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## **Industry Competitiveness – The Role of Regional Sharing of Distance-Sensitive Inputs (The Israeli – Arab Case)**

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**INDUSTRY COMPETITIVENESS –  
THE ROLE OF REGIONAL SHARING OF  
DISTANCE-SENSITIVE INPUTS  
(THE ISRAELI – ARAB CASE)**

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**ABSTRACT**

This study offers a methodology to estimate how the availability of distance-sensitive inputs affects industrial performance of neighboring countries. It shows that replacing either distant foreign input suppliers or inefficient local ones with neighboring suppliers, could enhance a country's comparative advantage. Whereas the suggested methodology could be generalized for any type of regional trade liberalization, it is implemented to the case of allowing for trade between former non-trading neighboring countries. More specifically, the case of regional distance-sensitive input sharing between Israel and three of its Arab neighbors (Egypt, Jordan and Syria) is demonstrated.

**Key words:** Input sharing, Trade potential, Input-output tables, Distance sensitivity, Industry competitiveness.

## I. INTRODUCTION

The Heckscher-Ohlin-Samuelson (H-O-S) model of comparative advantage essentially claims that countries' comparative advantage is essentially the outcome of their comparative factor endowment. Hence, countries comparatively endowed with labor are likely to export labor intensive products whereas countries comparatively endowed with capital are likely to export capital intensive products. The logic behind the H-O-S theory may be extended to claim that a country's comparative advantage is determined by the availability of specific inputs. These inputs may be acquired within the country itself or imported<sup>1</sup>. Japan, for example, became a world leader in shipbuilding without having internal supplies of iron and steel, but through utilizing an apparently superior technology and management skills while importing metal scrap, which was widely available in the world markets.

The problem with the latter argument is that procurement of inputs from distant sources is subject to transportation costs and other trade barriers that increase the price of the acquired inputs. This might be one of the reasons for the extensive border trade between nations (United Nations, 1998). Thus, in the absence of trade barriers between neighboring countries, availability of specific inputs in a neighboring country might be as good as the availability of local inputs, for the creation of comparative advantage. The reason for that is the negligible wedge that might exist between local transportation costs and transportation costs from (and to) neighboring countries. One may therefore argue that in many cases comparative advantage may stem from the ability to source inputs from neighboring countries, rather than from local inputs endowment. In any case it is clear that access to locally scarce inputs in a neighboring country may reduce production costs and thus improve the overall competitiveness of specific industries within a country. The American Automobile and Electronics industries, for example, rely on Mexican inputs as a crucial factor to reduce production costs and hence maintain their worldwide competitiveness (Fatemi, 1990).

If certain inputs are not available within a country and the access to such inputs in neighboring countries is hampered (e.g. by tariff or non-tariff barriers) or denied (e.g. as a result of a political conflict), a country's comparative advantage in specific industries may be offset. The latter

argument is particularly true if the scarce inputs are distance sensitive, i.e. have high transportation cost per unit relatively to their unit production cost (Hirsch & Hashai, 2000; Hummels, 1999; Krugman, 1991). In this case imports of inputs from distant sources are expected to be very expensive. Removal of trade barriers and allowing access to inputs located in neighboring countries will enhance comparative advantage in these industries.

Whereas the above argument might be generalized to any type of regional trade liberalization (i.e. preferential trade arrangements (PTAs)), this study focuses on the more extreme case of allowing for trade between former non-trading neighboring countries. More specifically we relate to Israel and three of its surrounding Arab neighbors (Egypt, Jordan and Syria). Most research regarding the Israeli-Arab trade potential focuses on a comparative analysis of the current trade patterns of Israel and its Arab neighbors (Arnon & Weinblatt, 1994; Ben Haim, 1993; Ben Shahr, Fishelson & Hirsch, 1989; Halbach et al., 1995; Halevi, 1994; Sagi, 1999). This line of research ignores the probably more important question: *"Has the fact that Israel and its neighbors are virtually 'economic islands' affected the competitiveness of certain industries in these countries?"*

An economic island is a country with negligible border trade. Israel is surely an economic island. It cannot trade with its enemy neighbors (Lebanon and Syria) and its trade with past enemies (Egypt and Jordan) is negligible (about 0.3 % of Israel's international trade volume). Evidently, the political tension in the Middle East, the need to take severe security measures, administrative trade barriers and the ongoing Israeli-Palestinian conflict have negatively affected the volume of trade between Israel and its neighbors (Economist Intelligence Unit, 2001). Israel's surrounding Arab neighbors may also be regarded as economic islands as: a) their trade with Israel is null or negligible, b) the resemblance in their industrial structure inhibits the possibility of extensive trade in inputs and finished products. Thus, the ratio of intra-Arab trade to their overall international trade is very low (Fischer, 1992). It is possible that the complementary nature of Israel (comparatively endowed with capital and skilled labor) and the Arab countries (comparatively endowed with unskilled labor and natural resources, such as petrochemicals)<sup>2</sup>, will impact

<sup>1</sup> According to H-O-S theory factors of production are assumed to be immobile between countries.

<sup>2</sup> Economist Intelligence Unit (2001).

these countries comparative advantages once bilateral trade is allowed. If this is the case we may witness an increase in the volume of output and exports in the concerned countries, implying for an increased industrial competitiveness that stems from distance sensitive input sharing.

Several studies have tried to estimate the potential for Israeli-Arab trade in *distance-sensitive products* (Hirsch & Hashai, 2000) and the potential for trade based on *input sharing* (Hirsch, Ayal, Hashai & Gal-Yam, 1999; Rivlin & Hashai, 2000). The two latter studies have focused on the potential trade in inputs with 'Revealed' comparative advantage (Balassa, 1965), thus ignoring the fact that the comparative advantage of certain distance sensitive industries in Israel and its Arab neighbors may be hindered. The current study offers a new perspective to the analysis of the Israeli-Arab trade potential, by combining distance and input sharing and analyzing the impact of regional *distance-sensitive inputs* sharing on the overall industrial performance.

The study offers a methodology to estimate how the output and exports of a country's industrial sector are affected when imported and locally purchased inputs are substituted by inputs from neighboring countries with which trade was previously forbidden or distorted. The fact that imports of distance sensitive inputs is costly forced manufacturers either to absorb international transportation costs or to rely on local non-efficient suppliers. Thus, taking an absolute advantage point of view, the ability to purchase cheaper inputs from a neighboring country is expected to enable a more competitive production of finished products (stemming from the cheaper cost of production) that will be reflected in increased local sales and expanded exports.

## II. ANALYTICAL FRAMEWORK

A product's cost reflects the cost of raw materials and semi-finished products purchased to produce it as well as the cost of labor. We refer to all these cost components as 'inputs'. Some inputs are immobile (e.g. natural resources and to a certain extent labor) and their availability is perceived as a location advantage of a country (Dunning, 1977). Other inputs are mobile (raw materials and intermediate products). While scarcity of local immobile inputs forces firms to acquire them through Foreign Direct Investment (FDI) in the country with the location advantage, mobile

inputs can be acquired through imports. The current study focuses on the ability to access mobile inputs that are unavailable in the home country, through imports from neighboring countries. Gaining access to such inputs will henceforth be referred to as 'input sharing'.

The volume of input sharing between firms from different countries is clearly affected by the costs of transferring the inputs from one country to another. These include transportation costs, tariffs and the cost of non-tariff barriers (Ayal, Hirsch & Kalish, 1990; Casson, 2000; Helpman & Krugman, 1985; Hummels, 1999). The higher these costs are, the lower the volume of input sharing between the countries is expected to be. Thus, other things being equal, neighboring suppliers of distance sensitive inputs have a significant cost advantage over more distant suppliers.

To capture the impact of input sharing on a product's production cost, we may consider a world consisted of three countries: A and B - two former non-trading neighbors and R - a third distant country. Assuming production is comprised of  $n$  inputs, the following notation is used:

$C(k,i)$  - unit cost of input  $i$  in country  $k$ .

$T(lk,i)$  - international transportation cost, per unit of input  $i$ , from country  $l$  to country  $k$ .

For the sake of simplicity we assume that the markets for inputs and final goods are perfectly competitive, that profit margins of input suppliers in A, B and R are identical and that tariff barriers and local transportation costs may be ignored. We further assume that the  $n$  inputs are either distance sensitive or non-distance sensitive. For all distance sensitive inputs ( $i'$ ):

$$T(AB,i') < T(lk,i'); (k=A,B; l \neq A,B) \quad (1a)$$

For all non-distance sensitive inputs ( $i$ ):

$$T(AB,i) \approx T(lk,i'); (k=A,B; l \neq A,B) \quad (1b)$$

The overall cost of producing a product in A<sup>3</sup>, **before** trade between A and B is allowed, represents an optimal allocation of  $m$  locally purchased inputs and  $(n-m)$  imported ones:

$$C_A = \sum_{i=1}^m C(A,i) + \sum_{i=m+1}^n \{C(R,i) + T(RA,i)\} \quad m < n \quad (2)$$

<sup>3</sup> The case for country B is equivalent.

**After** trade between A and B is allowed, equations (1a) and (1b) imply that two phenomena may occur. One is the replacement of suppliers of distance sensitive inputs (from R) with suppliers from B, hence saving on transportation costs<sup>4</sup>. The production costs function is now:

$$C'_i = \sum_{r=1}^m C(A,i) + \sum_{r=m+1}^n \{C(R,i) + T(RA,i)\} + \sum_{r=n+1}^n \{C(B,i) + T(BA,i)\} \quad m < n < n \quad (3)$$

The second phenomenon is the replacement of some of the local suppliers of distance sensitive inputs by cheaper suppliers from B (that do not have to bear significant transportation costs to A). Production cost in this case is:

$$C''_i = \sum_{r=1}^m C(A,i) + \sum_{r=m+1}^n \{C(B,i) + T(BA,i)\} + \sum_{r=n+1}^n \{C(R,i) + T(RA,i)\} \quad m < m < n \quad (4)$$

As profit margins of the various suppliers are assumed identical, differences in suppliers' costs represent differences in their prices. Thus, we refer to two economic effects. If (3) < (2) (i.e.  $C(B,i) + T(BA,i) < C(R,i) + T(RA,i)$ ), for all  $n+1 \leq i \leq n$  one may refer to the *distance effect* - importing distance-sensitive inputs from cheaper proximate sources (in CIF<sup>5</sup> terms), as a substitute for importing these inputs from more distant suppliers. The main stimulus of this effect is savings on transportation costs. If (4) < (2) (i.e.  $C(B,i) + T(BA,i) < C(A,i)$ ), for all  $m+1 \leq i \leq m$  one may refer to the *inefficiency effect* - importing distance-sensitive inputs from neighboring countries at cheaper prices (in CIF price terms), as a substitute for purchasing more expensive inputs from local suppliers. Here the main stimulus is the superior efficiency of neighboring suppliers. Needless to say both effects are additive and thus may be conjunct.

If A and B represent Israel and its Arab neighbors, respectively, and R represents the rest of the world, one can easily see how allowing manufacturers from A to access B's inputs (or vice versa), is expected to enable a rightward shift of their supply curve, hence enabling them to offer lower prices at each production level. This price reduction is expected to give rise to output expansion and facilitate sales to the markets in A, B and R.

### III. EMPIRICAL ANALYSIS AND DATA

In order to empirically assess the impacts of distance sensitive input sharing we present a

partial equilibrium analysis, at the industry level (4 digits International Standard Industrial Classification (ISIC))<sup>6</sup>. The empirical analysis assumes all trade barriers between Israel and its neighbors are removed. Additionally, we assume that the markets for inputs and final goods at 4 digits ISIC level are perfectly (or semi- perfectly) competitive. This view is supported by the fairly large number of firms per industry in Israel, Egypt, Jordan and Syria<sup>7</sup> (Israel Central Bureau of Statistics, 1998b; UNIDO, 2001a, 2001b).

Once the distance and inefficiency effects are estimated, input-output tables are a suitable mechanism to measure the effect of cheaper inputs procurement on production costs and output volumes. These tables provide statistics on the volume of input purchases by each industry (in a specific country) from local and foreign industries. Thus, they may provide a reasonable estimate to the effect of a given input cost on the overall production cost in any industry (Bruno & Sachs, 1983; Davar, 1994; Leontief, 1953a, 1953b). In the absence of input-output tables for the concerned Arab countries' industrial sectors, the following empirical analysis will examine only the effect on Israeli industries acquiring inputs from industries in Arab countries.

**Estimating the Distance and Inefficiency Effects**  
The distance and inefficiency effects relate to differences in international transportation costs between Israel's current suppliers of distance sensitive inputs and potential Arab suppliers as well as to differences in the ex-factory price of these suppliers. Hence, both effects can be estimated by using equation (5):

$$Dis - InEff_i = DS_i * (RDist_i - BDist_i) + \left[ \frac{EmpOut_{i,R}}{EmpOut_{i,B}} * \{LabShare_i * \left( \frac{EmpWage_{i,B}}{EmpWage_{i,R}} \right) + (1 - LabShare_i) \} - 1 \right] \quad (5)$$

<i>Dis-InEff<sub>i</sub></i>	Distance and Inefficiency effects in input industry i
<i>DS<sub>i</sub></i>	Distance sensitivity index of industry i
<i>RDist<sub>i</sub></i>	The weighted average distance (in kilometers) from Israel's current import sources of industry i (RDisti = 0 in the case of local Israeli suppliers)
<i>BDist<sub>i</sub></i>	The distance in kilometers between Israel and a neighboring Arab country
<i>EmpOut<sub>i,R</sub></i>	Average output per employee in manufacturing input i (in its current sources)
<i>EmpOut<sub>i,B</sub></i>	Output per employee in manufacturing input i (in an Arab country)
<i>EmpWage<sub>i,R</sub></i>	Average annual wages cost per employee in input industry i (in its current sources)
<i>EmpWage<sub>i,B</sub></i>	Annual wages cost per employee in input industry i (in an Arab country)
<i>LabShare<sub>i</sub></i>	Ratio of labor cost to overall production cost in input industry i

<sup>4</sup> According to equation (1b) the savings on transportation costs for non-distance sensitive inputs are negligible.

<sup>5</sup> Cost, Insurance, Freight.

<sup>6</sup> Where required self conversion between classifications was employed.

<sup>7</sup> Data for Syria is only available at 3 digits ISIC level.

Equation (5) has two parts. First, we estimate the wedge in transportation costs to Israel, between current suppliers and potential Arab suppliers of input  $i$ . This wedge is proxied by subtracting  $BDist_i^8$  from  $RDist_i$  in each industry.  $RDist_i$  represents the shortest naval distance between Israel and each current source country (Waterman Steamship Corporation, 1959)<sup>9</sup>, weighted by each country's share of overall input  $i$ 's imports to Israel in 1994<sup>10</sup> (United Nations, 1994a). Next, this term is multiplied by a Distance Sensitivity (DS <sub>$i$</sub> ) index that measures the ratio of international transportation costs per kilometer, to input  $i$ 's CIF value at its port of destination. Calculation of the DS <sub>$i$</sub>  index is based on 1994 data for the U.S. industrial sector. The percentage of transportation costs (including insurance cost) from the overall CIF import value (as derived from Frankel 1997, Table 3.1b, Appendix B), of each input industry  $i$ , is divided by the 'weighted average distance' from the U.S. to its major import sources in that industry (United Nations, 1994b; Waterman Steamship Corporation, 1959)<sup>10</sup>. The DS <sub>$i$</sub>  index is a continuous measure of distance sensitivity. It is always positive; the higher it is, the greater is the input's sensitivity to distance<sup>11</sup>. In the case of substituting imported inputs with Arab inputs the wedge in transportation costs yields the percentage of savings in transportation cost for that input. In the case of substituting Israeli inputs with Arab ones the outcome yields the percentage of additional transportation costs of Arab suppliers comparing to current Israeli suppliers.

The second part of equation (5) relates to differences in inputs' production costs. Differences in production costs of current input  $i$ 's suppliers to Israeli industries and potential Arab suppliers are underpinned by two additional assumptions:

- a) The technology and manufacturing techniques, of an input  $i$ , are similar for suppliers at A, B and R (hence, no factor reversal is expected).

- b) Since capital is a mobile factor of production, capital costs are assumed to converge around the globe. Hence, differences in the cost of manufacturing an input are a function of labor cost and labor productivity (Casson, 1985).

The difference in production cost per employee between Israel's current input suppliers and that of potential Arab suppliers is a function of the per employee wage difference of these suppliers, adjusted by the ratio of labor cost to the overall production cost of that input-

$$\{LabShare_i * (\frac{EmpWage_{i,B}}{EmpWage_{i,R}}) + (1 - LabShare_i)\}$$

Multiplying this expression by the suppliers'

$$\text{comparative productivity } (\frac{EmpOut_{i,R}}{EmpOut_{i,B}})$$

enables us to estimate the difference in the production cost of input  $i$ . In the case of substituting imported inputs, average wages and output per employee, for each input industry, were calculated according to the weighted share of imports to Israel from each country of origin in 1994 (UNIDO, 2001a; United Nations, 1994a)<sup>12</sup>. In the case of substituting Israeli inputs these figures relate directly to the relevant Israeli industries (Israel Central Bureau of Statistics, 1998b; UNIDO, 2001a). In both cases the ratio of labor cost to overall production cost ( $LabShare_i$ ) was derived from the 1992 input-output tables for Israel (Israel Central Bureau of Statistics, 1998a). This underlines the assumption that the technical factor composition is similar internationally.

### Cost Reduction in the Purchasing Industries

In order to estimate the overall production cost reduction of input purchasing industries due to the distance and inefficiency effects we use Israeli input-output tables for 1992 (Israel Central Bureau of Statistics, 1998a). Nevertheless, due to

<sup>8</sup> We refer to the aviation distance between Tel Aviv and Cairo (approximately 420 kilometers), Tel Aviv and Amman (120 kilometers) and Tel Aviv and Damascus (250 kilometers), respectively.

<sup>9</sup> In calculation of distance from landlocked countries, land distance to the nearest exit port is added.

<sup>10</sup> We refer to the major import sources, supplying 70% of the 1994 imports in industry  $i$ .

<sup>11</sup> For a detailed calculation see Hashai, 2002.

<sup>12</sup> Countries accounting for at least 50% of total imports were selected. Output and wages data relates to 1992-1996, according to data availability.

technical limitations of input-output tables, the calculation of cost reduction when substituting imported inputs differs from that of locally purchased inputs.

In the case of substituting imported inputs, the cost-reduction ratio achieved in procuring industries is composed of direct and indirect impacts. The direct impact relates to reduction of production costs, in an industry, as a result of reducing inputs prices. The indirect impact stems from the fact that the above reduction in production costs also benefits industries that do not procure inputs from the Arab countries but procure inputs from industries that do.

Calculation of the cost-reduction ratio in the substitute of imported inputs is based on input-output tables in monetary values (Davar, 1994). The calculation employs the direct coefficients matrix, the Leontief matrix and the production factors direct coefficients matrix. The direct coefficients matrix ( $A_{nn}$ ) is a matrix where the  $a_{ij}$  term represents the local input of industry  $i$ , required to produce one product unit of industry  $j$ . We use  $A_{nn}$  to calculate matrix  $B_{nn}$ , according to equation (6):

$$B_{nn} = (I_{nn} - A_{nn})^{-1} \quad (6)$$

$B_{nn}$  is the inverse matrix of the Leontief matrix (Leontief, 1953a, 1953b), which is the difference between the unit matrix and the direct coefficient matrix. The  $b_{ij}$  term represents the overall input (direct and indirect) of industry  $i$  required to supply one product unit of industry  $j$ .  $B_{nn}$  relates both to industry  $i$ 's inputs procured directly by industry  $j$  and to industry  $i$ 's inputs procured by other industries, from which industry  $j$  in turn procures inputs. The production factors direct coefficients matrix ( $C_{mn}$ ) is a matrix where the  $c_{kj}$  term represents the inputs of production factor  $k$  required to produce one product unit of industry  $j$ . Production factors in input-output tables include inputs of import industries as well as labor, taxes and subsidies. Matrix  $S_{mn}$ , the matrix of overall production factor coefficients equals:

$$S_{mn} = C_{mn} * B_{nn} \quad (7)$$

The  $s_{kj}$  term represents the overall input (direct and indirect) of production factor  $k$  required to supply one product unit of industry  $j$ .

If we define a vector  $P_n$  as the supply price vector of the various final products in the input-output tables and a vector  $F_m$  as the supply price vector

of the various production factors, we can note that:

$$P' = A' * P' + C' * F' = B' * C' * F' = S' * F' \quad (8)$$

In the initial general equilibrium (before input sharing), all the terms in vectors  $P$  and  $F$  equal 1. Substituting the new cost rate for the imported inputs (as production factors) yields the reduction in supply prices of the final products.

However, in the case of the substituting local inputs, we can relate only to the direct cost-reduction of industries procuring input  $i$ . This cost reduction is the product of input  $i$ 's cost reduction and the proportion it constitutes from the overall input cost per dollar of output in industry  $j$ . Repeating this exercise for all input industries where Arab input suppliers are cheaper than current Israeli ones yields a quantitative estimate of the total cost reduction achieved per dollar of output in industry  $j$ . This kind of calculation does not take into account the *overall* impact of procuring cheaper inputs, as it ignores the fact that local industries with lower production costs (due to cheaper input procurement from Arab suppliers) may provide cheaper inputs to other industries (which do not necessarily procure inputs from Arab suppliers). Input-output tables in monetary terms enable this effect to be calculated only for production factors (imported inputs, labor, taxes, etc.), and not for the local input industries themselves (Davar, 1994). Thus calculation of the impact of replacing local input suppliers constitutes only a first-degree approximation for the overall expected cost reduction.

Calculation of the cost-reduction ratio in the substitute of local inputs also employs the direct coefficients matrix ( $A_{nn}$ ), where the change in the cost of any input  $i$ , represented by  $a_{ij}$  term (the direct coefficient) affects the overall production cost of industry  $j$ . Thus, the overall cost reduction rate per industry  $j$  is calculated according to equation (9):

$$CR_j = 1 - \sum_{i=1}^n a_{ij} * cr_i \quad (9)$$

$CR_j$  Overall cost reduction rate in industry  $j$ .  
 $a_{ij}$  The proportion of input  $i$  of the overall production cost in industry  $j$ .  
 $cr_i$  Rate of cost reduction of input  $i$ .

### Estimating Output Expansion

Substituting for cheaper input suppliers should lead to output expansion, as the supply curve in the concerned industries shifts rightward. For the

sake of simplicity, this study assumes that at 4 digits ISIC level there are two industry groups. Industries in which imports exceed exports are defined as import substitute industries whose output is targeted to the local market (hereinafter - "Israeli local industries"). Most of the products that are classified within these industries are assumed to be designated to the local market. Industries in which exports exceed imports are defined as "Israeli export industries". A substantial part of their output is assumed to be targeted to export markets. Because this partition is somewhat arbitrary, we have verified that the mean ratios of exports to output for these two groups are significantly different ( $p \leq 0.02$ ;  $df=58$ ; T value = 3.163).

In order to calculate the link between prices and output volume we need data on supply and demand price elasticity for industries at 4 digits ISIC level. In the absence of such detailed data for Israel we use international elasticities as a proxy. This approach is supported by studies that reveal similar demand elasticities in Israel and the U.S. for specific industries (Aigner, Newman & Tishler, 1994; Tishler, 1983).

Based on various sources (Brown, Deardorff & Stern, 1991; Davenport, 1986; Deaton, 1997; Dixit & Stiglitz, 1977; Lluch, Powel & Williams, 1977; Stern et al., 1976) we have derived minimum and maximum values (in absolute terms) for supply and demand elasticities of 4 digits ISIC industries in Europe and the U.S. As these sources list different values for supply and demand elasticities in specific industries, we chose to be conservative in relating to upper and lower limits reported in the literature. The range of industry demand elasticities, employed for our calculations, was (-0.5) to (-2.7), while the range of supply elasticities was 0.5 to 2.0<sup>13</sup>. The range of demand elasticities conforms to Kondor's (1982a, 1982b) estimates that demand elasticities for imports to Israel average between (-0.8) to (-1.6).

In order to estimate the output expansion in Israeli local industries, the demand and supply

functions in an industry are defined according to the following equations<sup>14</sup>:

$$P_{\text{supply}} = \alpha + \beta Q ; (P - \text{price}, Q - \text{quantity}, \alpha, \beta > 0) \quad (10a)$$

$$P_{\text{demand}} = \gamma - \delta Q \quad (\gamma, \delta > 0) \quad (10b)$$

If we arbitrarily define an industry's import price to Israel as  $P_w + M_x = 1$  ( $P_w$ -world price;  $M_x$ -transportation costs to Israel<sup>15</sup>), we can determine that in local industries the intersection between the demand and supply curves is at a price higher than 1. Since supply elasticity ( $E_s$ ) and demand price elasticity ( $E_d$ ) equal:

$$E_s = (dQ/Q) / (dP/P) = (1/\beta) / (Q/P) \quad (11a)$$

$$E_d = (dQ/Q) / (dP/P) = (1/\delta) / (Q/P) \quad (11b)$$

And since the current output designated to the local market (total output minus exports), the current demand (i.e. consumption) and the supply and demand elasticities are also known<sup>16</sup>, we can compute the parameters  $\alpha$ ,  $\beta$ ,  $\gamma$  and  $\delta$  for each industry.

Now, let  $x$  denote the per-unit production cost-reduction ratio resulting from procuring inputs in Arab countries. We can derive the new supply function after cost reduction by equation (12):

$$P' = \alpha - x + \beta Q \quad (P' - \text{new price}, Q - \text{quantity}, \alpha, \beta, x > 0) \quad (12)$$

Since each of the required values is known, the ratio and volume of output expansion can be estimated according to the intersection between the new supply curve and the demand curve<sup>17</sup>, as specified in equation (13):

$$\Delta Q = (1 - \alpha_i + x) / \beta_i - Q \quad (13)$$

$\Delta Q$	Output expansion
$Q$	Industry output <i>before</i> input sharing
$\alpha, \beta$	Parameters of the supply curve, as calculated for minimal/maximal supply elasticity
$x$	Ratio of cost reduction, due to distance and inefficiency effects.

<sup>13</sup> Industry elasticity data can be obtained from the author.

<sup>14</sup> As the changes in production costs are relatively small (see Table 2), the use of linear functions to approximate the true functions is reasonable.

<sup>15</sup> As Israel is relatively small comparing to the world economy, one may assume an indefinite supply at that price and that Israeli customers will bear international transportation costs.

<sup>16</sup> We relate 1996 data (Israel Central Bureau of Statistics, 2000).

<sup>17</sup> If the new supply curve and the demand curve intersect below  $P_w + M_x$ , the calculation should be slightly altered. In our case the curves of all local industries intersect above  $P_w + M_x$ .

Based on the methodology described above we can use equations (10)-(12) to estimate the export expansion (i.e. output designated for exports) of Israel export industries. If we arbitrarily define the export price of Israeli exporters as  $P_w - M_x = 1$ <sup>18</sup>, the demand and supply curves intersect at a price lower than 1. As the current export volume and the supply elasticity are known, we can calculate the parameters  $\alpha$  and  $\beta$  for each industry. Then we can use equation (13) to calculate the ratio and volume of export expansion at the point of intersection between the new supply curve and the export price ( $P_w - M_x = 1$ ).

#### IV. RESULTS

Equation (5) was implemented to calculate input costs differences for 34 input industries identified as distance sensitive in previous studies (Hirsch & Hashai, 2000; Hashai, 2002). Table 1 sums up the distance and inefficiency effects of 11 input industries (out of the 34) for which imports from Egypt, Jordan or Syria are identified as cheaper than Israel's current local and foreign input sources. For the remaining 24 input industries the distance and inefficiency effects were negative, i.e. current input suppliers are cheaper than

potential Arab suppliers. For each of the 11 industries, the cheapest supplier was chosen among Egypt, Jordan and Syria.

Some of the values in Table 1 are negative. As implied from equations (3) and (4), when substituting imported inputs negative values of the inefficiency effect indicate that savings on transportation costs have to be adjusted due to the comparatively higher productivity of Israel's current input suppliers (in the rest of the cases both effects are additive). In the case of substituting inputs currently purchased in Israel, the inefficiency effect has to be adjusted by a negative distance effect due to the higher transportation costs that potential Arab suppliers incur.

Table 1 reveals that though only a limited number of Arab industries is able to supply cheaper inputs to Israeli industries, most of these input industries exhibit substantial cost reductions, averaging between 33% to 55% of Israel's current input costs. Input cost reduction is mainly expected in the food, wood, paper and machinery industries (ISICs starting with 31,33,34 and 38). Syria is likely to be the most prominent input supplier.

**TABLE 1 - THE DISTANCE AND INEFFICIENCY EFFECTS (PERCENTAGE)**

Imported Inputs Substitutes						
No.	ISIC	Industry	Arab Source Country	Distance Effect	Inefficiency Effect	Total Cost Reduction
1	3312	Wooden and cane containers and small cane ware	Syria	23.97	37.33	61.30
2	3320	Furniture and fixtures, except primarily of metal	Syria	4.61	31.82	36.43
3	3411	Pulp, paper and paperboard	Syria	27.72	42.79	70.51
4	3512	Fertilizers and pesticides	Jordan	30.37	-5.97	24.40
5	3812	Furniture and fixtures primarily of metal	Syria	4.77	-4.54	0.23
6	3841	Ship building and repairing	Syria	3.54	-0.39	3.15
<b>Average</b>						<b>32.67</b>
Israeli Inputs Substitutes						
1	3115	Vegetable and animal oils and fats	Jordan	-0.10	46.83	46.74
2	3117	Bakery products	Syria	-0.48	91.38	90.91
3	3311	Sawmills, planking and other wood mills	Syria	-1.10	29.57	28.47
4	3312	Wooden and cane containers and small cane ware	Syria	-1.10	19.55	18.45
5	3412	Containers and boxes and other articles of paper, paperboard and pulp	Syria	-0.73	69.36	68.64
6	3825	Office, computing and accounting machinery	Egypt	-0.13	76.64	76.51
<b>Average</b>						<b>54.95</b>

Sources: Own calculations and Hashai, 2002.

n.e.c - not elsewhere classified

<sup>18</sup> The net price Israeli exporters face equals to the world price ( $P_w$ ) minus transportation costs to the world markets ( $M_x$ ). As Israel is relatively small comparing to the world markets, one may assume an indefinite demand in that price. The intersection between Israel's demand and supply curves is below that price.

Table 2 presents percentage values for the accumulated production-cost reduction in selected Israeli industries, resulting from substituting imported and local inputs with cheaper Arab inputs (as identified in Table 1). The highest cost reductions are in the paper industries (ISICs 3411,3412). This result probably stems from the fact that wood and paper, for which substantial cost reduction was identified in Table 1, are major inputs of these industries. Other industries with high cost reductions are the food and wood industries (ISICs starting with 31 and 33). Cost reduction in these industries probably stems intra-industry input procurement. On average (for all industries) production cost reduction is 2.6% (1.26% as a result of imported inputs substitution and 1.34% as a result of local inputs substitution).

Table 3 describes the output expansion in Israeli local industries as a consequence of importing cheaper distance-sensitive inputs. Columns (1) and (2) list the minimum and maximum volumes of output expansion, as calculated based on equation (13). Columns (3) and (4) present the minimal and maximal percentage of change in the output of Israeli local industries, as an indication for the relative impact of input sharing. Table 3 indicates that Israeli local industries procuring cheaper inputs from suppliers in neighboring Arab countries are expected to increase their output by about \$430-\$900 million per annum, which is an increase of about 2.5-5% in these industries output. The most prominent industries in which output expansion is expected are paper, paper products and the printing and publishing industries (ISICs 3411,3412, 3420).

**TABLE 2 - COST REDUCTION IN ISRAELI INDUSTRIES PROCURING INPUTS FROM EGYPT, JORDAN AND SYRIA (PERCENTAGE, INDUSTRIES FOR WHICH COST REDUCTION IS ABOVE 4%)**

	<b>ISIC</b>	<b>Israeli Industry (Inputs Purchaser)</b>	<b>Cost Reduction</b>
1	3115	Vegetable and animal oils and fats	5.8
2	3116	Grain mill products	5.6
3	3117	Bakery products	6.3
4	3121	Food products n.e.c.	4.1
5	3219	Manufacture of textiles n.e.c.	6.9
6	3311	Sawmills, planking and other wood mills	4.6
5	3312	Wooden and cane containers and small cane ware	7.2
9	3411	Manufacture of pulp, paper and paperboard	24.5
10	3412	Containers and boxes and other articles of paper, paperboard and pulp	21.2
11	3420	Printing, publishing and allied industries	7.0
12	3825	Office, computing and accounting machinery	6.1
		<b>Average for all industries</b>	<b>2.6</b>

Source: Own calculations based on Input-Output tables (Israel Central Bureau of Statistics, 1998a)  
n.e.c - not elsewhere classified

**TABLE 3- OUTPUT EXPANSION IN ISRAELI LOCAL INDUSTRIES (1996 DATA, \$ MILLION AND PERCENTAGE)\***

	ISIC	Industry	Total change in output		Change in output %	
			min	max	min	max
			(1)	(2)	(3)	(4)
1	3117	Bakery products	18	55	3.2	9.5
2	3311,3312	Sawmills, wood mills, wood and cork products	13	26	5.9	11.8
3	3320	Furniture and fixtures, except primarily of metal	27	55	3.7	7.4
4	3411	Manufacture of pulp, paper and paperboard	45	90	24.5	49.0
5	3412	Containers and boxes and other articles of paper, paperboard and pulp	115	230	21.2	42.4
6	3420	Printing, publishing and allied industries	96	192	7.0	14.0
7	3521	Manufacture of paints, varnishes & lacquers	12	23	7.0	14.0
8	3699	Manufacture of non-metallic mineral products n.e.c.	11	22	0.9	1.8
9	3812,3813, 3819	Structural metal products and fabricated metal products	16	32	0.5	1.0
10	3825	Manufacture of office, computing & accounting machinery	11	22	6.1	12.2
11		Other industries	62	155	(-)	(-)
		<b>Total output expansion &amp; Average change</b>	<b>426</b>	<b>902</b>	<b>2.3</b>	<b>4.8</b>

Sources: own calculations based on industry data (Israel Central Bureau of Statistics, 2000)

\* - Selected industries with minimal output expansion of \$10M.

*Legend:*

Min: output expansion, calculated by minimal demand and supply elasticities

Max: output expansion, calculated by maximal demand and supply elasticities

%- Percentage

Table 4 describes the export expansion in Israeli export industries as a result of importing cheaper distance-sensitive inputs. Columns (1) and (2) indicate the minimum and maximum expected volume of export expansion, calculated according to equation (13). Column (3) and (4) present the minimal and maximal percentage of change in

the exports of Israeli industries. Israeli export industries are expected to increase their exports by about \$230-\$520 million per annum, indicating an increase of about 1-2.5% in their total exports. Most of the export expansion is concentrated in Israeli chemicals industries (ISICs starting with 35).

TABLE 4- EXPORT EXPANSION OF ISRAELI INDUSTRIES (1996 DATA, \$ MILLION AND PERCENTAGE)\*

	ISIC	Industry	Total change in exports		Change in exports %	
			min	max	min	max
			(1)	(2)	(3)	(4)
1	3121	Food products not elsewhere classified	16	48	2.1	6.2
2	3511	Manufacture of basic industrial chemicals except fertilizers	75	150	4.6	9.2
3	3512	Manufacture of fertilizers and pesticides	24	48	1.7	3.4
4	3529	Manufacture of chemical products not elsewhere classified	20	41	1.1	2.2
5	3560	Manufacture of plastic products	16	32	0.8	1.6
6	3832	Radio, television & communication equipment	46	92	0.7	1.4
7		Other industries	34	107	(-)	(-)
		<b>Total export expansion &amp; Average change</b>	<b>232</b>	<b>518</b>	<b>1.0</b>	<b>2.3</b>

Sources: own calculations based on industry data (Israel Central Bureau of Statistics, 2000)

\* - Selected industries with minimal output expansion of \$10M.

*Legend:*

Min: export expansion, calculated by minimal demand and supply elasticities

Max: export expansion, calculated by maximal demand and supply elasticities

%- Percentage

## V. SUMMARY AND CONCLUSIONS

The findings of this study reflect the impact of the distance and inefficiency effects on the output of the Israeli industrial sector as a result of distance sensitive input sharing with Egypt, Jordan and Syria. The analysis assumes that all political and administrative trade barriers between Israel and its Arab neighbors are removed. Our results show that about two thirds of the output expansion is expected to be designated to the Israeli local market whereas about a third will be targeted to export markets. The overall output expansion to local and export markets is estimated by about \$660-1,420 million per annum, contributing 0.7%-1.5% to the 1996 Israeli gross domestic product.

Various implications arise from the above results. In the Israeli-Arab context the identified output and export expansion, represents a missing part in previous studies that have tried to forecast the Israeli-Arab trade potential (Ben Shahr, Fishelson & Hirsch, 1989; Ben Haim, 1993; Halevi, 1994; Arnon & Weinblatt, 1994; Halbach et al., 1995; Sagi, 1999). Although the analysis

doesn't assess the impact of purchasing Israeli distance sensitive inputs by Arab industries, it is actually larger than previous Israeli Arab potential trade forecasts<sup>19</sup>. However, comparison of the minimum and maximum estimations presented in Tables 3 and 4 reflects a high sensitivity of the results to price elasticities. In addition our estimations assume the absence of tariff between Israel and its neighbors. Thus, the above estimations should be treated cautiously and interpreted as upper limit estimation.

The analysis shows that Israeli-Arab input sharing is expected to occur as a result of replacement of imported inputs as well as inputs currently procured in Israel. This fact indicates that conflicts with current local input suppliers, which may be harmed by the commencement of trade with Arab countries, are expected (Hirsch, Ayal, Hashai & Gal Yam, 1999). Even though economic integration theory indicates that replacement of inefficient local suppliers by more efficient foreign ones is likely to improve economic welfare (Viner, 1950), policy makers should be aware of

<sup>19</sup> Which is estimated by tens to few hundred million dollars annually.

such potential conflicts, due to the political sensitivity of commencing trade relations with former enemy countries.

In the broader context, we argue that regional distance-sensitive input sharing, rather than finished goods trade, could be the primary enhancer of comparative advantage in a region due to trade liberalization. If comparative advantage is interpreted, according to the basic notion of the H-O-S model, as the outcome of comparative input abundance, then input sharing increases the volume and variety of inputs within a region in comparison to the rest of the world. Thus, countries within that region may improve their comparative advantages due to distance sensitive input sharing. Moreover, the fact that Israel and its Arab neighbors differ significantly in their standard of living (Economist Intelligence Unit, 2001) indicates that PTAs between developed and developing countries may stimulate trade due to the complementary nature of inputs availability in each country.

The methodology to quantify the impact of regional input sharing, which was demonstrated in this study, could be applied to regional PTAs. Relating to suppliers' comparative cost of tariffs, in addition to the distance and inefficiency effects, is quite straightforward. Quantifying the cost of non-tariff barriers, when comparing local, regional and foreign input suppliers, is probably more complex. Overall, it is evident that Input-Output tables are an important empirical tool to capture the full impact of trade liberalization.

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