Determinants of Estonian Export of Goods: An Econometric Analysis and Comparison with Latvia and Lithuania

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Tallinn
2001

The goal of this paper was to analyse empirically the importance of different determinants of Estonian export and compare the results with Latvia and Lithuania. For a theoretical model, the imperfect substitutes model was chosen.

For empirical estimation Estonian nominal export was disaggregated by commodity groups, by customs procedures and by groups of destination countries. Besides that an equation of real aggregate goods' export and models of Latvian and Lithuanian export by commodity groups were estimated.

According to estimated models Estonian export is mainly determined by manufacturing output in Finland and Sweden and real economic growth in other EU countries. Also real consumption in neighbouring countries is important for Estonian export, but here the countries of influence change – the influence of Russia declines as the influence of Western countries rises. Prices and exchange rates have smaller effect to Estonian exports.

The comparison of the results of Estonian export modelling to those of Latvia and Lithuania shows that the main determinants of export in three countries are different. While Estonian export is mainly influenced by Nordic economies, Latvian and Lithuanian export is mainly influenced by Germany and the UK. The influence of Russia has declined in all three countries, remaining the highest in the case of Lithuania.

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Introduction

During the period of Estonian own currency, export has been one of the leading factors of economic growth in Estonia. When export sector has grown, also the whole economy has grown. When there has been an export crises (for instance end of 1998 – beginning of 1999), the whole economy has gone to recession.

In spite of its importance, export has been one of the most difficult economic indicators to forecast. The biggest mistakes in economic forecasting made by this time (for instance underestimating the recession in 1999) have been mostly due to mistakes in the forecasts of export. This has brought about the need for a thorough econometric analysis of the importance of different determinants of Estonian export. Such an analysis could then be used in improving the forecasts.

The goal of the paper was to find out the most important determinants of Estonian export, measure their effect and compare the results with those of Latvia and Lithuania. The following was done:

- overview of imperfect substitutes model and its previous empirical performance;
- estimation of models of Estonian disaggregated nominal export and aggregated real export of goods and tests of their properties;
- estimation of Latvian and Lithuanian export models;
- comparison of estimated models.

Accordingly the paper consists of three parts. In the first part the authors analyse the most often used theory in export modelling – the imperfect substitutes model and its empirical performance. In that part also a brief description of possible problems that may occur during the estimation is given.

In the second part of the paper the models of Estonian export are estimated and the elasticities of statistically relevant variables calculated. The estimated models are:

1) model of Estonian export of goods following the BEC-SNA division (capital goods, industrial supplies and consumption goods);
2) model of Estonian export of goods following the HS division of goods. Here the standard 21-good division is aggregated to 4, considering the similarity of goods and the destination countries;
3) model of Estonian export of goods by customs procedures (direct export and subcontract export);
4) model of Estonian export of goods by destination countries (CIS, CEE countries and Western countries).

Besides that an equation of real aggregate goods' export is estimated. After that the comparison of different models is carried out and the conclusions made.

In the third part of the paper the models of Latvian and Lithuanian exports are estimated. Because of data unavailability these models are estimated only following the aggregated HS division of goods. After that the three estimated models (Estonian, Latvian and Lithuanian) of export by HS division are compared and conclusions made.

1. Overview of imperfect substitutes model and its suitability for estimation

There are a lot of theories of international trade, for instance gravity model (Deardorff 1984, pp 503–504; application on Estonian data: Paas 2000), Hechser-Ohlin theory (Jones, Neary 1984, pp 14–20), perfect substitutes model (Goldstein, Khan 1985, p 1051), imperfect substitutes model (Ibid p 1045), neotechnology theory (Borkakoti 1998, pp 313–333), neofactor proportions theory (Ibid pp 292–312), synthesis of the last two (Borkakoti 1998, p 351) etc. At the same time only a few of them are capable of capturing the short-time effects of different variables affecting a country's export and can therefore be used in practical modelling of export time series. Probably the most often used theory in this respect is the imperfect substitutes model. This model has been a baseline in modelling export of different countries that are similar to Estonia[1], for instance Finland, Latvia etc. More detailed description of the export models where the imperfect substitutes model has been used, as well as exact quotations, are given in Table 1.

Table 1. Overview of export equations in different countries

Country	Characteristics	Year and author	Factors
Estonia	Currency board system Transition country Small state	Fainshtein (1999) Leppä, Martihhina, Meriküll (1999) van Miltenburg (1997[a])	Export prices Real exchange rate Income index in aggregated export market World GDP Cumulative investments with depreciation World price level/domestic price level Imports in the world Lags of exports Export prices/world market prices Utilisation rate
Latvia	Fixed exchange rate Transition country Small state	van Miltenburg (1997[b])	Imports in the world Export prices/world market prices Utilisation rate
Lithuania	Currency board system Transition country Small state	Kazlauskas, Leppä (2000) van Miltenburg (1997[c])	World GDP Foreign prices (EU)/domestic prices Foreign prices (CIS) multiplied with RUR exch. rate/dom. prices Imports in the world Export prices/world market prices Utilisation rate
Slovakia	Transition country Small state	Spanikova (1998)	Imports in the world Export prices/world market prices

[1] The criteria used were: small country, transition country, fixed exchange rate, currency board system.

Czech Republic	Transition country Small state	Havlicek (1996)	Lags of exports Total imports of neighbouring countries Foreign prices/domestic prices
Russia	Transition country	Ministry of Finance of Russian Federation (2000)	Lags of exports Fuel prices GDP gap Lag of exports/demand of the world Real exchange rate World price index
Finland	Fixed exchange rate Small state	Willman *et al* (1999)	World price index Demand of export markets Relative price of exported products
Luxembourg	Small state	Guarda *et al* (1998)	Foreign real total output Foreign prices/export prices
The Netherlands	Small state[2]	de Bondt *et al* (1996)	World trade Export prices/prices of competitors Utilisation rate/utilisation rate in the world

The imperfect substitutes model (Goldstein *et al* 1985, p 1045) focuses on export of goods that are not perfect substitutes of the goods in the destination country's market. This model determines the export mainly by two factors – the income level in destination country and prices at home and in destination countries. As a model:

$$X^D = f(Y^* e^+, PX^-, P^* \cdot e^+)$$
$$X^S = g\left[PX(1+S)^+, P^-\right]$$
$$X^S = X^D$$

where X^D and X^S demand for exported products in destination countries and domestic export supply;
Y^* income level in destination countries;
e exchange rate;
PX domestic export prices;
S subsidies;
P^* price level in destination countries;
P domestic price level.

The advantage of this model is that it can be used in estimating export of different products and to different destination countries. In Estonian case, however, there was a need for some additional changes:

1) the subsidies were dropped from the model, as they are not relevant in Estonian case;
2) the prices of Western, low inflation trade partners were dropped from the model because it is unrealistic that 1–4% changes in those prices would affect the competitiveness of Estonian exports remarkably as our price level is still 2.5–3 times (see for instance Sepp *et al* 2000, p 15)

[2] As compared to neighbouring country, Germany.

lower than that of our partners. Also in Estonia big share of exports is subcontract trade between foreign multinational and its Estonian subsidiaries, where prices are not determined by market;

3) different additional supply side factors to cover the rapid restructuring of Estonian manufacturing sector and therefore also the rapid change in the quality and quantity of Estonian export goods were tried. Out of them foreign direct investments appeared to have statistically significant effect in some equations.

During the estimation period Estonian export has also experienced many shocks (see Appendix 3). Out of these shocks the start and end of export to Russia through custom warehouses and the shocks caused by Elcoteq could not be modelled on macro level in most of the equations. Therefore corresponding dummies were introduced.

2. Estimation of Estonian export model

2.1. Analysis of the aggregation level

Estonian export of goods can be modelled either in constant prices (1995 prices) or in current prices. The difference between these two can be seen on Figure 1.

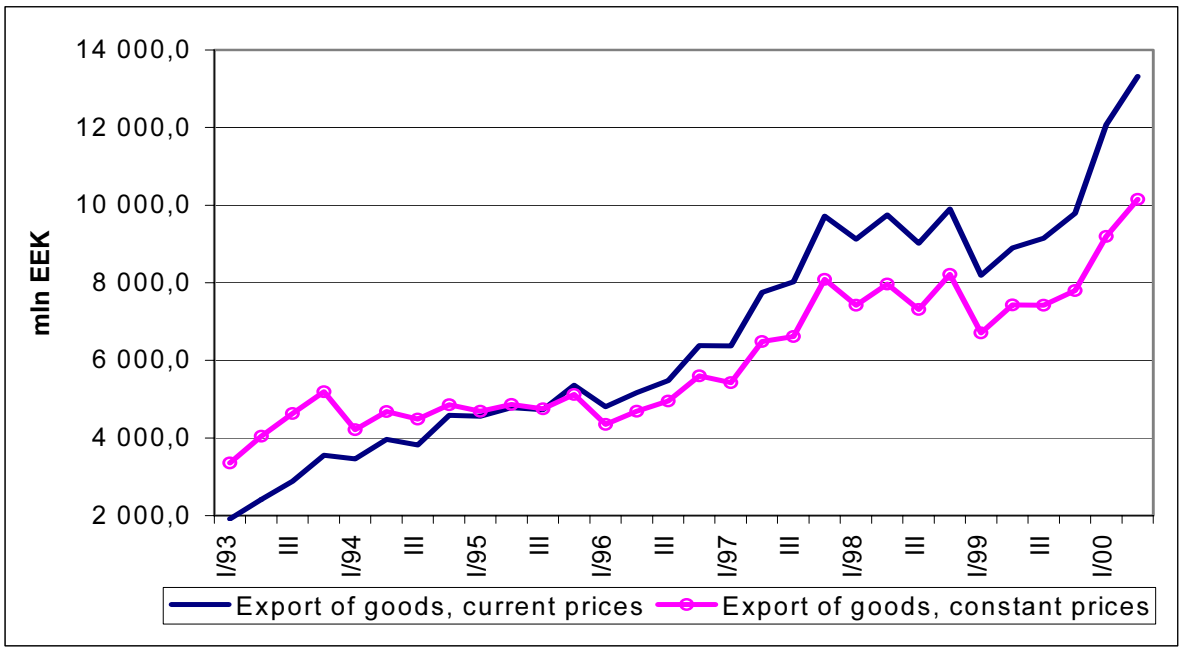

Figure 1. Export of goods in current and constant prices

In constant prices only aggregate data is available, whereas in current prices it is possible to disaggregate exports in several ways – by commodity groups, by destination countries or by customs procedures[3]. In order to be able to make comparisons and conclusions and in order to statistically find out the best way of aggregation to model Estonian export, we decided to estimate four models of nominal disaggregated export and equation of real export of goods. The four models were the following:

1) model of nominal export by commodity groups following the BEC-SNA[4] division that divides export into capital goods, industrial supplies and consumption goods (see Appendix 1.1);
2) model of nominal export following the HS division (see Appendix 1.2). Here the traditional 21-group HS division was aggregated to 4 as given in Table 2;

[3] Due to differences in methodology the sum of disaggregated export data of Eesti Pank is not always equal to aggregate export in current prices provided by Statistical Office of Estonia (see http://www.stat.ee/wwwstat/content/E_S_VK_EA). But the difference is very small and does not therefore affect the results.
[4] Broad Economic Categories – System of National Accounts.

Table 2. Aggregation of Estonian export by HS

Group	Included groups from 10-good division	Corresponding groups of 21-good division	Common features
1	Chemical products	6-7	Raw materials, main destinations Latvia and Russia
	Mineral products	5	
2	Food products	1-4	Finished goods, main destination Russia
	Transport equipment	17	
3	Machinery and equipment	16	Mostly subcontract export to Finland and Sweden
	Textile, clothes, footwear	8, 11-12	
	Furniture, toys, sport equipment	20	
	Other industrial products	13-14, 18-19, 21	
4	Wood, paper and articles thereof	9-10	Raw materials, main destination EU countries
	Metals and articles thereof	15	

3) model of nominal export by customs procedures. Here export was divided in two groups: subcontract export (procedure 3151 *Re-exportation after inward processing*) and direct export (procedure 1000 *Direct exportation* and all other procedures except 3151; see Appendix 1.3);
4) model of nominal export by destination countries. Here two equations were estimated: export to CIS and CEE countries and export elsewhere (mainly to the EU; see Appendix 1.4).

2.2. Estimation results

The equations were estimated with ordinary OLS following the scheme of imperfect substitutes model. In order to get the estimation for aggregate export equations of different subgroups were summed. Explanatory variables were chosen according to: 1) the share of different destination countries in each group of export (the variables of the biggest destination country(-ies) were chosen)[5]; 2) the structure of commodities – for consumption goods the aggregate consumption of the destination country(-ies) was used, for other goods RGDP or real manufacturing output was used. In some equations of subcontract export to exporting manufacturing sector of Sweden and Finland real export of destination countries gave even better result than manufacturing output.

To catch the price effect either consumer price index (in case of Eastern trade partners) or nominal exchange rate was used. Also the deflator of Estonian export of goods was tried but it turned out to be

[5] Due to the rapid changes in the structure of destination countries, in some equations some of the explanatory variables change during the estimation period (as the influence of Russia declined and the influence of other countries rose).

statistically insignificant[6]. After estimating *ex post* forecasts were run, in order to test the forecasting accuracy of the equations.

The models estimated and their *ex post* forecasts are in Appendices 4.1 to 4.5. The notations[7] used and the sources of data are given in Appendix 2. The summary of the results is given in Table 3: Elasticities in the table are calculated at two time periods: 1998:1 and 2000:1, correspondingly. If only one elasticity is given, then the elasticities in two periods were equal by the given model.

Table 3. Summary of the results of estimation

Model	Income of Eastern trade partners and corresponding elasticities	Income of Western trade partners and corresponding elasticities, capital elasticity	Price and exch. rate variables and their elasticities	Std. of *ex post* forecast 1997:1–2000:2, mln kroons
XG by commodity groups (BEC-SNA)	RCONS_RUS 0.35; 0	RCONS_FIN 0; 0.81 RMANUF_FIN 1.06; 1.28 RMANUF_SWE 0.57; 0.58	CPI_RUS 0.15 E_RUS 0.15 E_FIN 0.3; 0.6[8]	300.3
XG by commodity groups (HS)	-	RX_FIN 0.42; 0.66 RX_SWE 1.39; 2.10 FDI 0.02	CPI_LAT 0.20 E_RUS 0.07; 0.04 CPI_EST -1.74; -1.75 E_UK 0.16; 0.21	211.4
XG by customs procedures	RCONS_RUS 0.56; 0.45	RGDP_FIN 3.15; 2.55 RGDP_GER 2.67; 2.17 RMANUF_FIN 0.37; 0.57 RMANUF_SWE 0.41; 0.63	-	280.4
XG by destination countries	RCONS_RUS 0.49; 0.25	RGDP_GER 0.59; 0.77 RMANUF_FIN 0.48; 0.62 RMANUF_SWE 0.45; 0.59	-	158.3
Aggregated XG in constant prices	RCONS_RUS 0.23; 0	RMANUF_FIN 0.88	-	151.7

According to the table and the equations in the appendices we can make the following conclusions:

- The best results in modelling Estonian export can be obtained either by estimating aggregate export or export as a sum of export to different destination countries (standard error of *ex post* forecast of those two is up to twice smaller than in other models).
- The most important determinants of Estonian export are manufacturing output in Sweden and Finland (main destinations of subcontract export) and real economic growth in

[6] Here may be two reasons: a) the prices of exports to Russia are often artificially changed in order to avoid customs tariffs and b) big share of exports to the West consists of subcontract exports between foreign multinational and Estonian subsidiaries, where the prices are formed by the will of parent company, not by market.

[7] The notations are formed as follows: RCONS, RMANUF, RX, RGDP stand for consumption, manufacturing output, export and GDP, respectively, (all in constant prices); FDI for foreign direct investments; E for exchange rate and CPI for consumer price index. RUS, FIN, SWE, UK and GER denote Russia, Finland, Sweden, the United Kingdom and Germany, respectively.

[8] EEK/FIM exchange rate fixed on January 1, 1999.

Germany (as a proxy of real economic growth of the EU[9]). The elasticity of Estonian export to those determinants is up to 3, which is very high.

- The elasticity of Estonian export to real consumption in the destination countries of consumption goods is below 1. Here the influence of Western countries rises, as the influence of Russia declines.
- The price and exchange rate variables have smaller effect.
- Foreign direct investments have small positive effect on aggregate level and this effect can be captured only in equations where the export of foreign-owned firms has a majority.
- There are a lot of sudden leaps in Estonian export that can not be modelled on macro level (for instance Elcoteq in 1997 and 2000:1, different free trade arrangements and other shocks), therefore corresponding dummy variables had to be introduced.

These conclusions show that Estonian export has overcome the Russian crises of 1998–1999. The results also show that after the reorientation of trade (from Russia towards the Nordic countries) Estonian export has become very sensitive to developments in the exporting manufacturing sector of Finland and Sweden. Such a big sensitivity is good as long as the growth in those sectors is strong, but can be a potential source of risk when the growth in those sectors weakens[10].

[9] Germany was used as a proxy of EU because data for EU is available with a big lag (before data for EU can be published, data for all EU countries has to be collected, and that takes time).

[10] Such a scenario is not very unrealistic, because for instance exports to non-EU countries (where the influence of slowing growth of US economy is rather big) account for over 16% of GDP and 44% of total exports in Finland (National Board of Customs and Statistics Finland) and over 25% of GDP and 44% of total exports in Sweden (Statistics Sweden).

3. Comparison of Estonian, Latvian and Lithuanian export models

As quarterly statistics of all three countries' disaggregated exports is available only as classification of harmonised system (HS), the commodity groups according to HS were observed. The data of traditional 21-group HS division was aggregated into four bigger groups, according to the similarity of the products (group 1 and group 4) or destination countries (group 2 and group 3)[11], as in the case of Estonia (see table 2).

The equations were estimated with ordinary OLS following the imperfect substitutes model as in the Estonian case (equations are shown in Appendices 4.2, 4.6, 4.7). The explaining variables were chosen according to main destination countries. After estimation the elasticities (notations are given in Appendix 2) were calculated for the total export in each country (see Table 4). The elasticities given correspond to the end of estimation period.

Table 4. Summary of the results of estimation for Estonia, Latvia and Lithuania

Model	Income of Eastern trade partners and corresponding elasticities	Income of Western trade partners and corresponding elasticities	Price and exch. rate variables and their elasticities
XG_EST	-	RX_FIN 0.66 RX_SWE 2.10 FDI 0.02	CPI_LAT 0.20 E_RUS 0.04 E_UK 0.21 CPI_EST -1.75
XG_LAT	RGDP_RUS 0.14 RGDP_EST 0.17	RX_UK 0.89 RMANUF_GER 1.43 FDI 0.05	E_LIT 0.53 E_RUS 0.02 CPI_LAT -0.63 XHI_FOOD -0.04
XG_LIT[12]	RGDP_RUS 0.51 RGDP_LAT 2.04	RMANUF_GER 0.62 RCONSTR_GER 0.08 FDI 0.02	CPI_LAT 0.79 E_EU 0.20 E_LAT 1.14 E_RUS 0.16 CPI_LIT -0.71

According to the estimation results following conclusions can be made:

- Estonian exports do not depend on changes in Russian GDP. As we could see there can be found a decreasing dependency on Russian consumption (see Table 3).
- Latvian and Lithuanian exports are influenced by Russian and neighbouring Baltic state income level, the dependency of Lithuanian exports on GDP in Latvia is especially great. This is mostly due to the exports of mineral fuels to Latvia.
- Western oriented exports of each country are explained by production in destination countries.

[11] See also Appendices 1.5 and 1.6.

[12] Although data based on special trade system (as was used in the case of Estonia and Latvia) is more exact it was not available in the case of Lithuania. Therefore data based on general trade system was used instead.

  - Estonian export is highly dependent on Swedish exports (elasticity 2.10), because the majority of Estonian exports is subcontract export to Swedish (also to Finnish) exporting manufacturing sector.
  - Latvian exports are quite sensitive towards a) manufacturing in Germany, which can be explained by big share of pulp of wood and timber in total exports the main destination country of what is Germany; b) Latvian textile exports depend on exports of the United Kingdom where Latvian textiles are used as input to exported textile products.
  - Lithuanian exports are also quite dependent on manufacturing in Germany, mainly because Lithuanian textile is used as input in Germany.
- Exports of each country are influenced by foreign direct investments made in the respective country, but the elasticity is very low in every case (0.02 in Estonia and Lithuania, 0.04 in Latvia).
- Estonian exports have quite low elasticities concerning price and income variables, except for Estonian own price level. This can be observed as supply-side factor. Estonian exports are overelastic against price level changes at home. This may show that products are bought from Estonia mainly because of their low production costs and low price.
- Latvian exports are influenced by exchange rates and export prices. These variables occur only in one equation that describes food exports. The elasticity is very small (0.04).
- Lithuanian exports depend on Lithuanian price level. The elasticity is not so high as that of Estonian exports but this variable is still very important. Lithuanian exports are more influenced by exchange rate changes between national currency and Latvian currency. Lithuanian exports are closely related to Latvian economy (high elasticities against Latvian GDP, exchange rate and consumer price index) that is mainly due to the Lithuanian mineral fuel export to Latvia which has a very big share in total exports.
- Lithuanian exports are also influenced by exchange rate of national currency against the euro and the Russian rouble that indicate the bettering of the trade position when national currency weakens against the currencies of main trading partners.

Estonia, Latvia and Lithuania have quite a similar export pattern. They all have found export partners among Western countries and there is a lot of subcontract exports. In every state there is a special product group the exports of which have much bigger share in total exports than any other. In longer perspective such a big concentration can be a source of risk in all three countries.

Estonian exports are more directed to Nordic countries (especially Finland and Sweden), Latvian and Lithuanian exports are more bound to German market. While the export pattern of the three countries is rather similar, the main destination countries are different. Such a division may cause asymmetries in business cycles of the three Baltic states in the future, as the pattern of Nordic economies and the cycle of other European countries are rather different. Also as Nordic countries are more open to the rest of the world than other EU countries, the shocks in world economy can have bigger effect on Estonian export (through Nordic countries) and shocks in Europe to Latvia and Lithuania (through Germany).

Conclusions

In this paper the export models of Estonia, Latvia and Lithuania based on imperfect substitutes model were estimated. The models of Estonian export were estimated by commodity groups, by customs procedures and by destination countries, the models of Latvia and Lithuania were estimated only by commodity groups. After estimation the models were compared and conclusions made.

In the first part of the paper an overview of imperfect substitutes model and its suitability for estimation is given. The imperfect substitutes model has been a base for modelling export in most of the countries similar to Estonia and with small modifications turned out to be also a good base for estimating the models of Estonian, Latvian and Lithuanian export.

In the second part of the paper Estonian export was first analysed in order to find the best aggregation level for estimation. Then five models with different ways of aggregation were estimated: two models of export by commodity groups (BEC_SNA, HS divisions), one by customs procedures, one by destination countries and finally equation of aggregate export. The first four models were estimated in current prices, aggregate export was estimated in constant prices.

According to the results of the estimation the model of export by destination countries and the equation of aggregate export behaved the best in *ex post* forecasts. According to estimated models Estonian export is mainly determined by manufacturing output in Finland and Sweden and real economic growth in other EU countries. Elasticity of Estonian export to those factors is very high – up to 3, which is mostly due to subcontract relations. Also real consumption in neighbouring countries is important for Estonian export, but here the countries of influence change – the influence of Russia declines as the influence of Western countries rises. Prices and exchange rates had smaller effect on Estonian export. Foreign direct investment had also small positive effect, but that effect could be captured only in modelling subgroups of export where the share of foreign-owned firms is very big.

In the third part of the paper export models of Estonia, Latvia and Lithuania by commodity groups (HS) were estimated. The results show that exports of all the three Baltic states depend mainly on changes in destination countries' manufacturing output, exchange rate changes and changes in domestic price level. Export in Lithuania as compared to Estonia and Latvia is more tightly connected to Russia, but all the three have been shifting from Russian oriented exports to Western oriented. Estonia exports mainly to the Nordic countries (machinery, timber, textiles), Latvia and Lithuania to Germany and the United Kingdom. The share of subcontract export in total exports to Western countries is high in all three countries. This can be a risk for stability of economic development as subcontract relations can be very volatile. Also the difference in main destination countries of exports (Nordic countries versus Germany and the UK) can be a source of disturbances in the future because of asymmetries between their business cycles.

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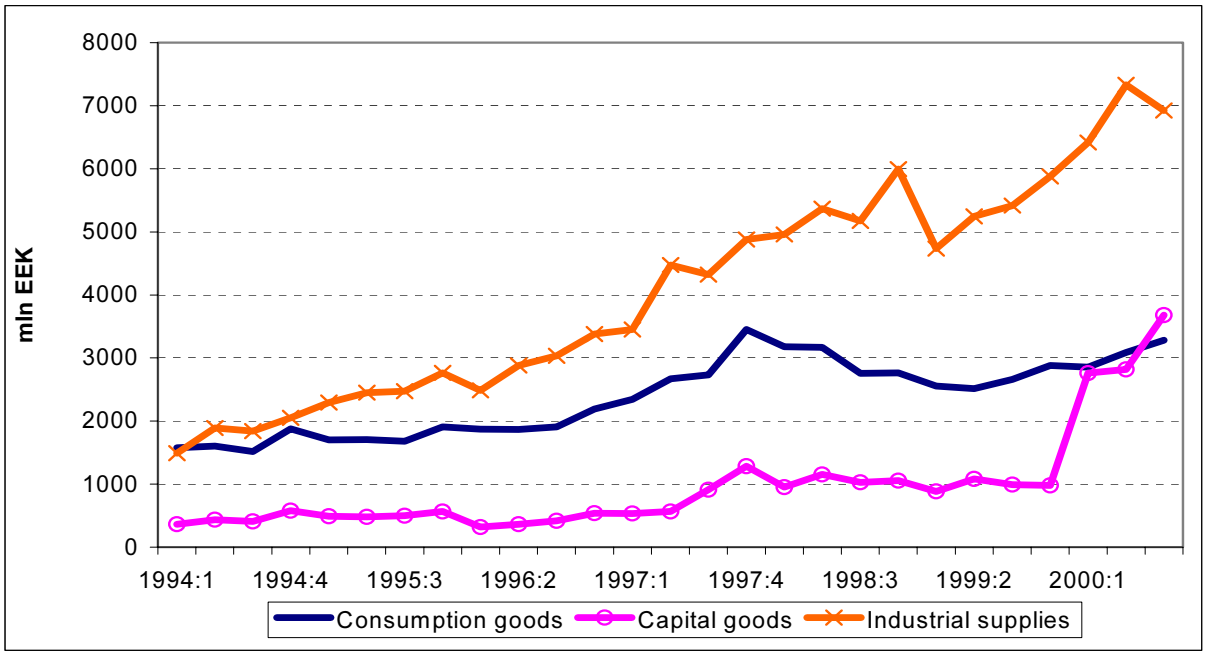
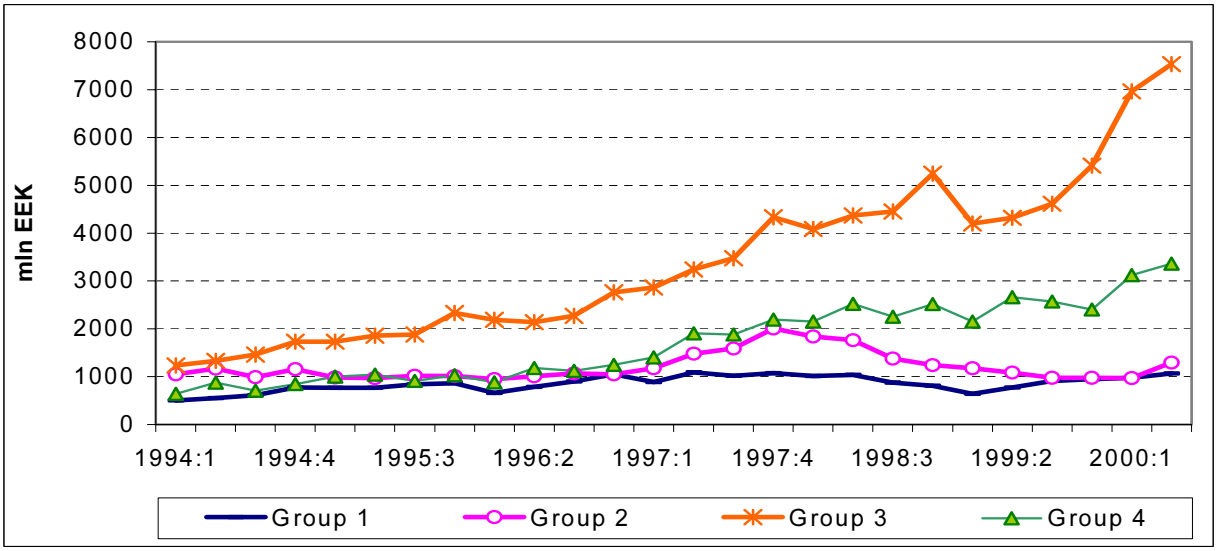
1. Appendix 1. Disaggregated export in current prices

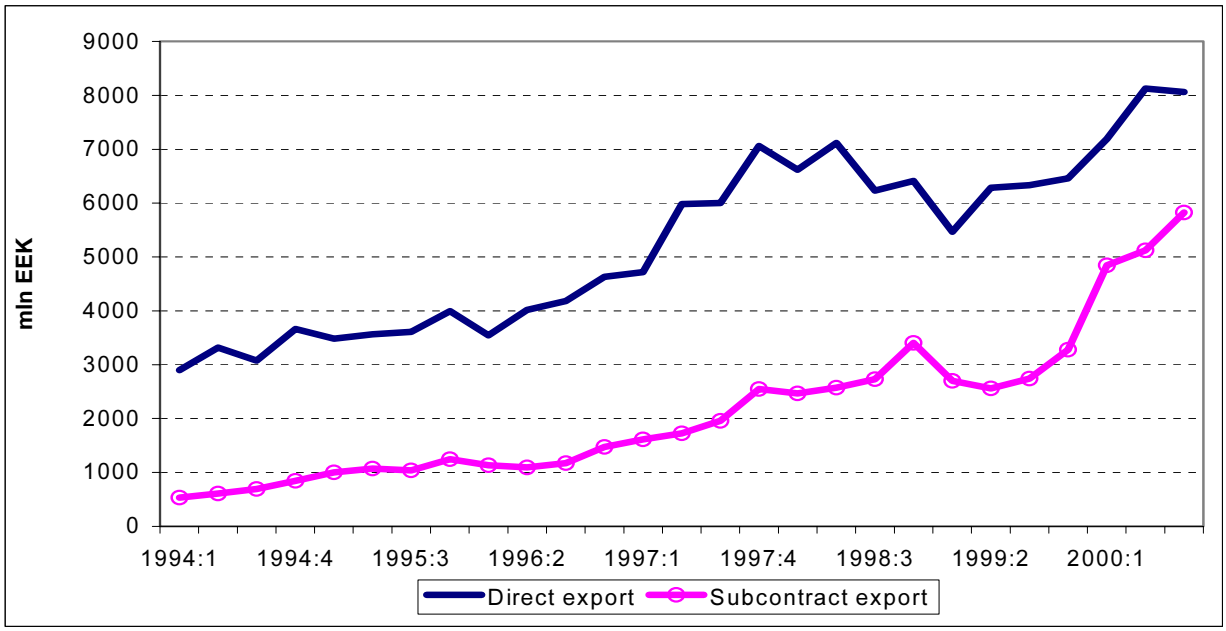
Appendix 1.1. Export by commodity groups (BEC-SNA division)



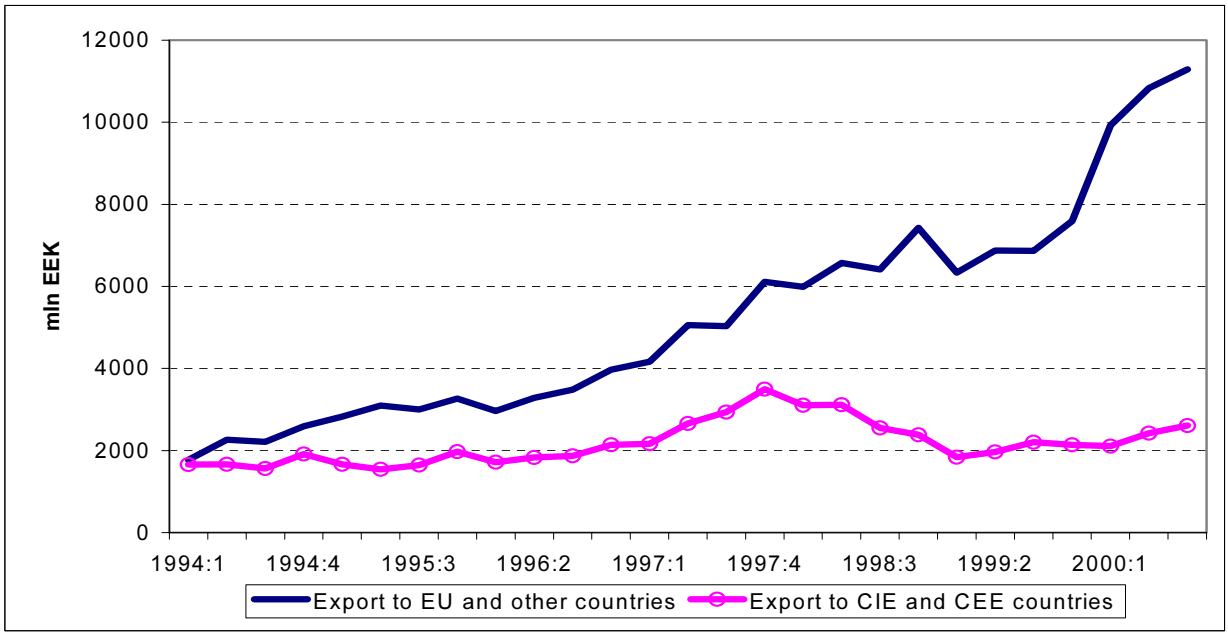
Appendix 1.2. Export by commodity groups (4 groups out of HS)



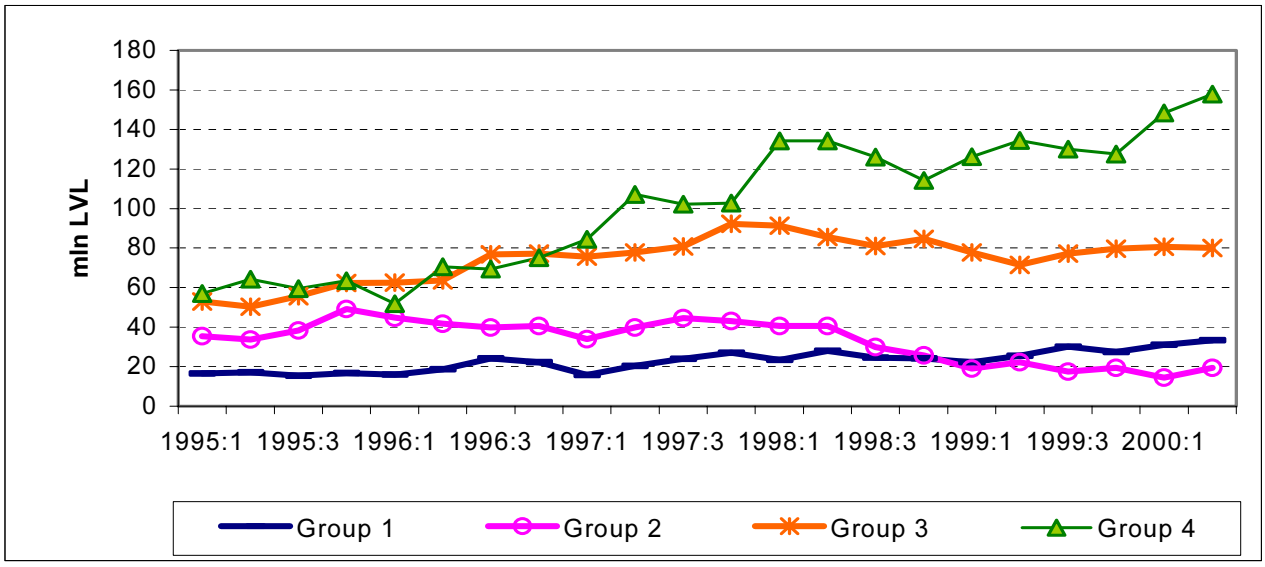
Appendix 1.3. Export by customs procedures



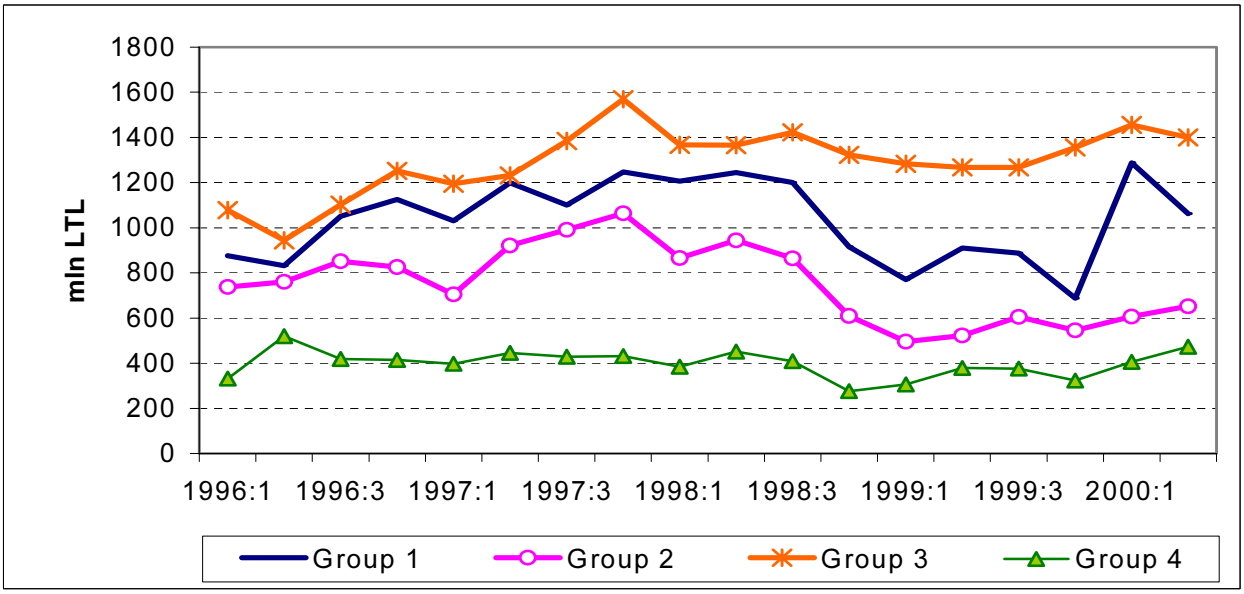
Appendix 1.4. Export by destination countries



Appendix 1.5. Export by commodity groups in Latvia (4 groups out of HS)



Appendix 1.6. Export by commodity groups in Lithuania (4 groups out of HS)



Appendix 2. Data and sources

CONSTR_GER	Construction in Germany (OECD)
CPI_EST	Consumer price index of Estonia (Eesti Pank (Bank of Estonia) BOE)
CPI_LAT	Consumer price index of Latvia (OECD)
CPI_LIT	Consumer price index of Lithuania (OECD)
CPI_RUS	Consumer price index of Russia (OECD)
E_EU	LTL/EUR exchange rate (OECD)
E_FIN	EEK/FIM exchange rate (BOE)
E_LAT	LTL/LVL exchange rate (OECD)
E_LIT	LVL/LTL exchange rate (OECD)
E_RUS	National currency/RUR exchange rate (BOE, OECD)
E_UK	National currency/GBP exchange rate (BOE, OECD)
FDI	Foreign direct investment in described country (BOE, Bank of Latvia, Bank of Lithuania)
PX_FOOD	Export price index of prepared foodstuffs in Latvia (Monthly Statistics Bulletin of Latvia)
RCONS_FIN	Real aggregate consumption in Finland (OECD)
RCONS_RUS	Real aggregate consumption in Russia (OECD)
RGDP_EST	Real GDP in Estonia (OECD)
RGDP_FIN	Real GDP in Finland (OECD)
RGDP_GER	Real GDP in Germany (OECD)
RGDP_LAT	Real GDP in Latvia (OECD)
RGDP_RUS	GDP in current prices/consumer price index in Russia (OECD)
RMANUF_FIN	Real manufacturing output in Finland (OECD)
RMANUF_GER	Real manufacturing output in Germany (OECD)
RMANUF_SWE	Real manufacturing output in Sweden (OECD)
RX_FIN	Real exports in Finland (OECD)
RX_SWE	Real exports in Sweden (OECD)
RXG	Real aggregate export of goods (Statistical Office of Estonia)
XG	Nominal aggregate export of goods (BOE)
XG1, XG2, XG3, XG4	Nominal national exports of certain commodity group out of HS division; the tails _EST, _LAT, _LIT denote the country under observation
XG_CAP	Export of capital goods (BOE)
XG_CONS	Export of consumption goods (BOE)
XG_DIRECT	Direct and other export (not subcontract export) (BOE)
XG_EAST	Export to CIE and CEE countries
XG_IND	Export of industrial supplies (BOE)
XG_SUB	Subcontract export (BOE)
XG_WEST	Export to Western destination countries (all countries except CIE and CEE) (BOE)

DME_y1q1_y2q2	Dummy variable, during period y1q1...y2q2 equal 1, else 0
DMS_yyqq	Dummy variable, period yyqq equal 1, else 0
...FROMyyqq	Given variable is added to equation from yyqq
...SA	Seasonally adjusted
...UNTILyyqq	Given variable is excluded from the equation after yyqq

Appendix 3. Major shocks for Estonian exports

Following is a list of shocks for Estonian exports that were considered to be potential causes for the inclusion of dummy variables. The list does not include shocks that had a clear economic reason and that could therefore be modelled without a dummy variable (for instance the effect of the Russian crisis of 1998 on consumption goods' export).

- During the estimation period several free trade agreements have come into force that have affected Estonian exports positively:
  - 01.04.1994 Free trade agreement for manufactured goods between Estonia and other Baltic states;
  - 01.01.1995 Free trade agreement for manufactured goods between Estonia and the EU;
  - 14.03.1996 Free trade agreement between Estonia and the Ukraine;
  - 01.01.1997 Free trade agreement for agricultural goods between Estonia and other Baltic states;
  - 01.06.1998 The agreement to abolish non-tariff trade barriers between Estonia and other Baltic states;
  - 13.11.1999 Estonia became the member of the WTO.
- From 3rd quarter of 1996 to 4th quarter of 1999 a big share of exports to Russia went through custom warehouses where different artificial schemes including off-shore companies allowed the exporters to avoid the high customs tariffs of Russia.
- The reliability of trade data changed in the 1st quarter of 1997[13] and that caused an artificial leap in Estonian export statistics that was not caused by any economic factor[14].
- There are several one-time shocks in Estonian export caused by only one big exporter, which cannot probably be modelled on macro level (for instance Elcoteq in 1997 and 2000).
- The crisis in Russia (end of 1998) caused an overall depression in Estonian economy that had an effect also on sectors where export to Russia was not important.

[13] Since that period the official statistics tries to eliminate the artificial price changes of export through custom warehouses to states where there are high customs tariffs for Estonian products (eg export to Russia).

[14] Unfortunately the free trade agreement for agricultural products with Latvia and Lithuania came to effect also during that period, so it is hard to estimate how much of the leap in Estonian export was caused by each of the two mentioned factors.

Appendix 4. Export models and their *ex post* forecasts

In the following models all exogenous variables (except dummies) are seasonally adjusted. Endogenous variables are either seasonally adjusted (with end _SA, in equations) or not (for summing up aggregate export). XGF denotes estimated export. After each equation of the model, its main statistics are given. Full statistical protocols of the equations are available upon request.

Appendix 4.1. Equations of Estonian export model by commodity groups (BEC-SNA)

Model:

*dlog(XG_CAP_SA)=1.8*dlog(RMANUF_FIN)+2.7*dlog(E_FIN)+0.38*DMS_9701+*
t-statistic: (1.70) (2.48) (4.31)

*0.36*DMS_9703_9704+1.15*DMS_0001-0.06*
(5.25) (12.5) (-2.37)

R^2*=0.93; DW=2.23*

dlog(XG_IND_SA)=2.81(0.57*dlog(RMANUF_FIN(-1))+*
t-statistic: (5.55) (2.80)

*0.43*dlog(RMANUF_SWE(-1)))+0.29*dlog(CPI_RUS(-1)*E_RUS(-1))+0.13*DMS_9702*
(2.80) (4.41) (2.93)

R^2*=0.75; DW=2.24*

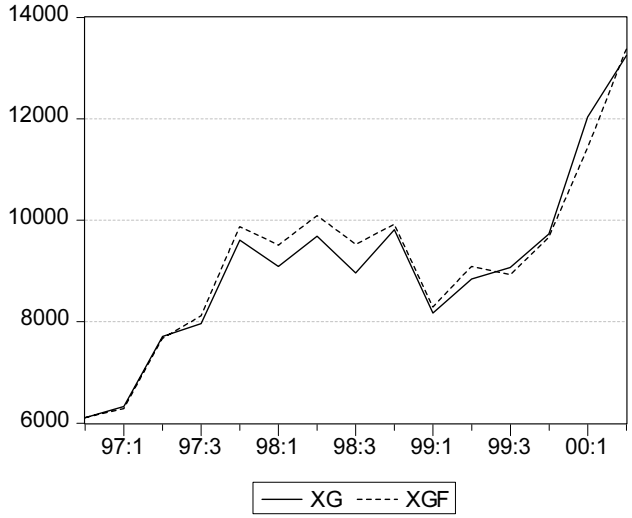
*dlog(XG_CONS_SA)=3.2*dlog(RCONS_FIN_FROM9901)+0.94*dlog(RCONS_RUS_UNTIL9804)+*
t-statistic: (2.35) (7.15)

*0.14*DMS_9702-0.05*DME_9901_9904+0.04*
(4.74) (4.11) (-2.65)

R^2*=0.82; DW=2.72*

XG=XG_CAP+XG_IND+XG_CONS

Graph of actual and *ex post* forecasted export (mln kroons):



Statistics of *ex post* forecast:

Root Mean Squared Error, mln kroons	300.3
Mean Absolute Error, mln kroons	237.5
Mean Abs. Percent Error	2.55
Mean Error, mln kroons	106.9
Mean Percent Error	1.25
Theil Inequality Coefficient	0.016

Appendix 4.2. Equations of Estonian export model by commodity groups (HS)

Model:

*dlog(XG1_SA) = 1.84*dlog(CPI_LAT(-2)) + 0.24*dlog(E_RUR)*
t-statistic: (*1.97*) (*2.38*)

R^2*=0.36; DW=2.17*

*dlog(XG2_SA) = -0.07 + 0.23*DME_9701_9704 - 1.84*dlog(CPI_EST) + 0.14*dlog(E_RUR) +*
t-statistic: (*-3.85*) (*7.84*) (*-1.98*) (*2.27*)

*0.17*DMS_9603*
(*3.47*)

R^2*=0.90; DW=2.82*

*dlog(XG3_SA) = -0.03 + 0.03*dlog(FDI) + 2.57*dlog(RX_SWE) + 1.20*dlog(RX_FIN(-1)) –*
t-statistic: (*-2.36*) (*3.00*) (*7.17*) (*6.34*)

*1.61*dlog(CPI_EST)*
(*-2.26*)

R^2*=0.91; DW=2.87*

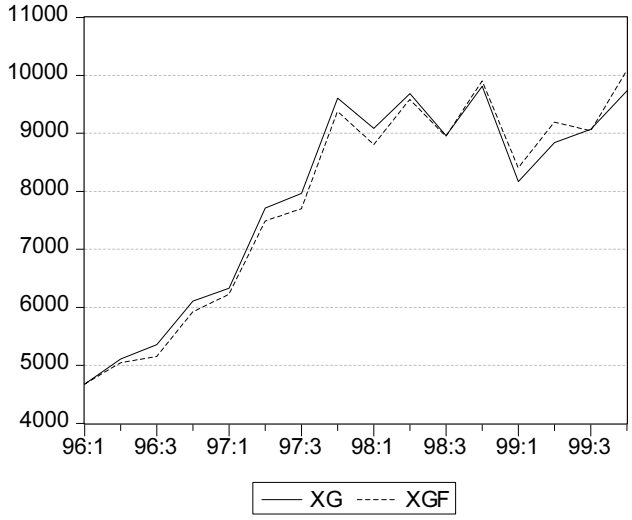
*dlog(XG4_SA) = 2.38*dlog(RX_SWE) - 2.86*dlog(CPI_EST) + 0.81*dlog(E_UK(-1)) +*
t-statistic: (*4.55*) (*-2.41*) (*2.30*)

*0.06*dlog(FDI(-3))*
(*2.38*)

R^2*=0.74*; *DW=1.31*

XG = XG1+ XG2 + XG3 + XG4

Graph of actual and *ex post* forecasted export (mln kroons):



Statistics of *ex post* forecast:

Root Mean Squared Error, mln kroons	211.36
Mean Absolute Error, mln kroons	182.37
Mean Abs. Percent Error	2.31
Mean Error, mln kroons	-44.26
Mean Percent Error	-0.74
Theil Inequality Coefficient	0.013

Appendix 4.3. Equations of Estonian export model by customs procedures

Model:

*dlog(XG_DIRECT_SA)=3.59*dlog(RGDP_GER)+0.76*dlog(RCONS_RUS)+4.21*dlog(RGDP_FIN)-*
t-statistic: (2.22) (5.79) (5.21)

*0.17*DMS_9904*
(-4.25)

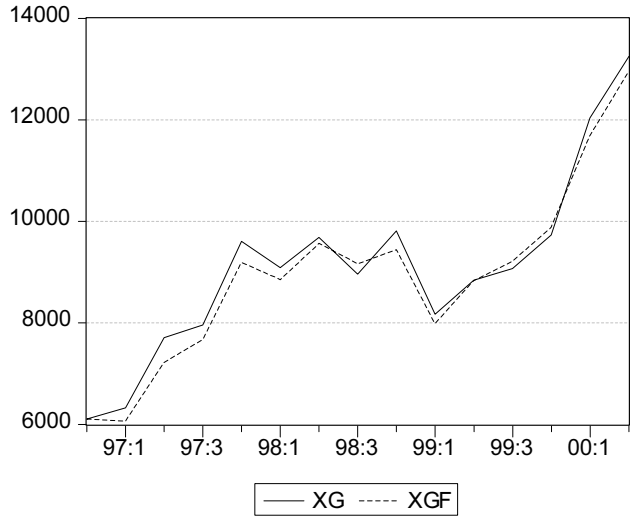
R^2*=0.80; DW=2.47*

dlog(XG_SUB_SA)=2.96(0.47*dlog(RMANUF_FIN)+0.53*dlog(RMANUF_SWE(-1))-*
t-statistic: (4.01)(2.94) (2.94)
*0.27*DMS_9901+0.3*DMS_0001+0.04*
(-5.02) (5.54) (2.46)

R^2*=0.82; DW=2.65*

XG=XG_DIRECT+XG_SUB

Graph of actual and *ex post* forecasted export (mln kroons):



Statistics of *ex post* forecast:

Root Mean Squared Error, mln kroons	280.4
Mean Absolute Error, mln kroons	251.1
Mean Abs. Percent Error	2.782
Mean Error, mln kroons	-180.7
Mean Percent Error	-2.018
Theil Inequality Coefficient	0.015

Appendix 4.4. Equations of Estonian export model by destination countries

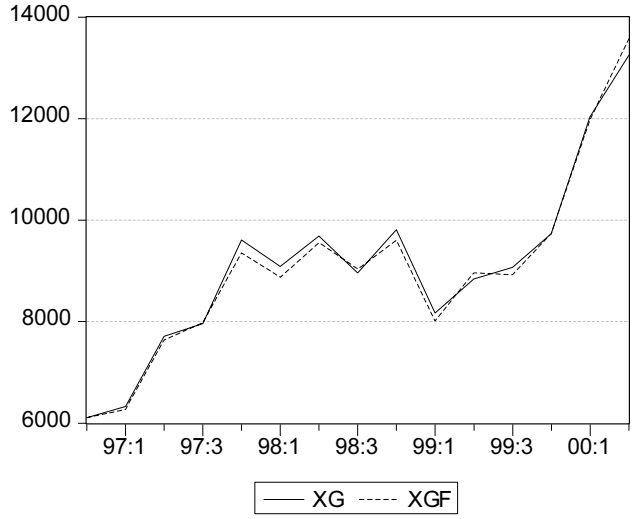
Model:

dlog(XG_WEST_SA)=2.47(0.39*dlog(RGDP_GER(-1))+0.31*dlog(RMANUF_FIN(-1))+*
t-statistic: (1.51)

*0.3*dlog(RMANUF_SWE))+0.13*DMS_9702-0.12*DMS_9901+0.24*DMS_0001+0.02*
(3.36) (-3.00) (6.48) (1.88)
R^2=0.84; DW=2.29

*dlog(XG_EAST_SA)=1.27*dlog(RCONS_RUS)+0.18*DMS_9702-0.23*DMS_9904+0.05*
t-statistic: (7.79) (3.72) (-4.73) (4.06)
R^2=0.83; DW=2.14

Graph of actual and *ex post* forcasted export (mln kroons):



Statistics of *ex post* forecast:

Root Mean Squared Error	158.3
Mean Absolute Error	130.4
Mean Abs. Percent Error	1.364
Mean Error	-54.3
Mean Percent Error	-0.677
Theil Inequality Coefficient	0.008

Appendix 4.5. Equation of Estonian real aggregate export

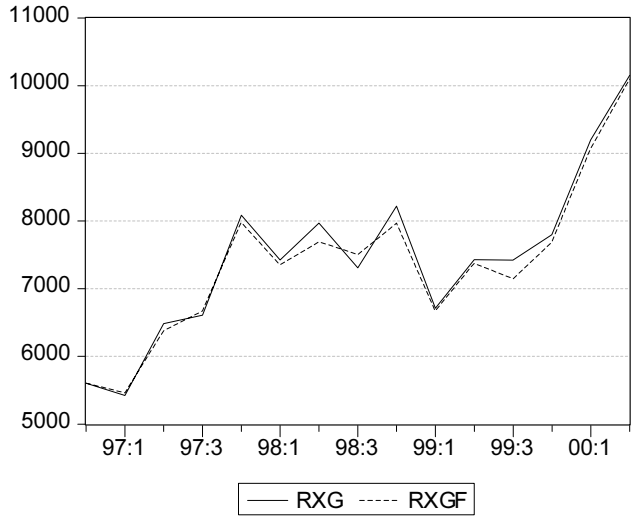
Equation:

*dlog(RXG_SA)=0.88*dlog(RMANUF_FIN(-1))+0.23*dlog(RCONS_RUS_UNTIL9804(-1)+*
t-statistic: (2.43) (1.88)

*0.07*DME_9603_9704+0.27*DMS_0001-0.007*
(4.21) (8.78) (-0.7)

R^2*=0.90; DW=3.39*

Graph of actual and *ex post* forecasted export (mln kroons, in 1995 prices):



Statistics of *ex post* forecast:

Root Mean Squared Error	151.7
Mean Absolute Error	126.6
Mean Abs. Percent Error	1.65
Mean Error	-85.0
Mean Percent Error	-1.12
Theil Inequality Coefficient	0.01

Appendix 4.6. Equations of Latvian export model by commodity groups (HS)

Model:

*dlog(XG1_SA) = 0.80*dlog(RGDP_RUS) + 1.71*dlog(RGDP_EST(-2)) + 5.13*dlog(E_LIT(-1)) –*
t-statistic: (*5.83*) (*2.25*) (*4.07*)

*0.26*DMS_9701*
(*-4.74*)

R^2=*0.83*; *DW=1.81*

*dlog(XG2_SA) = -0.07 + 0.30*dlog(E_RUS) - 0.76*dlog(PX_FOOD)*
t-statistic: (-2.11) (*2.29*) (*-2.59*)

R^2=*0.54*; *DW=2.61*

*dlog(XG3_SA) = 2.70*dlog(RX_UK(-2))+ 0.18*dlog(RGDP_RUS(-2)) + 0.04*dlog(FDI(-1)) -*
t-statistic: (3.87) (*3.11*) (*3.74*)

*1.94*dlog(CPI_LAT) + 0.17*DMS_9603 - 0.06*DMS_9803*
(-2.60) (*5.72*) (*-2.21*)

R^2=*0.91*; *DW=2.17*

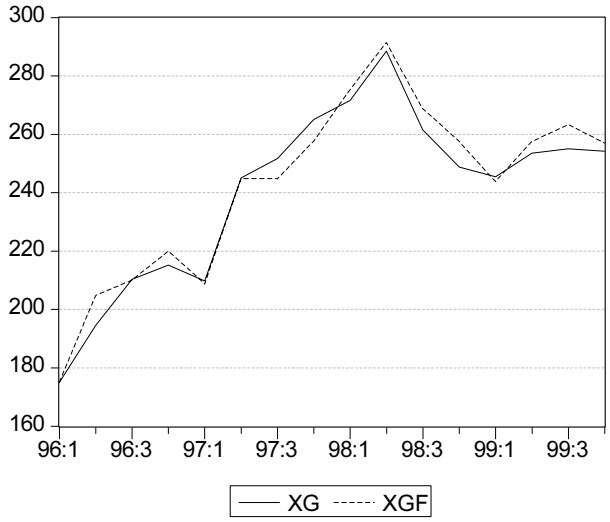
*dlog(XG4_SA) = 2.75*dlog(RMANUF_GER) + 0.07*dlog(FDI_LAT(-1)) + 0.12*DMS_9602 +*
t-statistic: (4.13) (*2.70*) (*1.77*)

*0.11*DMS_9604+ 0.21*DMS_9801*
(2.28) (*4.18*)

R^2=*0.82*; *DW=2.01*

XG = XG1 + XG2 + XG3 + XG4

Graph of actual and *ex post* forecasted export (mln lats):



Statistics of *ex post* forecast:

Root Mean Squared Error, mln lats	5.65
Mean Absolute Error, mln lats	6.48
Mean Abs. Percent Error	1.93
Mean Error, mln lats	2.34
Mean Percent Error	1.01
Theil Inequality Coefficient	0.01

Appendix 4.7. Equations of Lithuanian export model by commodity groups (HS)

Model:

*dlog(XG1_SA) = -0.10 + 5.86*dlog(RGDP_LAT) + 4.29*dlog(CPI_LAT(-1)) + 6.14*dlog(E_LAT(-2))*
t-statistic: (*-2.27*) (*2.89*) (*2.29*) (*3.00*)

R^2=*0.60*; *DW=1.97*

*dlog(XG2_SA) = 5.19*dlog(RGDP_LAT) + 0.32*dlog(E_RUS) + 1.12*dlog(E_EU) –*
t-statistic: (*3.66*) (*4.51*) (*1.75*)

*2.03*dlog(CPI_LIT)*
(*-1.86*)

R^2=*0.81*; *DW=2.46*

*dlog(XG3_SA) = 0.04 + 1.22*dlog(RMANUF_GER(-2)) + 1.00*dlog(RGDP_RUS) +*
t-statistic: (*4.67*) (*3.40*) (*8.72*)

*0.23*dlog(E_RUS(-3)) + 0.03*dlog(FDI(-2)) - 0.16*DMS_9602*
(*6.51*) (*2.61*) (*-6.42*)

R^2=*0.94*; *DW=1.71*

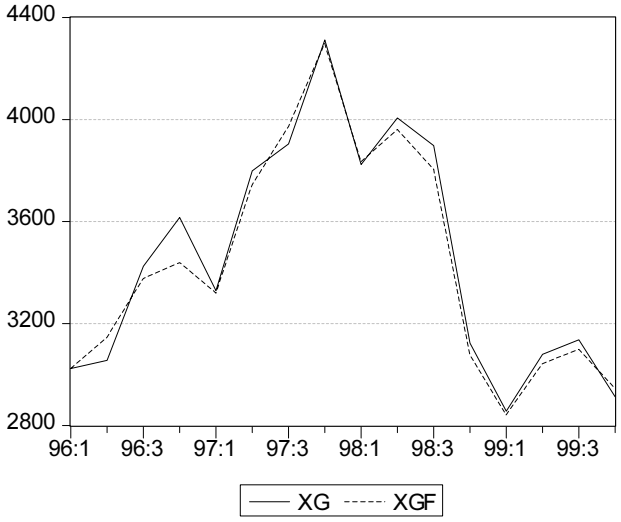
*dlog(XG4_SA) = 0.06 + 1.21*dlog(CONSTR_GER(-3))+ 0.32*dlog(E_RUS) + 0.06*dlog(FDI(-4)) –*
t-statistic: (*1.85*) (*4.50*) (*3.50*) (*2.05*)

*2.71*dlog(CPI_LIT(-1)) + 0.47*DMS_9602*
(*-1.89*) (*4.62*)

R^2=*0.85*; *DW=2.87*

XG = XG1 + XG2 + XG3+ XG4

Graph of actual and *ex post* forecasted export (mln litas):



Statistics of *ex post* forecast:

Root Mean Squared Error, mln litas	66.68
Mean Absolute Error, mln litas	51.85
Mean Abs. Percent Error	1.49
Mean Error, mln litas	24.79
Mean Percent Error	-0.67
Theil Inequality Coefficient	0.01