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Globalization indicators - the import content of export

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GLOBALIZATION INDICATORS – THE IMPORT CONTENT OF EXPORT

1. Introduction

1. The catchword ‘globalization’ seems to appear in almost every facet of human interaction ever more frequently, with its definition and interpretation differing from subject to subject. *Economic globalization* is often used to describe the wide range of changes in the way the international economy works and it applies to almost all facets of national policy and corporate activity: the financial market, government policy, competition and corporate strategies (Hatzichronoglou, 1996). Globalization is a dynamic and multidimensional process within which national resources are becoming internationally mobile while nations are growing increasingly interdependent through globalization of trade, internationalization of production processes and increasingly preponderant cross-border investment and multinational activity. Signifying a new phase in international transactions between countries, international trade in goods and services is increasingly matched and surpassed by international investment.

2. The main reason why countries engage in trade is to increase their standard of living, i.e. an increase in economic growth, which is attained by undertaking or expanding activities in which a country is efficient and profitable. International relations have entered a new phase due to several changes in available technology, regulations and transaction possibilities, leading to increasing cross-border integration and interdependence and set in motion not only a strong expansion of total trade in goods and services but also a drastic increase in international financial flows¹. Competition from foreign entities is no longer confined to imports; trade is increasingly matched by multinational activity in all areas of economic life. Standard and traditional (trade) indicators are thus becoming less effective and telling than before, not because the data on which they are based are less accurate but because the framework of international activity, within which they need to be interpreted, has changed. Globalization places new and different requirements on existing indicators and accordingly, there exists a growing need to supplement existing indicators of integration and openness with new indicators which are capable of looking look beyond the surface of international trade and international investment (Hatzichronoglou, 1996 and Hatzichronoglou, 2003c). Such indicators are still relatively scarce, since globalization is a fairly new phenomenon, but also due to the rather ‘national’ focus the involved countries are compelled to adopt². Nevertheless, the OECD has put forward significant efforts to ‘lead the way’ in such measurement issues, by trying to capture key economic consequences of (increasing) globalization with new and relevant indicators.

2. The Manual on economic globalization indicators and the Import Content Of Export

3. During the past decade, the OECD has published many documents and working papers in which significant attempts are made to tackle this issue. One of the most interesting and recent in dealing with

1 Important factors and features which invoked the globalization phase at the end of the 1980s, are widespread deregulation policies in many areas of transaction, the introduction of new ICT which facilitated cross-border transactions and improved transportation and transaction possibilities.

2 It has become increasingly easy for enterprises to shift production facilities abroad or to engage in obscure intra-firm trade and transfer pricing, thereby masking firm performance from national points of view. International organizations and institutions such as the OECD or Eurostat can and do play an important role as initiator and supervisor of a joint effort to multilaterally agree on definitions, statistical units and measurement issues with respect to the phenomenon of globalization.

globalization measurement problems, is the *Manual on economic globalization indicators* as developed by T. Hatzichronoglou (2003b)³. Among other things, this manual introduces several interesting new insights and (still) provisional indicators with respect to globalization, one of which is the so-called 'Import Content Of Export' indicator. This indicator moves away from standard analysis of international trade or capital movements and focuses on internationalization of production processes as a sign of progressing globalization. It is argued that the necessity to import in order to produce export is an integral characteristic of international economic integration and the globalization of production (Hatzichronoglou, 2003a). This new 'globalization-indicator' measures the internationalization of production processes and takes into account the relative dependence on foreign inputs by individual sectors. For instance, when export demand for the production of a certain sector increases, then to be able to export a larger amount of goods, production needs to increase. This however implies that more inputs are needed, domestic as well as foreign. The indicator as developed by the OECD makes use of input-output tables and is capable of calculating the amount of import necessary to produce one unit of export. A high import content in export production indicates a significant degree of integration and dependence on foreign production and thus an internationalized production process⁴.

4. In order to analyze individual production processes and the relative dependence on foreign input composition by a certain country, it is necessary to look at input-output tables; in this article the Netherlands will serve as an example. Input-output tables show (among other things) intermediate deliveries between sectors of economic activity, deliveries of sectoral output to final domestic demand (domestic consumption, investment, government consumption), sectoral output exported, the creation of value added by each sector, the amount of imports going into the sectors as well as total sectoral output⁵. Input-output tables have two 'sides'; a supply-side which should be read horizontally and a use-side which should be read vertically. A column in an input-output table represents the purchases of sector i from all n sectors; i.e. the inputs (as well as imports) needed in the production process of sector i as well as the value added created in production. The purposes for which sector output is used are shown in each row; the output of sector i is partly destined for intermediate deliveries to other sectors and the rest is delivered to final demand (either domestic or exports). In sum, sectors need to produce output not only to satisfy foreign and domestic final demand, but also to allow other sectors to produce output as well.

5. The total output that sector i needs to produce depends on total final demand and the requirements all other sectors make, which they need in order to produce enough output to satisfy intermediate demands *they* encounter from all other sectors as well as final demand (but how much output this is, again depends on the intermediate deliveries required and final demand, etc. etc.) Then to be able to calculate the amount of sector output that is needed, W. Leontieff has developed a useful mathematical model, which takes into account the economic cycle sectoral output goes through (see for instance Miller & Blair, 1985). Equation (1) shows this model, in which the output of each sector (vector x) is calculated by multiplying the total amount of final demand (export and domestic) for each sector's output (vector f) with the so-called Leontieff inverse, in which I signifies a unity matrix and A is a matrix of technical coefficients⁶.

3 See for instance STI Working Papers 1996/5, *Globalization and competitiveness: Relevant indicators* or DSTI/IND 2003/4, *Indicators of economic globalization*.

4 As long as a high import content is matched by a significant amount of value added creation within the domestic economy, the negative effect of high imports on the trade balance is compensated by national income creation.

5 Via OECD Olisnet input-output tables for various countries can be obtained, (including for the Netherlands, which are used in this research) classified on ISIC rev. 3 level.

6 Matrix A is calculated by dividing each intermediate input flow as shown in the input-output table by the total output of the receiving sector. Each cell in matrix A then consists of a so-called technical coefficient, which shows the ratio of inputs from sector i used in the total output of sector j .

$$1. \quad \underline{x} = (I - A)^{-1} \bullet \underline{f}$$

6. The fact that intermediate and final demand can also be met through the use of imports, next to domestic production, is rather implicitly incorporated in equation (1). Rewriting equation (1) as is done in equation (2), more clearly shows the contributions *competing* imports make to production for final and intermediate demand.

$$2. \quad \underline{x} = (I - (A - MC))^{-1} \bullet \underline{f}^d$$

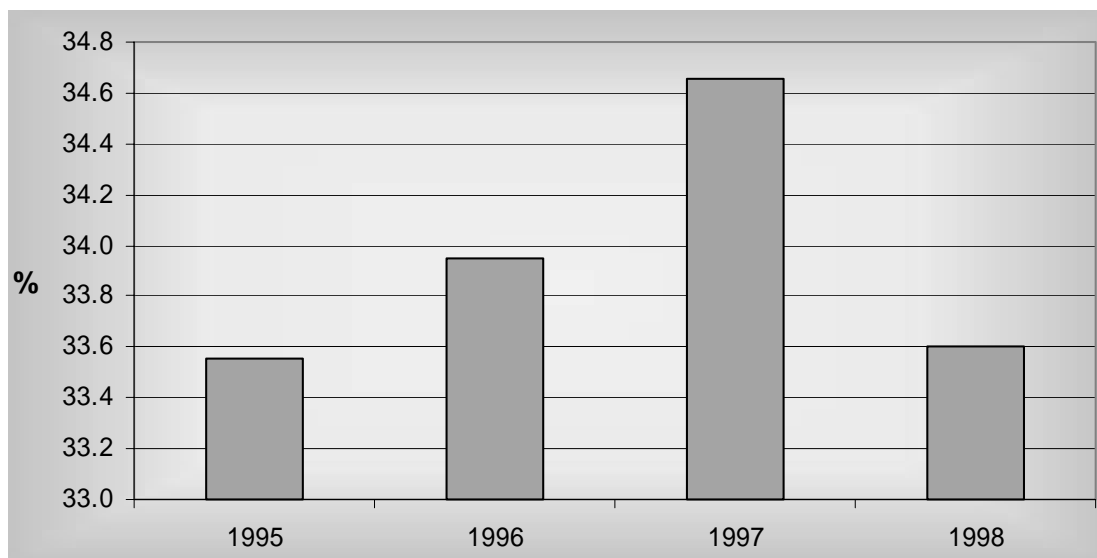
7. Equation 2 makes it possible to calculate the necessary amount of output from each sector, in order to satisfy final and intermediate demand, while taking into account that a certain part of this intermediate demand is met through *competing* imports and a certain part of final demand is satisfied via imports straightaway (via re-exports)⁷. The Leontieff inverse is able to take into account the fact that output of a certain sector is produced using both domestic and imported inputs (=direct), but also that the required domestic inputs may contain imported elements as well (=indirect)⁸. Direct and indirect imports constitute total *embodied imports* and are very important to take into account when analyzing the extent of total foreign import usage (Hatzichronoglou, 2003b). These elements of input-output analysis and the concept of the Leontieff inverse are essential in the calculation of Mr. Hatzichronoglou's Import Content Of Export indicator (ICOE), which is shown in equation (3).

$$3. \quad ICOE = \underline{m} \bullet (I - A)^{-1} \bullet \frac{\underline{e}}{E}$$

8. The first term in this equation represents a row-vector in which element i shows the amount of imports entering sector i as a share of sector i 's output. This vector m is multiplied by the Leontieff inverse, which is calculated as defined and constructed as in equation 2 (not 1!), which yields a row-vector containing the total *embodied imports* in output per sector. The last term in equation (3) shows the ratio of sectoral exports (column-vector) to total exports, i.e. the sum of each sector's exports, which is then multiplied with the *embodied imports* vector. The result of these calculations is a single figure for the economy as a whole, which shows the fraction of imports in an average unit of export. To be able to calculate this indicator, the Leontieff inverse in particular, requires the availability of a Total Uses input-output table and a Competing Imports input-output table. The National Accounts division at Statistics Netherlands constructs such tables on a yearly basis. However, since the indicator is relatively new and unorthodox, I decided to adhere to the Dutch input-output tables as provided by the OECD, to avoid running into classification difficulties or other practical difficulties. These were available for the years 1995 through 1998 and figure 1 shows the results of these calculations.

7 Competing imports consist of imported goods and services which constitute 'close' substitutes to goods and services produced in the domestic economy. In the case of the Netherlands for example, orange juice is a competing import good compared to domestically produced apple juice. Non-competing imports do not constitute competition for domestic production and therefore do not enter equation 2. Obviously, the higher data is aggregated, the more imports can be regarded as competing.

8 This implies that calculating the Leontieff inverse, requires a Domestic Uses input-output table, which is the difference between a Total Uses input-output table and a Competing Import Flows table.

Figure 1: The import content of Dutch exports (in percentages)

9. Since 1995, the import content of export production has risen for the Netherlands, from 33.56% to 34.65% in 1997. In 1998 the rate had fallen somewhat to approximately the same level as in 1995, but more or less the same decline is found in Dutch overall trade, where as of early 1997 import and export growth had slowed down significantly. Between 1998 and 1999 growth in trade picked up again, so it is to be expected that the import content of export rate has picked up again. In sum it can be stated that an increasingly large share of Dutch exports consists of and depends on foreign inputs and production processes.

3. Problems and adjustments

10. The Import Content Of Export indicator, in its basic shape, yields interesting results and represents a significant step towards tackling the problem of measuring globalization (see the OECD's *Manual* for several interesting adjustments such as value added measurement). However, there are two main points of criticism with respect to the assumptions made regarding the indicator which need to be discussed and concern the data that is required to calculate the indicator as well as consequences for cross-country comparison. First of all, an important objection that can be made has to do with way international trade data is incorporated in input-output tables. Collection of Dutch trade data takes place on the basis of *commodities* or *commodity flows*, for instance the amount of oranges imported or the number of televisions exported by the Dutch economy. Input-output tables, however, are constructed on the basis of *economic activity* or ISIC, which refers to the economic activity of industries or sectors, for instance the activities of the *Agriculture, hunting, forestry and fishing* sector. Obviously, there is an inherent difference in classification methods, which might imply that, when constructing input-output tables, commodities are assigned to economic activities which in fact have little to do with the production or manufacturing of these commodities⁹. This might distort or bias the amount of embodied imports but should however not influence the overall Import Content Of Export.

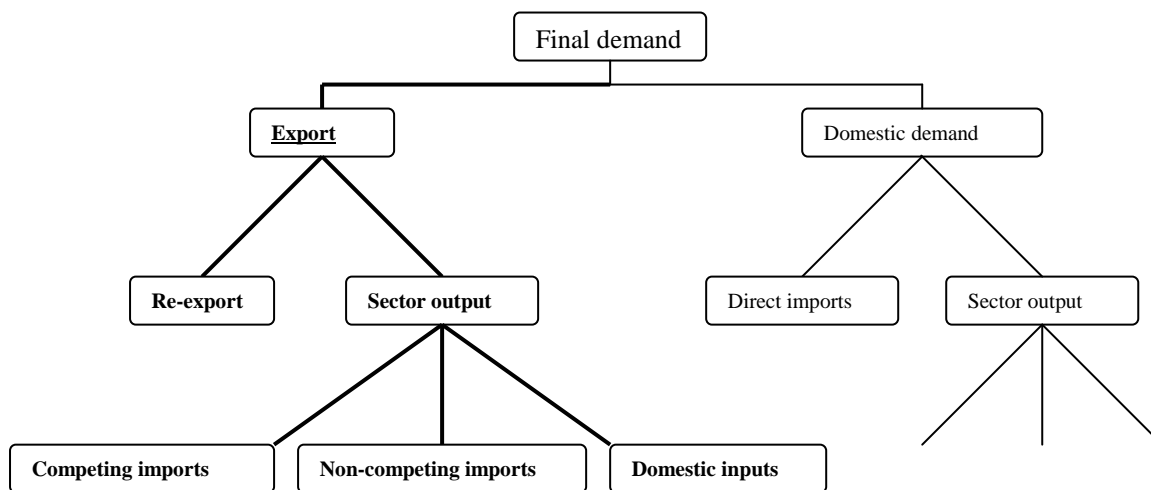
9 For example, commodities destined for export are often not physically delivered to the final destination by the manufacturer but by a third party, such as a transport company or wholesaler. The actual activity of exporting is then carried out and assigned to a different entity than the enterprise which produces the actual commodity.

11. Another, more important comment has to do with the fact that the construction of the overall ICOE-indicator causes a significant amount of trade to be overlooked in the case of the Netherlands. By focusing exclusively on imports entering a sector of production (i.e. vector m consists of competing and non-competing imports), rather than estimating the importance and influence of *total* imports entering the Netherlands and *total* exports leaving the Netherlands, the indicator measures a structurally lower embodied import and import content of export than if total imports and exports were taken into account. Re-exporting is a significant economic activity in the Netherlands, accounting for almost 30% of total Dutch trade in goods and services during the 1990s¹⁰. Although it may appear of lesser economic importance in terms of value added creation, re-exporting nevertheless needs to be incorporated in the calculation of the indicator. Due to its relative importance, Statistics Netherlands puts a lot of effort in extracting re-export data from standard international trade and has placed this data as an individual, separate entry in the Total Uses (single figure) and Competing Import Flows table (re-export column). This implies that, when equation (3) is applied, the import content of export *produced* in the Netherlands is measured, since only imports entering and exports leaving a production process are included. Many other OECD countries however do not explicitly extract re-exports from their data (per sector), which implies that if there are in fact re-exports taking place, they are somehow assigned to a certain sector (e) and therefore automatically included in (total) sectoral exports; E^{11} . The consequence is that the OECD-indicator leads to a different interpretation between countries that report re-exports separately and countries that do not, causing comparisons of the Import Content Of Export between countries to be structurally biased. This implies that, based on the type of data which is presently available for OECD countries, it might be concluded that the indicator is not yet equipped for cross-country comparisons.

4. New model

12. Basically, two general solutions are conceivable to deal with this issue. Either countries which do not yet separate re-exports from their import and export data need to start doing so or countries which do extract re-export data from total trade, such as the Netherlands, need to develop and adopt a more difficult indicator in order to involve *total* Dutch imports and exports in the calculation. Only then can the indicator be used for unbiased, overall monitoring of globalization among the different countries.

Figure 2: Construction of export demand



10 Statline, Statistics Netherlands

11 Due to the lesser importance of re-exports relative to the Netherlands and the complicated procedure of measuring the activity, many countries do not report re-exports as a separate activity on sectoral basis (as can be seen in the input-output tables provided by OECD Olisnet).

13. Figure 2 shows that final demand consists of domestic demand and demand which originates from abroad; i.e. exports. Dutch exports are either produced within the domestic economy or imported directly from abroad, which constitutes re-exports. Moreover, export products produced within the domestic market can be produced using (a combination of) competing, non-competing and domestic inputs. This implies that, in terms of import content of export, not only the competing and non-competing imports are essential, but also the branch of re-exports.

14. Dutch Import Flows matrices show the amount of competing imports each sector imports from each (foreign) sector, as well as the row-vector of non-competing imports entering each Dutch sector and the column-vector of re-exports, showing the total amount of imports directly going to exports. By calculating the ratio of competing import flow i to sector j , to the amount of output produced by sector j , produces a matrix of competing import coefficients. The latter two types of imports are only available as a vector, which need to be transformed into a matrix in order to add them to the matrix of competing imports coefficients. Non-competing imports enter a sector of production, which implies that a diagonal matrix can be constructed, where cell (j,j) shows the ratio of non-competing imports entering sector j to sector j 's output¹². Re-exports do not enter a sector of production, so in order to incorporate these, a diagonal matrix is constructed of which cell (j,j) shows the ratio of re-exports to total exports of sector j . By then there are three matrices, of which two diagonal matrices, which show the import coefficients of each type of import, in order to meet export demand.

15. With some further manipulations, it is possible to obtain a matrix T , which shows the *total* import content of intermediate deliveries in order to produce 1 unit of export¹³. In order to produce 1 unit of export, sector j needs intermediate deliveries from sector i (which consist for $x\%$ of imports and $(1-x)\%$ of domestic inputs), from sector k (which consist for $x\%$ of imports and $(1-x)\%$ of domestic inputs), from sector l , etc. etc. Calculating this model in terms of the OECD input-output tables yields a 40*40 table, with an abundance of information on every individual intermediary relationship, which is far too detailed for the scope of this paper.

Table 1: Adjusted input-output classification

Clusters of economic activity	ISIC rev. 3	Description
1	15/19	Food, beverages, tobacco, textile, textile products, leather and footwear
2	20/22	Wood, wood products, pulp, paper, printing and publishing
3	23/25	Coke, refined petroleum products, nuclear fuel, chemical products, rubber and plastic products
4	26/29, 36, 37	Heavy manufacturing industry and remaining manufacturing activity
5	30/33	ICT sector
6	34, 35	Transport equipment
7	40/45	Utility sectors and construction
8	50/55	Trade, repair, hotels, restaurants
9	1/15, 60/99	Residual group: Agriculture, quarrying, transport, storage, post, telecommunications, financial and business services, government and other services

12 A diagonal matrix is a matrix with only entries on the diagonal, i.e. (i,i) , (j,j) , (k,k) etc.

13 At first it is necessary to calculate a matrix Z , which shows the amount of domestic production needed per sector to produce 1 unit of export, since the amount of competing and non-competing imports required depends on these amounts of sector output, as can be seen in figure 2. Then to calculate the amount of competing and non-competing imports needed to produce this amount of domestic output, each of these two import coefficient matrices need to be multiplied with matrix Z .

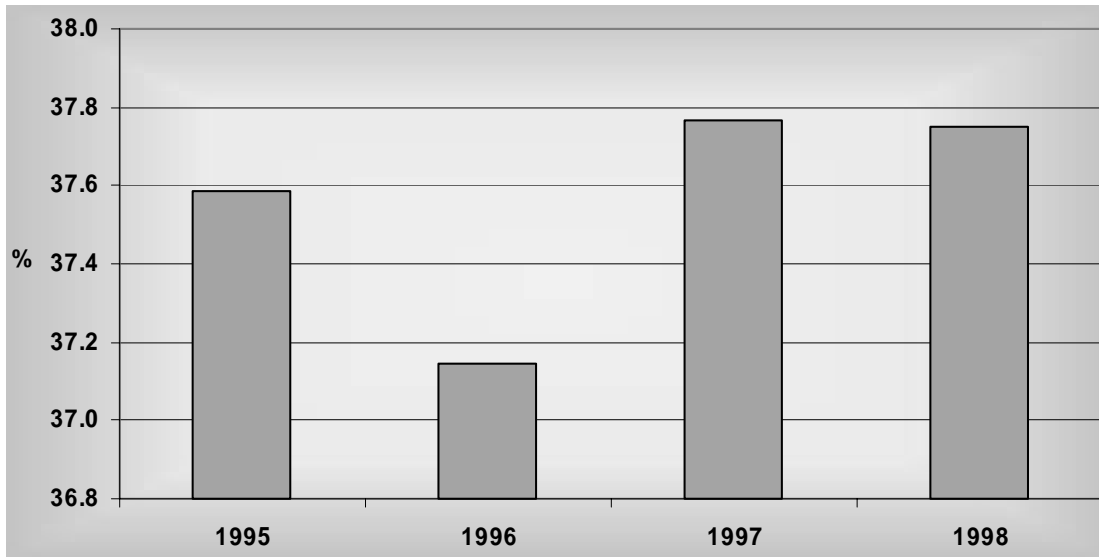
16. To remedy this, the input-output tables are adjusted, as such that the division into n sectors occurs at a higher aggregated level of classification, i.e. n needs to be reduced by sizing down the input-output matrix. Reducing 40 sectors of activity to 9 clusters, as defined in table 1, yields a far less complex matrix as displayed in table 2 (based on 1998 data). It shows that, in order to deliver 1 unit of export, sector 1 needs deliveries from sector 2, which consist for 39.93% of imports. Sector 1 also needs deliveries from sector 3 (to be able to deliver the same unit of export), which consist for 66.35% of imports.

17. The percentage of import in intermediate deliveries in order to produce 1 unit of exports now do incorporate re-exports. Another advantage of this calculation is that the import content of export is now available in a more detailed level. By now it is not only possible to say which deliveries are most important for the export of a certain sector but also how important imports are in these deliveries. It is possible to calculate what an increase in demand for a certain sector's exports implies in terms of import demand of *each* sector and for the trade balance in general. For instance, it might be possible that an increase in exports of sector j affects the amount of imports needed by sector i to a larger degree than in sector j . These linkages are important to determine in order to predict the effects of a change in (the importance of) trade on a country's national income.

Table 2: Import content of export (1998)

	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>
<u>1</u>	26.01	48.73	38.57	51.98	36.44	40.15	36.11	36.35	27.58
<u>2</u>	39.93	27.74	35.12	36.22	31.60	30.92	38.67	29.54	27.49
<u>3</u>	66.35	67.83	34.98	50.57	56.73	58.08	48.06	55.07	54.83
<u>4</u>	48.35	41.16	47.98	39.25	54.08	42.26	39.03	47.61	43.64
<u>5</u>	79.52	75.14	76.59	79.55	67.86	67.51	73.61	78.65	77.30
<u>6</u>	64.11	65.67	56.44	63.84	68.26	42.62	64.77	88.09	55.73
<u>7</u>	1.82	2.09	2.15	1.76	1.66	1.52	0.63	1.60	1.24
<u>8</u>	1.01	1.01	1.06	0.96	1.06	1.00	0.93	0.96	0.95
<u>9</u>	29.40	29.14	48.86	30.74	37.29	37.12	17.30	17.50	11.16

18. However, the main objective in terms of Mr. Hatzichronoglou's indicator is to monitor the development of globalization, in terms of internationalization of production processes in general rather than in detailed fashion. What is of interest is the overall intensity and extent of globalization, preferably comparable to other OECD countries. Therefore, in order to adhere to the goal of the original indicator, it is necessary to transform the resulting import content of export matrix into a single, representative number for the whole economy. Each column of table 2 shows the percentage of imports in every intermediate delivery needed for the delivery of 1 unit of export of that sector, including re-exports. When the average import content of each column leads is calculated and subsequently multiplied by e/E , an overall import content of export number is calculated, taking into account the fact that the activity of exporting is not equally important for each sector. Figure 3 shows the results of these calculations.

Figure 3: Adjusted import content of Dutch exports (in percentages)

19. Compared to figure 1 several conclusions can be drawn. As was to be expected, the adjusted calculations yields a significantly higher import content of export: 3.12 percentage points higher in 1997 and even 4.15 percentage points in 1998. Moreover, the overall development of the indicator is somewhat different: figure 3 shows a decrease in import content in 1996 relative to 1995, while figure 1 shows an increase. A possible explanation might be that re-exports were relatively significant in 1995, yielding a high ranking in figure 1 but relatively low in figure 3, and experienced a slowdown compared to other types of imports in 1996, leading to a decrease in figure 3.

20. With this paper, I aimed to show that the original Import Content Of Export indicator, when applied to the Netherlands, overlooks a significant portion of Dutch trade and therefore yields a structurally lower import content of export. When a somewhat different (more difficult) model is introduced, this problem is remedied and yields, as it turns out, significantly different results.

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