ESTIMATES OF THE TRADITIONAL EXPORT AND IMPORT DEMAND FUNCTIONS IN THE CASE OF CROATIA

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Introduction

The following analysis should be considered an initial attempt to apply traditional econometric methods in explaining some of the basic relations within an important sector of the Croatian economy. In that regard the expression "attempt" has not been used to justify the subjective deficiencies of the analysis that follows, but to draw attention to some of the objective difficulties that need to be kept in mind when discussing its empirical results. In spite of the significant statistical problems, it seems that the attempt is worth-while. It will offer at least rough information on the existing interrelations among some of the important economic variables in the economy in question.

During the last two years (1992-93), in which Croatia acted as a fully sovereign country, performance of her foreign trade sector has shown respectful amount of viability providing solid basis for optimism regarding the future economic development. In spite of the presence of war, break-down of trade with a number of former Yugoslav republics, sharp drop in the trade with CIS area, restrictions on exports of strategic commodities introduced by the domestic authorities as well as certain degree of imports control introduced by the European Community, the share of goods exports has reached 50 percent of GDP. Including services into this measure increases the relevant share up to tree-quarters of the total output confirming high degree of country's economic openness as well as importance of exports as a determinant of the future economic growth.

In that regard analysis of the determinants of foreign trade flows and in particular of some crucial parameters determining the Croatian

export performance becomes a meaningful objective. It should be mentioned that a substantial number of empirical studies have been done in this field during the last forty years in order to estimate trade equations for individual countries and to determine price and income effects in the foreign trade. Thereby the purpose has not exclusively been to test certain theoretical hypothesis but also to help decision-makers to improve the evaluation of potential policy options.[1]

Theoretical background: brief overview of the basic concepts

Under the notion of trade equations usually are understood equations for the time series behavior of quantities and prices of goods exports and imports. Although an appropriate answer to the question how these equations should be specified depends on a number of factors, among which, according to Goldstein and Khan (1985, p. 1044), the most important include the type of the good being traded, its final use, institutional framework under which trade takes place, purpose of modeling exercise as well as availability of data, theory suggests two basic models: model of imperfect and model of perfect substitutes.

Fundamental assumption underlying the imperfect substitutes model is that neither imports, nor exports can be considered perfect substitutes for the domestic products. Perfect substitutes model, on the other side, assumes perfect substitutability between domestic and foreign goods and is typically used in the case of highly disaggregate data set. Since under the key assumption of the perfect substitutes model each country would be only an exporter or an importer of a traded good but not both, which is not observed in the real world, this model has attracted much less attention in the empirical studies than the imperfect substitutes model. The two models are usually perceived as competitors, but Goldstein and Khan (1985) suggest their possible

[1] *An extended overview of empirical* studies is *given in Stern, Francis, and Schumacher* (1976) as *well* as *in Goldstein and Khan (1985).*

coexistence: one should be applied in the case of aggregate and the other in the case of highly disaggregate data.

Another important concept refers to the demand-supply relationships in the export and import equations. In this regard, theory suggests that the systems of export/import demand and supply equations should be simultaneously solved, in order to emphasize the simultaneous relation between quantities and prices and to avoid possible biased results.[2] However, most of the empirical studies have been concentrated on the estimation of export and import demand equations, while the supply relationships .have been handled by the assumption of infinite price elasticity. Infinite price elasticity may be justified in the case of import supply, but in the case of a small open economiy it is quite hard to believe that infinite price elasticity of export supply holds. Namely, if the world demand for the goods from a certain small open economy increases, this country will most probably be unable to meet the demand without the change in price of exports (unless there exist large idle resources).[3] The important advantage of such assumption is, however, that it allows the estimation of the export and import demand equations by single-equation methods in which the price variables are exogenous.

Export demand equation should, according to the theoretical concepts, be specified as a function in which the quantity demanded is explained by the income level of potential importing regions, exported good's own price and price of imperfect substitutes on the importing market. Some other, for a particular country specific, but in general lest significant explanatory variables such as dummy variables for unusual occurrences, seasonal variables, lagged variables aimed to capture responses in time, foreign exchange reserves, credits and other variables that take into account special circumstances, might be

[2] *Stern, Francis and Schumacher (1976).*

[3] *Goldstein and Khan (1978).*

incorporated as independent variables as well.[4]

Consequently, the conventional model for estimating export demand equation suggests the following relation:

$$\underset{}{EX} = \underset{+}{f(Y(f)}, \underset{-}{p(ex)}, \underset{+}{p(f))}$$

where signs below the variables indicate the signs of the partial derivatives and, accordingly, the expected signs of regression coefficients. EX stands for quantity of exports, Y(f) for income of the importing region, p(ex) for price of the exported good's own price and p(f) for price of imperfect substitutes on the foreign market. Usually the above function is reexpressed in real terms in order to get real exports related to the real income and relative price variables.

At the same time the income of importing country, imported good's own price and price of the imperfect substitutes on the importing (in this case domestic) market should appear as key explanatory variables in the import demand equation.

Traditional aggregate demand function for imports includes, therefore, the following relation:

$$\underset{}{IM} = \underset{+}{g(Y(d)}, \underset{+}{p(d)}, \underset{-}{p(im))}$$

where IM represents quantity of imports, Y(d) income of the importing (domestic) country, p(d) price of the imperfect substitutes on the domestic market and p(im) price of the imported good. As in the previous case the equation is commonly reexpressed in real terms. Real imports becomes that way related to the real income and relative prices. Often export and import equations incorporate lagged dependent variables that are supposed to capture partial adjustments of desired to actual level of exports/imports in time.

[4] *Stern, Francis, and Schumacher (1976); Goldsiein and Khan (1985).*

Let us mention at the end of this section that recent empirical work has indicated that the estimates of both price and income elasticity by the traditional trade demand and supply equations, might be subject to certain biases because the aggregate levels of foreign trade are, according to the empirical results of these authors, best described as non-stationary integrated processes.[5]

Data and its sources: the origin of potential problems

In order to avoid any misinterpretation of empirical results, this section provides the description of all variables appearing in the estimated equations. Special attention has been given to the definition and sources of dependent variables.[6]

Trade equations are estimated using monthly data that covers period from January 1990 to December 1993. For the time being, we have maintained at the aggregate level of exports and imports.[7] Total value of goods exports and imports is expressed in the current US dollars due to unavailability of the Croatian export and import price data.

[5] *See, for example, Asseery and Peel (1991).*

[6] *Although accurate data is the fundamental prerequisite of every empirical work, one should point out its special importance in the case of estimating trade equations. Many studies (see, for example, Richardson (1972)) have shown how modest changes in the data have striking effects on the estimated price and income elasticities in trade equations.*

[7] *Goldstein and Khan (1985) suggest that although disaggregation is in general preferable principle, it may be advisable to estimate aggregate relationships in the case when data is not accurate and when the component equations are not well specified. Stern, Francis, and Schumacher (1976), on the other hand, strongly support the idea of disaggregation unless it can be assumed that individual industries respond uniformly to price/income changes. Lawrence (1989) also points out that working with aggregate levels of goods exports/imports completely ignores structure of the individual economy.*

The explanation beyond the choice of monthly, and not quarterly data, that at the very first glance seems to be more appropriate choice in this specific case (see Figure 1), lies in the fact that consistent time series on merchandise trade based on common methodology, exists only for the period beginning with January 1990. Since than the statistical reports have included the value of goods that are exported/imported for the purpose of final processing in the foreign trade figures, which had not been the case in the preceding period.

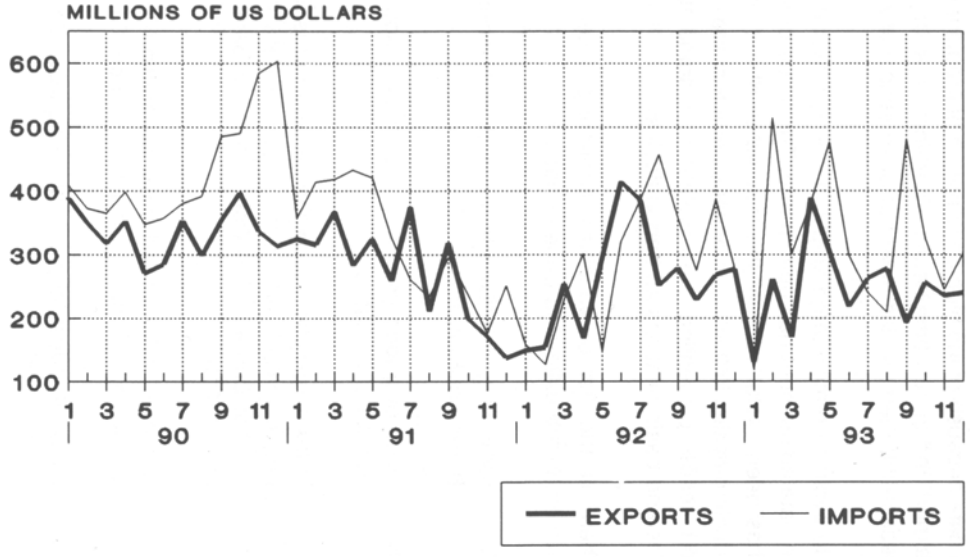
In addition to that, officially published data has covered the value of trade with the countries of former Yugoslavia only since January 1992. Therefore, on this occasion, trade equations are estimated using data that does not contain this portion of foreign trade. Although this might seem as a considerable deficiency because of the rather high share of trade with the former Yugoslav republics (approximately 1 /4) in the total value of foreign trade, one should be aware of the fact that this segment of trade has been determined, especially in the initial period after the break-up of the common internal market, in somewhat different way than the rest of the foreign trade flows. In short, this segment of foreign trade should be anyway estimated by a separate equation.

Figure 1 shows how two dependent variables, goods exports and imports, have behaved over the four-year estimation period. High degree of volatility is one of their major characteristics. This kind of dynamics is often hardly explained by purely economic reasons. It seems plausible to attribute at least a part of the explanation to still deficient mechanisms of collecting and processing the raw data information.[8]

[8] *To illustrate the dynamics of export and import time series, let us mention chat the average monthly value of commodity exports in the 1990-93 period was 279 million US dollars, wish the lowest value of 130 million US dollars experienced in January 1993, and highest of 415 million US dollars in June 1992. At the same time, the average monthly value of imports was 340 million US dollars, with the lowest imports of 119 million US dollars in January 1993 and highest of 603 million US dollars in December 1990.*

Figure 1

FOREIGN TRADE (GOODS ONLY)



Note: Trade with former Yugoslav republics is not included.
Source: Central Bureau of Statistics.

The presence of the seasonal component must not, however, be neglected. In this particular case, we were unable to use seasonally adjusted data because of the high contribution of irregular component to both export and import time series. Therefore, in spite of showing certain seasonal pattern, series have not been seasonally adjusted.

In order to avoid extremely large amplitudes in the export time series one more data adjustment has been made. The value of shipbuilding exports has been excluded from the total value of exports because long production cycles in this industry cause much of the confusion in the export series, preventing the revelation of some fundamental regularities and basic relations among variables.

Finally, here is the list of variables appearing, after logarithmic transformation, in the estimated trade equations:

EXPORTS: value of goods exports in US dollars (source: Central Bureau of Statistics);

IMPORTS: value of goods imports in US dollars (source: Central Bureau of Statistics);

IREER: index of real effective exchange rate, industrial producer prices (calculated on the basis of data obtained by Central Bureau of Statistics, Central Bank of Croatia, and OECD);

OECD: weighted index of industrial production in the OECD countries; seasonally adjusted (source: OECD);

INDPROD: index of industrial production (source: Central Bureau of Statistics);

DM/DOL: German mark/US dollar exchange rate (source: Central Bank of Croatia);

DUM MYY: dummy variable (where M stands for month and YY for year);

Estimation of export and import equations

The export and import equations are, in the case of Croatia, specified according to the model of imperfect substitutes, which, as mentioned earlier, prevails in the empirical literature, especially in those cases where estimation refers to the aggregate levels of goods exports and imports.

In spite of its shortages in the case of a small open economy, procedure that suggests estimating only export and import **demand** functions and assumes perfect price inelasticity of the corresponding supply functions is being followed.

Export and import equations are estimated by the ordinary least squares method following the logarithmic transformation of all variables. The chosen functional form of the regression model, commonly called log-linear model, has a very attractive feature in regard to the regression coefficients that can be interpreted as partial elasticities. They measure the percentage change in the dependent variable for a given change in the independent variable. It is in particular this feature that has made log-linear model so popular in the empirical work. Consequently, the estimated coefficients in our case indicate what will the percentage change in the level of exports/imports be, if the level of one of the independent variables changes for one percent, other variables remaining unchanged. Well known deficiency of the model is that partial elasticities are treated as constants in the entire estimation period.[9]

As we have already said, theory suggests that income of importing regions as well as relative prices should appear as basic explanatory variables in the export demand equation. In our case both those variables need to be approximated. For income of importing regions available proxy is variable OECD, the weighted index of industrial

[9] *Gujarati (1988).*

production in OECD countries, the most important Croatian trading partners. Instead of relative prices, index of real effective exchange rate (IREER) appears in equation 1. Some additional explanatory variables, specific for the case of Croatia, are used as well. First of all, that refers to variable IMPORTS because of the large share of exports of goods that have previously been imported for the purpose of final processing. Besides that, three dummy variables aimed to capture the unusual oscillations in the export series in February and July 1992, and September 1993 are also included.

As the estimated export equation shows, all regression coefficients have the expected sign and are significantly different from zero at the usual 5 percent level, except for the coefficient of constant and OECD variable. While the former indicates non-existence of autonomous exports, the second one sharply differs from our ex-ante expectations and can hardly be explained. We tend to attribute this result to the inappropriate specification of monthly proxy for the level of income in the importing regions.

The computed F-value is highly significant, while the explanatory variables account for about 80 percent of the variation in the dependent variable which, since the equation is being estimated at the monthly level, seems to be fairly satisfactory amount of explanatory power.

The results indicate positive significant relation between the real effective exchange rate and exports value. In particular, regression coefficient implies that one-percent change in the index of real effective exchange rate induced, holding other variables constant, increase of exports value by 0.41 percent with a three-month time lag. Highly significant are also coefficients of the IMPORTS variable, both without and with two-month time lag.

Let us turn our attention now to the import demand equation, labeled as the equation 2. In this case, explanatory variables are index of domestic industrial production (INDPROD), which approximates the

level of domestic (importing country) income, while proxy for relative prices is, as in the previous case, index of real effective exchange rate (IREER). Additional variables include exchange rate between German mark and US dollar (DM/DOL) and dummy variables for February and May of 1992 and January and February of 1993.

The variable DM/DOL should capture that part of variations in the dependent variable that are the result of changes in German mark-US dollar relation. Namely, official statistics reports the foreign trade figures exclusively in US dollars, while the substantial part of the foreign trade in the case of Croatia is being negotiated in German marks. Therefore, the changes in relation of these two currencies influence, when other factors remain the same, changes in the statistically reported imports value. We expect negative coefficient of DM/DOL variable, since the depreciation of German mark in regard to US dollar causes the decrease of Croatian imports value expressed in US dollars.[10]

The signs of estimated coefficients in equation 2 are expected and highly significant. The estimated import equation indicates significant negative relationship between the imports value and index of real effective exchange rate. One-percent change in the index of real effective exchange rate resulted, with one-month time lag, in the decrease of imports value by 0.45 percent, other variables being unchanged.

It is interesting to notice, when comparing the two estimated equations, that the IREER partial elasticity is almost identical in the case of both export and import equations - naturally, with the reverse sign. The distinction is that the dominant reaction in export series appeares with a three-month, and in import series with a one-month time lag. Faster reaction of imports to changes in real effective exchange rate presents a certain surprise, since the equations have been estimated for the

[10] *Kožar (1993).*

economy, in which the largest share of imports is assigned to the imports of raw materials (about 60 percents), hardly substituted by domestic goods, which is verified by the significant and fairly high estimated coefficient of industrial production variable. Nevertheless, in the case of both exports and imports, we may conclude that the index of real effective exchange rate matters but it is, definitely, not the only factor influencing the dynamics of dependent variables.

In order to test the parameter stability, Chow test has been applied. The test has confirmed that estimated parameters do not significantly vary across different samples and that regression for the period preceding January 1992 (point in time when the change in the definition of internal and external market has occurred) and one for the period following it are not significantly different. That indicates in the case of both export and import equations that no structural difference at the 5 percent significance level exists between these two subperiods.

In spite of the obvious statistical limitations, the information offered by this exercise seems plausible. Naturally, the sharp changes both on the internal and external market limit the information provided by it only to the short-term period and urge us that the results are in that sense fragile. That is the main reason why at this point no policy implications will be drawn out of the presented results. Moderate changes in the elasticities can be the result of the changes in trade during the process of economic development, changes in the governments trade policies or some other gradual modifications within foreign trade sector. Sudden shocks, such as those the Croatian economy has been experiencing during the last several years can fundamentally alter the basic demand and supply relationships. Hopefully, some more empirical work will be initiated in this field in the very near future in order to determine more precisely the "true" links, especially because of the potential importance of these information to policy makers. Hopefully, that work would also be supported by improved, more accurate and more credible data set.

EQUATION 1:
log-linear model

METHOD OF ESTIMATION = ORDINARY LEAST SQUARES

DEPENDENT VARIABLE: EXPORTS
PERIOD: 3/90 - 12/93
SUM OF SQUARED RESIDUALS = 0.87
STANDARD ERROR OF THE REGRESSION = 0.15
R-SQUARED = 0.79
ADJUSTED R-SQUARED = 0.75
DURBIN-WATSON STATISTIC = 2.05
F-STATISTIC (7, 38) = 20.44
NUMBER OF OBSERVATIONS = 46

VARIABLE	LAG	ESTIMATED COEFFICIENT	STANDARD ERROR	T-STATISTIC
CONSTANT		-9.04	9.80	-0.92
IMPORTS		0.46	0.07	6.45
IMPORTS	-2	0.33	0.07	4.59
IREER	-3	0.41	0.14	2.82
OECD	-1	1.73	2.05	0.84
DUM2_92		-0.44	0.17	-2.60
DUM7_92		0.44	0.17	2.63
DUM9_93		-0.41	0.16	-2.53

EQUATION 2:
log-linear model

METHOD OF ESTIMATION = ORDINARY LEAST SQUARES

DEPENDENT VARIABLE: IMPORTS
PERIOD: 1/90 - 12/93
SUM OF SQUARED RESIDUALS = 1.70
STANDARD ERROR OF THE REGRESSION = 0.21
R-SQUARED = 0.74
ADJUSTED R-SQUARED = 0.70
DURBIN-WATSON STATISTIC = 1.60
F-STATISTIC (7, 40) = 16.31
NUMBER OF OBSERVATIONS = 48

VARIABLE	LAG	ESTIMATED COEFFICIENT	STANDARD ERROR	T-STATISTIC
CONSTANT		5.69	1.02	5.59
IREER	-1	-0.45	0.17	-2.64
INDPROD		0.72	0.13	5.48
DM/DOL		-2.09	0.54	-3.86
DUM2_92		-0.72	0.21	-3.38
DUM5_92		-0.51	0.22	-2.34
DUM1_93		-0.81	0.21	-3.82
DUM2_93		0.61	0.21	2.90

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