d and P would still remain undistinguished and data compilation would be too cumbersome in the face of this limitation. We therefore follow the first alternative for our analysis.

A.2. Derivation of Equation (10) assuming $P^d = P^m = P$.

It is assumed that $P^d = P^m = P$ for the model derivation of equations (10)-(13) and estimation.

A_0^m in t_1 prices: $${}_1A_0^m = < P > A_0^m < P^{-1} >$$ (A2.1)

R_0 in t_1 prices: :

$${}_1R_0 = (I - < P > A_0^d < P^{-1} >)^{-1} = < P > (I - A_0^d)^{-1} < P^{-1} >$$

$${}_1R_0 = < P > R_0 < P^{-1} >$$ (A2.2)

$< R_0^{*k} >$ in t_1 prices: $$<{}_1R_0^{*k}> = < P >< R_0^{*k} >< P_k^{-1} >$$ (A2.3)

Therefore

G_0^k in t_1 prices: $${}_1G_0^k = < P > G_0^k < P_k^{-1} >$$ (A2.4)

Özet

Türkiye'de dış ticaretin serbestleştirilmesinin dışalım üzerindeki göreli fiyat ve teknoloji etkileri: 1973-1996

Bu çalışma, Türkiye'nin 1980'lerde "ithal ikamesi"nden dışalımda serbestleştirmeye geçişinin aramalı dışalımı üzerindeki etkilerini ele almaktadır. Kullanılan girdi-çıktı yöntemi iki yenilik içermektedir: Birincisi, dışalımın geriye bağ etkilerinin sunucu ve alıcı kesim bileşenlerine; ikincisi, zaman içindeki değişmenin göreli fiyat ve teknoloji bileşenlerine ayrıştırılmasıdır. Çalışmada 1973 ve 1996 girdi-çıktı çizelgelerinin toplulaştırılmasından elde edilen veriler kullanılmıştır. Kesimlerin fiyat artışları birbirinden hayli farklıdır ama teknoloji bileşeninin etkileri göreli fiyat bileşeninkine oranla çok daha büyüktür. Üretimin yapısı, Tarım, Dokuma-giyim, Besin gibi geleneksel dışsatım kesimleri de içinde olmak üzere, dışarıdan alınan girdilere daha da bağımlı hale gelmiştir.