Danmarks Statistik
MODELGRUPPEN

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New export aggregation and re-estimation

Resumé:

We estimate elasticities for exports based on the new aggregation suggested in DKN06209. Compared to estimates in earlier version of ADAM (Apr08), long term price elasticity for manufactured exports has fallen. This fall is attributed to the group fE7q, which is now zero when freely estimated in contrast to the non-zero restriction imposed in Apr08 model version. The other export categories more or less maintained their previous values.

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1. New Export Grouping

As part of the simplification process in ADAM, new aggregation for foreign trade has been suggested. Currently, there are 11 categories on the export side, 9 of which are goods and the rest 2 are services.[1] The division is still SITC. The 9 export categories are: food, 0, Tobacco, 1, miscellaneous unprocessed, 2+4, Energy, 3, chemicals, 5, manufactured goods, 6, machinery and transport equipment, 7, which is split into two (ships plus aircraft plus drilling rigs, and the rest of 7), and finally other finished goods, 8+9.

The new export aggregation consists of 5 groups (excluding services): SITC 0+1, 2+4, 3, 5+6+7q+8+9, and 7y. Group 5+6+7+8+9 corresponds to OECD's old definition of manufactures. Table 1 shows the old and new export grouping.

Table 1. ADAM export grouping

Exports	Old ADAM name	SITC equivalent	New ADAM name	Per cent of total exports, 1990*	Per cent of total exports, 2007*
Food Products, etc	E0	0			
Beverages and tobacco	E1	1	E01	0.169	0.106
Miscellaneous unprocessed	E2	2+4	E2	0.042	0.021
Fuels, lubricating oils, etc.	E3	3	E3	0.035	0.045
Chemicals	E5	5			
Manufactured goods	E6	6			
Machinery and other transport equipment	E7q	rest of 7			
Other finished goods	E8	8+9	E59	0.433	0.444
Ships, aircraft and drilling rigs	E7y	part of 79	E7y	0.026	0.005
Services excluding tourism	Es	-		0.221	0.336
Tourism	Et	-		0.072	0.042
Total Bill. DKK.	E	-		365	812

*In 2000 constant prices.

Over the period 1990 to 2007, besides the overall growth in exports, no major changes have been observed in the composition of exports except for the unprecedented growth in service exports excluding tourism. The growth of export volume plays a big role for the overall development of the economy, especially for small open economies like Denmark. Exports play a central role in the business cycle and help to pull the economy out of recession (Nielsen, 1999).[2]

[1] see DKN06209 and JNR06209 for new aggregation of imports.

[2] Nielsen (1999). Market Shares of Manufactured Exports and Competitiveness. Monetary review 2nd quarter, Danmarks nationalbank.

The aggregation is made using chain index formula. Here we show how it is made for group 'E59', and the aggregation for E01 is made in the same manner.

$$fe59 = \frac{fe5 * pe5_{-1} + fe6 * pe6_{-1} + fe7q * pe7q_{-1} + fe8 * pe8_{-1}}{pe59_{-1}} \quad (1)$$

$$pe59 = \frac{fe5 * pe5 + fe6 * pe6 + fe7q * pe7q + fe8 * pe8}{fe59} \quad (2)$$

Where, *fe<i>* and *pe<i>* are the volume and price of exports for the export group *i=5,6,7q,8,59*. The price *pe59* is denominated one in 2000, then equation (1) and (2) are executed iteratively by going forward and backward in time from 2000.[3]

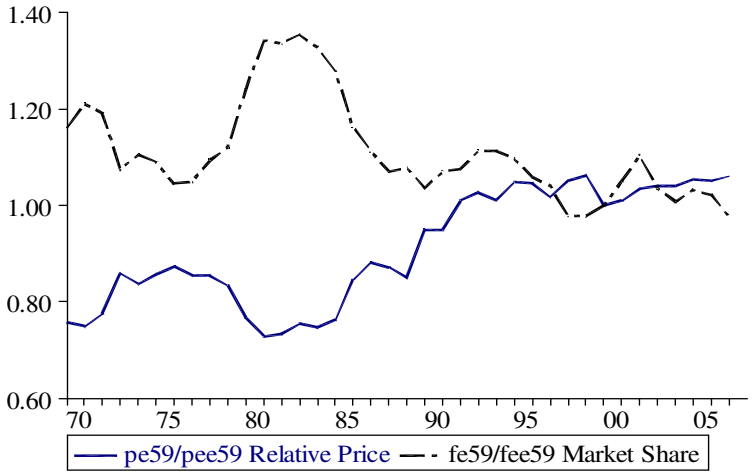
2. Manufactured Exports

Industrial exports comprise approximately half of the total exports. Figure 1 shows relative price and market share for manufactured exports. Market share is defined as the ratio between Danish export volume (fe59) and export market volume (fee59), the latter is calculated as a weighted sum of imports in 21 OCED countries. A comparison of market share and relative price shows that market shares are high when relative prices are low and vice versa. This picture is clear before 1990. During the early 1990's Danish manufacturers have gained considerable market share despite the deterioration in competitiveness. Nielsen[4] (2002) has showed that the gain in export share can be attributed mainly to the German market. The Danish market share grew by about 40% following the German reunification. This, in part, explains why there are no clear indications for market share growth after 1990 despite increase in the relative price.

Trade with the now emerging Eastern Europe has become important in recent years. It was also in these periods the single market in Europe became a practical reality. And the rise of China and other Asian countries for which price alone is not a determinant for trade is also worth mentioning. In part, this also explains the lack of clear correlations between market share and competitiveness.

[3] For details on chain index see Knudsen D. and Sethi F. (2004) *Chain indexing in a macro model – Aggregation and irreversibility.* Danmarks Nationalbanken, Working Paper.
[4] Nielsen, H. B. (2002). An I(2) cointegration analysis of price and quantity formation in Danish manufactured exports. *Oxford Bulletin of Economics and Statistics*, 64(5), 449-472.

Figure 1. Relative price and market share



3. Estimation

The estimation framework is based on the work of Armington (1969).[5] A long term relation between market share and relative price (excluding the constant term) can be given as

$$\log(fE / fEe) = -\omega * \log(pe / pee) + u_d \qquad (3a)$$

Where, ω is export price elasticity, *fE* is volume of exports, *fEe* is export market index, *pe* is export price, *pee* is competitors price and U_d is error term. This long term relation is augmented with a shift dummy to capture the German reunification and a trend to capture structural aspects that might not be explained by the simple relation.

Estimation of an export equation is subject to endogeneity problem. For instance, export prices can increase due to an increase in foreign demand for Danish goods. In this case export price increase is not associated with a decrease in Danish exports. Measurement problems can also produce a biased estimate.

To reduce this problem an equation for price is estimated simultaneously with (3a). Export prices are determined on the basis of costs. A long term price relation (excluding the constant term) can be written as:

$$\log(pe) = \log(pwew) + u_p \qquad (4a)$$

[5] Armington, P. S. (1969). 'A Theory of Demand for Products Distinguished by Place of Production', *International Monetary Fund Staff Papers*, Vol. 16, pp. 159 – 178. See also JAO05995 and ADAM (1995) for a detailed discussion of the estimation method.

Where, *pwew* is long-term marginal costs (= average cost), U_p is error term. Estimated export prices are not used in ADAM, they are only used for estimation purposes to reduce simultaneity problem in (3a).

Equation (3a) and (4a) hold in the long run. However, sluggish entry implies the changes in exports and prices in the short term will be less than the changes in the long run. Hence, the long term relations need to be reformulated in error correction form to be able to distinguish between long term and short term effects. For estimation the long term volume and price relations are reformulated in error correction form as follow:

$$d\log(fE) = \alpha_{f1} d\log(fEe) - \alpha_{f2} d\log(\frac{pe}{pee}) - a_{fd} U_{d,-1} \qquad (3b)$$

$$d\log(pe) = \alpha_{p1} d\log(pwenv) - \alpha_{p2} d\log(pee) - a_{pp} U_{p,-1} \qquad (4b)$$

Where, *pwenv* is short term marginal cost, α_{fd} and α_{pp} are error correction terms to the long run relations (3a) and (4a), respectively. Competitor price in (4b) is included to capture how exporters adjust prices to changes in competitors' price such as to maintain market share. Equations (3b) and (4b) are estimated simultaneously. The table below summarizes the estimation results.

Table 2. Estimation results.

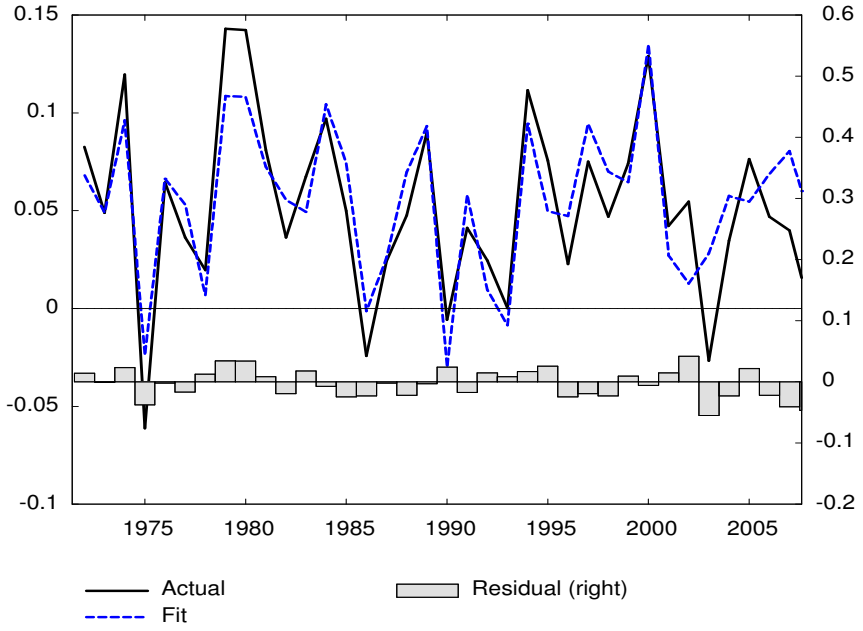
	Price Elasticity		Demand Elasticity	Error
Exports	Short term	Long term	(short term)	Correction
E0	-0.429	-1.647	0.350	-0.15
E2	-0.266	-1.775	0.529	-0.15
E59	-0.749	-2.000	0.621	-0.15
Et	0.662	-2.262	1	-0.20

Note: Estimation period is 1971-2005. Long term demand elasticity is restricted to 1 in all cases. To check the extent of the endogenity problem mentioned above, we have made a simple OLS estimation of fE59, and the long term price elasticity is -1.98. After all the simple OLS estimates are not different from the IV estimates reported in the table. No estimation is made for fEs, in the model the estimates for fE59 are used as a proxy for fEs.

Error correction is the rate at which the relationship approaches the long term equilibrium after a temporary imbalance, in our formulation, for instance, exports of goods adjust each period by 15% following shocks. The battery of misspecification tests (not reported for brevity) show the model has desirable properties. Figure 2 below shows the overall fit of the estimated relation for industrial exports. The model explains the variation in the data quite well. The model's failure to explain the variation in recent periods could be attributed to the now growing trade with emerging East Europe, the rise of China and other reasons mentioned above. At this level we could only hypothesize, one needs to scrutinize the data before such conclusions are drawn, and if this is the case we need to come up with a better way of modelling this new trade.

The long run price elasticity of manufactured exports is estimated at 2.00 which is lower than previous estimates in ADAM. In previous version of ADAM the long run price elasticity for the group E7q is restricted to be 1, when freely estimated the coefficient is zero, this in part explains the decline in industrial export price elasticity, see appendix for comparison of current estimates with previous model version (Apr08). The group E7q constitutes the largest category of manufactured exports; its price elasticity will reduce the industrial average if not restricted, but restricting it to 1 when it is in fact zero will give misleading figures. The short term elasticity for E59 is -0.75. A value of 2.00 is lower than the historical estimates of 3.8 in Jensen and Knudsen (1992)[6] and 3.14 in Nielsen (2002), but it is close to the most recent estimate of 1.9 in Andersen (2009) that applies a multivariate VAR model.[7] One can see the estimates for E0, E2 and Et from the table above.

Figure 2. Overall fit of the estimated fE59 relation.



4. Multiplier Analysis

We compare the old and new export relations with the help of a multiplier analysis. That is to compare Apr08 model with a similar model that only differs in terms of the export relation for industrial exports.[8] Figure 3 shows a multiplier experiment of public purchase of goods and services. In the short run, an increase in public expenditure boosts aggregate demand there by output and employment. In the medium to long term, overheating and pressure in the

[6] Jensen, L. S., and Knudsen, D. (1992). 'Multivariat Analyse af Udenrigshandelens Priselasticiteter' in Symposium i Anvendt Statistik, Aarhus, Danmark: UNI-C, pp. 413-428.

[7] Andersen, N. M. (2009). *Dansk Industrieksport, en Kointegrationsanalyse, økonomisk Institut,* Københavns Universitet.

[8] We only consider the change in industrial exports since this export group determine most of the dynamics in the foreign trade section of the model.

labour market entails higher wage increase in the domestic market than abroad which leads to a loss in our competitiveness and exports decline so that the pressure from aggregate demand subsides.

There is no significant difference between the old and new export relations. The main difference is that the positive effect on domestic price and output is higher with the new export relation. This is because export elasticities are lower in the new relation, there is a room for a large price increase before reduction in total export is equivalent to the long term equilibrium.

Figure 3. Effect of government purchase

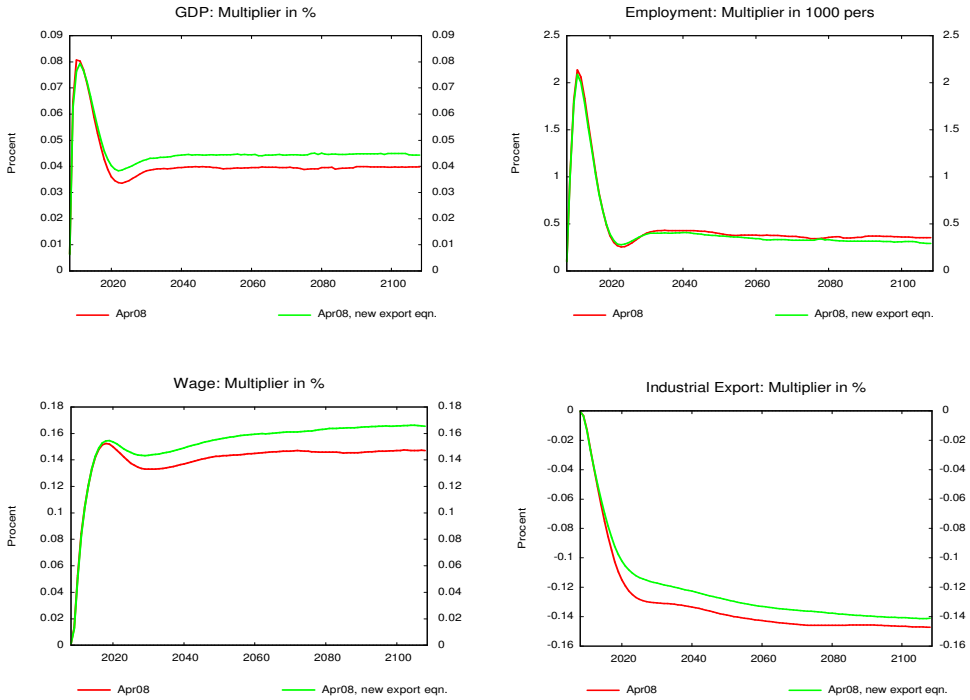
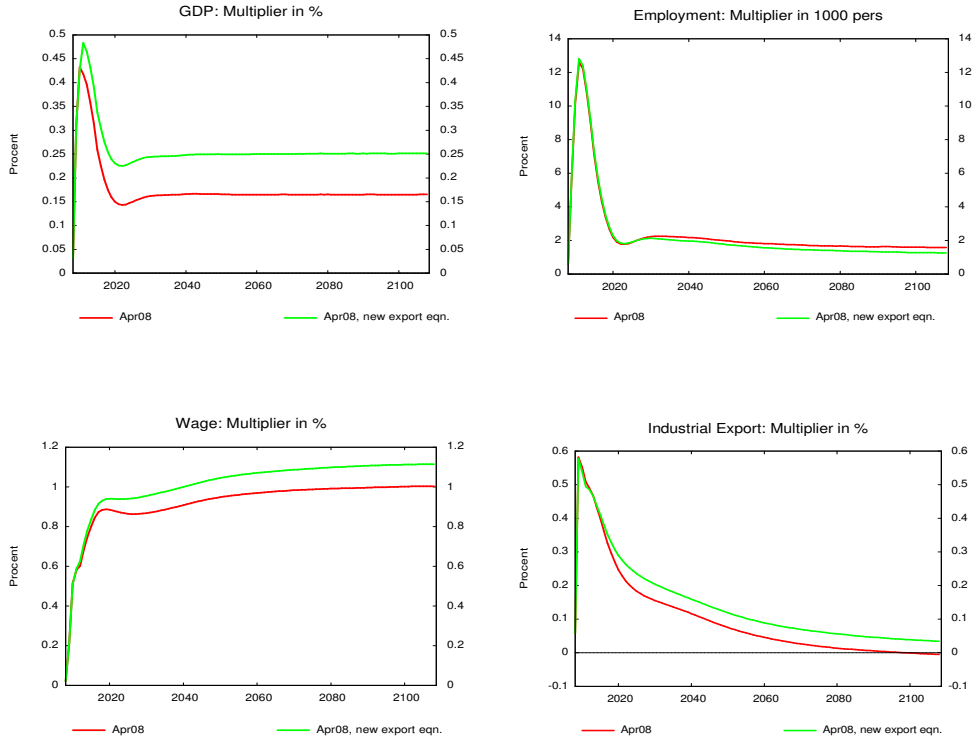


Figure 4 shows the effect of an increase in the market for Danish exports. The immediate effect of an increase in foreign demand is an increase in exports. This gives rise to expansionary effect on employment and output. This will lead to a rise in prices and wages which will consequently dampen the positive effect on exports.

Again there is no significant difference between the alternative export equations. A lower export price elasticity in the new relation means there is a room for larger price/wage increase before the reduction in total exports is equivalent to the long term equilibrium.

Figure 4. Effect of an increase in market for Danish exports



5. Conclusion

The purpose of this paper was to estimate elasticities for Danish exports based on a new aggregation. The overall results are not significantly different from estimates in *Apr08* model version. In general, the positive relationship between competitiveness and market share cannot be maintained after 1990. This is attributed to the German reunification, the growing trade with East Europe, the rising trade with China and other Asian countries and the Single market proposition. While the German reunification is captured with a shift dummy, an attempt was not made for the others. The long term price elasticity for industrial exports is estimated at 2.00 for the period 1970 to 2005.

Appendix

Table 1. Apr08 vs. Dec09

Export	Prise elasticity				Adjustment speed		Income elasticity	
	long term		short term				short term	
	Apr08	Dec09	Apr08	Dec09	Apr08	Dec09	Apr08	Dec09
E2	-1.85	-1.77	-0.28	-0.27	0.15	0.15	0.28	0.53
E5	-3.27		-0.74		0.15	0.15	0.52	
E6	-3.19	***-2.3*** ***-2.00***	-0.59	-0.65 -0.75	0.15	0.15	0.59	0.61 0.62
E7q	-1		-0.59		0.15	0.15	0.6	
E8	-3.11		-0.52		0.15	0.15	0.74	
Et	-2.23	-2.26	-0.66	-0.66	0.20	0.20	1	1

The long term price elasticity for fE59 has fallen from 2.3 in Apr08 to 2.0 in Dec09 (see table 1). In Apr08 the price elasticity for fE7q is restricted to 1. However, when this is freely estimated we obtain a coefficient of zero, this explains the fall in price elasticity for industrial exports, fE59, see table 2.

Table 2. Apr08 vs. Dec09

Export	Prise elasticity				Adjustment speed		Income elasticity	
	long term		short term				short term	
	Apr08	Dec09	Apr08	Dec09	Apr08	Dec09	Apr08	Dec09
E2	-1.85	-1.77	-0.28	-0.27	0.15	0.15	0.28	0.53
E5	-3.27		-0.74		0.15	0.15	0.52	
E6	-3.19	***-1.9*** ***-2.00***	-0.59	-0.65 -0.75	0.15	0.15	0.59	0.61 0.62
E7q	0.0		-0.59		0.15	0.15	0.6	
E8	-3.11		-0.52		0.15	0.15	0.74	
Et	-2.23	-2.26	-0.66	-0.66	0.20	0.20	1	1