Danmarks Statistik
MODELGRUPPEN
Arbejdspapir*

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Export market index: forecast for latest historical period

Resumé:

The paper explains the method used to construct data for export market and market price indices for the latest historical period. Export market indices are constructed based on import equations for partner countries and market price indices are set to follow the price developments in Germany and Sweden.

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Nøgleord: Gross domestic product, Domestic demand, Imports, Exports

1. Introduction

The export market and market price indices in ADAM are constructed based on a detailed trade statistics data from the OECD *international trade by commodity statistics* (ITCS). The market indices are proportionally adjusted to the OECD national accounts statistics for total goods, cf. DSI231112 and DSI10513.

The export market index, *fEe*, and the market price, *pee*, are calculated as a weighted sum of trading partners' volume and price of imports, respectively. Given as:

$$\frac{fEe}{fEe_{-1}} = \sum_j we_{j,-1} * \frac{fEe_j}{fEe_{j,-1}} \qquad (1)$$

$$\frac{pee}{pee_{-1}} = \sum_j we_{j,-1} * \frac{pee_j}{pee_{j,-1}} \qquad (2)$$

Where *j* denotes the vector of trading partners[1], we_j is country *j*'s share of total Danish exports and fEe_j and *peej* are volume and price of imports of country *j* from the world. The weights, we_j, are calculated using data from Statistics Denmark *StatBank*.

The ITCS-database provides annul data for partner countries with a lag of 2 years, for example, data is currently available only up to 2012. Hence a method for constructing a preliminary data for *fEe* and *pee* for the period 2013 and possibly a forecast for 2014 onwards is necessary. Previously, various methods have been tried in the model-group for extending export market indices, cf. JJJ240506.[2] We re-visit the previous work and present the different options for constructing the latest historical data for market indices. The presentation here is short. The pre-model MAKE presents a detailed description of the export market and provides tools for an in depth analysis of the export market, see DSI300514. In the following we present the different options and our preferred method.

2. What are the options?

In principle, one can knock on each of the statistical institutes in partner countries and look for forecasts for import prices and quantities, not feasible! Another alternative is to use the OECD's national accounts statistics for total

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[1] The partner countries are Australia, Austria, Belgium, Canada, Germany, Spain, Finland, France, Great Britain, Greek, Ireland, Iceland, Italy, Japan, Netherland, Norway, New Zealand, Portugal, Sweden, Switzerland and United States. The data for Belgium before 1993 is including Luxembourg.

[2] The motivation by then was, however, different from the present paper. The market indices were previously constructed based on data from the OECD *International Trade and Competitiveness Indicators* (ITCI). When the OECD discontinued publishing ITCI data in 2003, it was necessary to have an alternative way of constructing market indices. The export market indeices where constructed based on import equation for each partner countries as a function of GDP and the Danish import prices where used as a proxy for market prices.

goods. These data is available with a lag of 1-year (currently available up to 2013). The challenge is that exports of goods in ADAM are further split into sub-groups, and if we use the value for total goods as a proxy for manufactured exports, we still need an alternative method for the remaining groups – agriculture and raw materials.

Yet another alternative is to forecast imports of partner countries using import equations, for example as a function of GDP. Since GDP forecasts are available in the OECD Economic outlook, this method is doable. One can discuss further what form of equation to apply and which set of explanatory variables to use. Imports can also be estimated based domestic demand and exports. This is sounds more pedagogic. However, data for GDP forecasts is relatively easy to find. Technically, an equation with one explanatory variable is also easy to handle. Thus, we prefer to use GDP for ease of data availability and practical reasons. We consider the following three different forms of import equations and compare them in their predictive ability.

Level equation:

$$\log\left(fEe_j\right) = k + \beta * \log\left(GDP_j\right) + \varepsilon \qquad (3)$$

Difference equation:

$$\mathrm{Dlog}\left(fEe_j\right) = k + \alpha * D\log(GDP_j) + \varepsilon \qquad (4)$$

Error correction equation

$$\begin{aligned}\mathrm{Dlog}\left(fEe_j\right) &= k + \alpha * D\log\left(GDP_j\right) \\ &\quad -\gamma[\log(fEe_{j,-1}) - \beta * \log(GDP_{-1})] + \varepsilon \qquad (5)\end{aligned}$$

Equation (3) predicts imports solely on GDP. In equation (4), we predict imports conditional on GDP and the value of imports in the previous year, hence more informative. Equation (5) has the advantage of being a synthesis of the level and difference equations. We augment the difference relation with the lagged error term from the level relation. If γ is significant, we are better informed albeit complex.

3. Estimation result

The table below presents the estimation result for manufactured exports. A similar table for agriculture and raw materials can be found in the appendix. The equations (3-5) are estimated for the major trading partners. The choice among the different relations can depend on several factors. First, the estimated parameters should have the appropriate sign and magnitude. Second, simplicity is always an important factor. We have already decided to use GDP over domestic demand and exports, which is much simpler and data for GDP is easily available. Third, we can compare the different results based on how well they approximate the historical data.

Table 1. OLS estimates, dependent variable: manufactured imports

Partner country	Level Eq.	Difference Eq.	Error correction Eq.		
	β	α	α	γ	β
AUS	2.213	2.965	2.477	0.307	2.281
	(49.097)	(3.676)	(3.145)	(2.356)	(2.441)
AUT	2.408	3.595	3.581	0.649	2.418
	(93.190)	(8.713)	(10.940)	(5.125)	(5.082)
BEL	2.244	2.381	2.636	0.392	2.266
	(82.688)	(7.728)	(8.792)	(3.018)	(3.037)
CAN	2.200	2.520	2.858	0.187	2.258
	(39.246)	(6.692)	(7.254)	(2.260)	(2.283)
CHE	2.434	1.602	2.169	0.270	2.187
	(46.872)	(4.100)	(5.682)	(2.890)	(2.497)
DEU	3.110	2.355	2.603	0.036	4.744
	(30.268)	(7.325)	(7.888)	(0.753)	(1.145)
ESP	3.701	4.329	4.935	0.123	3.294
	(29.751)	(5.908)	(5.622)	(1.487)	(1.274)
FIN	2.110	3.028	3.082	0.329	2.231
	(46.146)	(12.329)	(16.855)	(4.992)	(5.343)
FRA	2.862	3.498	4.019	0.334	2.999
	(71.112)	(8.290)	(9.699)	(3.196)	(3.344)
GBR	2.131	2.346	2.547	0.288	2.060
	(61.488)	(7.604)	(8.751)	(3.075)	(2.902)
GRC	1.689	2.512	3.135	0.434	1.567
	(11.484)	(5.470)	(5.930)	(2.514)	(2.039)
IRL	1.327	2.015	2.433	0.213	1.127
	(28.282)	(7.000)	(7.979)	(2.745)	(2.185)
ISL	1.621	3.353	3.524	0.233	1.616
	(14.254)	(5.723)	(5.882)	(2.372)	(2.092)
ITA	3.215	3.962	4.857	0.086	5.118
	(38.328)	(9.933)	(11.538)	(1.141)	(1.872)
JPN	3.223	2.109	2.433	0.071	3.870
	(25.898)	(4.292)	(3.885)	(1.099)	(1.323)
NLD	2.457	1.852	1.951	0.224	2.555
	(72.886)	(5.267)	(5.624)	(1.790)	(1.884)
NOR	1.587	2.613	2.825	0.172	1.918
	(30.691)	(4.402)	(4.248)	(1.513)	(1.884)
NZL	2.250	2.109	2.595	0.458	2.216
	(47.092)	(4.429)	(5.639)	(3.095)	(3.033)
PRT	2.902	2.955	3.649	0.429	3.014
	(69.894)	(8.397)	(10.414)	(4.091)	(4.216)
SWE	2.307	3.121	3.114	0.335	2.238
	(47.051)	(7.496)	(8.009)	(2.609)	(2.493)
USA	2.513	2.834	3.360	0.358	2.493
	(70.810)	(7.336)	(7.872)	(3.068)	(2.961)
Avg*	2.535	2.741	3.020	0.228	2.965

*Avg is the weighted sum of the estimated coefficients, the weights are partners' share of total Danish manufactured exports in 2005.
The sample covers 1976-2012, for Greek it covers only 1990-2012. T-values are given in parenthesis.

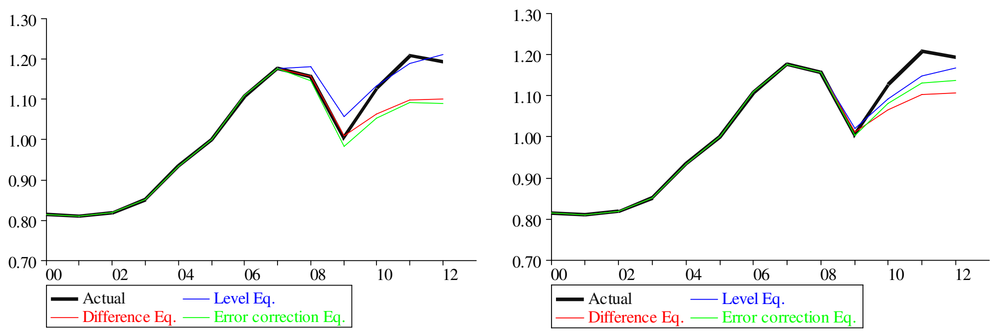
All coefficients have the appropriate sign. All of the coefficients in the level and difference equations are significant. In the error correction equation all short term elasticities are significant, but not all the long term elasticities and adjustment coefficients are significant. The average short-term import elasticity with respect to GDP is larger than that of the long term elasticity. It is common for imports to fluctuate more in the short term than in the long term. Both the long term and short term import elasticities in the error correction relation are marginally higher than the corresponding values in the level and difference equations. Overall, the different estimates are on average close to each other. For some countries, like Spain, the elasticities stand out from the others. This should not be a concern as it reflects the very pro-cyclical nature of imports in that country.

In terms of the estimated coefficients, none of the estimated relations are superior to the others, which make preference toward one difficult. Hendry and Clements[3] (2003) maintain shifts in deterministic terms – intercepts and linear trends – are the major source of forecast errors. In such cases differencing can improve forecasting performances as it lowers the degree of polynomial in time.

What we can do next is, therefore, simply compare the different formulations based on how well they can reproduce the historical market indices. We try to reproduce the observed export market indices based on import equations beginning the recent worldwide recession in 2008. The equations are re-estimated each time the forecast period is moved by one period, i.e. when forecasting *T+1* onwards, the equations (3-5) are re-estimated based on the sample up until *T*. Forecasts for *T+1* are corrected for the in-sample error in period *T*, so that there is a perfect fit at the forecast origin. From the predicted imports market indices are calculated. Figure 1 presents.

Figure 1. Export market index for manufactures: actual and forecast

a. forecast 2008 onwards *b. forecast 2009 onwards*



[3] Hendry and Clements (2003). Economic forecating: some lessons from recent research. Economic Modelling 20, 301-329, Elsevier.

c. forecast 2010 onwards *d. forecast 2011 onwards*

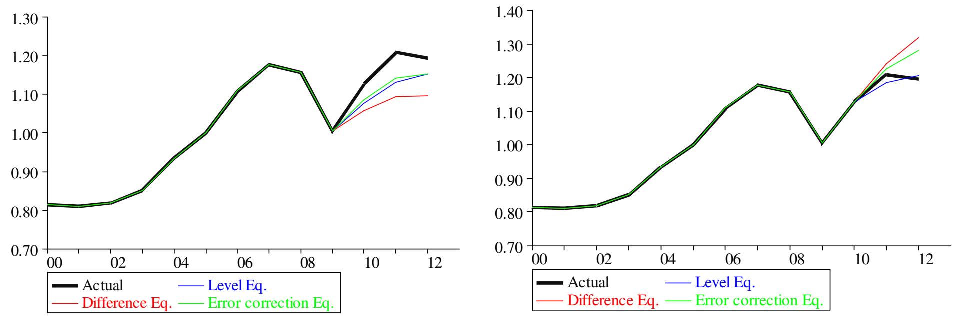
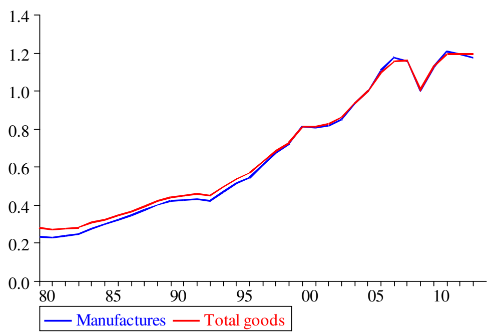


Figure 1a and 1b indicate that the difference relation is better in mimicking the actual values in the immediate term. The error correction does not add value to the difference equation. And the level equation is better in capturing the developments in the subsequent periods. The message from figure 1c and 1d is mixed.

Another alternative is to use the market index for total goods as a proxy for manufactures, see figure 2. The close proximity between the two indices is not an accident, the market indices for ADAM export groups are proportionally adjusted to add up to the national accounts total. If a choice is made for total goods, there has to be a way of calculating the market indices for agriculture and raw materials.

Figure 2. Export market index: manufactures and total goods



Export market prices

The preliminary data for export market prices for the latest historical period is calculated based on data from the OECD *monthly statistics for international trade*. The monthly statistics provides price and unit value indices for selected OECD countries. Because of lack of data we consider only the prices in Germany and Sweden as indicators for market prices. We estimate a simple regression equation for market prices based on Germany and Swedish prices, then the flash estimates for market prices are obtained from the fitted values. Such exercise is, for example, a common practice in the ECB for forecasting GDP of Euro area member states.[4]

[4] See, for example, Angelini et al. (2008). Short-term forecasts of Euro area GDP growth. ECB, working paper series NO 949/october 2008.

We estimate the following equation for each export group.

$$\log(\mathrm{pee} < i >) = \mathrm{k} + \alpha_1 * \log(deupee < i >) \\ + \ \alpha_2 * \log(swepee < i >) + \varepsilon \qquad (6)$$

Where i stands for the sectors 01, agriculture, 2, raw materials, 59, manufactures, and *deupee*$<i>$ and *swepee*$<i>$ are German and Swedish import prices for i in Danish krone, respectively. The data for export market prices for the latest historical period is therefore the fitted values from (6), where the data for German and Swedish prices for the latest period are taken from the monthly statistics. Table 2 presents the estimated results.

Table 2. Export market prices equations

Agriculture
log(pee01)
= 0.38200 * log(deupee01) + 0.67164 * log(swepee01) - 0.01763
(2.07638) (4.18521) (1.99146)
N=1976-2012 SE=0.0379 R Sq.=0.9405
Raw materials
log(pee2)
= 0.58595 * log(deupee2) + 0.43951 * log(swepee2) - 0.03054
(10.0880) (9.43559) (3.91718)
N=1976-2012 SE=0.0281 R Sq.=0.9813
Manufactures
log(pee59)
= 0.30740 * log(deupee59) + 0.71548 * log(swepee59) + 0.01607
(4.42404) (7.04537) (3.72537)
N=1976-2012 SE=0.0233 R Sq.=0.9849

4. Summary

The paper has presented the method used in ADAM to construct data for export market and market price indices for the latest historical period. The latest historical figure for export market indices is created based on import equations for partner countries. A simple difference equation for imports as a function of GDP is the preferred method. This form is preferred for its simplicity and for its potential in reducing forecast errors caused by shifts in deterministic terms. The difference equation is better in forecasting the first observation in the forecast period, and 1-year ahead is all that is required. The latest historical figure for market price indices is set to follow the price developments in Germany and Sweden through a simple price equation.

Appendix

Appendix I. OLS estimates, dependent variable: agricultural imports

Partner country	Level Eq.	Difference Eq.	Error correction Eq.		
	β	α	α	γ	β
AUS	2.006	1.050	1.009	0.138	2.352
	(23.473)	(0.994)	(0.978)	(1.499)	(1.748)
AUT	2.555	1.066	1.343	0.189	2.671
	(47.110)	(2.377)	(3.032)	(2.320)	(2.435)
BEL	1.555	0.544	0.549	0.175	1.562
	(31.705)	(1.446)	(1.436)	(1.835)	(1.835)
CAN	2.004	0.129	0.350	0.111	2.064
	(35.379)	(0.326)	(0.804)	(1.258)	(1.284)
CHE	1.044	-	-	0.109	1.698
	(11.236)			(1.415)	(2.154)
DEU	2.104	0.814	0.967	0.033	3.213
	(27.333)	(3.031)	(3.419)	(0.588)	(0.899)
ESP	3.067	2.721	3.108	0.128	3.199
	(26.964)	(3.476)	(3.817)	(1.592)	(1.625)
FIN	2.337	0.656	0.876	0.106	3.171
	(20.464)	(1.510)	(2.093)	(1.494)	(2.030)
FRA	1.516	0.617	0.723	0.129	1.619
	(30.136)	(1.716)	(1.824)	(1.542)	(1.656)
GBR	1.286	0.281	0.211	0.179	1.454
	(27.137)	(0.961)	(0.768)	(2.526)	(2.910)
GRC	1.406	1.206	1.373	0.617	1.381
	(15.740)	(2.491)	(3.065)	(2.906)	(2.658)
IRL	1.192	0.335	0.078	0.233	1.223
	(32.500)	(1.314)	(0.297)	(2.643)	(2.730)
ISL	1.592	0.786	0.595	0.081	0.743
	(19.215)	(2.195)	(1.611)	(0.969)	(0.419)
ITA	1.576	0.987	1.203	0.260	1.702
	(24.453)	(2.307)	(2.362)	(2.100)	(2.315)
JPN	1.396	1.303	1.143	0.204	1.272
	(27.601)	(3.677)	(2.591)	(1.781)	(1.545)
NLD	1.859	0.181	-	0.298	1.916
	(28.211)	(0.299)		(2.233)	(2.368)
NOR	1.471	0.583	0.844	0.106	1.794
	(24.830)	(1.185)	(1.562)	(1.282)	(1.583)
NZL	3.042	1.285	1.628	0.147	2.994
	(34.170)	(2.130)	(2.453)	(1.288)	(1.253)
PRT	2.530	0.797	0.946	0.194	2.613
	(34.401)	(2.204)	(2.484)	(2.786)	(2.939)
SWE	2.431	0.481	0.452	0.141	3.057
	(28.584)	(1.217)	(1.325)	(2.279)	(2.884)
USA	1.632	1.308	1.522	0.257	1.669
	(41.429)	(2.960)	(3.384)	(2.337)	(2.372)
Avg*	1.800	0.811	0.864	0.157	2.173

*Avg is the weighted sum of the estimated coefficients, the weights are partners' share of total Danish raw material exports in 2005. Coefficients with the wrong sign are not reported, and are given the average value when constructing the market indices.
The sample covers 1976-2012, for Greek it covers only 1990-2012. T-values are given in parenthesis.

Appendix II. OLS estimates, dependent variable: raw material imports

Partner country	Level Eq.	Difference Eq.	Error correction Eq.		
	β	α	α	γ	β
AUS	1.035	2.164	1.962	0.368	1.025
	(20.308)	(2.209)	(2.152)	(2.773)	(2.629)
AUT	1.558	2.076	1.935	0.099	1.681
	(18.711)	(3.419)	(2.952)	(1.164)	(1.224)
BEL	0.764	2.468	2.656	0.333	0.777
	(11.201)	(3.803)	(4.386)	(3.253)	(2.782)
CAN	1.238	1.350	1.905	0.326	1.251
	(19.584)	(2.071)	(2.871)	(2.586)	(2.472)
CHE	1.404	1.224	2.219	0.530	1.308
	(21.300)	(1.692)	(3.599)	(4.407)	(3.725)
DEU	1.536	1.897	2.234	0.092	2.392
	(13.812)	(3.427)	(3.912)	(1.154)	(1.708)
ESP	1.937	2.326	2.919	0.158	1.704
	(19.806)	(3.510)	(3.834)	(1.757)	(1.446)
FIN	2.248	2.047	2.466	0.315	2.250
	(29.698)	(4.193)	(4.945)	(2.466)	(2.415)
FRA	1.181	2.607	3.270	0.312	1.388
	(19.131)	(4.412)	(5.639)	(3.232)	(3.582)
GBR	0.174	1.857	1.623	0.441	0.197
	(4.407)	(3.910)	(3.723)	(3.347)	(2.258)
GRC	0.831	1.857	2.215	0.623	0.876
	(4.684)	(2.085)	(2.729)	(3.015)	(2.322)
IRL	0.775	0.997	1.796	0.683	0.766
	(25.803)	(2.173)	(4.424)	(4.727)	(4.335)
ISL	2.104	1.906	0.448	0.536	1.993
	(18.334)	(1.999)	(0.483)	(3.849)	(3.509)
ITA	0.811	3.326	4.085	0.650	1.052
	(12.441)	(6.514)	(10.682)	(7.521)	(7.911)
JPN	0.007	2.162	2.696	0.392	0.281
	(0.110)	(4.653)	(5.633)	(3.999)	(2.526)
NLD	2.205	2.391	2.273	0.362	2.282
	(35.115)	(2.933)	(2.826)	(2.226)	(2.329)
NOR	1.226	1.030	1.748	0.709	1.260
	(38.517)	(1.481)	(3.042)	(5.466)	(5.636)
NZL	0.805	-	0.675	0.919	0.804
	(12.970)		(0.943)	(5.204)	(4.638)
PRT	2.275	2.155	2.393	0.200	2.051
	(23.577)	(3.550)	(3.123)	(1.841)	(1.490)
SWE	1.375	2.252	2.585	0.459	1.334
	(26.396)	(4.910)	(6.381)	(3.755)	(3.584)
USA	1.743	2.210	2.673	0.273	1.692
	(35.925)	(4.710)	(5.092)	(2.547)	(2.341)
Avg*	1.345	2.102	2.461	0.326	1.642

*Avg is the weighted sum of the estimated coefficients, the weights are partners' share of total Danish raw material exports in 2005. Coefficients with the wrong sign are not reported, and are given the average value when constructing the market indices.
The sample covers 1976-2012, for Greek it covers only 1990-2012. T-values are given in parenthesis.