Danmarks Statistik
MODELGRUPPEN

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# Export Market and Market Price Indices for ADAM

**Resumé:**

The working paper *DSI231112* has presented data for export market and market price indices for the different export groups in ADAM, based on trade statistics at detailed SITC level. This paper compares the price and quantity indices in *DSI231112* with alternative indices based on data from OECD-collected national accounts statistics. The latter contains data for total goods only. In value terms the two data are very similar and produce market indices for total goods in value that are quite close. However, the price-quantity split differs so that the short-term movements in quantity indices are more pronounced in the unit value data than in the national accounts data, and the vice versa for price indices. This difference is especially significant in 2009. If we prefer the national account-based market volume index for total goods, it is possible to derive the market index for manufactures (SITC5to9) by a residual method, where the unit value-based data for SITC0to4 is deducted from the national account-based index for total goods. Alternatively, all the unit values of the trade statistics data can be proportionally adjusted to match the national accounts import prices before SITC5to9 is calculated.

The alternative manufacturing market indices are shown in figure 6 p.9. We chose to use the proportionally adjusted figures for ADAM's variables.

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**Keywords**: Export market index, Market price, Unit value, National accounts statistics

## 1. Introduction

In this paper we compare the export market and market price indices for total goods constructed based on unit values from the detailed data in *DSI231112* with equivalent series constructed from the OECD National Accounts Statistics. In value terms the two market indices resemble each other pretty well. However, there are some differences concerning the price-quantity split, especially concerning the recession year 2009. If the two sources had happened to produce the same market index for total goods, it would be straightforward to apply the unit value data to disaggregate the total goods market index into ADAM sub-groups, e.g SITC5to9, manufactures. But, there is a discrepancy, and therefore we may calculate the SITC5to9 market index in more than one way. We may choose to rely fully on the unit value data, we may choose to derive the SITC5to9 market index residually by subtracting the unit-value-based indices for SITC 0 to 4 from the national accounts based index for total goods, or we may adjust the unit-value data proportionally until it produces the same total index as the national accounts before we calculate SITC5to9 market index. In the following section we present the OECD national accounts statistics and in the subsequent sections we present the options for export market and market prices for ADAM export groups.

## 2. OECD National Accounts Statistics

The OECD iLibrary provides aggregate national accounts statistics for member countries. Included are value and volume of total imports of goods. Export market and market price indices for total goods can be constructed based on these data.

National accounts prices are constructed using various methods in individual countries. Members of the EU construct prices using the chained Paasche index formula, whereas e.g. the United States uses the chained Fisher index formula. Since the main part of Danish exports is to EU countries, we consider the national accounts based market price to be a chain Paasche index and, consequently, the volume export market index to be a chain Laspeyres index. Hence for comparison purpose, it would be appropriate to construct the unit value based market prices based on Paasche index and the export market index based on the Laspeyres index. Nevertheless, we have seen in *DSI231112* the downward and upward biases in Paasche and Laspeyres indices render them misleading and that the Fisher index shall be used. Even though our preferred choice is the Fisher index, for comparison purpose we also report the Paasche price and the Laspeyres quantity indices when necessary.

In *DSI231112* the market index has been constructed in three different ways: chained Laspeyres, Paasche and Fisher indices. These formulae have significance only when aggregating the detailed 5-digit SITC unit values to 1-digit SITC unit values at the country level. Once partners import prices and quantities at 1-digit SITC are available using one or the other index formula to construct export market and market price indices does not alter the final result. The OECD constructs these market indices based on weights in a fixed base

year. The box below explains the difference between this weighting scheme and the weighting used for constructing market indices for ADAM.

**Box 1: Market index measures**

In ADAM the volume export market index is constructed using the chain Laspeyres formula, defined as:

$$\frac{fEe_t}{fEe_{t-1}} = \sum_j \frac{X\_DNK\_j_{t-1}}{X\_DNK\_WLD_{t-1}} * \frac{fEe_{j,t}}{fEe_{j,t-1}} \qquad (1)$$

Where *j* is partner countries, *fEe* is the Danish export market index in volume, $fEe_j$ is country j's import in volume, *X_DNK_j* is Danish export to country j, and *X_DNK_WLD* is total Danish exports to partner countries. Thus the growth in the market for Danish exports is measured as a weighted sum of the growth in trading partners' import. The weight is country *j*'s share of total Danish exports in the previous year. An alternative to (1) is to use e.g. 2005 as fixed base and weight. This fixed weight index can be written as:

$$\frac{fEe_t}{fEe_{2005}} = \sum_j \frac{X\_DNK\_j_{2005}}{X\_DNK\_WLD_{2005}} * \frac{fEe_{j,t}}{fEe_{j,2005}} \quad \Leftrightarrow$$
$$X\_WLD\_j_{2005} * \frac{fEe_t}{fEe_{2005}} = \sum_j \frac{X\_DNK\_j_{2005}}{fEe_{j,2005}} * fEe_{j,t} \qquad (1^*)$$

Equation (1*) gives an export market that is equal to total Danish exports in 2005. OECD uses a similar formula but replaces total imports to country *j* in 2005, $fEe_{j,2005}$, by total world exports to country *j* in 2005:

$$fEe_t^{OECD} = \sum_j \frac{X\_DNK\_j_{2005}}{X\_WLD\_j_{2005}} * fEe_{j,t} \qquad (2)$$

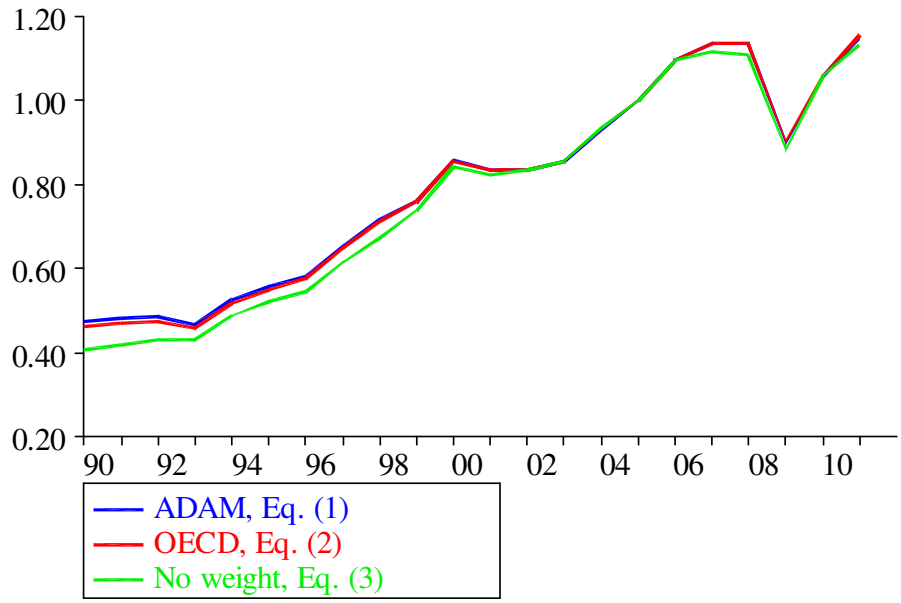
For a trade matrix that is harmonized $fEe_{j,2005}$ should equal $X\_WLD\_j_{2005}$. However, in practice they differ, but also in practice $fEe_{j,2005}$ is used instead of $X\_WLD\_j_{2005}$ in equation (2) as the former is readily available, this is for example the case in the Danish National Bank. Consequently, the difference between ADAM's and OECD's index is basically only a question of chained versus fixed weight indices.

Both the ADAM and the OECD calculations are extended index approaches. It is sometimes proposed to measure the export market as a simple sum of partners' imports, i.e.

$$fEe_t^{SUM} = \sum_j fEe_{j,t} \qquad (3)$$

This practice is not advisable as it fails to discriminate the Danish trading partners by their share of Danish exports. In particular, this method is not appropriate when using chained price or volume indices.

The figure below presents market index for industrial exports in volume terms based on the equations above. Equation (1) and (2) yield similar results, the market index based on equation (3) is somewhat different from the others. As in *DSI231112,* here too we use chain indices.

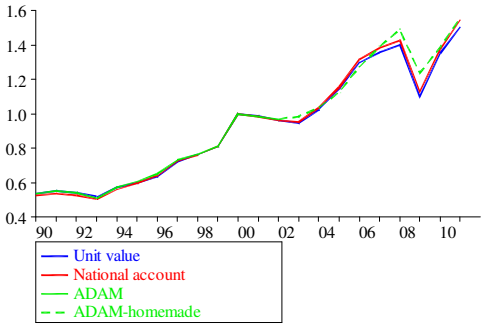



Note: the trading partners considered are Australia, Austria, Canada, Switzerland, Germany, Spain, Finland, France, Great Britain, Greek, Ireland, Iceland, Italy, Japan, Netherland, Norway, New Zealand, Portugal, Sweden and United States.

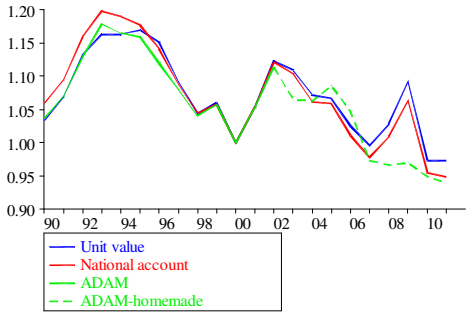
Figure 1 presents the export market index and market share for total goods in value terms. The different labels are as follow: the series "Unit value" is based on unit values from the detailed SITC data, the series "National account" is based on the OECD national accounts statistics, and the series "ADAM" is the data used in ADAM, and could be considered a vintage version of the national accounts data (with homemade data for 2003 and onwards). In the model group since 2003 export market indices have been calculated by approximating imports of trading partners as a constant share of their respective GDP and Danish import prices are used as a proxy for market prices. The resulting time series are not official figures, and this data is labeled "ADAM-homemade".

**Figure 1. Market index and market share for total exports of goods in value terms (2000=1)**

***a. export market value index***




***b. market share in value***




In value terms the unit value data and the national accounts data produce very similar export market indices. Before 2002 the data from ADAM is also similar with the other two datasets. Figure 1b shows the market share (Danish exports

as a ratio of the market index) for total goods excluding services. All the three datasets show the Danish market share in value terms has been falling moderately over the last 20 years.

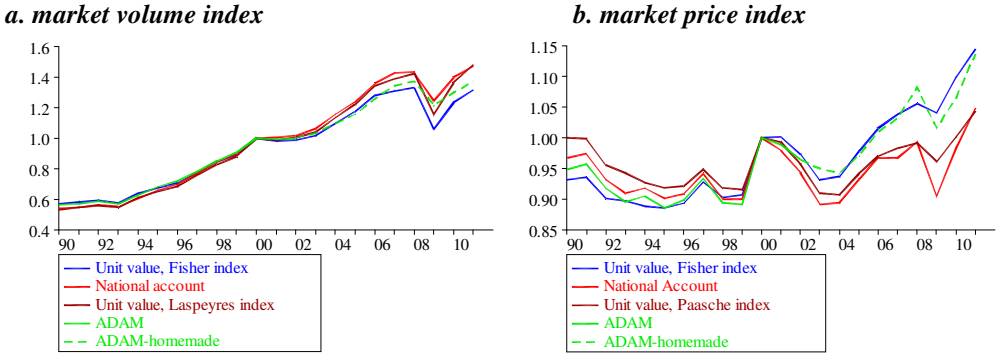
Figure 2 presents the export market in volume and market price for total goods. We have concluded in *DSI231112* that the Fisher index is the ideal index to use due to upward and downward biases in the Laspeyres and Paasche indices, respectively. In this section, for comparison purposes only, we recall these indices. This is because most of Denmark's trading partners are members of the European Union, and EU member states use Paasche price indices in the national accounts. It would be natural to use the Paasche version of the unit value price index when comparing with national accounts data.

The Fisher-based unit value exhibits a marked difference in trend from the national account data. The Fisher-based unit value for total goods seems to increase by more than the national accounts price index for total goods. This difference in trend may reflect the quality adjustment of not least high technology products in the national accounts price indices. For example, computer prices are efficiency adjusted, and their prices fall overtime. Unit values do not have such quality adjustments.

Alternatively, the trend difference can be largely reconciled by using Paasche price and Laspeyres quantity indices. There is a lot of similarity between the Paasche price and the Laspeyres quantity indices from the unit value data and the national accounts price and quantity indices. This could, however, be due the downward and upward biases in Paasche and Laspeyres indices that the unit value data and the national accounts data look alike.

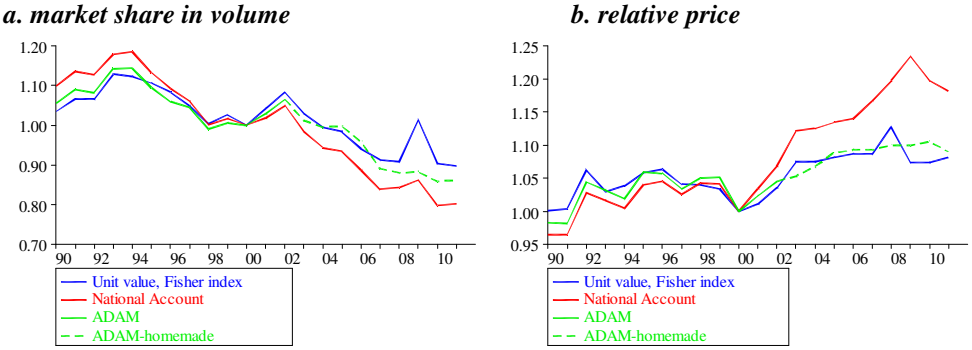
Besides the difference in trend, there is also a marked difference in the recession year 2009, in which the national accounts import prices drop by a solid 9 per cent while the unit value of the trade statistics data only falls by 1 per cent. We do not have a good explanation of the difference in 2009. The unit value calculation relies on outlier detection and deletion, and we may wrongly be deleting actual price falls in a recession year like 2009. However, a closer scrutiny of the outlier filtering process in *DSI231112* indicates no such omission of price changes in 2009.

**Figure 2. Market index in volume and market price for total goods (2000=1)**



From here on we report only the Fisher index for the trade statistics data as it is our preferred index. Figure 3 compares market shares in volume terms and relative prices (Danish prices relative to market prices) for total goods from the different sources. The market share based on the Fisher index falls moderately. In 2009 there is a pronounced gain in market share in real terms in the unit value data and only a small gain in the national accounts data. This gain in market share reflects that Danish exports have fallen less than the market index. Whether the gain in real market share in 2009 is as large as in the unit value data or as small as in the national accounts data is open to discussion. Compared to the relative price based on the national accounts data, the relative prices based on the trade statistics data rise only moderately. The two relative prices exhibit a significant difference in 2009, the former shows a loss in price competitiveness and the latter shows a gain in price competitiveness.

**Figure 3. Export market share in volume terms and relative prices for total goods (2000=1)**




Given that the unit value and the national account datasets produce different export market volume and market price indices for total goods, we have three options for such indices for the disaggregated ADAM export groups. First, we can disregard the differences between the unit value and the national accounts figures and continue to use the Fisher indices as presented in *DSI23112*. Second, we can choose to derive the SITC5to9 market index residually by subtracting the unit- value-based indices for SITC 0 to 4 from the national accounts based index for total goods. Third, we can adjust all the unit value data proportionally so that they add up to the national accounts total for goods. The following sections present the calculations needed for the second and third option.

## 3. Manufactured exports as a residual

If we use the national accounts data for total goods, one of the alternatives for reconciling the detailed data to add up to the national accounts data is to residually calculate the market index for SITC5to9. Exports of goods in ADAM are divided into five groups: agricultural products, 01, material, 2&4, energy,3, manufactured goods excl. ships and aircrafts, 59, and ships and aircrafts, 7y. For homogeneous products unit value based price indices can be reliable. Thus, if we assume the export groups 01, 2&4, 3 are more homogeneous than the group 59, we can use the detailed data for the former and create export market and market price indices for 59 as a residual by

subtracting the trade statistics based results for SITC 0 to 4 from the national accounts total. That is we use the national accounts indices for total goods and the trade statistics based unit value indices for export groups 01, 2&4, and 3 to produce export market and market price indices for manufactured exports.

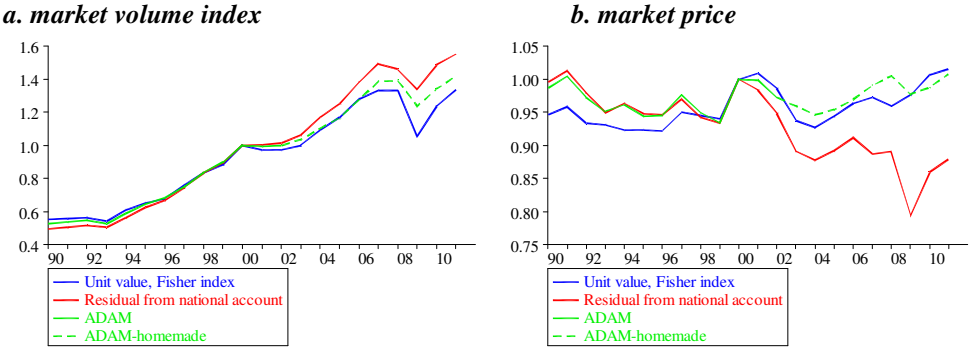
Market price, *pee59*, and market index, *fee59*, for industrial exports including ships and aircrafts as a residual from the national accounts data for total goods are constructed by first creating industrial import price and quantity for each partner country as a residual. We first define industrial imports in current prices, *M59*, and previous year prices, *DM59*, for each partner as:

$$M59 = M09 - M01 - M24 - M3 \quad (4)$$

$$DM59 = DM09 - DM01 - DM24 - DM3 \quad (5)$$

Where, *M09* and *DM09* are national accounts data for total goods in current and previous year prices, respectively, and the remaining groups are as defined above and are taken from the detailed unit value data that are based on the Fisher index. The ratio *M59/DM59* [=(*pM59*fM59*)/(*pM59*fM59*)] is equivalent to $pM59/pM59_{-1}$ which can be cumulated to give price levels for each partner's industrial import, and the price levels are used to make the volume of industrial imports as *fM59=M59/pM59*. Once prices and quantities of industrial imports for partner countries are ready, export market and market price indices for industrial exports can be created. Figure 4 reports the residually calculated export market and market price indices for manufactures.

**Figure 4. Market index in volume and market price for manufactured exports, (2000=1)**




The residually calculated data resembles to a larger extent the national accounts price for total goods. The residually calculated prices tend to fluctuate more than the unit-value-based price and the vice versa for the quantity. One drawback in this calculation is that any error in the other export groups (01, 2&4, 3) will be reflected in the residual price and quantity indices. Figure 5 presents the market share and relative prices for industrial exports for the different datasets. The market share based on the Fisher index falls less than the market share based on the national accounts. The ADAM data before 2002 closely resembles the residually calculated data.

**Figure 5. Market share in volume and relative price for manufactured exports, (2000=1)**

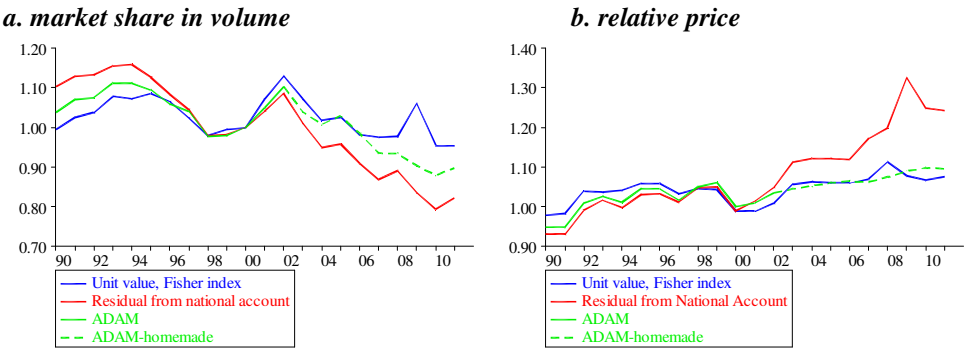



Figure 1b showed that the Danish market share for total goods in value terms increased in 2009. According to the unit value data for manufactured exports the gain in market share for manufactures is a real market gain in volume terms and according to the residually calculated market share it is mainly a gain in the terms of trade/loss of price competitiveness, see figure 5. This reflects the basic difference between the national accounts data and the unit value data in 2009.

## 4. Proportional Adjustment

Residually calculating the export market and market price indices for SITC5-9 runs the risk of including errors in the unit value data for SITC 0-4 in the price and quantity indices for manufactured exports. An alternative is to spread out the difference between the unit value and the national accounts total among all the detailed SITC components, i.e proportionally adjust all the unit value-based export market and market price indices for the different export components in ADAM so that they add up to the national accounts total.

We proceed as follow: first the detailed imports of each trading partners at current and previous year prices from the unit value data are proportionally adjusted to their respective national accounts total for imports at current and previous year prices. That is for each partner we multiply the detailed imports by the ratio of national accounts total to unit values total, given as:

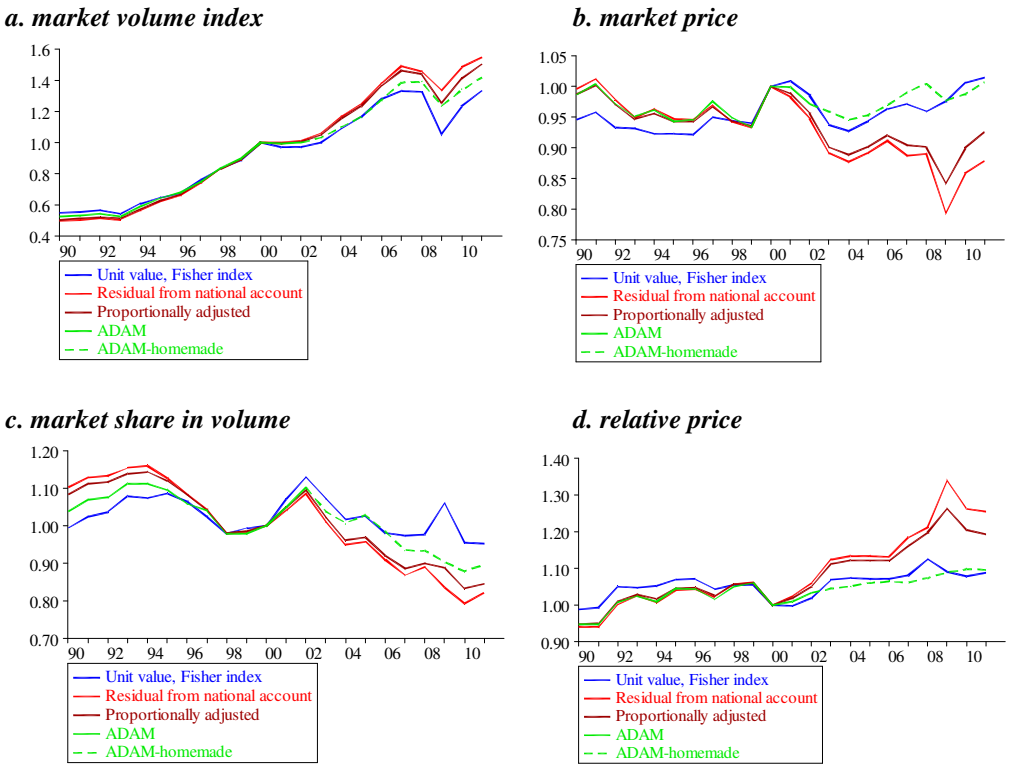
$$\widehat{M} < i >= M < i > * \frac{M09}{\sum_i M<i>} \quad (6)$$

$$\widehat{DM} < i >= DM < i > * \frac{DM09}{\sum_i DM<i>} \quad (7)$$

Where $i$ = 01,24,3,59, *M09* and *DM09* are national accounts data for total goods in current and previous year prices, respectively, *M<i> and DM<i>* are unit value data for SITC-$i$ in current and previous year prices, respectively. Note that the current value fraction applied in (6) is closer to 1 than the fraction in (7). The ratio between the proportionally adjusted imports in current price ($\widehat{M}$) and in previous year prices ($\widehat{DM}$) gives relative price changes that can be cumulated to price levels, i.e. $\widehat{M} < i > / \widehat{DM} < i > = pm < i > / pm < i >_{-1}$. The price levels are used to deflate value of imports to get quantity of imports.

From here on the Fisher index can be used to construct export market and market price indices. Figure 6 shows export market and market price indices for manufactured exports with four different cases, the other export components are reported in the appendix. An important difference between the residual data and the proportionally adjusted data is that the price in 2009 drops relatively by a smaller proportion in the proportionally adjusted series. This is because the discrepancy between the national accounts and the unit values total is now spread out in all export components.

**Figure 6. Export market, market price, market share, and relative price, manufactured exports, (2000=1)**




Basically, figure 6 represents the possibilities we have to choose between: the pure unit value Fisher indices, the residually calculated indices and the proportionally adjusted Fisher unit value indices.

## 5. Estimation

We can finally compare the alternative datasets for industrial exports by estimating the export equation. The different datasets can be compared in terms of the estimated parameters and the predicting ability of the equations. The sample period is 1970-2011, the datasets are extended before 1990 using data from ADAM. Here we only report the estimated result, for a detailed discussion of the export equation see ADAM book. Table 1 presents the estimation result.

The estimated parameters are not significantly different from one another. The long term and short term price elasticities are marginally lower in the unit value data. The predicted market share from the unit value equation rises more

significantly than the other predicted market shares in 2009, this is consistent with a short term demand elasticity less than one, see figure 7.

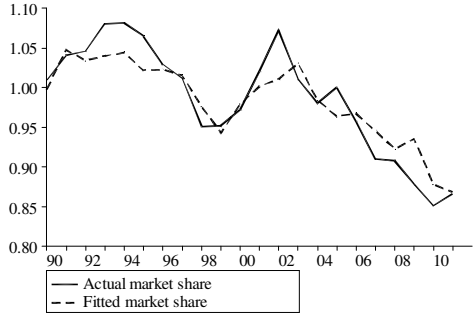
**Table 1. Estimation output, manufactured exports**

| Variable | ADAM-name | ADAM data | Unit value data | Residual data | Proportionally adjusted data |
|---|---|---|---|---|---|
| Manufactured export | Dlog(fE59) | | | | |
| Market change | Dlog(fEe59) | 0.81 [0.08] | 0.66 [0.05] | 0.62 [0.07] | 0.64 [0.06] |
| Relative price change | Dlog(pe59/pee59) | -0.71 [0.10] | -0.71 [0.08] | -0.77 [0.07] | -0.75 [0.07] |
| Lagged export | $\log(fE59_{-1}/ fEe59_{-1})$ | -0.40 [0.11] | -0.46 [0.08] | -0.40 [0.07] | -0.41 [0.08] |
| Relative price | $\log(pe59_{-1}/pee59_{-1})$ | -1.57 [0.18] | -1.46 [0.14] | -1.52 [0.11] | -1.56 [0.12] |
| Reunification dummy | dum91 | 0.18 [0.03] | 0.18 [0.02] | 0.17 [0.03] | 0.18 [0.03] |
| Dummy change | Dif(dum91) | 0.06 [0.03] | 0.06 [0.02] | 0.05 [0.02] | 0.05 [0.02] |
| $R^2$ | | 0.78 | 0.86 | 0.87 | 0.87 |

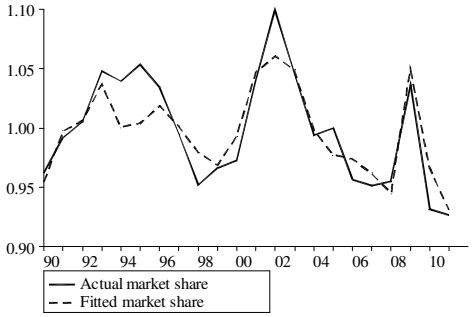
Note n=1971-2011, standard errors in square bracket. The battery of misspecification tests, not printed here, show the two models have desirable properties. The error correction coefficient and the short term reunification dummy are restricted. The long term relation, e.g for the proportionally adjusted data, is given as: *log(fe59) = log(fee59) -1.57*log(pe59/pee59)-0.18*dum91*.

**Figure 7. Actual and fitted market share, manufactured exports**

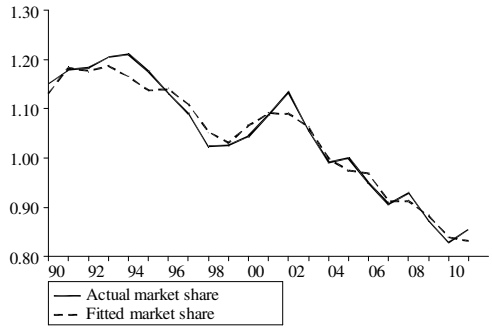
***a. ADAM data (homemade after 2002)***



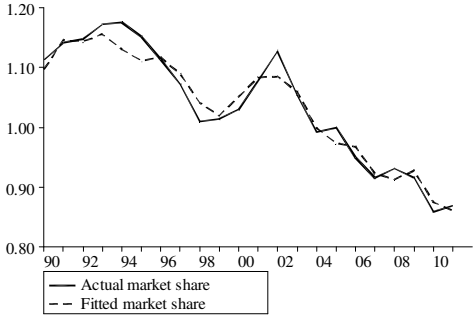

***b. unit value data***




***c. residual data***




***d. proportionally adjusted data***



## 6. Conclusion

We have presented the new export market data, volume and price, that is included in the latest version of ADAM. The new export market data reflects the national accounts data for total imports of goods of our main trading partners. These national accounts data for foreign counties are taken from OECD's database. Total imports of goods are not broken down on sub-groups in the official national accounts, so we supplement the national accounts data by detailed international trade statistics data, also collected by OECD from the national statistical institutions.

The trade statistics data has to be split into volume and price and to this end we use unit values as prices. There is a lot of noise in the detailed unit values, which makes it necessary to filter out extreme changes at the detailed level. The filtering removes the largest outliers, but the filtered unit values are still volatile. This volatility makes chain indices biased. More specifically, a chained Laspeyres price index, weighting the detailed unit values, will be upward biased and a ditto Paasche price index will be downward biased to a considerable magnitude. The geometric average of Laspeyres and Paasche, i.e. the Fisher index, is more robust to volatile inputs and is our preferred index.

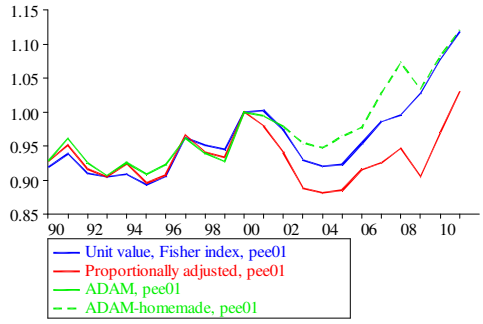
Now, the total Danish export market for goods can be calculated on the basis of both national accounts data and trade statistics data. In nominal terms the results are similar. However, the split of value into volume and price differs, reflecting the basic difference between price indices and unit value. For instance, import price indices are quality adjusted, unit values are not. In the case of computers, for example, the national account price indices are efficiency adjusted, and consequently the computer price index falls steeply over time. The unit value of computers represents the import value divided by the number of computers imported, and this simple average price of computers is not necessarily falling over time.

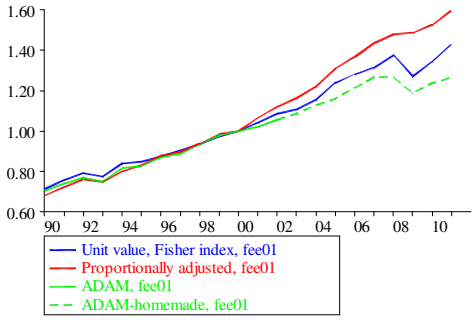
To adjust for the difference between the two datasets, we proportionally adjust the detailed unit values of the trade statistics data by the ratio between: 1) the national accounts price of imported goods and 2) the trade statistics based Fisher chain index for the unit value of total imported goods. With this adjustment, the two datasets basically produce the same time series for the aggregate market price and volume, and the import price and volumes of the trade statistics data are used to produce export market and market price indices for the export groups in ADAM.

# Appendices

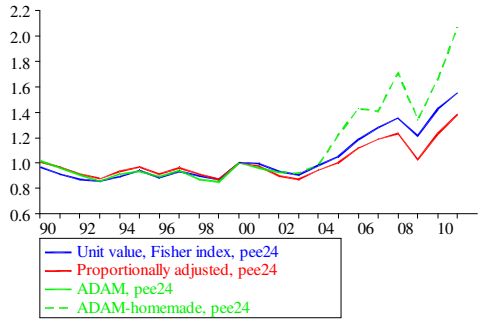
## Appendix I. Market price and export market indices

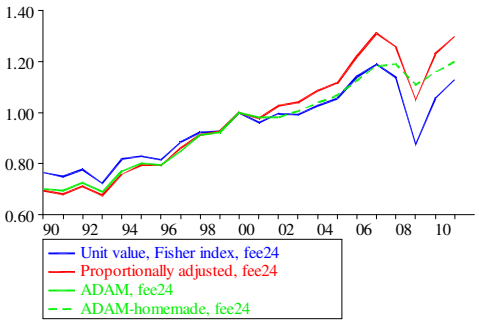
### a. agricultural exports (2000=1)




### b. material exports (2000=1)




### c. energy exports (2005=1)