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MODELLING OF ESTONIAN EXPORTS AND IMPORTS

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The author has examined the main approaches to the modelling of export and import flows. The possibility of substitution of empirical proxies for theoretical variables is discussed. The results of trade aggregation CES-functions and empirical estimation of export and import equations obtained are analyzed.

INTRODUCTION

The fast changes in the Estonian economy over the last two years have been significantly determined by the changes in the orientation and structure of foreign trade. In general the Estonian economy is characterized by a high level of openness. The ratio of exports to GDP in Estonia is higher than the average level in the countries with the so-called "small open economy".

This shows that modification of terms and conditions of foreign trade has a great and even decisive impact on the main macroeconomic parameters and the situation in the Estonian economy. The problem invites further investigation involving the methods of econometric analysis. These methods can be helpful to obtain the following:

— to reveal the impact of both internal and external factors on the structure and dynamics of export and import volumes;

— to estimate the degree of the effect of these factors on the above-mentioned parameters, among them on the estimation of such parameters as price and demand elasticity of exports, price and income elasticity of imports, elasticity of substitution of imports by domestic production, etc.;

— to forecast exports and imports based on the proposed dynamics of the main macroeconomic parameters as well as to develop general equilibrium trade models for estimating the equilibrium level of export and import volumes.

The main problem springs from the lack of the data required. The situation, however, is not hopeless. Some parameters can be estimated with certain approximation on the basis of the existing time series.

During the last two years the Estonian economy has been developing under the influence of market laws. It became especially noticeable after the monetary reform in June 1992. Therefore, the available data for the last two years are quite suitable for the econometric analysis. The present research has been carried out on this basis. However, these time series are too short to reveal long-term trends. Nevertheless, the results of the analysis performed are of some interest for studying the Estonian foreign trade development.

The Estonian Statistical Department has started the work on the calculation of import, export and domestic price indices for various commodity groups. Later this information will be of certain practical significance for analyzing foreign trade by the methods considered below.

1. BASIC PRINCIPLES OF DEVELOPMENT OF FOREIGN TRADE MODEL

1.1. Statement of the problem

In modelling foreign trade two main approaches are considered, the imperfect substitution model and the perfect substitution model. The basic assumption in the imperfect substitution model is that both imports and exports are not completely replaced by domestic goods.

This is supported by a large number of empirical works which have shown that there are significant price differentiations between the same goods in different countries as well as between domestic and export prices in one and the same country. It means that in this case the "law of one price" does not work.

As shown in [1], the imperfect substitution model possesses the following distinctive characteristics.

The basic assumption is that consumers maximize utility in accordance with the budgetary restrictions. The volume of import and export demand is considered as a positive (direct) function of the income level in a given importing region and domestic prices, and a negative (back) function of import prices.

The volume of export and import supply is a positive function of the level of export prices and a negative function of domestic prices for goods in a given exporting country.

The key endogenous parameter in this model is the level of domestic prices the changes in which determine largely the changes in import and export volumes.

The usual assumption of this model is perfect competition, which proposes independent functions of demand and supply as well as the equilibrium properties of the model.

All these assumptions are mere approximations to the economic reality, and yet the given theoretical model has received wide acceptance and a set of applied models has been developed on its basis.

The imperfect substitution model being the basic one in constructing the equations of foreign trade, there exist valid reasons to use the perfect substitution model as well. First of all, there are homogeneous goods which are sold at common prices on international commodity markets. Their demand and supply do not depend on the level of differentiation between domestic and foreign goods. Besides, the assumptions of this model form the basis for the development of the so-called small open economy model.

This model has no separate functions for import demand or export supply. Instead, the demand for imports is considered as an excess of domestic demand above the domestic supply. The supply of exports is considered as an excess of domestic supply over the domestic demand. Thus, estimation or forecast of import demand or export supply in this model is reduced to forecasting domestic demand and supply, where imports and exports being defined residually. The domestic demand is considered as a negative function of prices and a positive function of income. The domestic supply is a positive function of prices and a negative function of the unit cost.

A second important assumption in the model is the existence of only one price of goods. This price is determined by the ratio of the world demand to the world supply of the given goods. A country can influence the price of goods if it able to influence the world demand or the world supply of these particular goods. If it is too small to influence the world price, then an increase in domestic supply reduces imports without any change in prices.

1.2. Modelling of exports

1.2.1. Construction of export demand equations on the basis of Armington assumptions

The present approach is based on the assumptions of the imperfect substitution model. Imperfect substitution for imports and domestic goods is explained by the distinction of their consumer properties. Works [2, 3] favour the view that the consumer properties are contained in varying proportions in different goods, so the demand for them exists at reasonable price differentiations. The level of substitution for these goods determine their price elasticity. Close substitutions lead to a high price elasticity, and vice versa.

The main assumption of the Armington model [2] is that goods produced in one country and relating to one commodity group are homogeneous, while goods produced in other countries are heterogeneous. It is assumed that every country has separate demand curve for each kind of goods.

The specification of an export demand function is based on the macroeconomic theory assumption that the main factors of an export volume of goods i from country m are the level of external demand for these goods, and the ratio of export prices of goods i in country m to the competitive prices for these goods in the external market. A log-linear specification of equations of export demand as shown in [4], is the most convenient because it enables to estimate the elasticity of the export volume of these factors.

Thus, we have

$$\log(X_i) = a_{0i} + a_{1i} \log(M_i) + a_{2i} \log(P_i/P_{wi}), \qquad (1)$$

where X_i is the Estonian export of goods i in constant prices;

M_i is the external market demand for goods i in constant prices;

P_i are the Estonian export prices of goods i;

P_{wi} are the competitive prices for goods i in the external market;

a_{0i}, a_{1i}, a_{2i} are the coefficients of the model.

a_{1i} is the external market share elasticity of export volume. Theoretically $a_{1i} > 0$.

a_{2i} is the price elasticity of export volume. Theoretically $a_{2i} < 0$.

Market share is determined as the ratio of the export of given goods to the external market demand for the given goods. The change in the market share reflects the change in the level of competitiveness of the given goods in the external market, which includes the competitiveness of prices and nonprices.

The change in price competitiveness can be seen directly from the change in the price ratio. The change in nonprice competitiveness reflects on the market share elasticity.

When dealing with an aggregate external market, it can be assumed that the market share elasticity of Estonian exports is constant and identical to that of the main Estonian trade partners. This assumption gives a possibility to calculate the aggregated level of the external

market demand for goods i, as the weighted average of the main Estonian trade partners' demand.

$$M_i = \Sigma_l (W_{il} M_{il}) / \Sigma_l W_{il}, \quad (2)$$

where M_{il} is the demand for Estonian exports i in country l;
W_{il} are weights.

These weights may be calculated in different ways [5, 6]. In our model they are calculated as the ratio in Estonian export of goods i to country l to aggregate Estonian export of goods i in the base year.

Similarly, competitive prices of goods i in the external market are calculated as the weighted average prices of the main Estonian trade partners.

$$Pw_i = \Sigma_l (W_{il} Pw_{il}) / \Sigma_l W_{il}, \quad (3)$$

where Pw_{il} are the prices of goods i in country l (in common currency).

1.2.2. Construction export equations in small open economy model

In modelling the Estonian economy it is helpful to use the assumptions of a small open economy model.

The most important assumptions in this model are as follows:

1. A change in demand and supply in countries with a small open economy does not influence international prices.
2. Goods produced domestically and abroad are homogeneous.

The last assumption transmits to the small open economy model all the properties of the perfect substitution model. Thus, exports in the given model are determined as the difference between domestic production and domestic demand. For imports, this assumption is accepted for the so-called noncompetitive imports, which are not produced in Estonia and are closely connected to the existing demand.

The equation of export supply is built on the basis of the assumption of the small open economy model.

The volume of exports is determined as the difference between domestic supply and domestic sales. In a general way domestic supply is a function of production capacity, the unit cost of domestic output and prices. The main factors of domestic sales are price and consumes' income. So, as in [6] the formula for volume of export is as follows:

$$X = S - D = s(P, M, UC) - d(P, Q) = v(P, Q, M, UC), \quad (4)$$

where X is the volume of export;
S is the volume of production;
D is the volume of domestic sales;
P is the price;
Q is the domestic income;
M is the production capacity;
UC is the unit cost.

1.3. Modelling of imports

Equations of imports in most of empirical works are built on the demand side. Import prices are regarded as exogenous. Two main categories of imported goods, competitive and noncompetitive are considered.

Noncompetitive imports are resulted from intermediate and final demand in the respective year. Input-output tables are commonly used to obtain these data. That presuppose a preliminary forecast of changes in elements of the intermediate and final demand.

The main factors of a competitive import volume on the demand side are relative prices (the ratio of import prices to prices of domestic production) and income.

Hence, the log-linear model of import volume is as follows:

$$\log(I) = a_0 + a_1 \log(PI/PD) + a_2 \log(INC), \quad (5)$$

where I is the volume of import;

PD is the domestic price;

PI is the import price;

INC is the income;

a_0, a_1, a_2 are model coefficients;

a_1 is the price elasticity of exports;

a_2 is the income elasticity of exports.

It is theoretically assumed that $a_1 < 0$, $a_2 > 0$.

The given approach allows to estimate the equations independently of one another and to predict import volumes. However, it fails to estimate the total demand, as the aggregate of imports and domestic production. The Armington model, the main assumptions of which have been described above, is used for this purpose.

Goods for domestic consumption and import goods aggregate into a composite product described by a production function.

$$X_i = f_i(I_i, D_i), \quad (6)$$

where X_i is the volume of a composite product for goods i;

I_i is the volume of import of good i;

D_i is the volume of goods i for domestic consumption.

Imports and domestic prices are denoted by PI and PD respectively. We make the assumption about the minimization of the cost by the producer. Then the degree of substitutability between the two inputs is a function of their prices.

Application of these general assumptions to the specifications of a composite product function is considered as a CES-function.

It is assumed that consumers are seeking to minimize their total expenditures. This minimization is executed by way of their distribution between import and domestic goods. The main factor of the distribution of aggregate demand between imports and domestic goods is the ratio of imports and domestic prices for the correspondent commodity groups. The distribution of total expenditures between import and domestic goods also depends on the level of their substitutability, which can vary from 0 to infinity. In the first case it is possible to speak of non-competitive imports, in the second, perfect substitution takes place.

In the Armington model there is (except noncompetitive imports) partial substitution of domestic goods for imports. This model is based on the hypothesis for the constant elasticity of substitution of domestic goods for imports. It presumes the usage of CES-functions (functions with constant elasticity of substitution).

In [3] this function is called a trade aggregation function:

$$Q^D = AC(BI \times I^{-r} + BD \times D^{-r})^{-1/r}, \quad (7)$$

where Q^D is the aggregate demand for domestic market;

I is the imports;

D is the goods for domestic consumption;

BI, BD, AC, r are the parameters of the trade aggregation function;

$r = (1 - \lambda)/\lambda$,

where λ is the elasticity of trade substitution between import and domestic goods.

Then a function (8) dependent on the ratio of import prices and the domestic ones is entered.

$$I_i/D_i = [(PD_i/PI_i)(BI_i/BD_i)]^{\lambda_i}, \quad (8)$$

where PD_i, PI_i are the domestic and import prices for the given commodity group.

The conclusion of the equation (8) is given in [2]. The last equation is used for estimating the CES-function parameters.

2. EMPIRICAL PROXIES OF THEORETICAL VARIABLES

Theoretical models cannot be directly used for the construction of empirical equations. They are in need of further concretization in terms of the available statistical data. Furthermore, empirical proxies are discussed only for the variables used in constructing export and import empirical equations.

A general question of value variables is the problem of subtraction of a volume component. For foreign trade parameters, this question is not so simple. At present, the Estonian export and import data are based on customs statistics. Customs statistics take into account all export and import transactions at contract prices in Estonian kroons at current exchange rate.

As long as there is inflation in Estonia, in terms of the growth of industrial and consumer prices and the exchange rate of the Estonian kroon remains pegged to the German mark, the question arises as to whether it is necessary to deflate the parameters of imports and exports and which deflators should be used. This question has no single answer. Its solution depends on the kind of export and import goods, on the orientation of transaction prices in the home market, on the world prices, or on the contractual level. All things considered, the calculations presented below have been performed for deflated and nondeflated parameters of exports and imports.

In our calculations the index of consumer prices for the given commodity groups (or *CPI*, if these data are not available) is taken as a deflator of imports, as it is assumed that import transaction prices are oriented to the domestic prices. For some commodity groups, which are mainly consumed in industrial sector, imports are deflated to the index of industrial prices, too.

As regards exports, we have no data of the dynamics of prices in export markets. Therefore it is only the change of import value that can be obtained, with the help of the index of industrial prices.

The volume of production is deflated to the index of industrial prices. The income is deflated to the index of consumer prices.

There may emerge some problems concerning price variables in the described models. These models deal with relative prices, i. e. the ratio of domestic price to import price, export price to competitive price in an external market, export price to domestic price, etc. The information about external prices is unavailable. The data on import and export prices in the period under consideration also unsuitable for the calculation due to the impossibility of aggregation of them into the available structure. At present, the Estonian Statistical Department calculates indices of import and export prices, therefore they can be used in calculations in further investigations.

Thus, some simplifications are entered in our empirical model. We suppose that external prices in corresponding periods do not vary (it is close to the truth, for the 7 quarters' data), hence the dynamics of

relative prices is determined by that of the domestic prices. Such domestic prices are used as the industrial or consumer price indices, depending on a particular commodity group. A detailed description is given below in analyzing the empirical results.

In the present research theoretical variable production capacity is replaced by the volume of production, because the latter reflects its dynamics most adequately.

The change in the unit cost is expressed in terms of the index of industrial prices.

The theoretical approach presented the general principle of the construction of external market demand parameter in the Armington model. To build this parameter two variables are used — the demand for Estonian export of goods i in country l and unit weights for the demand variables in each country for the given goods. As a rule unit weights are calculated on the basis of a given base period. In the present calculation weights for each commodity group are calculated on the basis of the Estonian exports in the first half of 1993. Due to the available information, the data on only three main Estonian trade partners are used in the model — Finland, Sweden, Germany. In the period under consideration these countries accounted for 42 percent of the Estonian exports. Unfortunately, necessary data on Russia are not available. So, weights are calculated by the following formula:

$$W_{il} = (E_{il}/E_i)/\Sigma_l(E_{il}/E_i), \tag{9}$$

where W_{il} are the unit weights for calculating the change in the external market demand for goods i in country l ($l=3$);

E_{il} is the Estonian export of goods i to country l in the first half of 1993;

E_i is the Estonian export of goods i in the first half of 1993.

Because we use in calculation only data for three countries, $\Sigma_l E_{il} \neq E_i$. Therefore, the denominator is necessary for weights reduction, so that they would add up to 1.

In the literature on empirical modelling of exports a lot of proxies of the change in export demand for trade partners are used. The indices of gross product, national income, industrial production, investments are most frequently used.

According to the information on the main economic indicators in the above-mentioned countries, the best results have been received by using the aggregate import index for the given countries. This parameter is taken as the basis to calculate changes in external market demand for the Estonian exports. Short-term forecasting is quite justified. Long-term forecasting requires more general indicators.

Thus, the change in external market demand has been calculated by the following formula:

$$ID_{ext,\,i} = \Sigma_l(I_{imp,\,l} W_{il}), \tag{10}$$

where $ID_{ext,\,i}$ is the index of the change in external market demand in commodity group i;

$I_{imp,\,l}$ is the index of aggregate imports in country l.

In import demand equations it is assumed that the change in relative prices of consumer goods reflected on the changes in the consumer price index for the given commodity group, as to goods for industrial consumption its effects the index of industrial prices.

The second independent variable in the import demand equations, the income, is replaced by the unit money income, which is deflated to the index of consumer prices.

3. EMPIRICAL RESULTS

3.1. Problems of statistical data

All statistical data for the estimation of export and import equations, except the changes in external market demands for Estonian exports, have been taken from "Eesti Statistika Kuukiri" for the years of 1992—1993 [7]. In preparation of these data two main problems arose, namely comparability and aggregation. Comparability of the data in the first half of 1992 is most problematic because they are in rubles. However, in regression models the general tendencies can be seen in conversion of rubles into Estonian kroons.

The next problem concerns some change in the structure of data on the volumes of production and indices of industrial prices published in 1992 and 1993. We have to aggregate them to a comparable form.

The monthly data are aggregated to quarters, because it is only quarterly statistics on exports and imports that are published.

The data on foreign trade with the main Estonian trade partners in the first half of 1993 have been obtained from the Statistical Department of Estonia and quarterly economic indicators for these countries — from the data base of the Central Bureau of Statistics of Norway.

Estonian input-output tables for 1966—1991 are used for estimation of the elasticity of substitution of domestic production for imports. Deflating these data leads to the results which can be hardly relied on. Therefore a nondeflated data were used.

3.2. Estimation of CES-function parameters

As shown above, the CES-function is widely used in export and import modelling. The specification of import demand equations as CES-functions allows to connect the changes in the factor price ratio (import and domestic prices) with the changes in the factor volumes (volume of imports and volume of output for domestic consumption) through the elasticity of substitution parameter.

The key problem is to define the elasticity of substitution. The common way to do it is through the time series for factor prices and factor volumes. Having no time series for import and export prices, we choose an other way of estimation, i.e. using time series for import and CES-aggregates, which are the volumes of domestic demand for a given commodity group.

The CES-function being nonlinear, the direct use of the OLS-method is impossible. That's why, the method described in [8] is used.

Table gives the results of the estimation of the CES-function parameters for the branches in the input-output tables for 1960—1991.

The trade aggregation CES-function parameters of imports and domestic production for branches of Estonian input-output Tables for 1960—1991

Branches	S	P	σ	R^2	$S=I/D$
Machinebuilding	2.21	6.32	0.13	0.69	0.55—0.77
Wood and paper industry	—0.46	1.24	0.44	0.85	0.15—0.3
Construction materials	—0.38	1.25	0.44	0.85	0.08—0.17
Light industry	—3.9	0.23	0.81	0.52	0.4—0.67
Food industry	—0.28	1.63	0.38	0.73	0.15—0.28
Agriculture	—0.54	0.72	0.58	0.85	0.07—0.1
Total import	—0.1	7.17	0.12	0.79	0.19—0.3

In analyzing these results we should write the definition of elasticity of substitution parameter for the production function factor from [9].

Let $q=F(A, B)$ be a production function, $S=A/B$ a ratio of factors. The concept of the marginal norm of substitution for factors is entered:

$$R=(\partial F/\partial A)/(\partial F/\partial B). \tag{11}$$

If factor A increases to ∂A, when $q=$const, the second factor B decreases to $R\partial A$.

Elasticity of substitution for factors is as follow

$$\sigma(S, R)=\mathrm{d}\ln S/d\ln R. \tag{12}$$

If the ratio of factors S changes by 1%, with the proviso that $q=$ =const, the marginal norm of substitution for resources changes by $(1/\sigma)$ %.

From the definition it is obvious that the given parameter has no direct economic interpretation. The marginal norm of substitution for factors R and the ratio of factors S is more convenient in the analysis. The σ is directly proportional to S and inversely proportional to R.

The greatest and the least values of S, that equal to the ratio of imports to the production for domestic consumption are given in Table. In comparing S and σ, there appear direct dependencies showing that the more S, the more σ.

It is proposed to use the obtained CES-function parameters in the construction of a general equilibrium trade model. Despite the ratio of imports to domestic production for the estimated period was not determined by prices and, in general, was not formed under the influence of market laws, it reflected the existing structure of economy. The current orientation of foreign trade and its branch structure have changed, but the ratio of the above-mentioned parameters is more stable, and it is possible to use them as the initial value in the model.

3.3. Equations of export demands and supply

With respect to the considered empirical proxies of theoretical variables, estimation of export equations is as follows.

1) Equation of export demand — the Armington model

$$\ln(X_i)=a_0+a_1\ln(D_{ext,\,i})+a_2\ln(PPI_i) \tag{13}$$

or

$$\ln(X_i)=a_0+a_1\ln(D_{ext,\,i})+a_2\ln(CPI_i). \tag{14}$$

2) Equation of export supply — small open economy model

$$\ln(X_i)=a_0+a_1\ln(V_i)+a_2\ln(PPI_i)+a_3\ln(CPI_i), \tag{15}$$

where X_i is the export value or volume of commodity group i;

PPI_i is the index of industrial prices of commodity group i;

CPI_i is the index of consumer prices of commodity group i;

V_i is the volume of production or the value of commodity group i.

On the basis of the parameters of estimating equations (elasticity coefficients) given in APPENDIX I, it is possible to make the following conclusions.

1. In export demand equations, exports are elastic to changes in external market demand, i.e. $a_1>1$. It is true for all the considered commodity groups, so that the change in the Estonian export demand has a strong influence on its dynamics. Therefore the improvement of methods of forecasting D_{ext} is of great significance.

2. Domestic price elasticity of export demand is positive in all commodity groups. It does not correspond to the theoretical model. Due to the fact that domestic prices are considerably lower than the prices

of corresponding goods in the countries-importers of Estonian goods (exceptions may be in the CIS nations), i.e. the domestic prices have a certain safety level. Therefore, increase in domestic prices does not result in the decline in exports volumes, which explains the results obtained.

3. In the equations of export supply, output elasticity of exports is positive, which corresponds to the theoretical model; however, the level of elasticity changes for different commodity groups. The output elasticity of exports is the highest in such commodity groups, as "Machinery and Mechanical Appliances" and "Chemical and Parachemical Products", which can be explained by the share of exports in the production of these goods.

4. Industrial price elasticity of export supply is negative in all commodity groups, except the group "Textiles and Textile Articles". It can be explained by the index of industrial prices reflecting the movement of the unit cost. The higher the unit cost, the less the volume of export, other condition being equal.

5. Consumer price elasticity of export supply is positive, the reasons for which are considered in Item 2.

6. Statistical reliability of the calculation for nondeflated data is higher than for the deflated ones.

On the basis of the analysis of the empirical equations of export demand and supply the following conclusions for commodity groups were made:

— The main factors in the exports of live animals and animal products and products of food industries (commodity groups 1 and 4) are the unit cost, the level of domestic prices and the external market demand.

— The exports of mineral products (commodity group 5) are elastic to the output, the unit cost, the level of prices in industries and external market demand.

— As regards products of the chemical and parachemical industry (commodity group 6), essential factors of exports are the volume of production, domestic prices and the external market demand. The high level of external market demand elasticity of export is explained by strong orientation to exports in this branch.

— In wood and articles of wood (commodity group 9), important export factors are the unit cost and external market demand; for products of the pulp, paper and paperboard industry (commodity group 10), external market demand is the only factor of importance.

— For textiles and textile articles (commodity group 11), equations for export demand cannot be relied on ($R^2<0.6$). It can be explained by the fact that the imports of textile production in European countries have a certain quota and, in general, the exports of these goods are rather hesitant.

— For footwear, umbrellas, etc. (commodity group 12) these factors are the volume of production and the level of domestic prices.

— For machinery and mechanical appliances (commodity group 16), exports are elastic to the volume of production, external market demand, the unit cost and domestic prices.

— For industry and total exports the main factors are external market demand and domestic prices.

3.4. Equations of import demands

In terms of empirical proxies, the estimating equations of import demand are as follows:

$$\ln(I_i) = a_0 + a_1 \ln(INC) + a_2 \ln(PPI_i) \quad (16)$$

or

$$\ln(I_i) = a_0 + a_1 \ln(INC) + a_2 \ln(SPI_i), \quad (17)$$

where I_i is the import value or volume for commodity group i;

INC is the unit money income.

For the parameters of estimating equations (elasticity coefficients) given below, some general conclusions can be made:

1) All commodity groups have a positive income elasticity of imports. For consumer goods, income elasticity of imports is high, for goods of industrial consumption, it is lower.

2) In many cases, income elasticity of imports is higher for nondeflated data than for deflated ones. Taking into account higher statistical reliability in the first case, it is closer to the reality. Price elasticity of total imports and industry is considered to be higher for nondeflated data with a higher coefficient of determination.

3) For all commodity groups, except "Products of the Food Industries" and "Wood and Articles of Wood", domestic price elasticity of imports is negative, which corresponds to the theoretical model. In these two commodity groups the result can be interpreted as follows. In the given model growth of domestic prices (we do not use relative prices but only domestic ones) increases the supply of imports in given commodity groups, which blocks any changes in demand.

4) For goods of industrial consumption and products of the food industries price elasticity is low, in commodity groups 11 and 12, elasticity of consumer prices of import is rather high.

5) As it was stated above, statistical reliability of the calculation for nondeflated data is higher than for the deflated ones.

The results of the calculation are produced in APPENDIX II.

On the basis of the empirical equations of the import demand the following conclusions for commodity groups can be reached:

— For products of the food industries and live animals and animal products (commodity groups 1 and 4), income is an important factor of import demand.

— Demand for imported mineral products (commodity group 5) is inelastic to the factors considered. However, negative elasticity of prices (less of unit) takes place.

— Export demand for products of a chemical and parachemical industry (commodity group 6) is elastic to income; price factors are of no important.

— Export of wood and articles of wood (commodity group 9) is elastic to income. The elasticity to the general level of prices is also positive.

— Essential factors of export demand for pulp, paper and paperboard products (commodity group 10) are income and the level of prices (the latter having low statistical reliability).

— For products of textile industry and footwear, umbrellas, etc. (commodity groups 11 and 12), there is a high income and price elasticity of export demand.

— For machinery and mechanical appliances (commodity group 16), exports are elastic to income and prices for value data and inelastic for deflated data. The statistical reliability of the first results is higher.

— In industry as well as in the total imports income and price elasticity is high for value data. For deflated data all elasticities are below unity. The statistical reliability in the nondeflated case is also higher.

ESTIMATING PARAMETERS OF EXPORT DEMAND AND SUPPLY EQUATIONS

Commodity group/model type	Deflator	a_0	Export elasticity for				R^2
			V	D_{ext}	*PPI*	*CPI*	
1	2	3	4	5	6	7	8
1. Live animals and products							
SOE*	—	8.08	0.04		—1.01	3.52	0.967
SOE	*PPI*	8.52	0,04		—0.96	3.25	0.903
ARM**	—	10.3		3.03	1.47		0.723
ARM	—	8.9		3.46		2.1	0.924
4. Products of the food industries							
SOE	—	5.24	0.64		—1.13	3.14	0.941
SOE	*CPI*	5.26	0.64		—0.5	2.14	0.856
ARM	—	7.79		1.7	2.21		0.87
ARM	—	8.19		1.33		2.77	0.934
ARM	*CPI*	8.85		1.33		1.77	0.838
5. Mineral products							
SOE	—	7.01	1.41		—2.54	1.38	0.937
SOE	*PPI*	7.02	1.41		—2.13	1.38	0.923
ARM	—	9.0		4.31		1.72	0.814
ARM	*PPI*	8.18		4.94		1.24	0.789
6. Chemical and parachemical products							
SOE	—	0.45	1.87		—0.78	1.67	0.855
ARM	—	9.09		3.78	1.56		0.65
9. Wood and articles of wood							
SOE	—	5.82	0.55		—0.15	2.44	0.986
SOE	*PPI*	7.03	0.55		—1.15	2.44	0.98
ARM	—	8.08		2.55		2.42	0.98
ARM	*PPI*	8.31		2.51		1.98	0.954
10. Pulp, paper and paperboard							
SOE	*PPI*	8.56	0.77		—1.56	0.8	0.772
ARM	—	8.51		5.52	1		0.866
ARM	—	9.25		6.11		0.61	0.9
ARM	*PPI*	9.73		5.52	0.1		0.903
ARM	*PPI*	9.48		6.07		0.18	0.913
11. Textiles and textile articles							
SOE	—	6.17	0.76		0.88	0.26	0.894
SOE	*PPI*	6.43	0.76		0.64	0.26	0.781

1	2	3	4	5	6	7	8
12. Footwear, umbrellas ...							
SOE	—	0	1.88		—0.8	1.62	0.893
SOE	*PPI*	0	1.69		—0.73	1.66	0.647
ARM	—	6.41		2.51	2.05		0.885
ARM	—	7.32		0.51		1.71	0.924
ARM	*PPI*	7.89		1.63		0.93	0.7
16. Machinery and mechanical appliances							
SOE	—	0	1.85		—3.71	4.12	0.823
SOE	*PPI*	0	1.78		—2.81	4.04	0.642
ARM	—	9.42		1.37		2.05	0.884
ARM	*PPI*	9.89		1.88		1.4	0.71
Production							
SOE	—	6.55	0.85		—0.98	1.7	0.953
SOE	*PPI*	6.72	0.85		—1.13	1.7	0.737
ARM	—	11.9		1.3		1.52	0.941
ARM	—	10.9		2.31	1.8		0.964
ARM	*PPI*	12.1	2.31		0.8		0.801
Total export							
SOE	—	6.69	0.85		—1.14	1.9	0.953
SOE	*PPI*	6.52	0.85		—0.29	0.89	0.708
ARM	—	11.9		1.57		1.36	0.947
ARM	—	11.1		2.38	1.85		0.966
ARM	*PPI*	12.4		1.8	0.7		0.7

* SOE — small open economy model.
** ARM — the Armington model.

ESTIMATING PARAMETERS OF IMPORT DEMAND EQUATIONS

Commodity group	Deflator	a_0	Import elasticity for			R^2
			INC	*PPI*	*CPI*	
1. Live animals and products	—	4.87	3.86		—0.26	0.987
	CPI	5.9	2.6		—0.26	0.976
4. Products of the food industries	—	0	1.57		0.17	0.806
	CPI	0	1.49		1.06	0.621
5. Mineral products	—	7.9	0.75	—0.34		0.77
	CPI	7.29	0.74	—0.59		0.568
6. Chemical and parachemical products	—	3.71	1.15	—0.11		0.935
	CPI	0	1.74	—0.07		0.61
	CPI	0	1.73		—0.03	0.51
9. Wood and articles of food	—	—4.6	1.81	0.32		0.942
	—	—0.4	1.04		1.17	0.967
	CPI	—0.4	1.04		1.21	0.875
	PPI	2.1	0.53		1.93	0.929
10. Pulp, paper and paperboard	—	0	1.53		—0.49	0.927
	CPI	0	1.69	—1.69		0.75
12. Footwear, umbrellas ...	—	—0.5	1.62		—1.08	0.738
	CPI	0.14	1.62		—2.08	0.64
16. Machinery and mechanical appliances	—	0	1.99	—1.49		0.814
	—	0	2.03		—1.25	0.858
	CPI	8.87	0.5		—0.3	0.717
	PPI	6.98	0.82	—0.62		0.748
Production	—	0	2.3		—1.56	0.901
	—	0	2.42	—1.79		0.893
	CPI	9.12	0.722		0.548	0.834
	CPI	9.5	0.68	—0.53		0.831
Total export	—	0	2.3		—1.55	0.9
	—	0	2.42	—1.79		0.887
	CPI	9.3	0.69		—0.5	0.833

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EESTI EKSPORDI JA IMPORDI MODELLEERIMINE

Grigori FAINŠTEIN

On vaadeldud ekspordi- ja impordivoogude modelleerimise põhilisi teoreetilisi lähenemisi. Lähtudes olemasolevast statistilisest baasist on käsitletud võimalusi mudelites olevate teoreetiliste muutujate asendamiseks empiirilistega. On esitatud kaubandusagregatsiooni CES-funktsiooni hindamise tulemused. Toodud on ka vaadeldud mudelite alusel koostatud ekspordi—impordi regressioonivõrrandi hinnangu resultaadid ning analüüsitud saadud tulemusi.

МОДЕЛИРОВАНИЕ ЭКСПОРТНЫХ И ИМПОРТНЫХ ПОТОКОВ ЭСТОНИИ

Григорий ФАЙНШТЕЙН

В статье рассматриваются основные теоретические подходы к моделированию экспортных и импортных потоков. Обсуждаются возможности замещения теоретических переменных модели эмпирическими заменителями с учетом имеющейся статистической базы. Приводятся результаты оценки CES-функций торговой агрегации, а также уравнений экспорта и импорта по товарным группам на основе исследованных моделей. Проведен анализ полученных результатов.