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Vida Bobić

Income and Price Elasticities of Croatian Trade - A Panel Data Approach

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Vida Bobić

1. Introduction

The Croatian economy has for some time been faced with significant problems of external imbalance as seen primarily through the continued presence of a growing current account deficit. This deficit is, in turn, for the most part a consequence of a large deficit in merchandise trade. In fact, the high dependence on imports as well as the lackluster export performance are continuously stressed as some of the key issues facing the Croatian economy. With this in mind, the analysis of merchandise trade and its determinants is of great interest and potentially of significant value in making conclusions on its future developments and prospects.

The purpose of this paper is to determine the most important factors which affect movements in Croatian merchandise trade, with a particular interest in determining income and price elasticities of both imports and exports. If stable elasticity coefficients can be estimated using historical data, then this can be of great use in gauging the impact of changes in the economy as well as of fiscal and monetary policy measures on the trade balance and, consequently, on the current account. These elasticities can then be of great use in macroeconomic forecasting, as they describe the interdependencies between variables of interest and thus determine the intensity of the effect of fiscal and monetary policy measures. Determinants other than prices and income will also be analyzed. Perhaps the most interesting of these, given its much discussed influence on trade and competitiveness of Croatian goods, is the kuna/euro exchange rate.

The issues regarding merchandise trade in Croatia have been the subject of numerous debates and the topic of many analyses. However, the latter have for the most part been descriptive, while the number of papers treating the subject by applying econometric methods is relatively small. The aim of this paper is, therefore, to contribute to the field by quantifying the effect of the potential determinants of imports and exports using sectoral data for the period between 2000 and 2007. The benefits of using panel data are in that it allows the researcher to investigate changes in the series over time while taking into account the heterogeneity of the different sectors making up the dataset. In this it avoids both problems associated with using a simple cross-section, since information on a single point in time will not say anything on how changes in underlying factors affect the dependent variable, as well as those that arise from using aggregate data in time-series analysis, which often leads to aggregation bias. Panel data

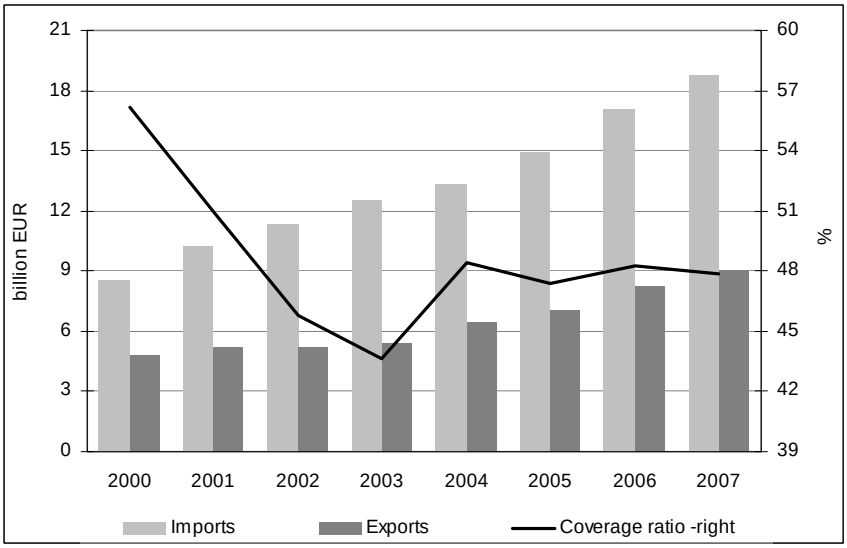
allows the taking into account of existing differences between sectors when estimating the impact of policy on trade flows. Using panel data methods also means that the estimation will be based on a much larger set of observations, something of particular importance in the case of transition countries, where the length of available time series is limited.

The rest of the paper is organized as follows: the second section gives an overview of Croatian trade and its characteristics during the analyzed period, while the third presents the theoretical background and econometric method applied in the estimation, as well as a summary of relevant research on the topic. The variables included in the specification and data characteristics are listed in the fourth section, estimation results are presented in the fifth section, while the sixth concludes the paper.

2. Characteristics of Croatian trade, 2000 - 2007

The many and substantive changes that occurred during the 1990s in the political and economic system of Croatia and many of its neighboring countries, which accounted for a large share of the Croatian export market, as well as the liberalization of trade in the same period, resulted in significant structural breaks in the data. These breaks make it very difficult to conduct econometric analysis and obtain meaningful results, which is why this estimation was based on data for the period between 2000 and 2007. Croatia became a member of the World Trade Organization (WTO) in 2000, after which the only significant institutional change came with the signing of the Central European Free Trade Agreement (CEFTA) in 2003. Although this is a relatively short period, given that panel data methods will be applied, it nevertheless contains enough information and a sufficient number of observations to serve as the basis for econometric analysis.

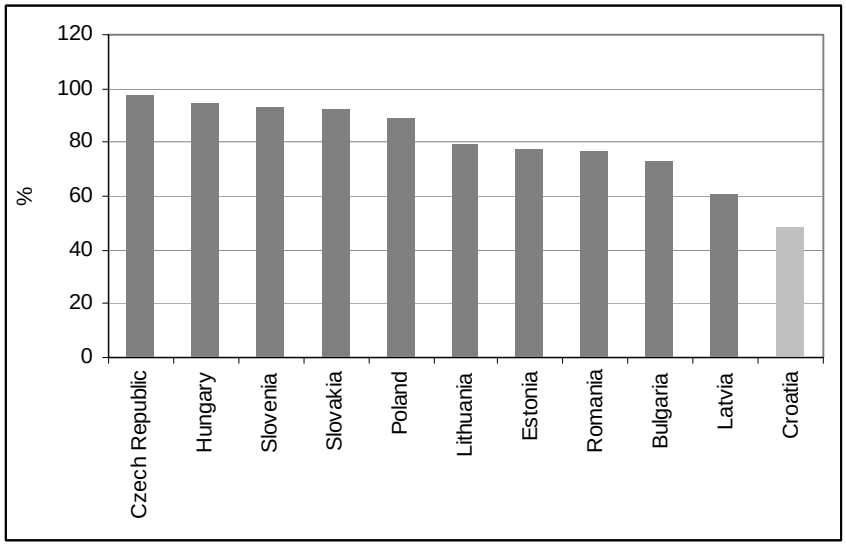
Figure 1: Trade performance, 2000 - 2007



Source: Croatian Bureau of Statistics

During the period in question, Croatian merchandise trade was characterized by constant growth of both imports and exports. Much stronger growth of the former resulted in a very low coverage ratio, with exports accounting for, on average, just under half of total imports (48.6%). The reasons for such dismal trade results can be found in the numerous deep structural problems and low competitiveness of the economy after the collapse of the centrally − planned economic system and the negative consequences of the mismanaged process of privatization. However, although most transition countries in Central and Eastern Europe faced similar problems, none, with the possible exception of Latvia, has consistently recorded such a pronounced imbalance in international trade.

Figure 2: Average 2000 - 2007 merchandise trade coverage ratio (Exports as % of Imports)



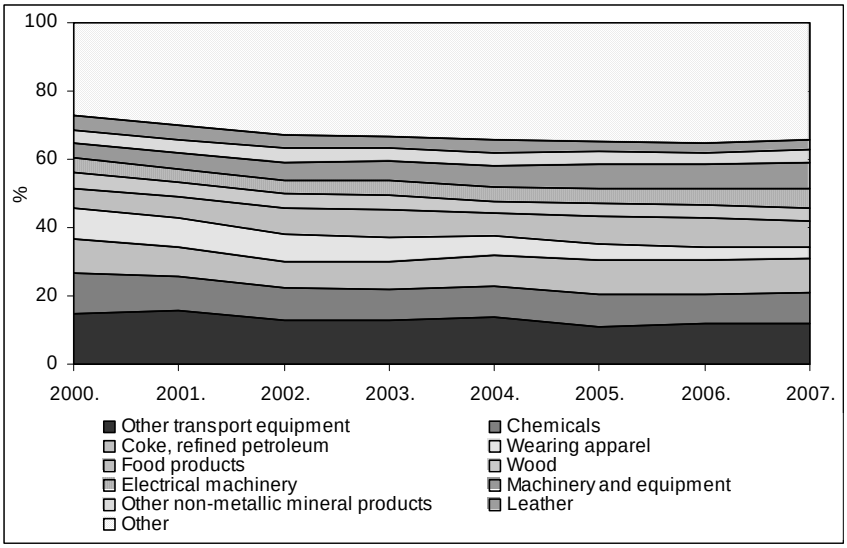
Source: Eurostat

The Croatian trade deficit has recorded extremely high growth rates in every year during the period in question, except 2004 (-2,5% annual growth, mostly due to export growth). Exports increased from EUR 4.8 billion in 2000 to EUR 9.0 billion in 2007, with an average annual growth rate of 10,7%. Growth was considerably slower, if not altogether absent, during the first half of this period, recording much more dynamic growth in the later years.

Imports more than doubled in the same period, increasing from EUR 8.6 billion in 2000 to EUR 18.8 billion in 2007, with an average annual growth rate of 12.6%. Growth was slowest in 2004, increasing only 6.5%. The fact that Croatian imports grew at a much higher rate than the nominal GDP, which averaged 8.9% growth in the same period, should indicate a relatively high income elasticity of imports.

Given that the analysis is based on sectoral imports and exports according to the National Classification of Economic Activities (NCEA), it is important to look at structural dynamics in order to be aware of certain issues which might to some extent affect the outcome as well as the validity of the analysis. It is particularly important to take into account developments in those sectors which, due to their share in total exports and their higher volatility, significantly determine movements in aggregate exports. The most important of these is export of other transport equipment (NCEA 35), which in the case of Croatia mostly consists of ships, and which had the highest, albeit slightly decreasing, share in total exports during the analyzed period. This sector is characterized by significant differences in dynamics within each year, both of imports and exports, which is due to the very high value of individual ships, as well as to the method of gross accounting applied when recording their imports and exports. Significant seasonal volatility is also present in many other sectors, particularly in the export of textiles (NCEA 17) and wood (NCEA 20). In general, using disaggregated trade data for shorter time periods is problematic in the case of Croatia, because the values of imports and exports often vary widely from period to period, and even more so when sectors are very narrowly defined. Available quarterly data would have had to have been seasonally adjusted, which still would not have eliminated the problem entirely (Mervar, 2003), and it is due to these problems that annual data is used in this analysis.

Figure 3: Structure of exports according to NCEA, 2000 − 2007.

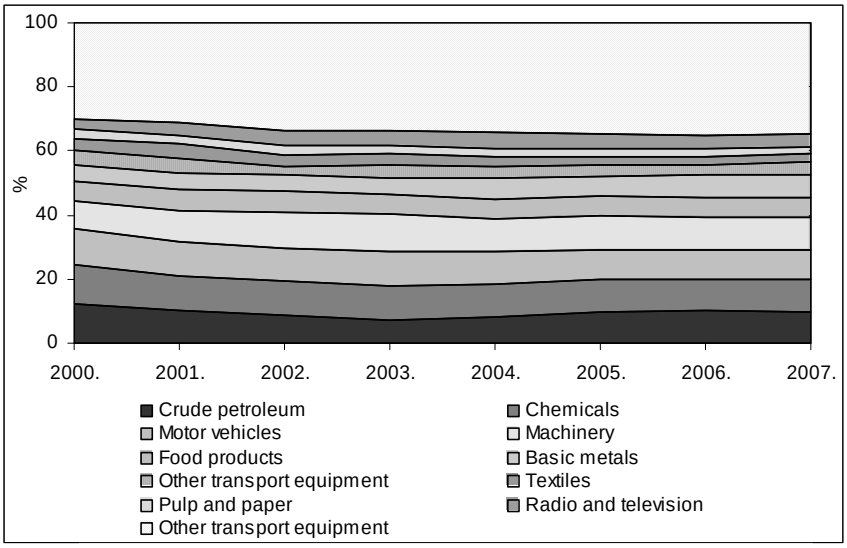


Source: Croatian Bureau of Statistics

Another point which has to be taken into account is the fact that the changes in the value of exports of certain sectors were highly dependent on administrative decisions, such as in the case of the exports of fish (NCEA 5), which depend to a large extent on quotas for fishing and exports of certain kinds of fish; of tobacco products (NCEA 16), where the price of the final products is regulated by the state; of food products (NCEA 15), etc.

As was the case with exports, no significant changes were recorded in the structure of imports, in which ten sectors with the largest share in the total made up for more than 65%. In fact, four sectors accounted for more than 10% each: crude petroleum, chemicals, motor vehicles and machinery and equipment.

Figure 4: Structure of imports according to NCEA, 2000 − 2007.



Source: Croatian Bureau of Statistics

3. Theoretical basis and issues in trade modeling

The framework and methods of trade modelling are numerous and the choice is determined by several factors: whether the purpose of the model is hypothesis-testing or that of forecasting future movements in the trade balance; data availability and the level of its disaggregation; the type of traded goods; and, ultimately, the final purpose of the model (Algieri, 2004).

Models of trade can essentially be divided into two basic groups – perfect and imperfect substitution models. Given that empirical evidence shows that prices of goods in different countries do not seem to converge to a single price, the law of one price does not appear to hold. The causes of international arbitrage inefficiency in the setting of one world price are many, but their discussion is outside the scope of this paper; however, it does indicate that the latter model is more suitable in this context.

3.1. Imperfect substitutes model

The basic assumption of this model is that neither imports nor exports serve as perfect substitutes for domestic goods. This assumption has for the most part been confirmed empirically, both in the short and in the long run. If domestic and foreign goods were perfect

substitutes, then countries would specialize, either only importing or only exporting each particular good. In practice, however, both domestic and imported goods can be found coexisting on markets, indicating that countries do not in fact specialize to such a high degree. If we were to analyze only trade of certain goods, the perfect substitutes model could be applied, such as in the case of some undiversified goods (for example, wheat or other agricultural products). However, given that in this paper we analyze total merchandise trade divided into sectors within which there is still a large number of very different goods, the application of the prefect substitutes model would not be appropriate.

The models of import and export demand assume that households first choose the level and structure of consumption which maximizes their utility and then allocate the chosen level between domestic and imported goods. The same is true of intermediary and investment goods, the demand for which is the result of the minimization of a cost function with a given level of production and input prices (Cubadda, Fachin i Nucci, 1999.). The result is therefore the same for all markets and all types of goods, and that is that sectoral imports depend on domestic demand in the importing country and relative prices. In line with that, import and export demand is specified as a function of the level of income in the importing country and of the price ratio of domestically produced goods and their imported substitutes.

$$I_i = f(Y_i, PIm_i / P_i)$$

$$X_i = f(Y_i^*, PEx_i / P_i^*)$$

where:

I_i ... imports;
X_i ... exports;
Y_i ... domestic income;
Y_{i*} ... world income;
PIm_i ... import prices;
PEx_i ... export prices;
P_i ... price of domestic goods;
P_{i*} ... price of foreign goods on the world market;
i ... groups of goods 1, ... 30, according to NCEA classification.

The model is specified as an exponential function, which means that applying a logarithmic transformation also modifies the hypothesis which is being tested; given that what is being estimated are coefficients on logs, they can be interpreted as elasticities. This type of specification is more appropriate for the description of nonlinear factors which determine growth, with an additional advantage in the fact that it reduces the impact of the size of each sector on estimation results, which could otherwise cause bias toward sectors with a larger share in the total. The coefficients on income (Y_i, Y^*) are expected to be positive, as are the coefficients on the prices of domestic substitutes in the importing country (P_i, P^*). On the other hand, elasticity coefficients on the prices of exports and imports (PIm_i, PEx_i) are expected to be negative. The income variable Y_i should reflect domestic demand for products of sector i in the import equation, just as Y^* should capture foreign demand in the export equation. Both of these variables will, however, in fact measure aggregate demand for all sectors goods, using real GDP as a proxy. While the expected sign of the coefficients is clear, hypothesizing on their absolute size is more difficult. The choice of price variables and the limitations which influenced it are discussed in more detail in Section 4. Also worth noting is the fact that the logarithmic transformation means that the coefficients on the price variables forming the ratio can be estimated separately.

In addition to these variables, other factors which potentially determine imports and exports will also be included in the estimation: the nominal exchange rate of the kuna against the euro (ER), foreign direct investment (FDI_i) and tariffs on imports ($Tariff_i$). Tariffs are introduced into the model because they represent one of the most common barriers to uninterrupted trade flows between countries and, as such, contribute to the market imperfections preventing the formation of a single world price. The exchange rate, on the other hand, affects the competitiveness of the economy as a whole, determining the price of a foreign product in domestic currency and vice-versa. Foreign direct investment influence supply-side determinants of exports and imports, reflecting to some extent the quality of physical capital as well as worker skills and market penetration potential (Benaček, Prokop, Višek, 2003). Therefore the functions which will in fact be estimated are specified as:

$$I_i = f_I(GDP, P\,Im_i, P_i, ER, FDI_i, Tariffs_i)$$

$$X_i = f_I(GDP^*, P_i^*, PEx_i, ER, FDI_i)$$

3.2. Econometric methods and issues

The previous version of this model was static OLS with fixed cross-section effects used to control for exiting differences between NCEA sectors (estimation results using this method are reported in the Appendix). However, the nature of the relationships being investigated and the dynamic aspect of data adjustment prompted the estimation of a dynamic model instead. If a static model is estimated and the underlying dynamics ignored, significant information might be lost, resulting in poor estimation results. By estimating a dynamic model, although the coefficient on the lagged dependent variable is of no particular interest, dynamics are allowed for in the underlying processes, which in turn might be essential for the recovery of consistent estimates of other parameters (Bond, 2002). The inclusion of lagged quantities, in addition to accounting for rigidities in adjustment, also lessens the problem of omitted variables. The dynamic model is then specified as:

$$y_{it} = \alpha y_{i,t-1} + \beta x_{it} + (\eta_i + \varepsilon_{it}) \qquad \text{Eq. (1)}$$

where y_{it} is the value of the dependent variable of sector i in period t; $y_{i,t-1}$ is the value of the dependent variable for the same sector lagged one period; x_{it} is the vector of explanatory variables for sector i in period t; η_i are the individual effects and ε_i is the disturbance term. The sectoral effects are being treated as stochastic, while a further assumption critical for the consistency of the model is that the disturbances ε_i are serially uncorrelated. The fixed effects model, which would control for sectoral differences when estimating a static model, is not applicable in this case. In order to remove individual sectoral effects, the equation is instead transformed by first-differencing. The most appropriate framework for obtaining estimates in this context is the Generalized Method of Moments (Arellano and Bond, 1991); the transformed model is then given by:

$$\Delta y_{it} = \alpha \Delta y_{i,t-1} + \beta x_{it} + \Delta \varepsilon_{it} \qquad \text{Eq. (2)}$$

where $\Delta y_{it} = y_{it} - y_{i,t-1}$. Estimation by GMM uses a different number of instruments for the lagged dependent and other endogenous variables for each period, depending on how many are available. In addition, the estimation may include other variables which are exogenous and therefore need not be instrumented. Arellano and Bond (1991) propose the use of lagged

levels of the endogenous variables as instruments, since this would result in a more efficient estimator, taking into account all available moment restrictions. In the case of the lagged dependent variable, valid instruments will be those which are correlated with $\Delta y_{i,t-1}$ and uncorrelated with Δv_{it}. An instrument which satisfies this condition is the lagged level of the dependent variable, since it is correlated with its first-difference, but orthogonal to the differenced disturbance term. In other words, in $t = 3$ the instrument for $\Delta y_{i,2}$ in Equation (2) is $y_{i,1}$; if $t > 3$ more lags may be used as instruments, so in $t = 4$ potential instruments for $\Delta y_{i,3}$ are both $y_{i,1}$ and $y_{i,2}$. The explanatory variable x, if assumed to be endogenous, is treated symmetrically with the lagged dependent variable y_{t-1} (Bond, 2002).

The validity of the assumptions can be tested in two ways: firstly, by testing for no second-order serial correlation in the first-difference residuals, a condition essential for obtaining consistent estimates, the initial hypothesis of no serial correlation in the original disturbance term can be confirmed (Arellano and Bond, 1991); secondly, if $t > 3$ the model is overidentified and the Sargan test can be used to test for overidentifying restrictions. The first condition of no second-order serial correlation, crucial for the validity of the instruments, requires $E[\Delta u_{it} \Delta u_{it-2}] = 0$, which is only defined for $t \geq 5$. Testing for validity of the instruments by using the test of overidentifying restrictions in effect tests for correlation of the residuals with all exogenous variables. The Sargan test will be constructed using the fact that $t > 3$ and the reported J-statistic.

3.3. Overview of existing literature

Within the large body of research on this topic of particular interest are papers which have dealt with the estimation of import and export elasticities for countries in the region and are comparable to Croatia, such as the Czech Republic, Slovakia and Poland. The estimates obtained in these papers often differ to a significant degree, not only among different countries, but also for the same country in different estimations. This is to a certain extent the result of differences in model specification, the choice of variables and the econometric methods applied in each case. On the other hand, a common characteristic of most of these papers is that their theoretical foundation is in the imperfect substitutes model.

The papers by Houthakker and Magee (1969), and Goldstein and Khan (1985) presented a comprehensive theoretical overview of the issues and techniques in modeling trade elasticities as well as empirical results for a number of countries, serving as a basis for many researchers in the field. Benaček, Prokop and Višek (2003) applied panel data methods on sectoral data for Czech trade flows, estimating static random and fixed effects models, while an updated version of the paper (Benaček, Podpiera and Prokop, 2005) estimated both a static and a dynamic model, the latter using thw two-step Arellano-Bond method; Tomšik (2000) also estimated Czech import and export elasticities using OLS on aggregate trade series and those of particular sectors. The latter approach was used in Vagač et al. (2001) on Slovakian trade data, while Algieri (2004), analyzing Russian data, and Catão and Falcetti (2002), for Argentinean trade data, estimated elasticities using an error-correction model. While the estimates in some papers confirmed the theoretical expectations about the sign, as well as size of the elasticity coefficients, others obtained results which to a certain extent differ from what was expected (Table 1).

Income and price elasticities of Croatian trade have previously been the topic of analysis in Mervar (2003), with the export and import functions being estimated using OLS as well as other methods; this was done both for aggregate imports and exports, but also for particular sectors according to the Standard International Trade Classification (SITC).

The values of the estimated income elasticity coefficients lie in the range from 0.17 to 5.3, while price elasticities varying from positive to negative values. In addition to the various methods used in the estimations, different data series were used for certain variables. For instance, in the case of the price variable, the data series which were used included unit value indices, producer and consumer price indices, etc.; similarly, for the income variable both nominal and real GDP were used, as well as real GDP reduced by exports, consumption and industrial production. Table 1 gives an overview of elasticity coefficients obtained in the aforementioned papers; in cases where multiple coefficients were estimated, the number included is that obtained in the way most similar to the methods applied in this paper.

Table 1: Estimated income and price elasticities for comparable countries

	Exports		Imports	
	Income elasticity	Price elasticity	Income elasticity	Price elasticity
Tomšik (2000) - Czech Republic	5.29	not significant	1.10	not significant
Benaček, Podpiera, Prokop (2005) - Czech Republic	1.55	0.14	3.08	0.23
Vagač et al. (2001) - Slovakia	-	-	1.99	-1.39
Wdowinski, Milo (2002) - Poland	2.10	-0.85	1.87	-1.05
Mervar (2003) - Croatia	0.86	not significant	2.04	-1.74

4. Selection of variables in the model

The previous section dealt with the theoretical background and described what should, according to theory, explain movements in the dependent variables - imports and exports. Conversely, this section lists variables and explains particularities of the data series which were actually included in the empirical analysis. The differences between theory and practice in this case arise primarily as a result of data availability.

4.1. Exports and imports

The estimations are based on real imports and exports data[1], that is, volumes of exports and imports in tonnes, as comparable units across all sectors. The panels therefore consist of 30 sectors according to the National Classification of Economic Activities (NCEA) for the period from 2000 until 2007. A similar approach, namely the estimation of elasticities based on trade volumes, is used in most empirical research, although there are exceptions such as in Benaček, Prokop and Višek, (2003.), who used nominal values. However, using values of imports and exports means the dependent variable already contains price effects, thus biasing the estimation.

[1] According to trade data of the Croatian Statistics Bureau.

4.2. Income

The income variable in the export equation is proxied by world total real GDP, whereas in the import equation real GDP for Croatia was used to proxy for domestic income. The choice of income variable in the literature has varied widely: in estimating export and export elasticities, Goldstein and Khan (1978) use real income of the importing economy, more specifically weighted average real income of all trade partners in the export equation; Senhadji and Montenegro (1998) use trade partners' weighted average GDP minus their exports, while Tomšik (2000) uses industrial production in estimating import elasticities.

Given that it could be argued that Croatian exports do not depend on changes in global income, but rather on that of importing countries, alternative specifications containing relevant data series were also tested. Among these are series such as the GDP of Croatia's main trading partners, both the total and weighted by their respective shares in Croatian exports or total trade. However, estimation results do not show a significant difference between these alternative measures of income nor any advantage of their inclusion in the specification; indeed, world income proves to consistently have a good fit, as opposed to some of the aforementioned alternatives. Furthermore, weighting the income variable with country shares in exports or imports would potentially introduce the impact of changes in the dependent into the explanatory variable, which could affect the validity of the analysis.

4.3. Prices

Exports and imports do not depend on their respective prices simply as such; rather it is their value relative to prices of same or similar products in the importing country that affects trade flows. An increase in prices of foreign goods in comparison with those in the importing country means, on the one hand, relatively more expensive imports which will work to lower imported quantities. On the other hand, exports will now be relatively cheaper, thereby increasing in volume. The ideal price index to be included in the import function would have to reflect changes in the prices of all imported goods relative to those of domestically produced substitutes in the importing economy, while that in the export function would have to compare the prices of all exports as opposed to those of competing goods produced abroad. It is immediately obvious that such indicators, at least on a disaggregated level, cannot be

constructed, particularly in the case of world prices of export substitutes. It is for this reason that various alternative indicators are used, all of which have certain advantages as well as drawbacks. The choice of indicator therefore depends on data availability and on the characteristics which are considered more useful and important in each particular case depending on the purpose and objectives of the analysis (Goldstein and Khan, 1985). For instance, Tomšik (2000) uses PPI, CPI and the harmonized index of consumer prices (HICP) in the importing country and in the rest of the world; Benaček, Prokop and Višek (2003) use unit value indices[2], while Vagač (2001) uses a combination of import price indices and PPI.

One of the possibilities is to compare price levels in the country with the price level in its trade partners; however, such data does not fit the purposes of this analysis nor does it have the necessary scope and level of disaggregation. Domestic CPI is a measure of the price level of all goods on the domestic market, both domestically produced and imported, which means that it cannot be used as a proxy only for export prices. PPI, on the other hand, does not include all the sectors which are part of the analysis. Furthermore, the price of a particular domestically produced good on the domestic market and its export price can diverge to some degree for longer periods of time as a consequence of various market imperfections (Goldstein and Khan, 1985).

Due to these limitations and lack of availability, the price indicators which were ultimately used in the analysis are unit value indices calculated from disaggregated data on euro values and quantities of exports and imports for the period in question. These indices have certain shortcomings which need to be taken into account, most important of which is the fact that aggregating data by sectors is likely to result in some loss of information; another significant problem is the influence which the changes in import and export structure have on the value indices. Namely, goods with high price variability may often have very low elasticity to those price changes, which would negatively bias the estimated price elasticity if the analysis was based on data with some level of aggregation. Furthermore, although goods in each particular group of the NCEA sectorization are similar, these sectors are nevertheless not perfectly homogenous and can contain goods which are notably different in type, size, weight, quality and price. Determining one unique price for each sector means that there will be discrepancies

[2] Unit value indices are calculated by dividing the total value of a product group by its quantity. Unit value indices are not strictly *price indices* since their changes may be due to changes in both prices and quantity. However, they are frequently used in economic analysis as a substitute for price indices.

between that price and the "real" price. Moreover, a decrease in the imported quantity of a particular good will lower its weight in the price index, meaning that a potential increase in the price of that good need not necessarily be reflected in an increase of the price index itself. In this sense, a unit price index would prove to be a better indicator than a unit value index, but its lack of availability, as well as that of other more precise data, means that the latter index is the best available alternative. Hence value per tonne, as a comparable unit for all sectors, is used as an approximation of unit value. All the limitations of the data described in this section have to be borne in mind when interpreting the estimation results. Most of the relevant literature and research dealing with this topic for the same practical reasons uses similar alternatives (Goldstein and Khan, 1985).

Despite the potential theoretical and methodological issues which could be reflected in the difficulty of interpreting the estimation results, the unit value index used here still contains very relevant information, useful in determining the impact of price changes on exports and imports, as well as on competitiveness through prices and quality. However, it is important to note that separating the effects on competitiveness of price and quality is difficult. It is to a certain extent possible to discern between the two, if the variable is statistically significant, by the sign on the coefficient (Benaček, Prokop, Višek, 2003). That is to say, a negative coefficient means that a decrease in export prices results in an increase in exports; the fall in prices could, in turn, either be a result of lower production costs or of lower quality. Clearly, an increase in exports cannot logically be a result of their lower quality, so it can be inferred that in this case the prevailing effect at work is that of price competitiveness. Conversely, if the coefficient is positive and significant, then the opposite is true - an increase in exports is most probably the result of higher quality, rather than of higher costs. Obviously, separating these effects is not usually so straightforward given that both effects may simultaneously be at play; the problem is even more difficult if they are working in opposite directions, making it impossible to determine the underlying factors.

It should be also be noted that the unit value index expressed in euros, as calculated from euro value and volumes data, to some extent also contains the effects the exchange rate has on prices. The intensity of this effect is determined by the way in which producers/exporters set prices of particular goods being exported, that is, whether they set prices in kuna or in euros. If exporters initially determine prices in kuna, independently of what they will be when converted into euros and only taking into account production costs, an increase in prices will

not necessarily result in a decrease in exports, because the final effect will depend on exchange rate movements. A depreciation of the kuna against the euro will dampen the impact of a price increase, resulting in a lower absolute value of the estimated coefficient. On the other hand, if exporters take the exchange rate into account when setting prices, the previously described effect will not occur, with the elasticity coefficient reflecting only the real price effect. On the imports side, it is assumed that exchange rate movements will have no impact on import prices which are in euros.

4.4. Exchange rate

The exchange rate variable which would, in this analysis, be the most appropriate competitiveness indicator of the economy as a whole is the real effective exchange rate, that is, the nominal exchange rate corrected for the price levels in the country and in the most important trade partners. However, the inclusion of this variable would mean that the effect of relative prices is accounted for twice - in the exchange rate and in the price variables. Therefore the nominal effective exchange rate, a weighted geometric average of bilateral nominal exchange rate indices of the kuna against the currencies of the five most important trade partners (eurozone, USA, Switzerland, Great Britain and Slovenia[3]), seems a viable alternative. A problem with this indicator arises, however, from the much higher volatility of the kuna/dollar exchange rate than that of the kuna/euro exchange rate and the high negative correlation of their rates of change. This means that the nominal effective exchange rate therefore reflects mostly the kuna/dollar rate movements, despite the euro's much higher share in total trade.

The limitations of these indicators prompted the use of only the nominal kuna/euro exchange rate, which is justified by the fact that the euro accounts for by far the largest portion in the merchandise trade currency structure. During the eight years under consideration, the share of the euro in total exports was 67% on average, and 70% in total imports. A decrease in the exchange rate reflects an appreciation of the kuna against the euro, which results in relatively cheaper imports and more expensive exports. This in turn means that the coefficient on the exchange rate variable should be positive in the export and negative in the import function.

[3] During most of the analyzed period, Slovenia was not as yet a member of the eurozone, entering in January 2007.

4.5. Foreign direct investment

Foreign direct investment should have a much stronger impact in the export equation, in which the interpretation of the coefficient is also much clearer than is the case with the import equation. An increase of FDI in a particular sector can be expected to increase its competitiveness and productivity - higher levels of investment should indicate that a given sector has some comparative advantages and the potential for growth, because it wouldn't have been able to attract investment otherwise (Benaček, Prokop, Višek, 2003). Higher competitiveness should then be reflected in higher exports. Low levels of investment, on the other hand, could mean that growth potential has not been recognized in a particular sector, which in turn means that it should export less. Therefore the sign of the coefficient on FDI in the export equation is expected to be positive.

4.6. Tariffs

The model, as described in the previous section, would be a realistic description of real-world developments if there were no impediments to international trade. However, these barriers are in fact numerous, the most important form of which are tariffs. We will ignore the existence of export tariffs, as they are usually much rarer. Apart from export tariffs, the export function also does not include tariffs levied to Croatian exports in importing countries. The very large number of countries to which goods are exported and the resulting equally large number of different tariffs being applied to those exports makes the construction of a single tariff indicator very difficult. Even if necessary data were available, the calculation of an "average" tariff would be very complex and prone to errors, resulting in a series which might only be a very rough approximation of the real tariff rates being applied. Indeed, trying to determine average rates when the differences between the tariff rates are so many and occasionally so large, could lead to wrong conclusions about the factors affecting trade flows and bias the whole analysis. Therefore, the impact of tariffs was included only in the import equation.

Tariff rates used in the estimation were calculated from data on values, tariff rates and tariff - exempt quotas according to the detailed tariff nomenclature[4]. Using this data, tariff revenues were calculated for each product category, which were then sorted into appropriate NCEA categories. Finally, these revenues were divided by the total value of imports in order to obtain the implied tariff rate for each sector.

5. Estimation results

While the fact that prices determine, to different degrees, imported and exported quantities is certainly true, it is also possible that the causal relationship works the other way around as well; in other words, quantities of exported or imported goods may influence the price asked for those same goods. On the other hand, in the case of a small country such as Croatia, which cannot significantly affect prices, it may be argued that prices should be taken as given, i.e. exogenous. However, imposing strict exogeneity assumptions in this case, meaning that prices would have to be treated as entirely independent of past or present exported/imported volumes, is too restrictive. Import and export prices are here therefore treated symmetrically with the lagged dependent variable, that is, instrumented with their lagged values. The other explanatory variables are assumed to be exogenous and not correlated with the individual sectoral effects. Two lags, $t - 2$ and $t - 3$, were used as instruments for the endogenous variables, which is prompted both by the relatively small sample size and the fact that additional lags brought little increased efficiency to the estimation, as measured by the standard errors.

5.1. Export function

Results of the export model estimation are summarized in Table 2. Due to high correlation between the import and export price variables, as well as the fact that their coefficients can be estimated separately, the former was dropped from the model owing to its lower statistical significance.

[4] The calculation is based on trade and tariff data provided by the World Trade Organization, according to the standardized Harmonized System 6-digit subheading level.

Table 2: Export model estimation results

	Coefficient	Std. Error	t-Statistic	Probability
GDP world	1.983	0.115	17.295	0.000
Export price	-0.578	0.053	-10.990	0.000
Exchange rate (HRK/EUR)	-0.561	0.415	-1.351	0.179
Cross-section fixed (first differences)				
SE of regression	0.166	Sargan test p-value		0.1824
J-statistic	19.733	2nd order autocorr. p-value		0.50

Both real GDP and export prices are significant and have the expected signs on the coefficients − world GDP growth will have a positive effect on Croatian exports, while an increase in prices will be reflected negatively in exported quantities. The negative coefficient on prices, apart from indicating that lower prices result in higher exports, also means that the competitiveness of Croatian exports manifests itself primarily through prices. In other words, these results seem to indicate that total exports are dominated by sectors that produce goods which are not high-quality and high value-added, meaning that increasing exports with the current structure in place will mostly be a result of lower prices, rather than increases in quality. It has to be noted that the possible presence of the exchange rate effect, described in Section 4.4 might mean that the elasticity coefficient is in fact higher, in absolute terms, than the one obtained here.

The nominal kuna/euro exchange rate does not appear to have a statistically significant effect on changes in exports[5], which is certainly not in line with expectations. However, given that the kuna showed an appreciation tendency during most of the eight-year period in question, strengthening against the euro by 7.3%, at the same time that exports were increasing as well, so that an absence of a statistically significant positive coefficient in the model is not in fact a surprising result. FDI does not appear to have a statistically significant impact on export volumes.

[5] The nominal exchange rate is the same for the whole economy, as opposed to the price variable which differs by sector, resulting in no significant correlation between these two series.

Both instrument tests confirm the validity of the instruments, as reported in the table. Neither the second-order serial correlation nor the Sargan tests reject the null hypothesis of serially uncorrelated errors.

5.2. Import function

Table 3 presents the import model estimation results. The coefficient on prices is, similarly to exports, negative and lower than one in absolute value. Relatively low price elasticity is in fact to be expected in the case of imports, as a result of the very high import dependence of the Croatian economy. The positive income elasticity coefficient of 2.22 is also within expectations and slightly higher than that for exports. This result is consistent with the observed widening of the trade imbalance during the analyzed period. If these coefficients are stable, they seem to indicate that income growth in Croatia would always have to be lower than the world average in order for the trade balance not to increase further. Given that the growth rate of real GDP in Croatia was slightly higher on average from 2000 until 2007 than that of world real GDP, and noticeably higher than in its most important trade partners, the difference between coefficients is in line with the growing trade gap.

Table 3: Import model estimation results

	Coefficient	Std. Error	t-Statistic	Probability
GDP_Croatia	2.219	0.071	31.480	0,000
Import price	-0.880	0.040	-22.097	0,000
Tariffs	-0.045	0.005	-8.886	0,000
Exchange rate (HRK/EUR)	-0.926	0.136	-6.797	0,000
Cross-section fixed (first differences)				
SE of regression	0.139	Sargan test p-value		0.3013
J-statistic	21.664	2nd order autocorr. p-value		0.72

The negative coefficient on tariffs, although statistically significant, is almost negligible (-0.045), indicating that the use of tariffs to dampen import growth has a very limited effect; FDI, as in the case of exports, was not significant. Unlike exports, imports are affected by

exchange rate changes, as evidenced by the statistically significant coefficient close to -1. Since the kuna recorded a steady appreciation against the euro during most of the eight years in question, this coefficient indicates that it has had a stimulating effect on imports, which were relatively cheaper than domestic goods thanks to the strong kuna. As is the case with exports, the Sargan test and the second-order serial correlation do not indicate any dynamic misspecification.

6. Conclusion

The aim of this paper was to estimate income and price elasticities of imports and exports, as well as to quantify the effect of other potential trade determinants. The estimated model is based on the imperfect substitutes model, which is in line with most empirical work on this topic. The basic hypothesis tested here was the dependence of export and import volumes on changes in income of the importing country as well as on changes in relative prices of domestically produced goods and their imported substitutes. In addition, the impact on trade of changes in other variables, such as the exchange rate and tariffs, was also tested within the model. Issues with data availability, its consistency and the length of the data series have significantly influenced the variables included in the model as well as the estimation technique.

In the estimation, dynamic panel data methods were applied to disaggregate data which allowed for sectoral differences in the data as well as for dynamic adjustment of the data through time. The Arellano-Bond method was used to estimate the model in first differences, where the lagged dependent and potentially endogenous explanatory variables were instrumented with their lagged levels.

The income and price elasticity coefficients, both in the import and in the export model, have the expected signs - increases in income positively affect exports and imports, while increases in prices lower them. Judging by the size of the coefficients, income effects appear to be much more substantial than price effects, which confirms the results obtained in Mervar, 2003, and is similar to results for most other countries. The somewhat higher income elasticity of imports than that of exports is in line with the observed widening of the trade gap during the analyzed period, given the rates of growth of the Croatian economy versus world

GDP growth. The signs on the price coefficients also seem to indicate that, in the case of Croatian exports, competitiveness works primarily through prices, rather than through quality of the goods. Results also imply that the exchange rate, frequently stressed as a key factor contributing to trade imbalances, does not in fact have such a strong role in determining export flows, while it does appear to have contributed to import growth. In this sense, the use of currency depreciation as an export promotion tool is not validated by the results of this estimation.

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Appendix

1. Results of the OLS fixed effects estimation

Exports (volumes), OLS cross-section fixed effects

	Coefficient	Std. Error	t-Statistic	Probability
C	-0.015226	0.042314	-0.359827	0.7195
GDP_WORLD	2.614040	1.136518	2.300042	0.0229
EX_PRICE	-0.628015	0.096338	-6.518851	0.0000
HRK_EUR	-1.006002	0.527598	-1.906757	0.0586
Cross-section fixed (dummy variables)				
Adjusted R-squared	0.444070			
S.E. of regression	0.116679			
F-statistic	6.029405			
Prob(F-statistic)	0.000000			
Durbin-Watson stat	2.047735			

Imports (volumes), OLS cross-section fixed effects

	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.091789	0.051722	-1.774649	0.0795
GDP_Croatia	3.881960	1.089402	3.563386	0.0006
IM_PRICE	-0.920175	0.024596	-37.41152	0.0000
Tariffs	-0.031149	0.010692	-2.913395	0.0046
HRK_EUR	-0.617684	0.323299	-1.910565	0.0594
Cross-section fixed (dummy variables)				
Adjusted R-squared	0.786766			
S.E. of regression	0.052013			
F-statistic	16.75210			
Prob(F-statistic)	0.000000			
Durbin-Watson stat	2.060308			

2. List of NCEA sectors included in the analysis

01 Agriculture, hunting and related service activities
02 Forestry, logging and related service activities
05 Fishing, operation of fish hatcheries and fish farms; service activities incidental to fishing
10 Mining of coal and lignite; extraction of peat
11 Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction
13 Mining of metal ores
14 Other mining and quarrying
15 Manufacture of food products and beverages
16 Manufacture of tobacco products
17 Manufacture of textiles
18 Manufacture of wearing apparel; dressing and dyeing of fur
19 Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
20 Manufacture of wood and products of wood and cork; manufacture of articles of straw and plaiting materials
21 Manufacture of pulp, paper and paper products
22 Publishing, printing and reproduction of recorded media
23 Manufacture of coke, refined petroleum products and nuclear fuel
24 Manufacture of chemicals and chemical products
25 Manufacture of rubber and plastic products
26 Manufacture of other non-metallic mineral products
27 Manufacture of basic metals
28 Manufacture of fabricated metal products, except machinery and equipment
29 Manufacture of machinery and equipment n. e. c.
30 Manufacture of office machinery and computers
31 Manufacture of electrical machinery and apparatus n. e. c.
32 Manufacture of radio, television and communication equipment and apparatus
33 Manufacture of medical, precision and optical instruments, watches and clocks
34 Manufacture of motor vehicles, trailers and semi-trailers
35 Manufacture of other transport equipment
36 Manufacture of furniture, manufacturing n. e. c.
40 Electricity, gas, steam and hot water supply