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Susanne Bärenthaler-Sieber,
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E-mail addresses: Susanne.Sieber@wifo.ac.at, Sandra.Bilek-Steindl@wifo.ac.at, Christian.Glocker@wifo.ac.at
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Medieninhaber (Verleger), Hersteller: Österreichisches Institut für Wirtschaftsforschung • 1030 Wien, Arsenal, Objekt 20 • Tel. (43 1) 798 26 01-0 • Fax (43 1) 798 93 86 • http://www.wifo.ac.at/ • Verlags- und Herstellungsort: Wien

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Abstract

In this paper we present a new long-term database on monthly export and import series for 23 economies during 1921-2010 and its first empirical application. Using these data, we analyse the synchronised decline in foreign trade during the Great Recession 2008/09 in a historical perspective. We investigate the following two research questions: First, we compare the degree of synchronisation of trade flows among the past major economic crises. Second, we investigate the synchronisation of the speed of the recovery after these recessions. In order to answer these questions we use both, descriptive statistics (like rolling correlations) and turning-point-oriented measures (Bry-Boschan routine, Markov-switching model).

Keywords: Synchronisation, Trade collapse, Turning Points, Economic History
JEL classification: C80, F14, N70

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1. Introduction

The aim of the paper is to present a new long-term dataset of monthly foreign trade series for 23 economies during 1921-2010 and its first empirical application. We analyse the international co-movement of high-frequency foreign trade series going back to the 1920s. The dataset includes monthly export and import series from Australia, Austria, Belgium, Brazil, Canada, Former Czechoslovakia, Denmark, Egypt, Finland, France, Germany, Greece, India, Italy, Japan, the Netherlands, New Zealand, Norway, Romania, Sweden, Switzerland, the United Kingdom and the USA. The collection of foreign trade series has a long tradition. Historical data for foreign trade can be found back until the beginning of the 20th century on different sources. But to our knowledge there exists no database which collects long-term foreign trade time series in a consistent way from the 1920s to 2010 on a monthly base. Regarding the collection of yearly data, we would like to refer to the "UN Historical Data 1900-1960 on international merchandise trade statistics" which provides foreign trade series of 22 countries on a yearly base.

Our monthly dataset was compiled using a variety of different sources, at which data before the year 1957 were not electronically available. We used the Monthly Bulletin Statistics of the League of Nations, *Mitchell* (2003), the "WIFO-Monatsberichte", print versions of the International Financial Statistics (IFS) of the International Monetary Fund (IMF) and the International Financial Statistics database of the International Monetary Fund. The data were collected and put together to form a consistent dataset. This collection of data makes it possible for the first time to compare the foreign trade dynamics between 23 countries on a monthly basis. The high frequency of the data is especially for analysis regarding cyclical movements of high importance. Additionally, the dataset contains yearly GDP deflators for all 23 countries. Here we used additional sources to form a consistent dataset.

Exploring this novel dataset enables us for the first time to examine the international co-movement of high-frequency foreign trade series going back to the 1920s. Thus, we are able to compare their cyclical behaviour among the major past economic crises, going back until the Great Depression in the 1930s. In our analysis we put a special focus on the past global recession in 2008/09, which is often referred to as the most severe one since the Great Depression following the stock market crash in 1929[1]). It will be denoted in the paper as Great Recession[2]).

[1]) Here we would like to refer to some literature analysing the recession 2008/09 in a historical context. Literature discussing the recession 2008/09 in context with the Great Depression includes *Aiginger* (2009, 2010A and 2010B), *Almunia et al.* (2010), *Eichengreen - O'Rourke* (2009), *Reinhart* (2009) and *Temin* (2010). Further analyses comparing the recession 2008/09 with other severe post World War II crises comprise *Baldwin* (2009), the *IMF* (2009), *Kuzin - Hillebrand* (2009), *Martins - Araùjo* (2009), *Reinhart - Rogoff* (2009), *Antonakakis* (2012), *Antonakakis - Scharler* (2012), as well as *Imbs* (2010).

[2]) We use the term "Great Recession" with capitalised letters following *Aiginger* (2010A).

The recent literature concerning this recession frequently referred to the occurrence of something like a "Great Trade Collapse"[3]), a highly synchronised downturn in foreign trade dynamics. The decline was even larger than the fall in production and the drop in GDP *(Baldwin,* 2009*)*. According to *Reinhart* (2009) this episode concludes the largest drop in world merchandise exports since 1938. *Baldwin* (2009) observed that all 104 countries mentioned in the *WTO* (2009) report experienced a drop in exports during the second half of 2008 and the first half of 2009. *Martins - Araùjo* (2009) conclude that periods of an abrupt decline of total trade flows, like it was observed during the Great Recession, were not uncommon at the individual country level, however these drops have not occurred in the past 11 years simultaneously except for the Great Recession. In a similar vein the results of *Antonakakis* (2012) suggest heterogeneous patterns of international trade cycles during collapses of international trade and US recessions between 1961 and 2007, however, international trade co-movements increased to unprecedented levels during the Great Recession. He concludes that his results highlight the relevance of international trade integration when examining these abrupt changes in the international trade behaviour. Additionally, there exists some evidence using yearly foreign trade series going back to the 1930s, which shows that the Great Recession has spread among the industrialised countries' foreign trade dynamics with a degree of speed not witnessed in the Great Depression *(Eichengreen - O'Rourke, 2009* and *Aiginger,* 2010A).

Extending the existent literature we concentrate on the question if the observed high degree of synchronicity in foreign trade dynamics during the Great Recession was unique in economic history after World War I. There are several reasons for the amplified co-movements of trade dynamics over time. According to *Baldwin* (2009) the recent degree of synchronisation in foreign trade was amplified by the increased importance of international supply chains. Vertically integrated production networks and just-in-time production transmitted demand shocks very quickly across countries. *Yi* (2009) argues in the same way that the increases in vertical specialisation over the last years (*Hummels et al.*, 2001) may account for some proportion of the synchronisation of the collapse in trade. Also according to the *WTO* (2009) report, besides the widespread fall in demand during the recession 2008/09, the increasing presence of global supply chains was a reason for the magnitude of the trade collapse.

There are further aspects indicating an asymmetry over the most recent business cycle in foreign trade co-movements. While more or less all industrialised countries fell in recession at the same time in 2008/09 and foreign trade constituted an important transmission mechanism, economic recovery seemed to have proceeded more uneven. Considering GDP data, growth rates were very different across countries at the beginning of 2010 and thereafter. Differences across countries regarding their fiscal balances and current accounts accounted for an unequal recovery measured by GDP data (*Aiginger*, 2010B). Given the

[3]) The term "Great Trade Collapse" has been used in *Baldwin* (2009).

observation that foreign trade downturn was highly synchronised in the Great Recession, raises next the question regarding the co-movement of the countries' exports and imports in the recovery phase of the crisis. We are going to investigate this issue focusing on the recovery of foreign trade after the Great Recession and other historical global crises.

Using this new high-frequency long-term dataset covering export and import data of 23 countries going back to 1921, this paper is aimed to complement the work by *Martins - Araùjo* (2009), *Aiginger* (2010A) and *Antonakakis* (2012). First, we compare the degree of synchronisation of the trade downturn in the Great Recession with other historical global crises, going back to the Great Depression. This may help to explain the extraordinary high decline in world trade in the Great Recession, which was enforced by the synchronicity effect (*Baldwin,* 2009). As countries' exports and imports fell at the same time during the Great Recession, there was no averaging out as it happened during other global crises. Second, we compare the degree of synchronisation of the speed of the recovery of trade flows after the investigated crises.

The paper is structured as follows: Section 2 describes the composition of the long-term foreign trade dataset and gives a short overview of the data. Section 3 shows the first application to this new dataset. We compare the degree of synchronisation of exports and imports between the past global crises applying different methods. We start the analysis by using a rolling correlation approach, where we consider a series of rolling windows to capture the bilateral correlations of the growth rates of the foreign trade series. Second, we use the method following *Bry - Boschan* (1971) in order to date peaks and troughs in each country's series and consider a recession as synchronised if a large number of countries' series exhibit a through at the same point in time. In a further step we compare the degree of synchronisation of the speed of the recovery of trade flows after the investigated crises. We conclude our analysis conducting a Markov-switching model following *Hamilton* (1989). We obtain probability estimates for each series being in recession which are the basis for calculating the degree of synchronisation. This measure covers synchronisation in a wider sense compared to the use of the Bry-Boschen routine. Section 4 provides our concluding remarks. Finally, all monthly export and import series of the 23 countries collected in the new dataset are plotted in the Appendix I.

2. The new long-term dataset

The basis for this paper is the construction of a long-term dataset of foreign trade data for 23 countries from 1921 onwards. Our dataset contains the following countries: Australia, Austria, Belgium, Brazil, Canada, Former Czechoslovakia, Denmark, Egypt, Finland, France, Germany, Greece India, Italy, Japan, the Netherlands, New Zealand, Norway, Romania, Sweden, Switzerland, United Kingdom and the USA. Before the year 1957 these data are not available in electronic form. Therefore we collected monthly export and import values back to the 1920s from various sources and put them together to obtain a long-run consistent dataset in electronic form. The data are in nominal values measured in national currency units.

Table 2.1 shows the country sample, the respective data coverage as well as the data sources. For most countries our sample starts in 1921, for some countries data are available only a few years later. Around WWII times there are no data available for most countries. Only for Denmark, Finland, India, New Zealand, Sweden, Switzerland, and the USA there exists continuous data material from 1921 to 2010. All data from January 1921 to December 1946 were mainly drawn from print versions of the Monthly Bulletin Statistics of the League of Nations (denoted with 1 in Table 2.1). Additionally, for cross-checks and missing values also the print versions of the "WIFO-Monatsberichte" were used as source (denoted with 4 in Table 2.1). Between January 1947 and December 1956 our main data source were print versions of the International Financial Statistics (IFS) of the International Monetary Fund (IMF; denoted with 2 in Table 2.1). From 1957 onwards, for most countries monthly data are available electronically from the IFS database of the IMF. This is the main data source for the period 1957 to present (denoted with 3 in Table 2.1). All data are put together to form a consistent dataset.

Further, we collected yearly data for the GDP deflator for all 23 countries. Here we used additional sources to form a consistent dataset. We primarily used *Mitchell* (2003), the University of Groningen database and the WIFO database.

The establishment of this new high-frequency historical foreign trade dataset builds on former work constructing the WIFO long-term database consisting of macroeconomic yearly data which were used in *Aiginger* (2010A and 2010B).

The constructed dataset is available on request from the authors. It includes the foreign trade data both, on a monthly base, and aggregated to quarters, as well as the GDP deflator on a yearly base.

The 23 countries were chosen regarding their data availability especially for the period 1921-1956 and their importance on the world market. The collected foreign data cover a high share of world market. Hence we consider the sample as comprehensive enough. The sum of all countries' exports as percent of world exports amounts to 72 percent in 1923 and falls to 48 percent in 2010. It declines over time, as countries not covered in the sample, e.g. China and other emerging countries gained importance in export market shares over time. Figure 2.1 shows the world market share of all considered countries between 1923 and 2010.

Table 2.1: Data coverage by country

	TIME SPAN				SOURCES (numbers see footnote)	
	Monthly foreign trade		Yearly GDP deflator		Monthly foreign trade	Yearly GDP deflator
Australia	Jan21-Jan42	Dec43-Dec10	1921-2010		Jan21-Dec47: 1; Jan48-Dec56: 2; Jan57-Dec2010: 3	1921-1948: 3,5; 1949-2010: 4
Austria	Jan23-Mar39	Jan46-Dec10	1923-1938	1946-2010	Jan23-Dec24: 4; Jan25-Dec37: 1; Jan38-Mar39: 4; Apr39-Dec47: 1; Jan48-Dec56: 2; Jan57-Dec2010: 3	1923-1945: 1; 1946-2010: 4
Belgium	Jan21-Sep40	May45-Dec10	1921-1940	1946-2010	Jan21-Dec47: 1; Jan48-Dec56: 2; Jan57-Dec2010: 3	1921-1923: 2; 1924: 1; 1925-1926: 2; 1927: 1; 1928-1929: 2; 1930: 1; 1931-1933: 2; 1934-1938: 1; 1939-1946: 2; 1947-1952: 1; 1953-2010: 4
Brazil	Jan21-Apr43	Dec43-Dec10[3])	1963-2010		Jan21-Dec47: 1; Jan48-Dec56: 2; Jan57-Dec2010: 3	1963-2010: 4
Canada	Jan21-Apr42	Nov 42-Dec10	1921-2010		Jan21-Dec47: 1; Jan48-Dec56: 2; Jan57-Dec2010: 3	1921-1949: 2,3; 1950-2010: 4
Former Czechoslovakia	Jan23-Jul39	Jan82-Dec10	1948-2010		Jan23-Dec47: 1; Jan48-Dec56: 2; Jan57-Dec2010: 3	1946-1992: 1; 1993-2010: 4
Denmark	Jan21-Dec10		1921-2010		Jan21-Dec47: 1; Jan48-Dec56: 2; Jan57-Dec2010: 3	1921-1949: 1; 1950-2010: 4
Egypt	Jan21-Dec40	Jan45-Dec10	1952-2010		Jan21-Dec47: 1; Jan48-Dec56: 2; Jan57-Dec2010: 3	1952-1981: 3,4: 1982-2010: 4
Finland	Jan21-Dec10		1921-2010		Jan21-Dec47: 1; Jan48-Dec56: 2; Jan57-Dec2010: 3	1921-1949: 1; 1950-2010: 4
France	Jan21-Aug39	Jan45-Dec10	1921-2010		Jan21-Dec47: 1; Jan48-Dec56: 2; Jan57-Dec2010: 3	1921-1938: 1; 1939-1949: 2,3; 1950-2010: 4
Germany[1])	Jan22-Jun39	Jan48-Dec10	1924-2010		Jan22-Mar39: 1; Apr39-Jun39: 4; Jul39-Dec47:1; Jan48-Dec56: 2; Jan57-Dec2010: 3	1921-1924: 2,3; 1925-1938:1; 1939-1949: 2,3; 1950-2010: 4
Greece	Jan21-Dec40	Jul45-Dec10	1927-1939	1946-2010	Jan21-Dec47: 1; Jan48-Dec56: 2; Jan57-Dec2010: 3	1927-1939: 1; 1946-1949: 1; 1950-2010: 4
India	Jan21-Dec10		1950-2010		Jan21-Dec47: 1; Jan48-Dec56: 2; Jan57-Dec2010: 3	1950-2010: 4
Italy	Jan21-Jul39	Jan46-Dec10	1921-2010		Jan21-Dec47: 1; Jan48-Dec56: 2; Jan57-Dec2010: 3	1921-1950: 1; 1951-2010: 4
Japan	Jan21-Dec40	Jan47-Dec10	1921-2010		Jan21-Sept40: 1; Okt40-Dec40: 4; Jan41-Dec47:1; Jan48-Dec56: 2; Jan57-Dec2010: 3	1921-1951: 2,3; 1952-2010: 4
Netherlands	Jan21-Dec40	Jan46-Dec10	1921-2010		Jan21-Dec47: 1; Jan48-Dec56: 2; Jan57-Dec2010: 3	1921-1939: 1; 1940-1947; 1,2; 1948-1949: 1; 1950-2010: 4
New Zealand	Jan21-Dec10		1921-2010		Jan21-Dec47: 1; Jan48-Dec56: 2; Jan57-Dec2010: 3	1921-1954: 7; 1955-2010: 4
Norway	Jan23-Sep41[2])	Jan45-Dec10	1921-1939	1946-2010	Jan23-Dec47: 1; Jan48-Dec56: 2; Jan57-Dec2010: 3	1921-1928: 1; 1929: 1,2; 1930-1939: 1; 1946-1949: 1; 1950-2010: 4
Romania	Jan25-Jun41	Jan81-Dec10	1980-2010		Jan25-Dec47: 1; Jan48-Dec56: 2; Jan57-Dec2010: 3	1980-2010: 4
Sweden	Jan21-Dec10		1921-2010		Jan21-Dec47: 1; Jan48-Dec56: 2; Jan57-Dec2010: 3	1921-1949: 1; 1950-2010: 4
Switzerland	Jan21-Dec10		1921-2010		Jan21-Dec47: 1; Jan48-Dec56: 2; Jan57-Dec2010: 3	1921-1931: 1,2; 1932-1949: 1; 1950-2010: 4
United Kingdom	Jan21-Dec40	Jan45-Dec10	1921-2010		Jan21-Dec47: 1; Jan48-Dec56: 2; Jan57-Dec2010: 3	1921-1951: 1; 1952-2010: 4
USA	Jan21-Dec10		1921-2010		Jan21-Dec47: 1; Jan48-Dec56: 2; Jan57-Dec2010: 3	1921-1928: 2,3; 1929-1949: 6; 1950-2010: 4

Source: Monthly foreign trade: 1…*League of Nations* (various volumes); 2…*International Monetary Fund* (various volumes); 3…*International Monetary Fund,* International Financial Statistics (IFS), database (electronically available); 4…*WIFO* (various volumes); Yearly GDP deflator: 1…*Mitchell* (2003); 2…*Bordo et al.* (2001); 3…*University of Groningen*; 4…*WIFO,* database (electronically available); 5…*Butlin* (1977); 6…*BEA*; 7…*New Zealand Institute of Economic Research (NZIER)*. – [1]) January 1948 - June 1990 only Western Germany. - [2]) January 1923 - December 1923 imports are missing. – [3]) January 1957 - December 1963 exports are missing.

Figure 2.1: International comparison of the world export market shares – Sum of all countries
Total exports as percent of world exports

Source: See Table 2.1, WTO, WIFO calculations. – Without Brazil, Former Czechoslovakia and Romania.

Figures AI.1 to AI.23 in the Appendix I show the collected monthly export and import series represented as year-on-year growth rates for all 23 countries. For most countries the series indicate high fluctuations at the beginning of the series in the 1920s and 1930s, showing the boom in the 1920s as well as the effects of the Great Depression in the 1930s. With the beginning of WWII for most countries, the collection of data was interrupted. For those countries where data are available around time of WWII, we included them in the dataset, but they are very erratic and posted three-digit or even four-digit growth rates in some countries. Therefore beginning from 1939 up to 1948 we removed them from the figures in the Appendix I. From 1949 all data are plotted again, but some high values are still found. The high volatility dampens out from the 1950s onwards. Later on, it can be observed that the collected foreign trade data lose even more of their volatility with the beginning of the 1980s. This observation goes along with the often referred phenomenon of the "Great Moderation", a decline in macroeconomic volatility since the mid 1980s; see for example *Stock - Watson* (2002), *Dalsgaard et al.* (2002). This moderation came to an abrupt end in the foreign trade series in 2008/09. The strong decline around the Great Recession can be seen in all figures.

Looking at certain country series it is worth mentioning some characteristics: the currency crisis in Brazil in the 1990s and the devaluation in the mid 1990s which can clearly be seen in the nominal data (which are all measured in units of national currency). Further, we like to mention the missing data in the Former Czechoslovakia and Romania from the beginning of WWII to the mid 1980s.

3. A first application – the synchronisation of foreign trade

In our first application of the new long-term dataset we explore the synchronisation of foreign trade dynamics over time. Therefore we divided the data described above into two subsamples, in one pre-WWII sample and one post-WWII sample. Considering the nominal values, the pre-WWII sample starts in 1923 (as some countries' data are available only since 1923) and ends in 1938. The post-WWII sample starts only in 1949 (even if there are earlier data for some countries available) and ends 2010. We exclude the collected data in the years directly after WWII from our analyses, as for most countries the data are very volatile and lack of a reasonable economic interpretation.

We further constructed a proxy for real values as falling trade activity was accompanied by price declines during past recessions. Having information on foreign trade prices is useful in order to disentangle the effects of prices and quantities on the declines in the trade values. Another advantage of deflating nominal trade statistics is to account for possible price changes between the countries within cross-country studies. Therefore we extended the dataset described above and calculated a proxy for real foreign trade volumes. As to our knowledge no monthly or quarterly export/import price indices – apart from unit values to some extent – are available back to the 1920s, we obtained real values using the GDP deflators. We are aware of the fact that the GDP deflator is not the most appropriate deflator, as GDP often includes a high share of non-tradables (*Francois - Wörz*, 2009A, 2009B). Moreover, GDP price indices are available on a yearly basis only. In order to construct monthly and quarterly data, we had to convert the GDP deflator to a higher frequency using the *BFL* temporal disaggregation method according to *Boot et al.* (1967). We constructed the real values for exports and imports for all countries in this way. Further, wherever possible, we conducted cross-checks in order to check the quality of the obtained data. For a selection of countries (Austria, France, Germany, Japan, the Netherlands and USA) we were able to compare the data with unit values taken from the IMF database which are available on a monthly base from 1958 onwards. We find the dynamics almost identical. Figure AII.1 in the Appendix II shows real export growth calculated using the GDP deflator compared to IMF real export growth measured in unit values for the USA as an example.

Considering the proxy for the real values, we used data of the following two subsamples: 1924-1938 and 1950-2010. Regarding the country sample we restrict the data further and concentrate on 18 countries (nominal values) and 17 countries (real values), respectively. We skipped the Former Czechoslovakia and Romania from the analyses, because in the post-WWII sample data are available only after the early 1980s. Data from Brazil, Egypt and Greece were taken out of the sample too, because they contain too many outliers (in the early 1990s in Brazil, in the mid 1970s in Egypt and during the 1950s and the early 1980s in Greece) which affect the analyses. The GDP deflator for India is available only after the year 1950; therefore the sample comprising the real values is even smaller. Summing up, the analyses below are conducted using the following sample:

Sample nominal values:

Time span: 1923-1938 and 1949-2010

18 countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, India, Italy, Japan, Netherlands, Norway, New Zealand, Sweden, Switzerland, United Kingdom and USA

Sample real values:

Time span: 1924-1938 and 1950-2010

17 countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, Norway, New Zealand, Sweden, Switzerland, United Kingdom and USA

Further, some analyses rely on seasonally adjusted data[4]). The data are adjusted using X12-ARIMA. Because of the extreme length of the time series and the missing observations during WWII times, the adjustment was done in 2 or 3 subsamples (depending on the data availability around WWII). We applied the seasonal adjustment procedure first for the nominal foreign trade series[5]). Further, seasonally adjusted data in real values are obtained indirectly using the seasonally adjusted nominal foreign trade values and the disaggregated price deflator[6]).

Synchronisation of time series can be measured using different instruments. In the following we first start with descriptive statistics (a correlation approach) and second we use turning-point-oriented measures (Bry-Boschan routine and a Markov-switching model).

3.1 The correlation approach

We start our analysis using a basic approach, the correlation approach. It is commonly applied in the literature to determine the degree of business cycle synchronisation considering series of GDP and/or industrial production (see for example *Massmann - Mitchell*, 2004 or *European Commission*, 2006 and 2007). Following this literature we consider a series of rolling windows to capture the bilateral correlations of the growth rates[7]) of export and import series of n countries under consideration. We start by using monthly data, where we focus only on a very short time period (synchronisation at a given month). To allow for a certain lead and lag among the series, we will use the quarterly data later on, too.

4) We eliminated both, the seasonal and the irregular component.

5) In those cases where a quarterly conversion of the monthly foreign trade data is conducted, please note that the seasonal adjustment process is applied after this conversion.

6) The high-frequency price deflator obtained by the *BFL* procedure does not have seasonality by construction.

7) We consider yearly growth rates of the data, which is the simplest form of detrending operation.

We form country-by-country pairs delivering $N = \frac{n(n-1)}{2}$ bilateral combinations and calculate the mean of the correlation coefficients $\rho_{j,t}$ of the $j = 1, \dots, N$ country combinations for every time period t using a window of h months[8]):

$$\bar{\rho}_t = \frac{1}{N}\sum_{j=1}^{N} \rho_{j,t}$$

A high value of the mean correlation coefficient is considered as evidence of high synchronisation between the foreign trade data of the observed countries at a certain time period. We further consider the variance v_t^2 of the N correlation coefficients

$$v_t^2 = \frac{1}{N-1}\sum_{j=1}^{N} (\rho_{j,t} - \bar{\rho}_t)^2,$$

as a higher degree of synchronisation (in a certain observation period compared to another period) is only properly indentified if the higher value of the mean goes along with a contemporaneously smaller variance of the correlation coefficients. We start by setting the window width to 8 years ($h = 96$), corresponding to the length of the business cycle following the definition of *Burns - Mitchell* (1946). Using our dataset we construct 8-year rolling windows before WWII and 8-year rolling windows after WWII. As noted by the *European Commission* (2006) and (2007), the results of the correlation approach are sensitive to the width of the window chosen. On the one hand longer windows are regarded to be more reliable, but on the other hand they may smooth out important medium-term changes. Moreover, correlations which are based on a short window allow for an analysis of very recent developments as they are closer at the end of data.

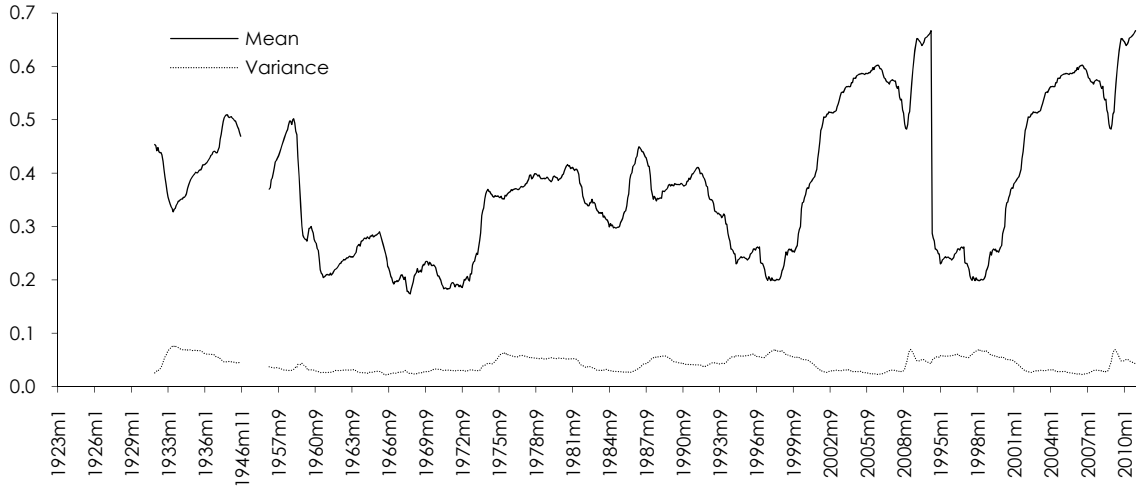
Figure 3.1 presents the first results, which are based on nominal export growth rates against the previous year for 8-year rolling windows. For each of these unweighted means 153 country-by-country bilateral correlation coefficients were calculated using a window of 96 months. As described above – due to data availability – the series was divided into two samples, a pre- and a post-WWII period. We further limit the sample of means of correlation coefficients to those cases, in which for each period within the rolling windows (e.g. for all 96 months in the case of monthly data and an 8-year rolling window) data were available. A high number of the mean of the correlation coefficients stands for a high degree of synchronisation. The figure also shows that the mean values around the Great Depression in the 1930s are much smaller than those around the Great Recession in 2008/09. The highest number of the whole series is reached - with a value of 0.67 - at the end of the portrayed time period for the rolling window 2003M1 to 2010M12. Based on this measure the synchronisation showed a clear upward trend between the late 1990s and the mid 2000s, followed by a short-lived drop until the window ending at the end of 2008, and a further sharp increase afterwards.

[8]) *Massmann - Mitchell* (2004) additional constructed a weighted mean (according to the size of the countries proxied by the total population in 1985). Results are reported to be similar to those of the unweighted mean.

Additionally, the analysis was repeated using import series (Figure 3.2). The results are similar: we find a high correlation at the end of the portrayed time period. Additionally, around the mid 1970s higher means of correlation figures are presented using the import series compared to the export series.

Figure 3.1: Mean and variance of pairwise correlation coefficients for an 8-year rolling window

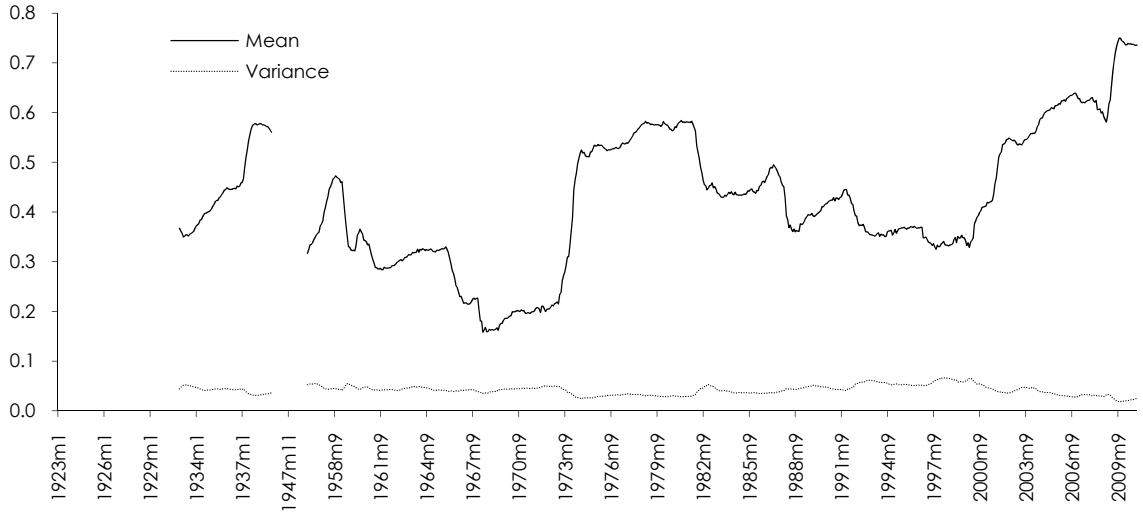
Nominal monthly export year on year growth rates



Source: See Table 2.1, WIFO calculations. – Unweighted average of pairwise correlations coefficients between 18 countries. Only those means of correlation coefficients are presented, for which data for all 96 months of the rolling window were available. The value at a given time point is the correlation calculated for the 8 year prior and including that time point.

Figure 3.2: Mean and variance of pairwise correlation coefficients for an 8-year rolling window

Nominal monthly import year on year growth rates



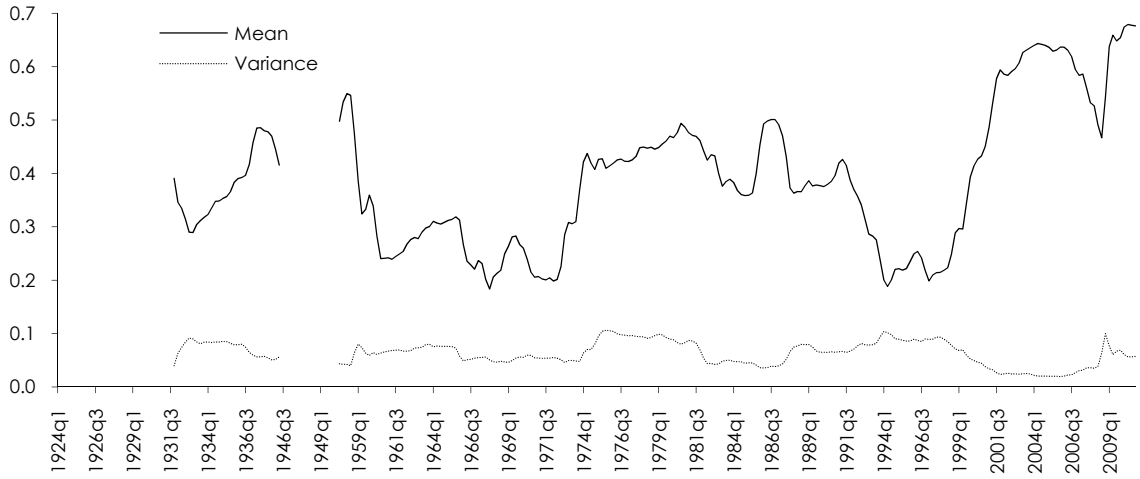
Source: See Table 2.1, WIFO calculations. – Unweighted average of pairwise correlations coefficients between 18 countries. Only those means of correlation coefficients are presented, for which data for all 96 months of the rolling window were available. The value at a given time point is the correlation calculated for the 8 years prior and including that time point.

The picture hardly changes if quarterly instead of monthly figures and/or seasonally adjusted and/or real data are used[9]). Figure 3.3 presents the results based on real, seasonally adjusted, quarterly export growth rates against the previous period for 8-year rolling windows. For each of these unweighted means 136 country-by-country bilateral correlation coefficients were calculated using a window of 32 quarters. Again the series was divided into a pre- and a post-WWII period sample and the sample of means of correlation coefficients was limited to those cases, in which for each period within the rolling windows data were available. Figure 3.3 shows again that there exists some tendency of increasing synchronisation over the portrayed time period. It shows that especially at the end of this period the mean of the pairwise correlation coefficients has increased considerable. With a value of 0.68 the analysis of quarterly real export figures shows the highest degree of synchronisation at the end of the sample.

The *European Commission* (2006) mentions as one major drawback of this measure of synchronisation its sensitiveness to the length of the rolling window chosen. Therefore, in a final step in the sensitivity analysis the length of the window was changed to 4 years. Again at the end of the period the highest degree of synchronisation is reported. As expected, the degree of fluctuation of the means of correlation coefficients is higher; it displays large and regular swings, reflected also in the higher values of the variance of the correlations.

Figure 3.3: Mean and variance of pairwise correlation coefficients for an 8-year rolling window

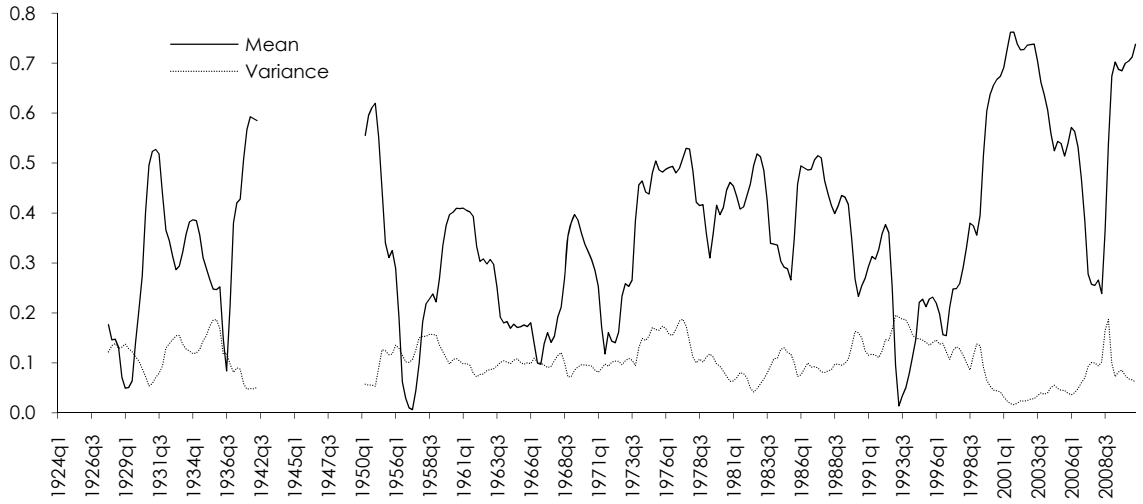
Real, seasonally adjusted quarterly export growth rates against previous period



Source: See Table 2.1, WIFO calculations. – Unweighted average of pairwise correlations coefficients between 17 countries. Only those means of correlation coefficients are presented, for which data for all 32 quarters of the rolling window were available. The value at a given time point is the correlation calculated for the 8 years prior and including that time point.

[9]) As check of robustness we repeated the analysis based on seasonally adjusted nominal export data, using growth rates against the previous month for the 8-year rolling windows. The results are similar to the ones just presented. Furthermore quite similar results occur also if real or real seasonally adjusted export data are used.

Figure 3.4: Mean and variance of pairwise correlation coefficients for a 4-year rolling window
Real, seasonally adjusted quarterly export growth rates against previous period



Source: See Table 2.1, WIFO calculations. – Unweighted average of pairwise correlations coefficients between 17 countries. Only those means of correlation coefficients are presented, for which data for all 16 quarters of the rolling window were available. The value at a given time point is the correlation calculated for the 4 years prior and including that time point.

3.2 Turning-point-oriented measures

Recessions can further be defined as synchronised or highly synchronised if business cycles of a large number of countries are in a recession at the same point in time or a given time window (*IMF*, 2009). We use this idea to compare the degree of synchronisation in the data over past recessions. The method relies on the identification of turning points (minima and maxima) in the underlying cycle. To date the cycle of our foreign trade data we use two different methods, one proposed by *Bry - Boschan* (1971) and a Markov-switching model following *Hamilton* (1989). Both techniques are commonly applied in the literature, and show different outcomes. While the method by *Bry - Boschan* (1971) indicates if an extreme value occurs in a given time period, or not, the Markov-switching model attaches probabilities to these events.

The Bry-Boschan routine

The method proposed by Bry - Boschan (1971) is a non-parametric and easily implementable algorithm to determine peaks and troughs in time series. The procedure consists of a sequence of steps, applying a range of smoothing filters and running the dating procedure on the filtered series respectively[10]). We use quarterly[11]) de-trended (obtained by Hodrick-

[10]) The method is sketched here only briefly, for more details we refer to the original paper by *Bry - Boschan* (1971) or to a description in *Scheiblecker* (2008).

[11]) We use quarterly data here as we consider cycles of two series as synchronised if their turning points coincide within a quarter, see also *IMF* (2009).

Prescott filtering[12]) seasonally adjusted series of exports and imports. After adjusting for extreme values (where values deviating more than 3.5 standard deviations from the mean represent an outlier), the dating process starts using a Spencer-moving average (a symmetrical 2x7 moving average filter with special weights), yielding very smooth cycles. The dating process is consecutively applied on lower degree filtered series until the original series is dated. Turning points are found by scanning all the series for common local minima and maxima where a minimum phase length (from peak-to-trough and trough-to-peak) and a minimum cycle length (peak-to-peak and trough-to-trough) has to be imposed. The minimum cycle length of the GDP series is usually assumed to be five to seven quarters (*Burns - Mitchell*, 1946). Considering the foreign trade series in the paper, the minimum cycle length was set to six quarters (imports) or seven quarters (exports), and the minimum phase length was set to three quarters[13]).

Peaks and troughs in foreign trade series of the countries under consideration are dated in this way, which allows for a cross-country comparison of the foreign trade cycles. As described above, we divide the series in two samples, a pre- and a post-WWII sample. We further set US time series as reference series, as it is possible to compare the results with the literature and to check the obtained troughs with the US business cycle contractions of the NBER[14])). Thus, the turning point analysis dates the troughs of the US foreign trade series and shows the leads (denoted with a positive value) and lags (denoted with a negative value) measured in quarters of the other series with respect to the reference series.

For nominal US export series we obtain a cycle length of 20.5 quarters between 1923 and 1938 and 17.2 quarters between 1949 and 2010. Our results differ a bit from *Mintz* (1961), who dated export cycles in the US back to 1921. Between 1921 and 1959 (excluding 1929-1937) she documented the average export cycle lasting only 13 quarters.

The NBER dates US GDP cycles to last for 13.3 quarters (from trough to trough) between 1919 and 1945 and 18.3 quarters between 1945 and 2009. NBER troughs are dated in 1921Q3, 1924Q3, 1927Q4, 1933Q1, 1938Q2, 1945Q4, 1949Q4, 1954Q2, 1958Q2, 1961Q1, 1970Q4, 1975Q1, 1980Q3, 1982Q4, 1991Q1, 2001Q4 and 2009Q2. Comparing the turning points in the historical foreign trade series in our analysis with those of the NBER, we find a perfect accordance regarding the Great Recession dated in 2009Q2 and a good accordance in the Great Depression. Based on the constructed long-term foreign trade dataset the Great Depression is dated 1932Q4, which is close to the recession dated in 1933Q1 by the NBER using US GDP data. Generally, we find turning points of import cycles more similar to those of GDP cycles than export cycles. This is what we would also expect from theory as imports

[12]) We use the standard parameter with λ=1,600. Another possibility for de-trending would be the use of the Baxter-King filter. After applying both methods, we decided to use for the HP-filter, as the obtained cycle length seemed us to be more reasonable.

[13]) Considering Austrian data, results by *Hahn - Walterskirchen* (1992) and *Bilek-Steindl* (2012) suggest the average duration of the business cycle in imports to be similar to the one of GDP, while the average export cycles were found to be slightly longer compared to GDP cycles.

[14]) http://www.nber.org/cycles.html.

depend on domestic demand whereas export fluctuations are mainly determined by foreign demand. Comparing troughs in US import cycles with those in US GDP we often find troughs in imports lagging GDP cycles with one quarter.

Table 3.1 shows the troughs in US import cycles dated by the Bry-Boschan routine and the degree of synchronisation at each trough. We measure synchronisation by calculating the mean of the absolute value of the leads and lags of the other countries' import cycles with respect to the US series at each trough dated in the US series. A small value stands for a high degree of synchronisation. The Great Recession is dated in 2009Q2. With a value of 0.51, the analysis shows the highest degree of synchronisation among the underlying recessions in this period. Two other highly synchronised recessions can be found after the oil crisis in 1975Q3 (0.61) and 1972Q2 (0.76). In the Great Depression in 1932Q4 we calculate a measure of synchronisation of 2.18 which is much higher (and therefore indicates a lower degree of synchronisation) than the measure of synchronisation in the Great Recession.

Similar results can be found investigating the synchronisation of export cycles (Table 3.2). In the Great Recession 2009Q2 the measure of synchronisation is only 0.27 and again the smallest among the considered recessions, while in the Great Depression (again dated in 1932Q4) the mean value is much higher and amounts to 2.79.

We further repeat the analysis for real values. We use the same inputs as for the nominal values, the minimum cycle length was set to 6 quarters (imports) or 7 quarters (exports), and the minimum phase length was set to 3 quarters. Results are similar to the nominal ones. The Great Recession is again dated in 2009Q2. Both, for real export and import series we find a high degree of synchronisation in the Great Recession, while in the Great Depression - dated again in 1932Q4 - the value is higher again. Tables 3.3 and 3.4 show the results for imports and exports in real values.

Based on the dating results above, we analyse the degree of synchronisation of the speed of the recovery of trade flows after the investigated crises. Therefore, we introduce a simple way to measure the persistence of past global economic crises, which simply contains counting the amount of quarters it takes until the negative output gap closes after a recession. Highly persistent series are usually characterised by slowly closing gaps. In this analysis we focus on the following six global recessions: the Great Depression in 1932Q4, the recessions in 1975Q1, 1980Q3, 1992Q1, 2001Q4 and the Great Recession in 2009Q2. The dating for the Great Recession and the Great Depression comes from the Bry-Boschan algorithm above, while the other recessions follow the NBER dating and/or are defined by the *IMF* (2009) as "highly synchronised recessions"[15]).

[15]) The *IMF* (2009) defines "highly synchronised recessions" as those during which 10 or more of the 21 considered countries in their sample were in recession at the time. Starting in 1960 and according this definition "highly synchronised recessions" occurred in 1975, 1980, 1992 and 2008. Three of these four recessions were proceeded by, or coincided with, an US recession.

Table 3.1: Synchronisation during troughs dated using the Bry-Boschan routine, imports (nominal)

Troughs dated for US series	Q3-1924	Q4-1932	Q2-1938	Q3-1949	Q3-1954	Q1-1961	Q2-1964	Q3-1967	Q3-1972	Q3-1975	Q1-1979	Q1-1983	Q4-1986	Q2-1991	Q4-1998	Q1-2002	Q2-2009
Measure for synronisation	5.71	2.18	4.18	1.33	3.53	3.87	3.29	2.11	0.76	0.61	2.71	1.18	1.69	6.24	1.19	6.00	0.51

sample: 1924Q1-1938Q4, 1949Q1-2010Q4, 18 countries

Source: See Table 2.1, Bry-Boschan (1971), WIFO calculations.

Table 3.2: Synchronisation during troughs dated using the Bry-Boschan routine, exports (nominal)

Troughs dated for US series	Q1-1926	Q4-1932	Q3-1936	Q2-1950	Q2-1955	Q1-1959	Q4-1962	Q1-1968	Q3-1972	Q4-1977	Q1-1983	Q1-1987	Q4-1993	Q3-1996	Q1-1999	Q2-2003	Q2-2009
Measure for synronisation	3.24	2.79	2.71	1.66	4.89	1.06	1.71	1.96	2.24	3.65	1.79	1.85	4.17	1.18	0.79	2.18	0.27

sample: 1923Q1-1938Q4, 1949Q1-2010Q4, 18 countries

Source: See Table 2.1, Bry-Boschan (1971), WIFO calculations.

Table 3.3: Synchronisation during troughs dated using the Bry-Boschan routine, imports (real)

Troughs dated for US series	Q3-1924	Q4-1932	Q2-1938	Q3-1954	Q1-1961	Q2-1964	Q3-1967	Q1-1971	Q3-1975	Q1-1983	Q2-1985	Q2-1991	Q1-1996	Q4-1998	Q1-2002	Q2-2009
Measure for synronisation	8.00	2.50	2.59	4.06	3.63	3.77	2.50	5.44	2.83	2.73	4.77	5.45	2.83	1.37	5.75	0.89

sample: 1924Q1-1938Q4, 1950Q1-2010Q4, 17 countries

Source: See Table 2.1, Bry-Boschan (1971), WIFO calculations.

Table 3.4: Synchronisation during troughs dated using the Bry-Boschan routine, exports (real)

Troughs dated for US series	Q1-1926	Q4-1932	Q2-1955	Q1-1959	Q4-1962	Q1-1968	Q2-1972	Q4-1977	Q1-1983	Q4-1985	Q4-1993	Q3-1996	Q1-1999	Q2-2003	Q2-2009
Measure for synronisation	2.50	4.38	5.94	1.37	2.33	2.29	1.75	4.06	2.07	5.39	4.25	1.02	0.50	1.89	0.47

sample: 1924Q1-1938Q4, 1950Q1-2010Q4, 17 countries

Source: See Table 2.1, Bry-Boschan (1971), WIFO calculations.

We consider the amount of quarters it takes to close the output gap (measured using the standard HP-filter) after the respective trough (dated as described below), where the quarter of the trough itself is not counted. Furthermore, in this analysis, only one quarter with a positive output gap is not considered as gap closure. After applying this procedure on all countries' quarterly series of imports and exports in nominal and real values, we calculate the cross-country mean and the cross-country standard deviation. The former shows how long-lasting crises were on average, while we use the later as a measure to compare how synchronous the countries recover after each trough. Table 3.5 shows the results for imports and exports, both in nominal and real values.

Table 3.5: Amount of quarters until output gap closes

	Import (nominal)		Export (nominal)		Import (real)		Export (real)	
Trough	Mean	Stdev	Mean	Stdev	Mean	Stdev	Mean	Stdev
1932Q4	10.9	4.9	9.0	5.8	9.7	4.6	7.2	5.9
1975Q1	3.4	3.7	3.9	3.7	3.4	2.2	5.1	4.1
1980Q3	2.1	3.5	1.9	2.4	1.8	3.3	2.6	4.5
1992Q1	8.4	6.9	6.6	5.6	8.4	7.0	7.1	6.6
2001Q4	10.1	6.9	8.7	7.9	8.1	6.7	8.3	7.9
2009Q2	3.8	1.4	3.8	1.0	4.0	1.2	3.8	1.0

Source: See Table 2.1, WIFO-calculations.

Comparing the Great Depression with the Great Recession it can be clearly seen from all tables that the mean duration of the negative output gap after the Great Depression was longer (e.g. 10.9 quarters, import in nominal values) compared to the mean duration after the Great Recession (e.g. 3.8 quarters, import in nominal values). Additionally, with a smaller standard deviation (e.g. 1.4 quarters, import in nominal values) the countries' foreign trade recovered more synchronised after the Great Recession compared to the Great Depression (standard deviation 4.8 quarters, import in nominal values). Comparing the standard deviation – which is here our measure for the degree of synchronised recovery after the crisis - over all recessions under consideration, we find the smallest value in the Great Recession[16]). One reason for the fast recovery after the Great Recession could be the fast and synchronised reaction of monetary and fiscal policy around the world. Even in 2012 the stance of both policy instruments was still extraordinary expansive. Considering the other recessions, a synchronised recovery can also be observed after the recession dated in 1975Q1. The mentioned results are observed for both export and import series, both in nominal and real values. They cover a common rebound in foreign trade occurring in most countries in our sample shortly after the trade collapse during the Great Recession. This is also evident when considering the seasonally adjusted quarter-on-quarter growth rates of the foreign trade series. Given the trough in 2009Q2, only two quarters later, in 2009Q4, percentage changes against the previous quarters, both of export and import series, suggest

[16]) This is also the case, when we calculate the coefficient of variation, which is a normalised measure and defined as ratio between the standard deviation and the mean.

positive growth rates in all considered countries again. Only Greece, which was taken out of the sample, experienced a quarter-on-quarter decline in exports in 2009Q4. The recently well discussed phenomenon of the asymmetry in the recovery after the Great Recession (core vs. periphery countries of the EU) which we experienced when looking at GDP data, is not supported in foreign trade development, mainly because of the country sample selected. As one of the main focus of this paper concerns the construction of long-term coherent trade time series, our dataset does not cover countries like Ireland, Spain, Cyprus and Portugal, where the data material does not go back to the 1920s. An analysis including these countries using a shorter time span is open to further research.

A Markov-switching approach

While the method proposed by *Bry - Boschan* (1971) only allows determining the occurrence of turning points, using a Markov-switching model further enables us to calculate the probability that an economy is in an expansionary or contractionary phase at a specific point in time[17]). The methodology used for the analysis presented in this section enables one to quantify the degree of synchronisation between business cycles. Since *Hamilton*'s (1989) seminal paper measuring the US business cycle using a Markov-switching autoregressive model, various extensions of Markov-switching models have been developed and are frequently applied in the literature to determine and compare the state of business cycles[18]). We will use a simple model and write our time series as an autoregressive process with the mean as the only component of the model having the Markov-switching property:

(1) $$y_t - \mu_{s_t} = \sum_{i=1}^{p} \varphi_i \left(y_{t-i} - \mu_{s_{t-i}} \right) + \varepsilon_t,$$

p is the lag length of the model, $\varepsilon_t \sim N(0, \sigma^2)$ and μ_{s_t} is the mean switching element between the states. The variable indicating the states s_t is modeled following a two-state Markov chain with transition probabilities $P(s_t = j | s_{t-1} = i) = p_{ij}$, with $\sum_{j=1}^{2} p_{ij} = 1, \quad i = 1,2,$ economic expansion: $(s_t = 1)$ and contraction: $(s_t = 2)$:

(2) $$\mu_{s_t} \text{ is } \mu_1 > 0 \text{ if } s_t = 1, \text{ and } \mu_{s_t} \text{ is } \mu_2 \leq 0 \text{ if } s_t = 2.$$

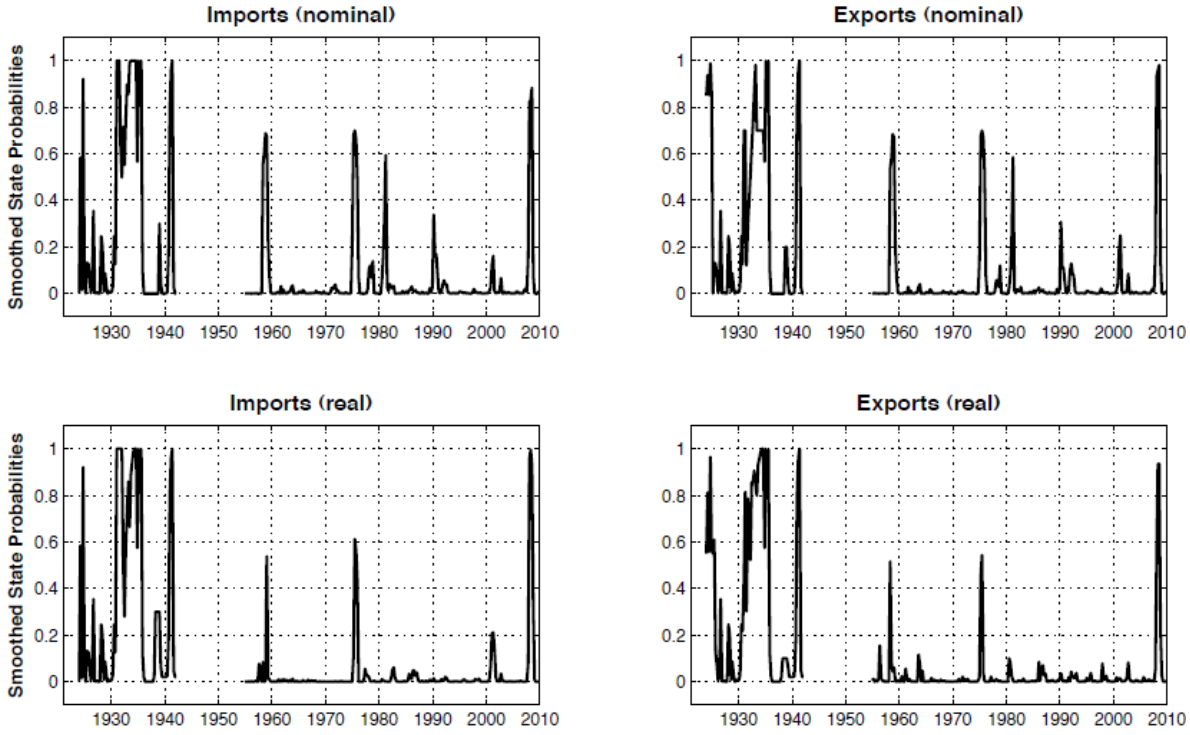
The model is estimated using maximum likelihood. Once the estimates of the parameters $\theta = (\mu_1, \mu_2, \varphi, \sigma^2, p_{11}, p_{22})$ are obtained, information about the unobserved states can be recovered using a smoothing algorithm. We calculate the smoothed probability of a recession based on the dynamic model and available information of the whole sample: $P(s_t = 2 | \{y_t\}_{t=1}^{T})$.

[17]) For a comprehensive discussion of Markov-switching models we refer to chapter 22 in *Hamilton* (1994) and *Krolzig* (1997).

[18]) See for example *Artis et al.* (2004).

Using quarterly data, we estimate equation (1) for exports as well as imports for each country. The estimation takes account of the WWII period and its immediate aftermath by estimating the model separately for the pre- and post-WWII episodes. The lag length p is evaluated based on various information criteria as well as the Ljung-Box test for checking the serial correlation property of the residuals; in particular, the number of autoregressive lags is determined by the dynamic characteristics of each time series. We proceed by computing smoothed state probabilities and summarise the estimation results by showing the median of the smoothed state probabilities across the countries in our sample for exports and imports - nominal as well as real - as depicted in Figure 3.5. We compute these probabilities using the smoothing algorithm as outlined in detail in *Krolzig* (1997). Smoothed state probabilities represent time series that correspond with the dimension of the original time series data. These time series can be interpreted in several ways – for example, by comparing them with official dates concerning recessionary periods.

Figure 3.5: Smoothed state probabilities



Source: See Table 2.1, WIFO calculations.

The focus on the median of the smoothed state probabilities is convenient as it summarises the results of all countries and presents them in a precise and condensed shape. Moreover, by considering the median, the smoothed state probabilities are still within the unit interval. A value close to 0 or 1 indicates that the majority of countries' export and import cycles are in an expansionary or contractionary phase. Both are a sign for a high degree of synchronisation. Having obtained these probabilities for the time series of all countries in the

dataset, we are in a position to measure the degree of synchronisation of foreign trade cycles.

The results depicted in Figure 3.5 point out the following facts. First of all, the pattern of the smoothed state probabilities is rather similar across exports and imports. The high degree of synchronisation across exports and imports is as expected. This does not come as a surprise as exports of one country must show up as imports in another one. Still it has to be noted that differences between export and import cycles could be significant for reasons related to the global trade/current account deficit on the one hand[19]) and to the fact that our sample of countries does not comprise the whole world rather than just a selected group of countries.

Secondly, the smoothed state probabilities for real exports and imports show a rather similar pattern compared to those of their nominal counterparts. This implies that global export and import cycles are predominantly a consequence of volume effects rather than of volatile price movements, in particular of sharp exchange rate changes.

Thirdly, the figure highlights the extent to which historical recession episodes characterise the pattern of international trade. Across countries the degree of synchronisation tends to be very pronounced during exceptional periods as in the years following the stock market crash in 1929 (Great Depression), the frictions accruing from the beginning of WWII, and from the Great Recession. Across the various trade measures, these three episodes share the highest degree of commonality. The post-WWII episode is, however, characterised by several minor recession episodes which affected global trade fluctuations, too. These episodes are depicted well by the smoothed state probabilities in Figure 3.5; the most important ones of these minor recession episodes are: (1) the recession of 1958 (sharp worldwide economic downturn), (2) the downswings during the 1970s and early 1980s due to volatile oil price movements, (3) the early 1990s recession which describes the period of economic downturn affecting much of the world in the late 1980s and early 1990s, and (4) the early 2000s recession which was characterised by a decline in economic activity that occurred mainly in developed countries ("dot.com" crisis). Across these different recession episodes the median of the smoothed state probabilities provides evidence for a certain degree of synchronisation, however, its value is far below unity. Hence the results indicate a certain degree of commonality within global trade cycles; however, it involves at times only specific countries and not the world economy as a whole.

The analysis presented here shows that the Great Recession has spread among industrialised nations with a degree of synchronicity not witnessed since the end of WWII. In post-WWII episodes, a general recessionary phase tended to affect individual countries with a greater degree of variation. This pattern was violated only during pronounced recessions both, in pre-WWII as well as in post-WWII episodes; more precisely, during the Great Depression and the frictions accruing from the beginning of WWII, as well as during the Great Recession.

[19]) See for instance The Economist, "Exports to Mars – Official statistics probably exaggerate global current-account imbalances", November 12th, 2011, print edition.

These results differ from the analysis obtained by the Bry-Boschan routine above, which did not find such a high degree of synchronicity among foreign trade dynamics in pre-WWII times. One reason for these differences is that the method by *Bry - Boschan* (1971) implies a measure for synchronisation in a stricter sense. Here we consider if an extreme value occurs in a given quarter, or not, while the Markov-switching model indicates the probabilities of these events. Quarters immediately before and after a trough show higher probabilities as well; so the Markov-switching model allows by construction for certain leads and lags when measuring synchronicity.

4. Conclusions

After establishing a new long-term dataset of high-frequency foreign trade data of 23 countries, the data are used the first time in this paper. Therein we provide first results regarding the degree of synchronisation of global foreign trade flows over the past recessions going back to the 1920s. Throughout the paper we used different kinds of methods and data (regarding their frequency, real and nominal values, seasonally adjusted and raw data) in order to highlight the possibilities with the new dataset.

The financial crisis of 2008/09 led to a deep and global recession, which affected the degree of synchronisation of foreign trade flows, too. Several culprits have been proposed in the literature to explain the high degree of synchronisation in the trade downturn during the Great Recession of 2008/09 (e.g. the credit crunch, global production chains, generalised loss of confidence). Using descriptive statistics as well as the turning-point-orientated measures by Bry and Boschan and a Markov-switching model our results state this extraordinary high degree of synchronisation among countries' foreign trade dynamics during the Great Recession, which was found to be the unique during post-WWII times. Other recession episodes (1958, 1970s, early 1990s and 2001) affected global trade fluctuations too, but the trade downturn did not happen as synchronous. Our results are also in line with the findings of *Antonakakis* (2012) and *Martins - Araùjo* (2009), who analysed global trade fluctuations in the recent past too, however, using different econometric methodologies. Furthermore, our newly established long-term dataset enables us to go back in time even more and to compare the degree of synchronisation in the Great Recession with those during recessions in pre-WWII times. Using both, rolling correlations and the method by Bry and Boschan we find an extraordinary high degree of synchronicity among trade flows in the Great Recession over our sample period. During the Great Depression in the 1930s the commonality in foreign trade was not as strong. However, according to the Markov-switching model, which covers synchronisation in a wider sense, the high degree of synchronisation underlying the recent trade collapse was not unique. Indeed exceptional occurrences have taken place already in pre-WWII times (Great Depression and frictions related to WWII), at least temporarily, at a degree of global trade synchronisation similar as observed during the Great Recession. The question as to why these global recessionary periods had rather heterogeneous consequences for international trade fluctuations remains unanswered for now.

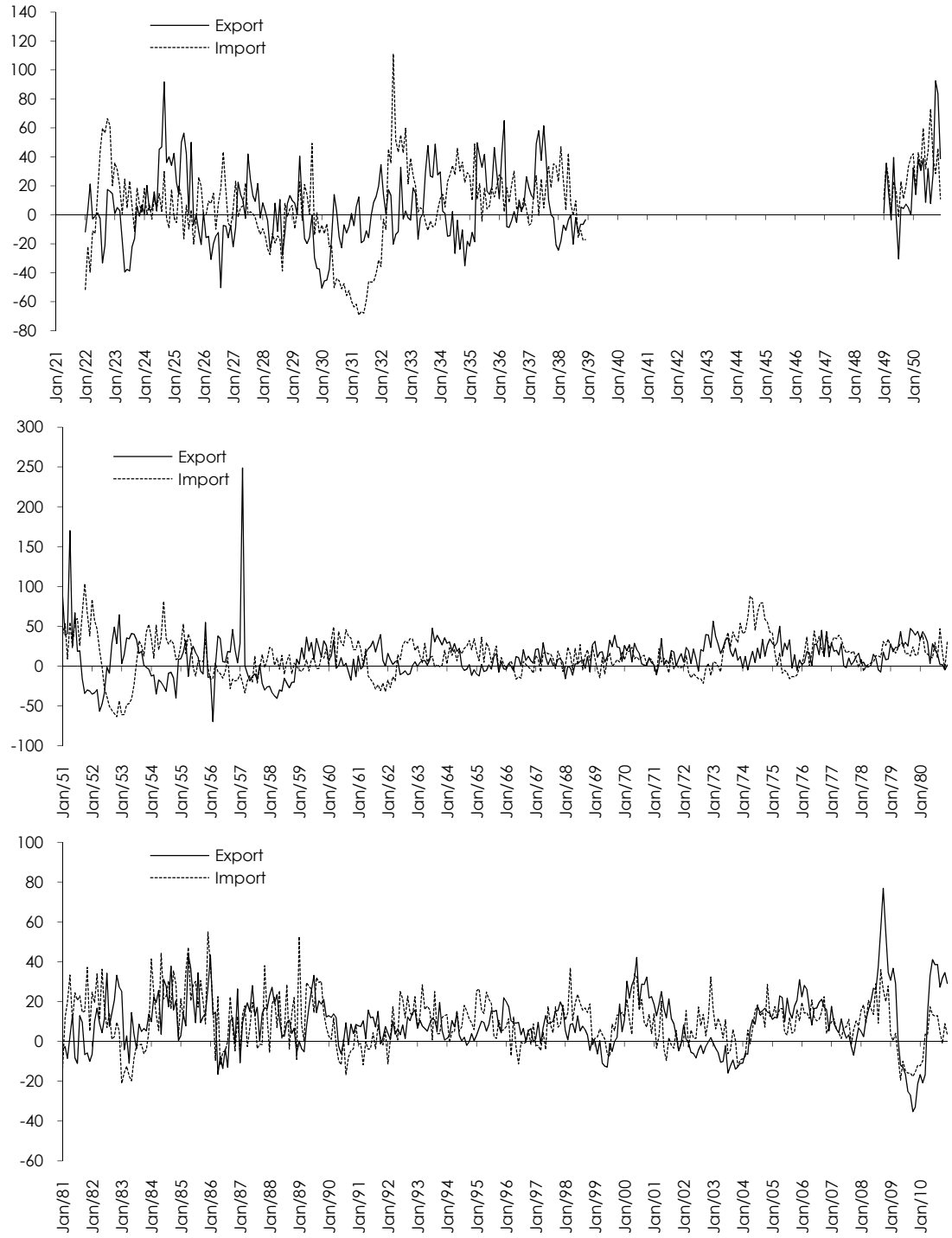
After the high degree of synchronisation in the trade downturn in 2008/09, exports and imports of the countries in our sample recovered similarly simultaneous again. They show a strong and common rebound shortly after the trade collapse. Compared to other recessions, we find the degree of synchronisation of the speed of the recovery of trade flows higher again. This does not support the phenomenon of the asymmetry in the recovery after the Great Recession (core vs. periphery countries of the EU) which we experienced when looking at GDP data. This may be a result of the country selection in our long-term dataset (we had

to abstract from most periphery countries of the EU), where we put the focus on the data availability going back a long time.

We further extended our dataset by including real values. Results using these data show rather similar patterns compared to those of their nominal counterparts. This implies that global export and import cycles are predominantly a consequence of volume effects rather than of volatile price movements, in particular in the form of sharp exchange rate changes.

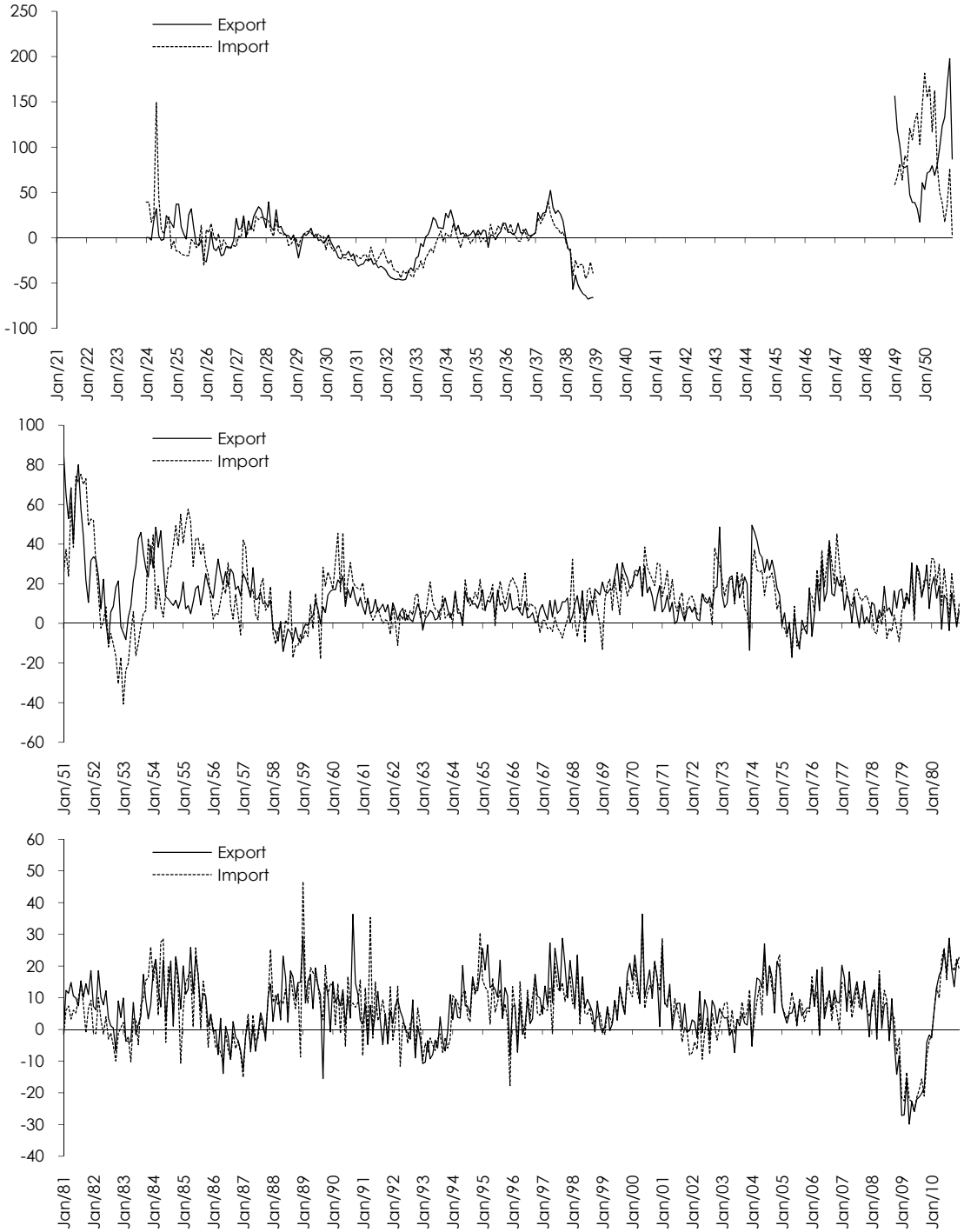
Appendix I: The new long-term dataset

Figure AI.1: Development of monthly foreign trade - Australia
Percentage change against the previous year



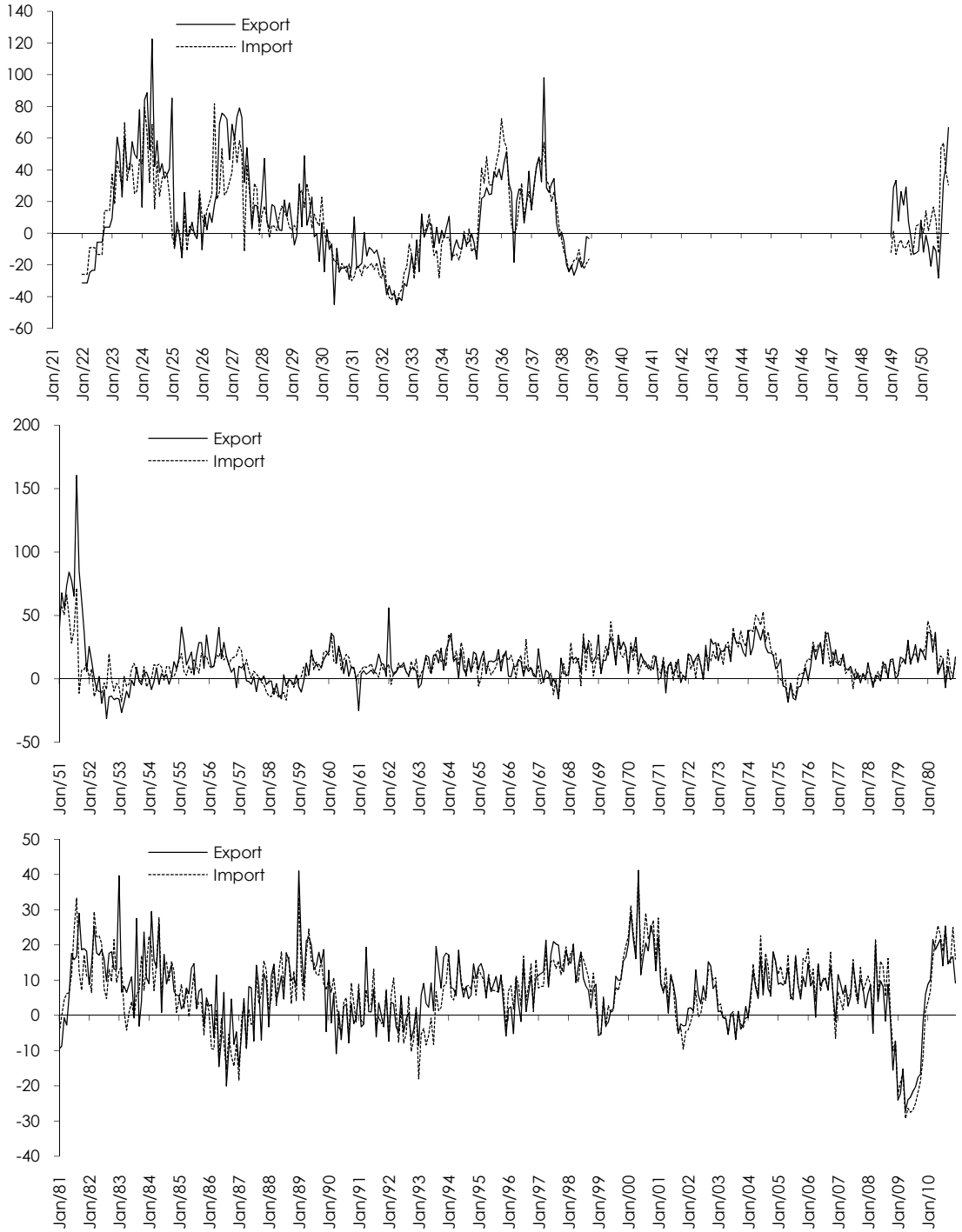
Source: See Table 2.1.

Figure AI.2: Development of monthly foreign trade - Austria
Percentage change against the previous year



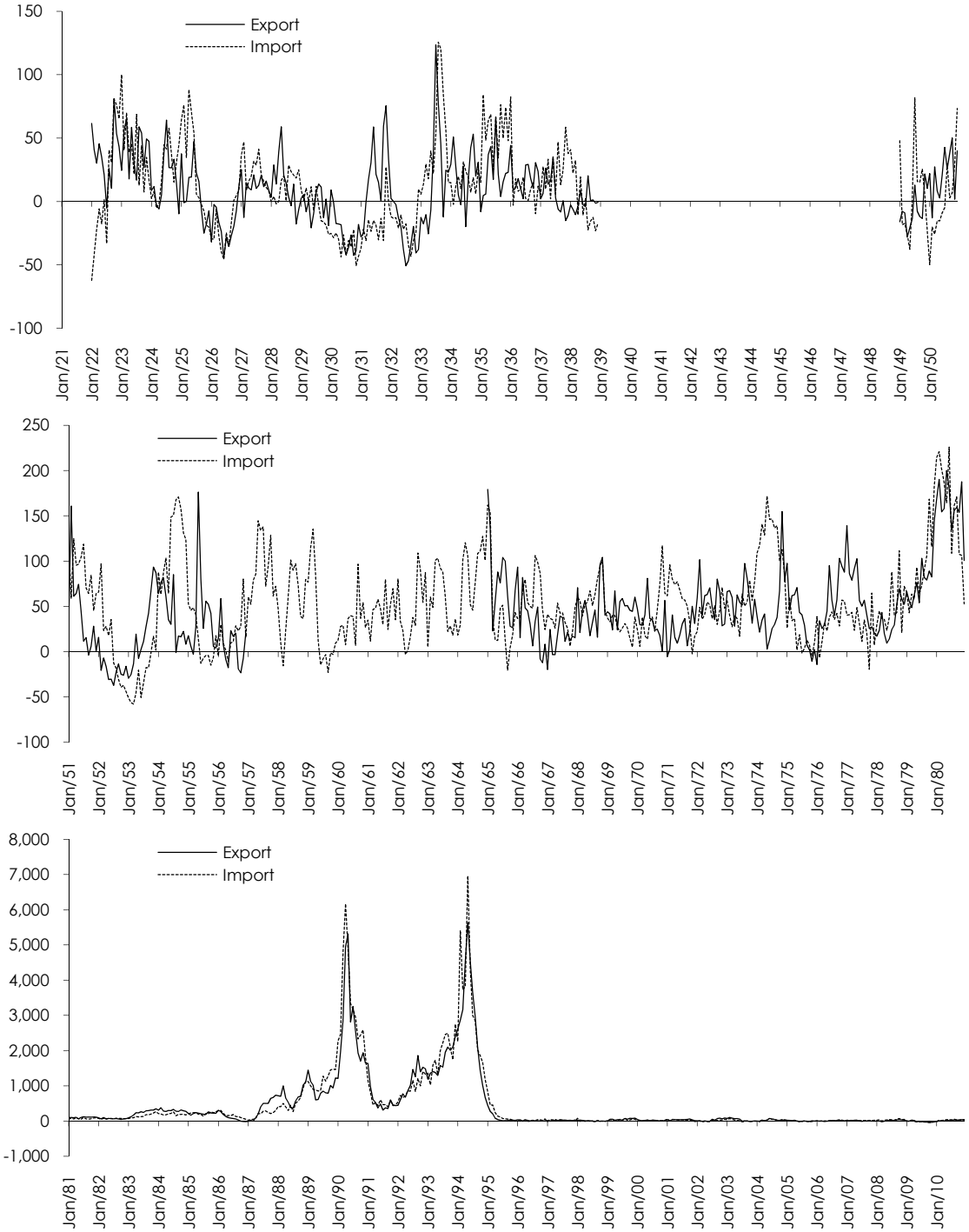
Source: See Table 2.1.

Figure AI.3: Development of monthly foreign trade - Belgium
Percentage change against the previous year



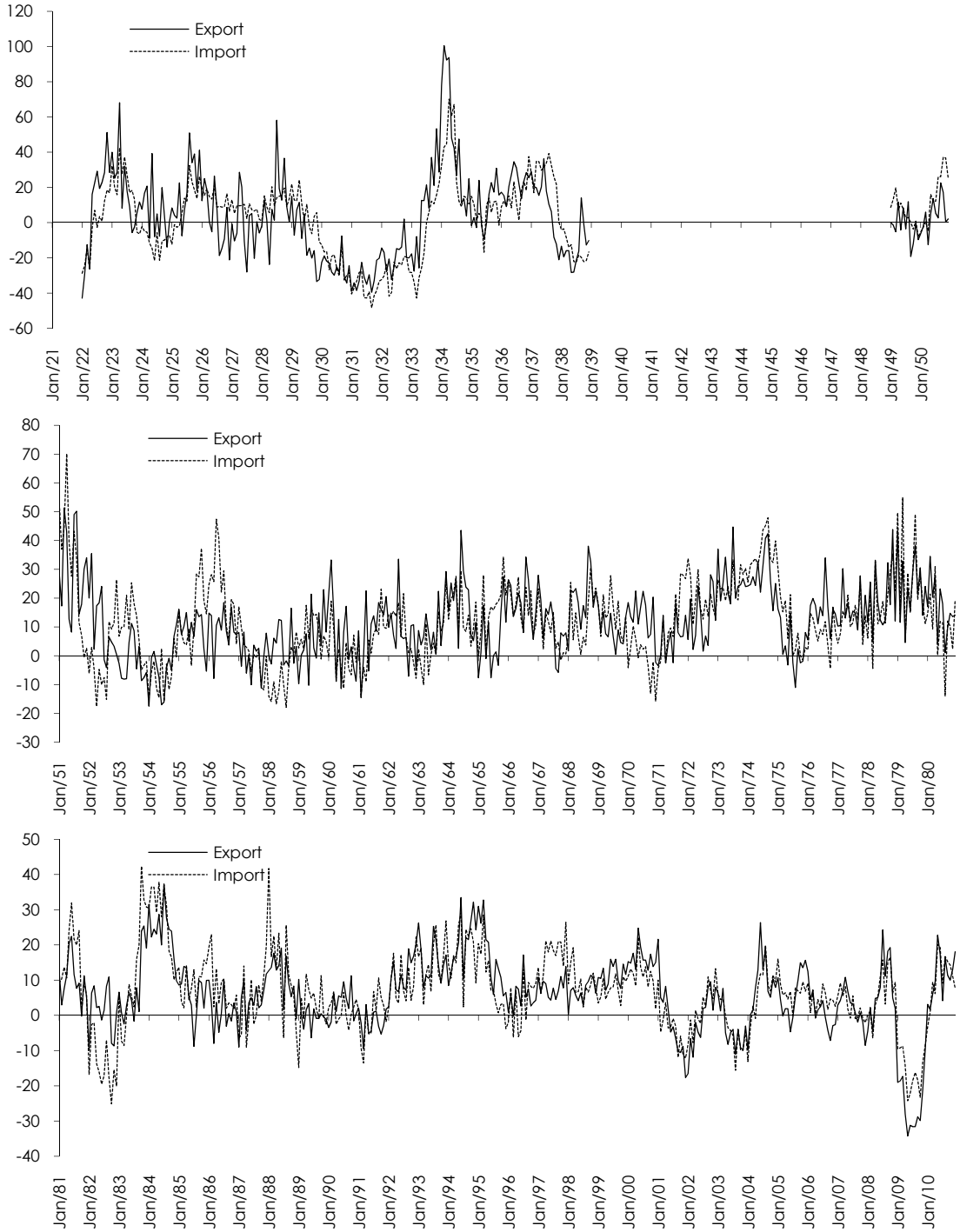
Source: See Table 2.1.

Figure AI.4: Development of monthly foreign trade - Brazil
Percentage change against the previous year



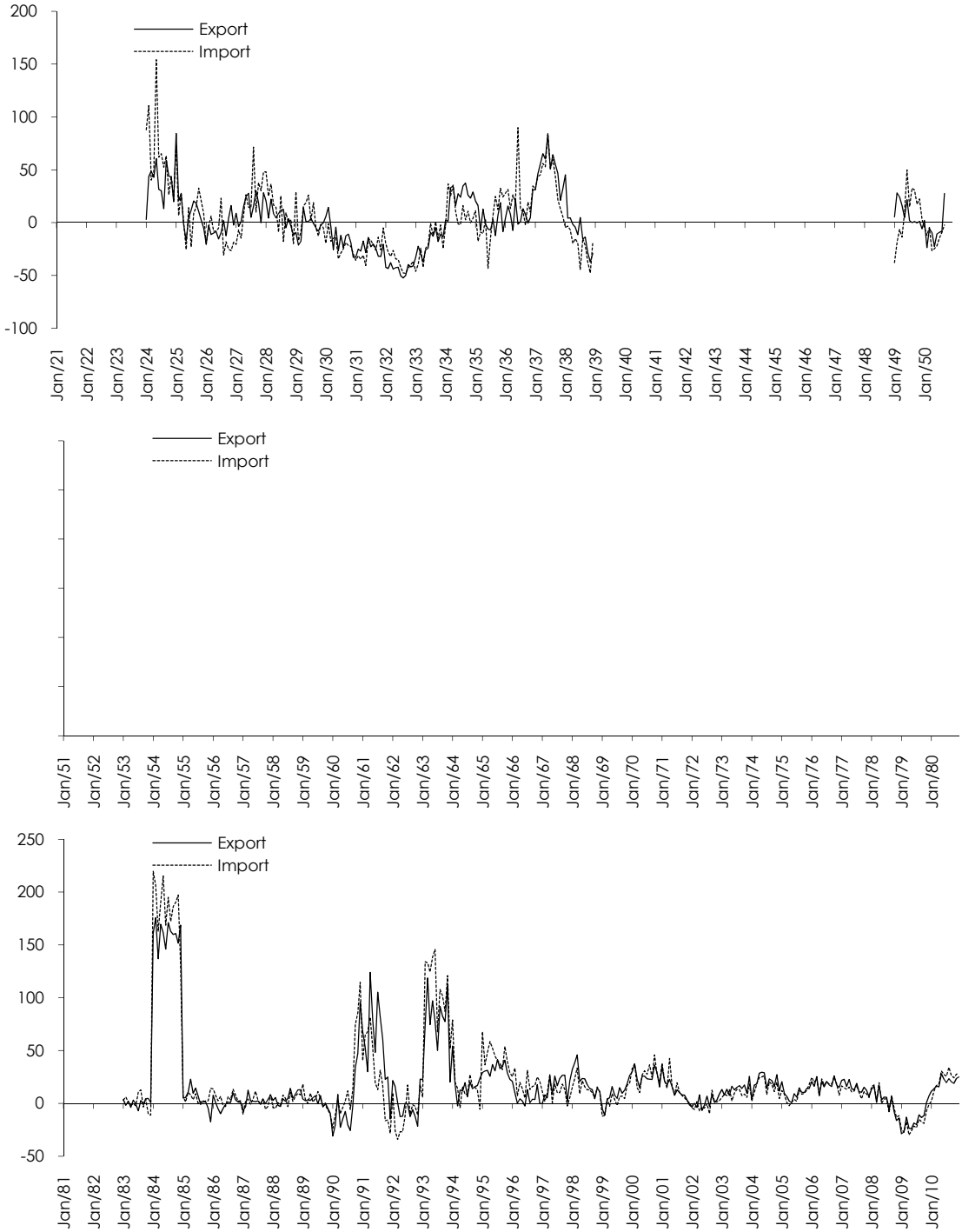
Source: See Table 2.1.

Figure AI.5: Development of monthly foreign trade - Canada
Percentage change against the previous year



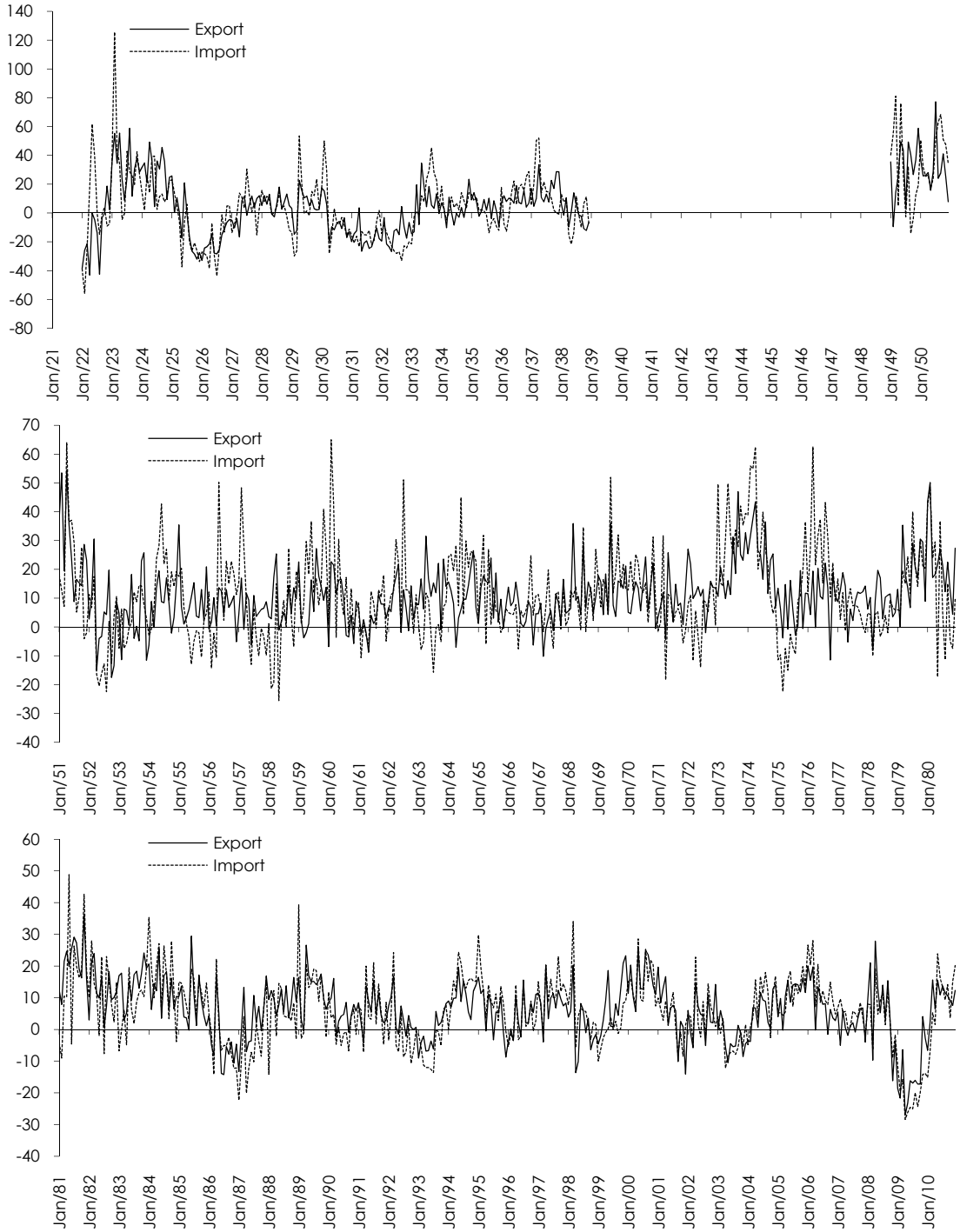
Source: See Table 2.1.

Figure AI.6: Development of monthly foreign trade – Former Czechoslovakia
Percentage change against the previous year



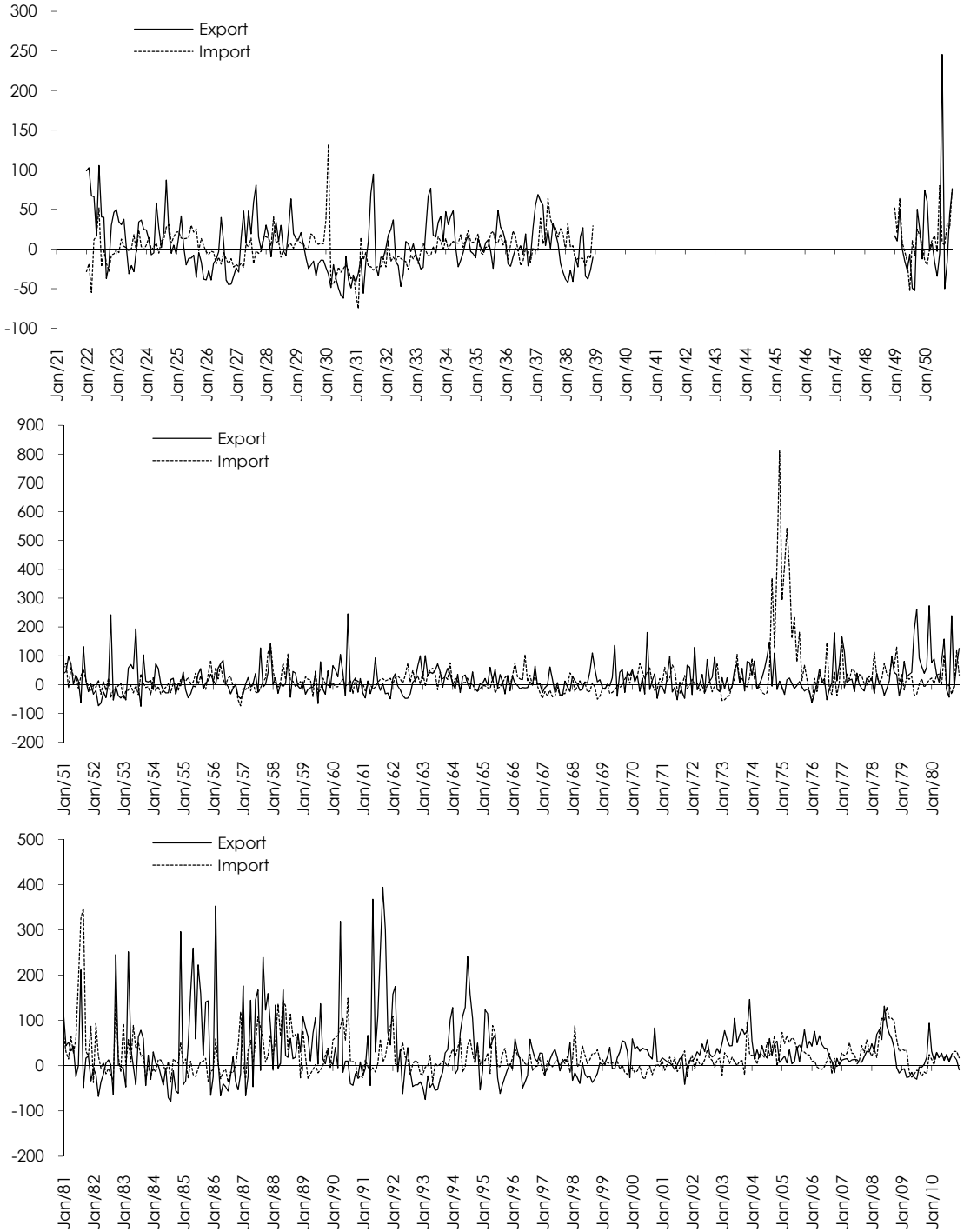
Source: See Table 2.1.

Figure AI.7: Development of monthly foreign trade - Denmark
Percentage change against the previous year



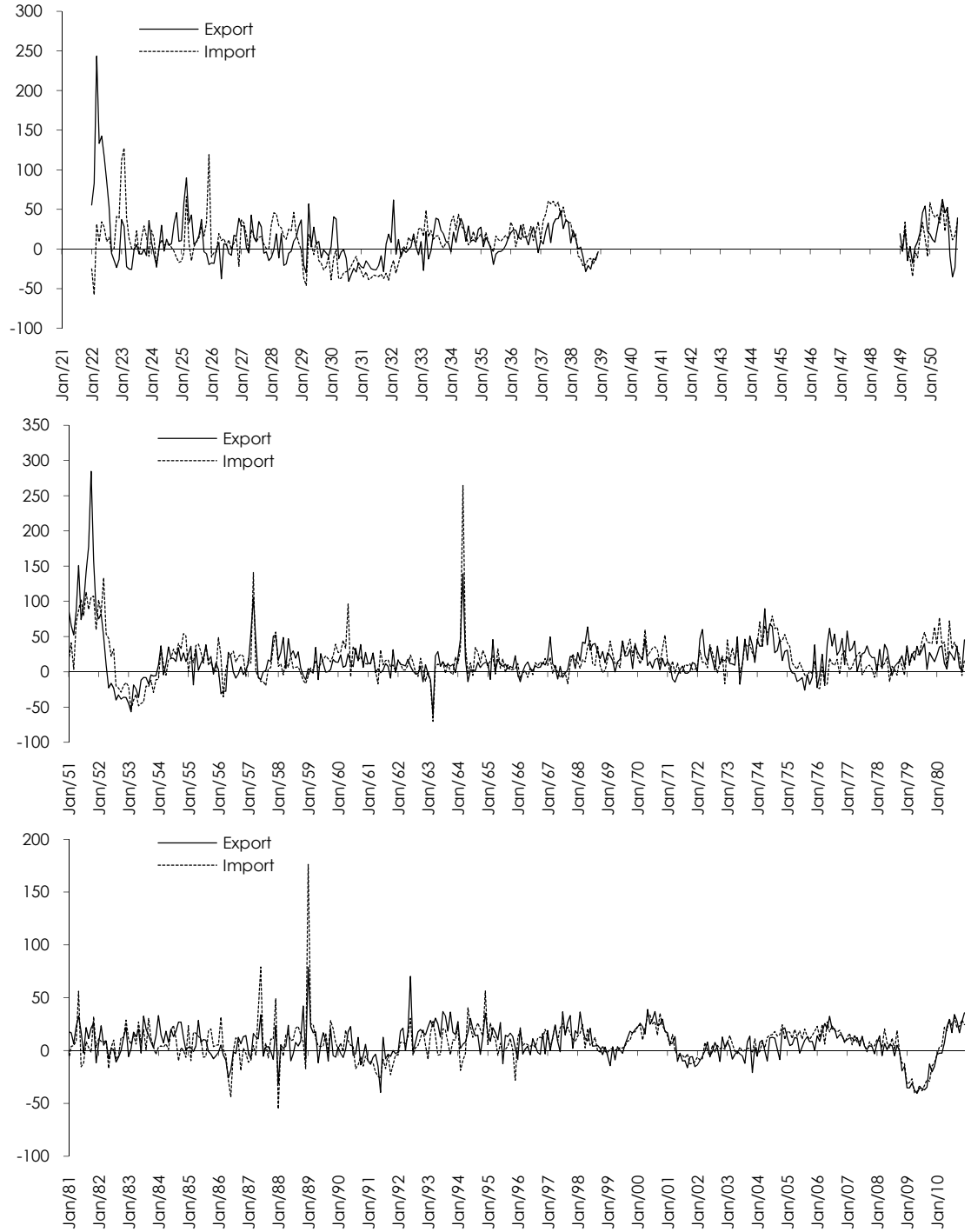
Source: See Table 2.1.

Figure AI.8: Development of monthly foreign trade - Egypt
Percentage change against the previous year



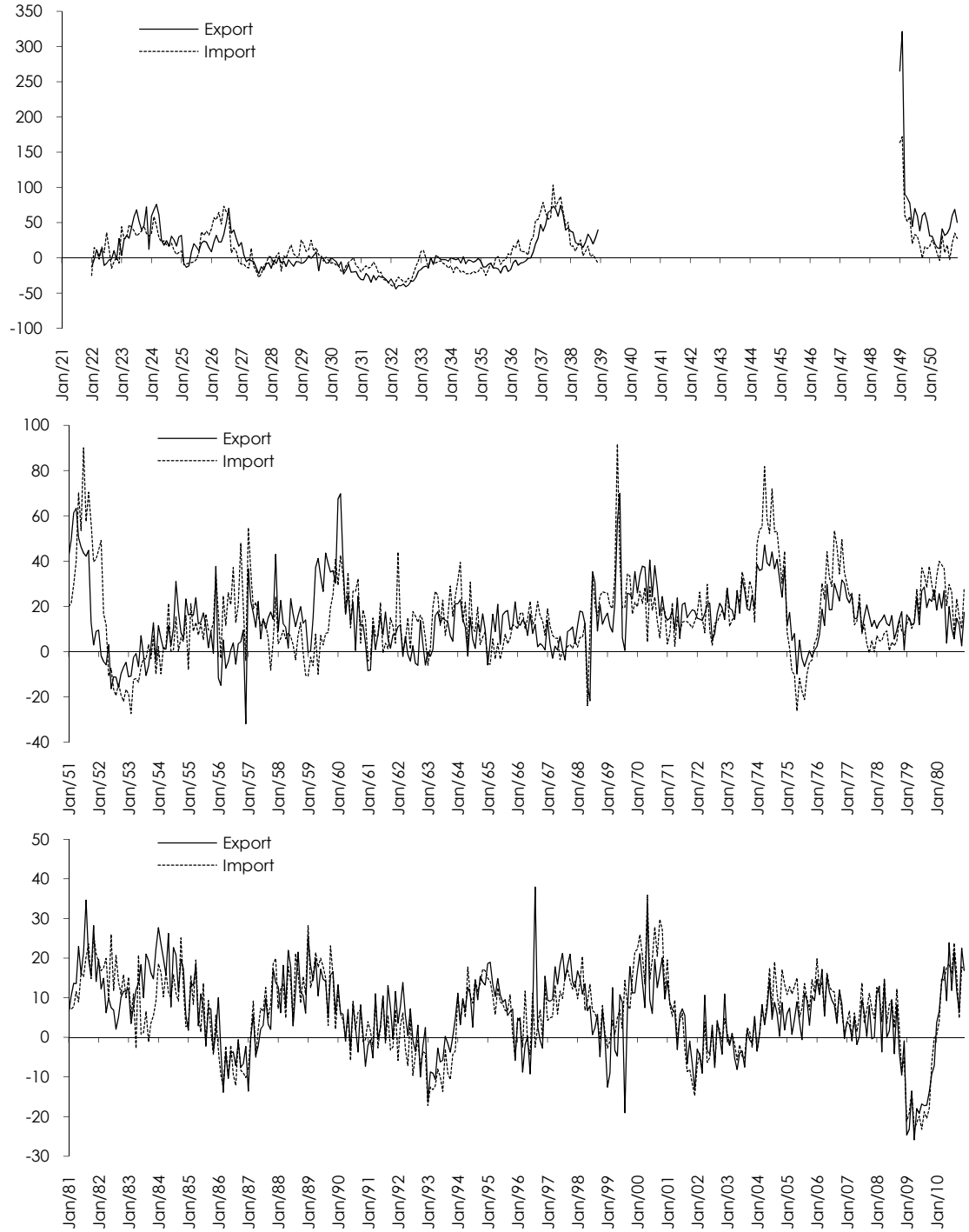
Source: See Table 2.1.

Figure AI.9: Development of monthly foreign trade - Finland
Percentage change against the previous year



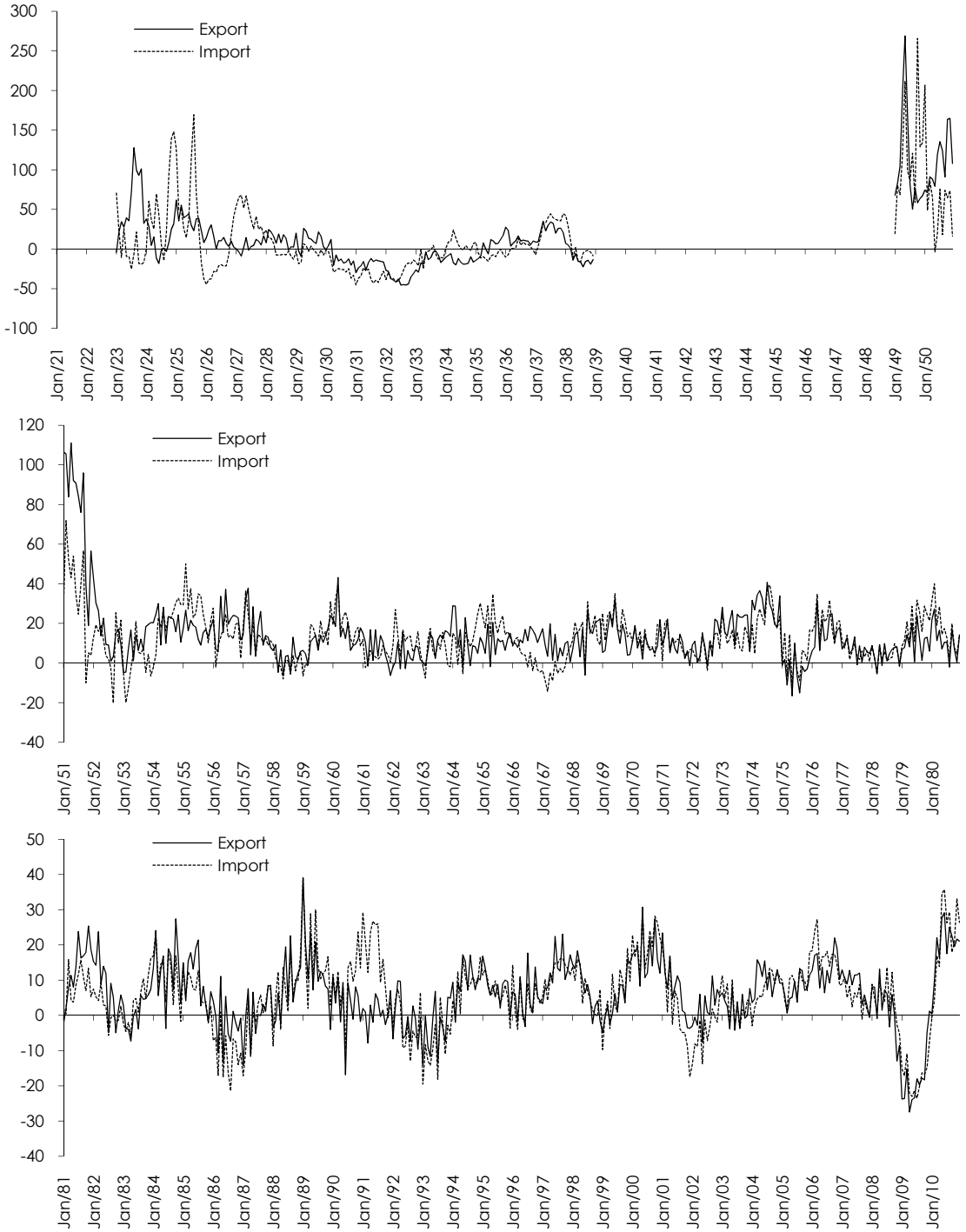
Source: See Table 2.1.

Figure AI.10: Development of monthly foreign trade - France
Percentage change against the previous year



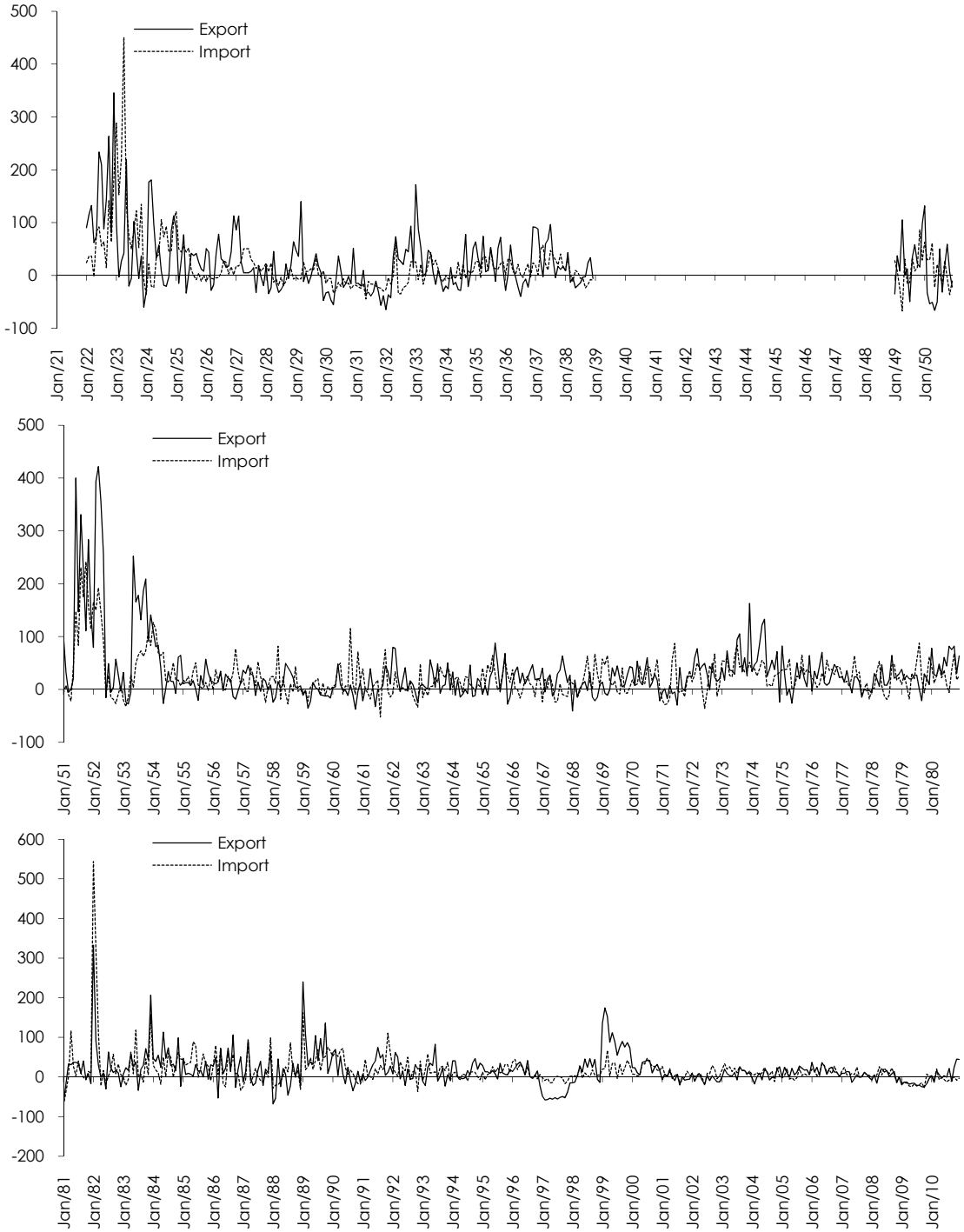
Source: See Table 2.1.

Figure AI.11: Development of monthly foreign trade - Germany
Percentage change against the previous year



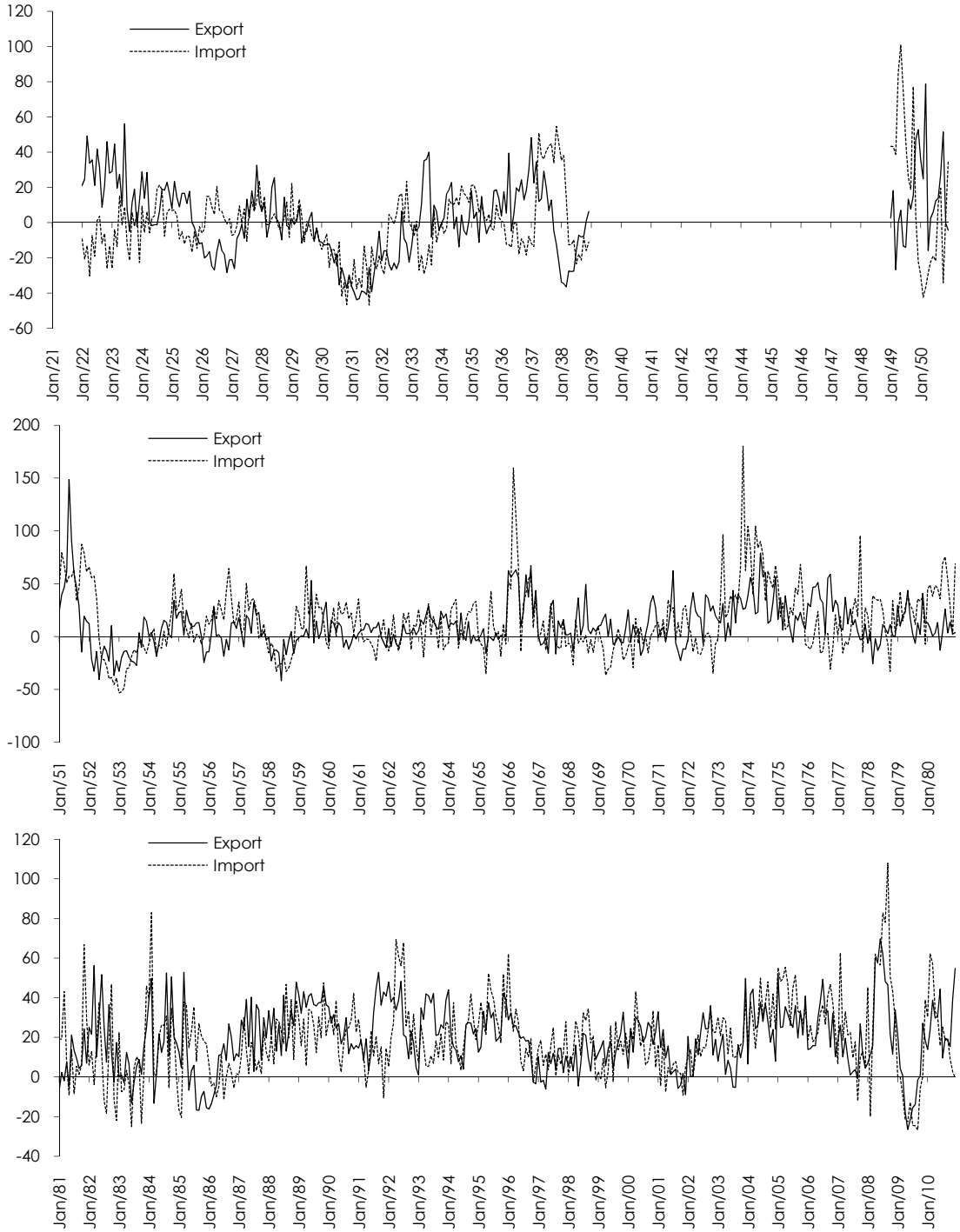
Source: See Table 2.1.

Figure AI.12: Development of monthly foreign trade - Greece
Percentage change against the previous year



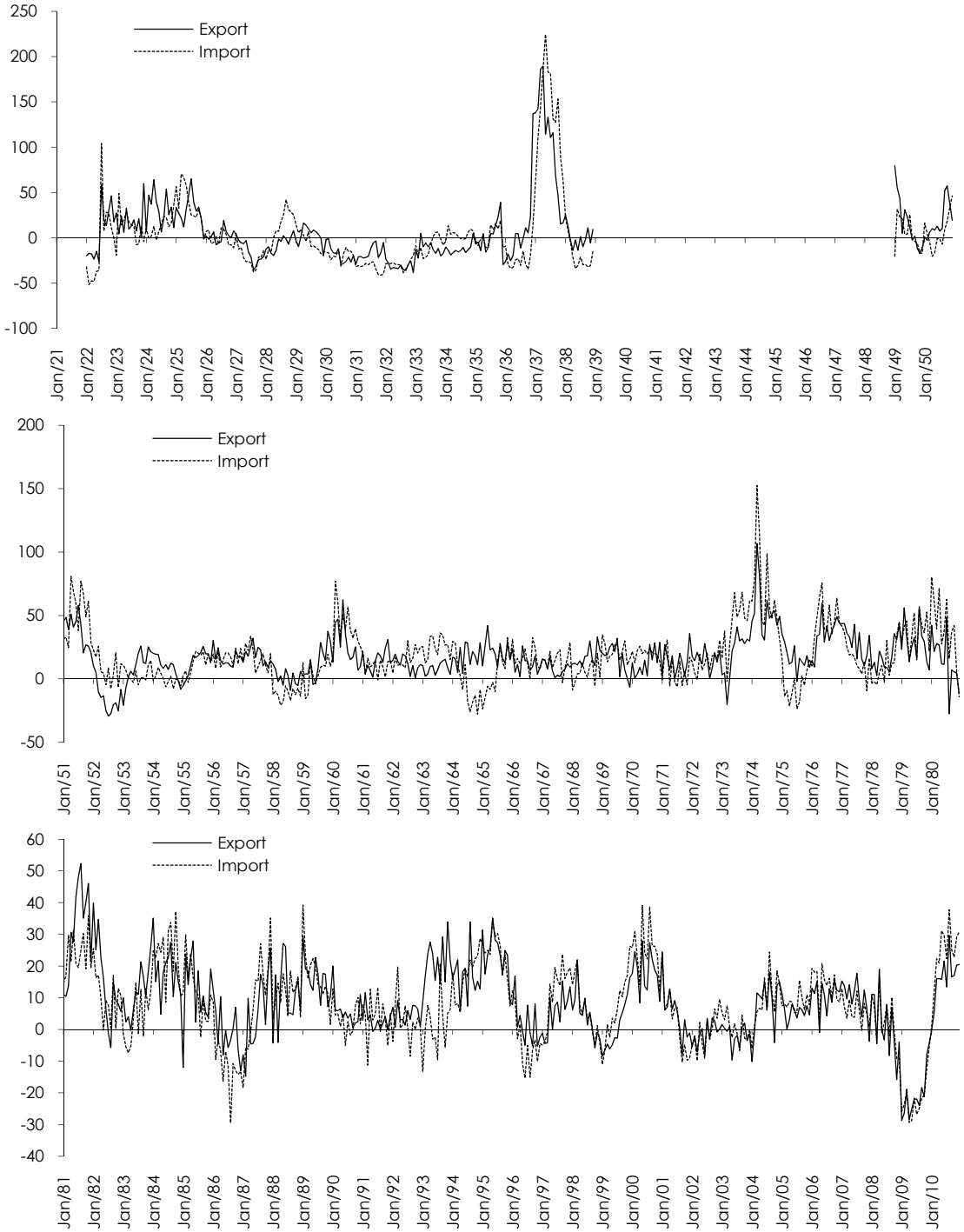
Source: See Table 2.1.

Figure AI.13: Development of monthly foreign trade - India
Percentage change against the previous year



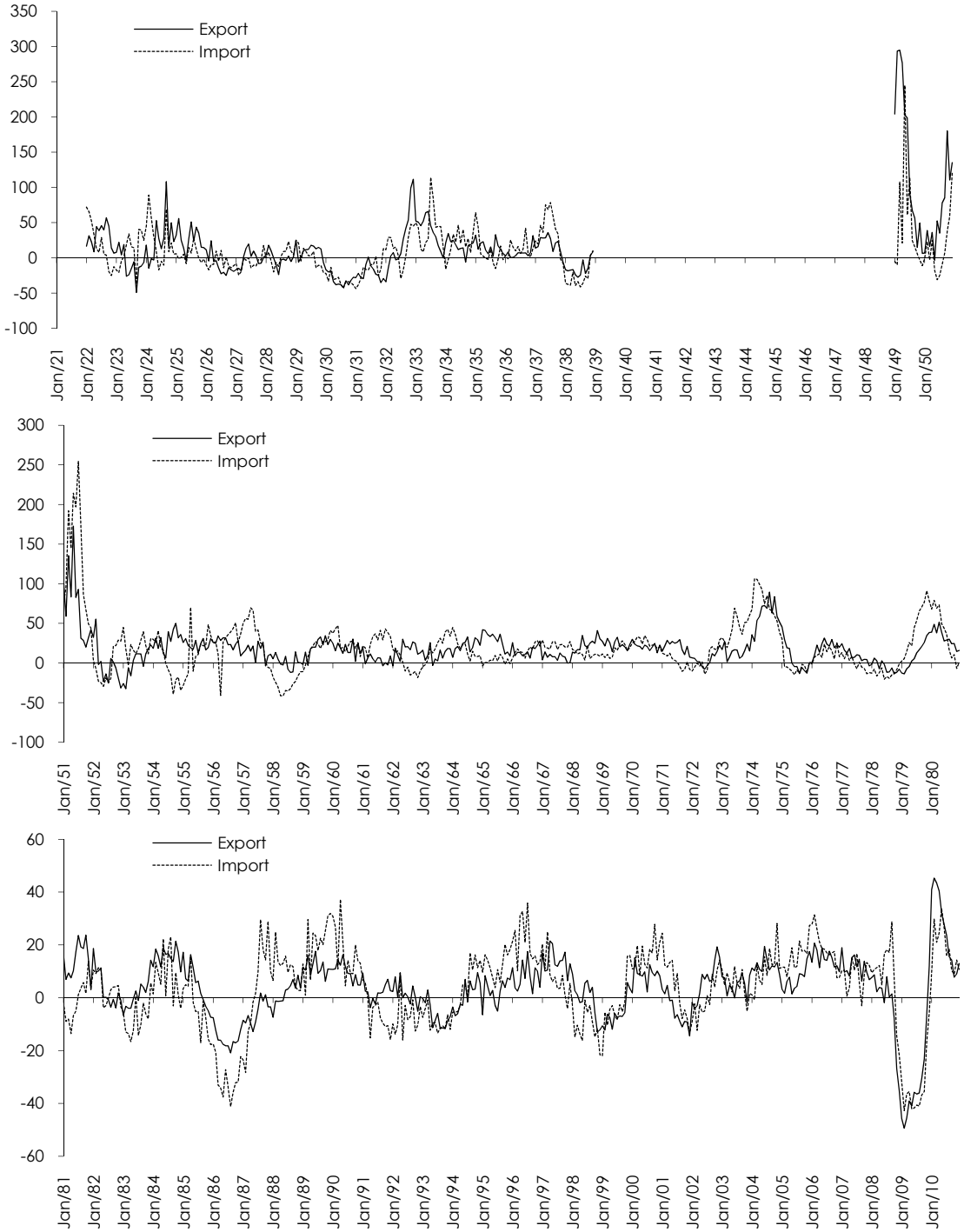
Source: See Table 2.1.

Figure AI.14: Development of monthly foreign trade - Italy
Percentage change against the previous year



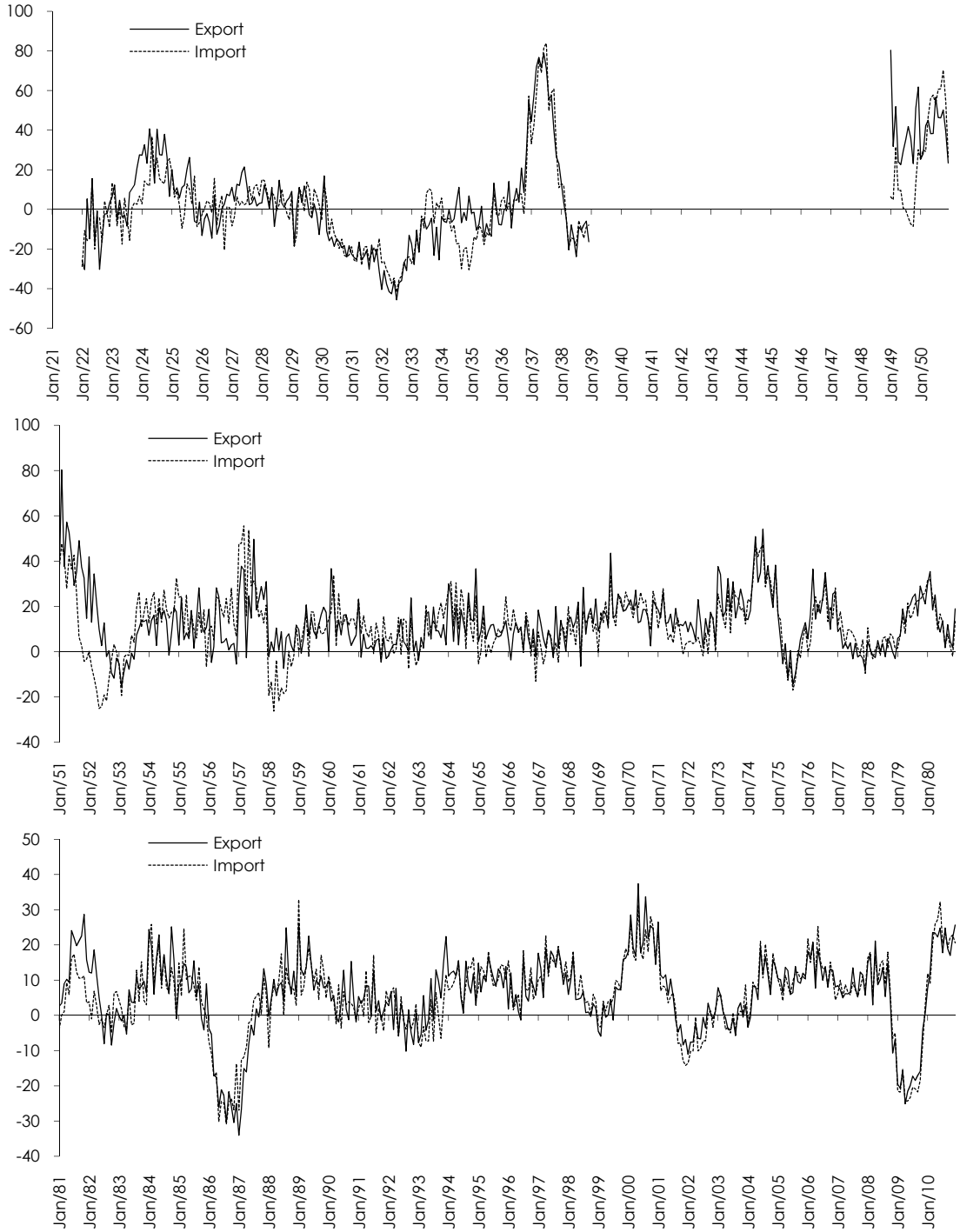
Source: See Table 2.1.

Figure AI.15: Development of monthly foreign trade - Japan
Percentage change against the previous year



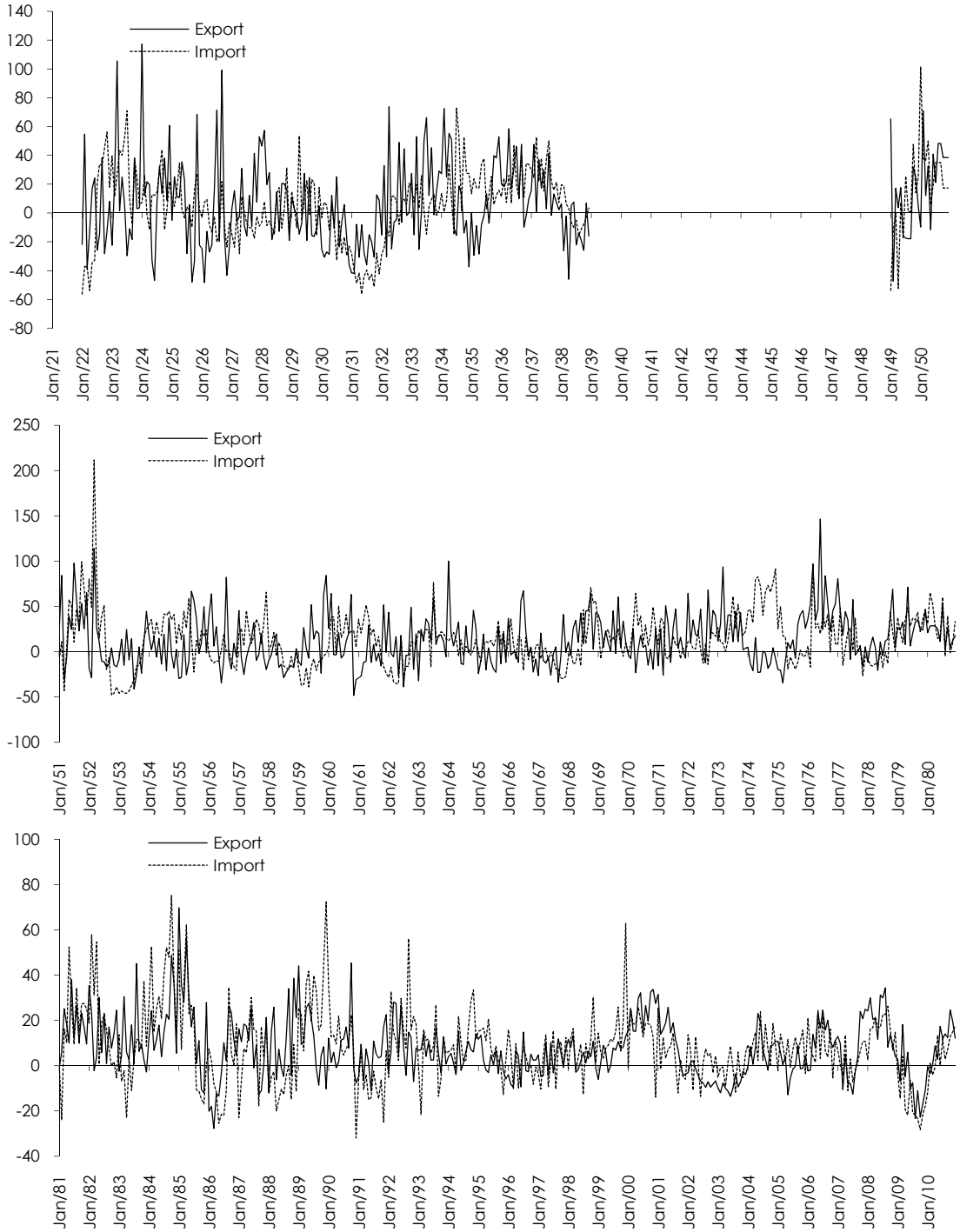
Source: See Table 2.1.

Figure AI.16: Development of monthly foreign trade - Netherlands
Percentage change against the previous year



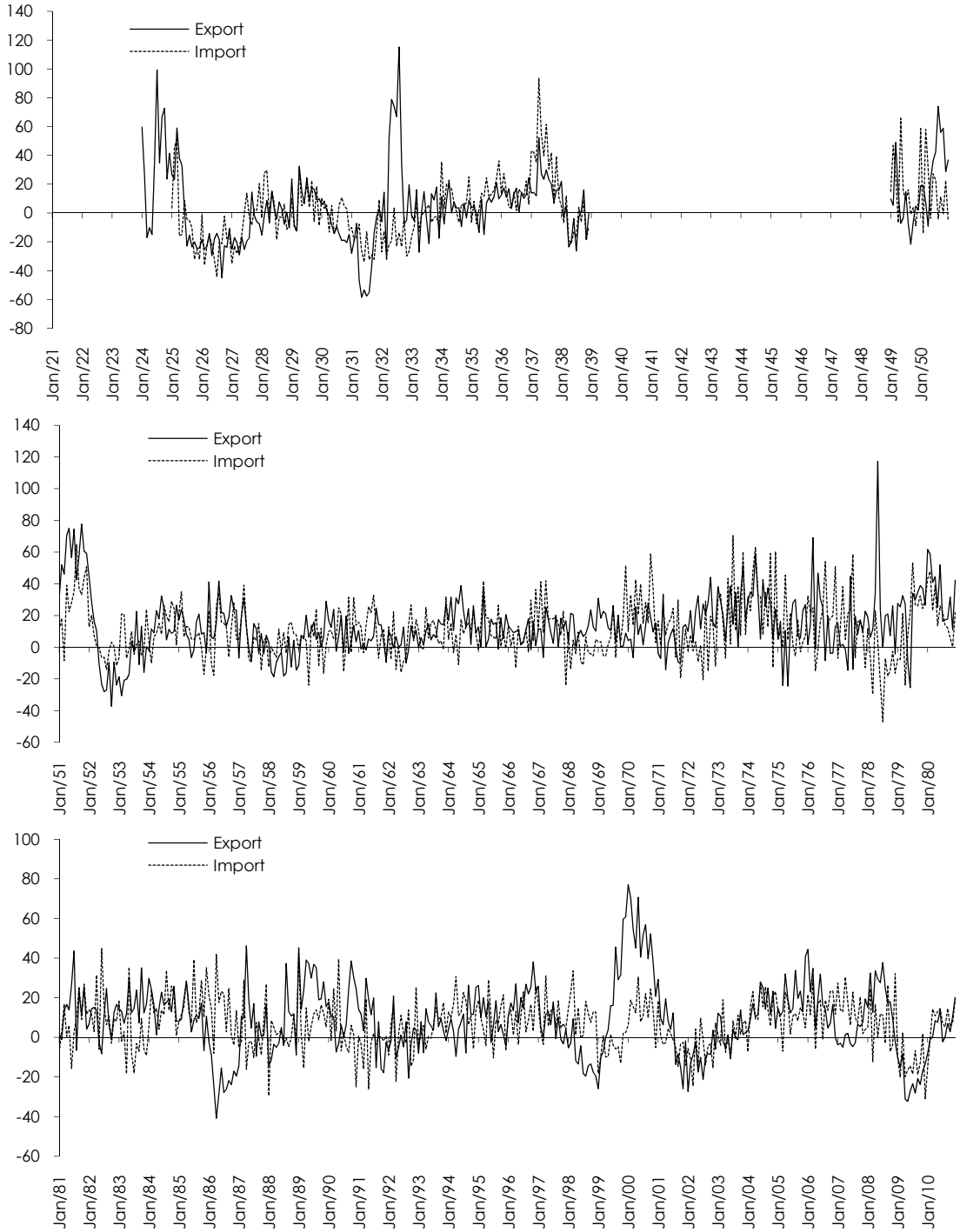
Source: See Table 2.1.

Figure AI.17: Development of monthly foreign trade – New Zealand
Percentage change against the previous year



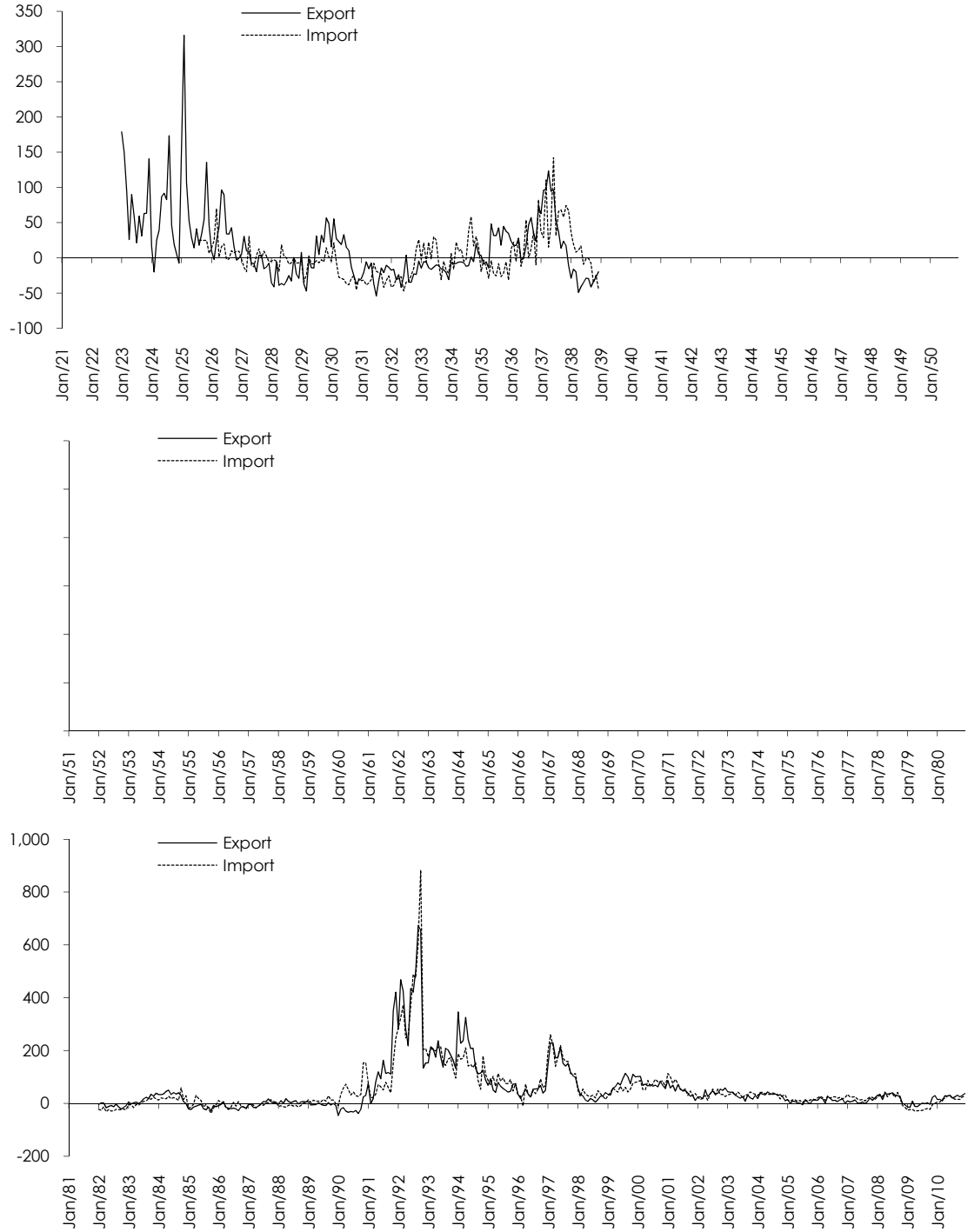
Source: See Table 2.1.

Figure AI.18: Development of monthly foreign trade - Norway
Percentage change against the previous year



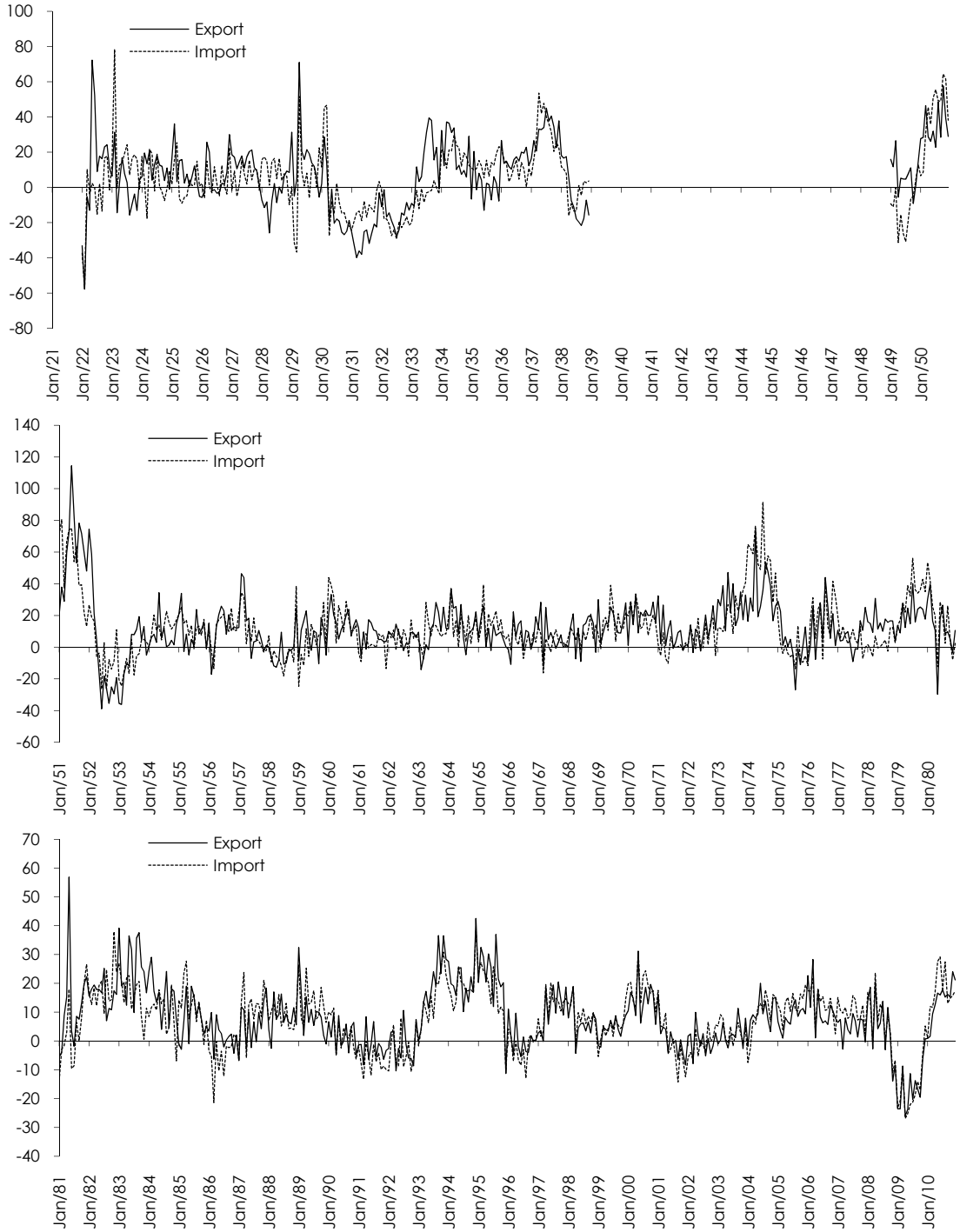
Source: See Table 2.1.

Figure AI.19: Development of monthly foreign trade - Romania
Percentage change against the previous year



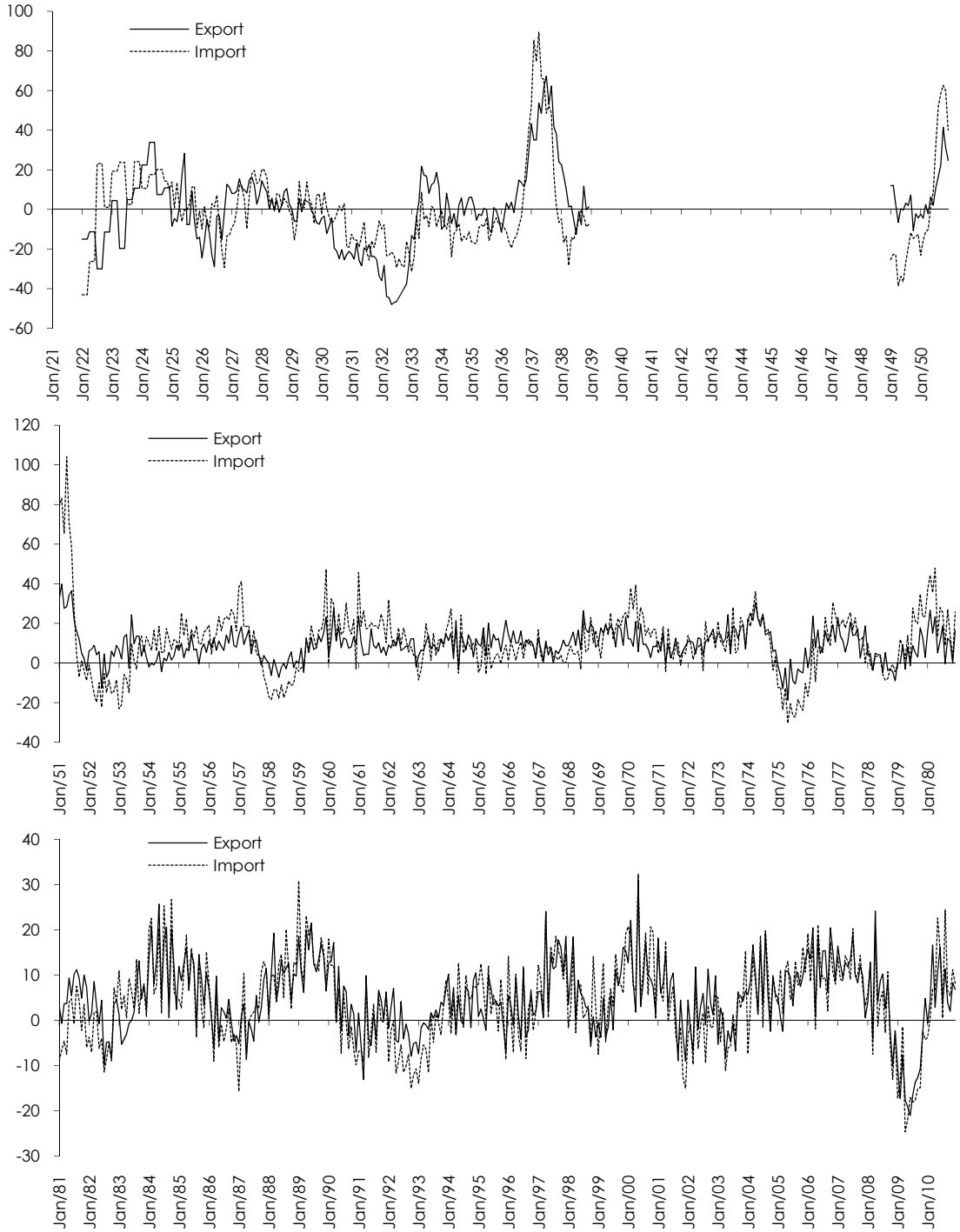
Source: See Table 2.1.

Figure AI.20: Development of monthly foreign trade - Sweden
Percentage change against the previous year



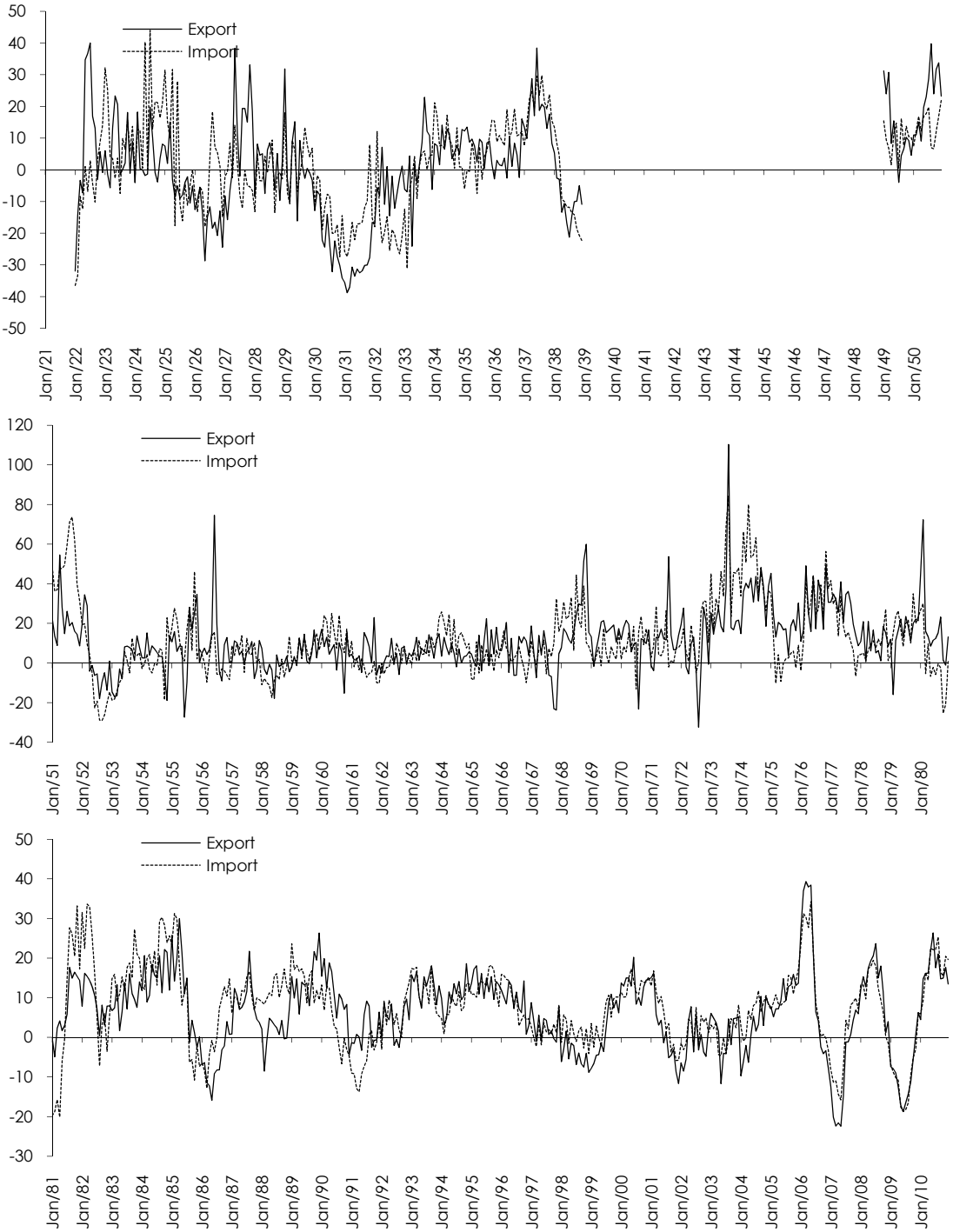
Source: See Table 2.1.

Figure AI.21: Development of monthly foreign trade - Switzerland
Percentage change against the previous year



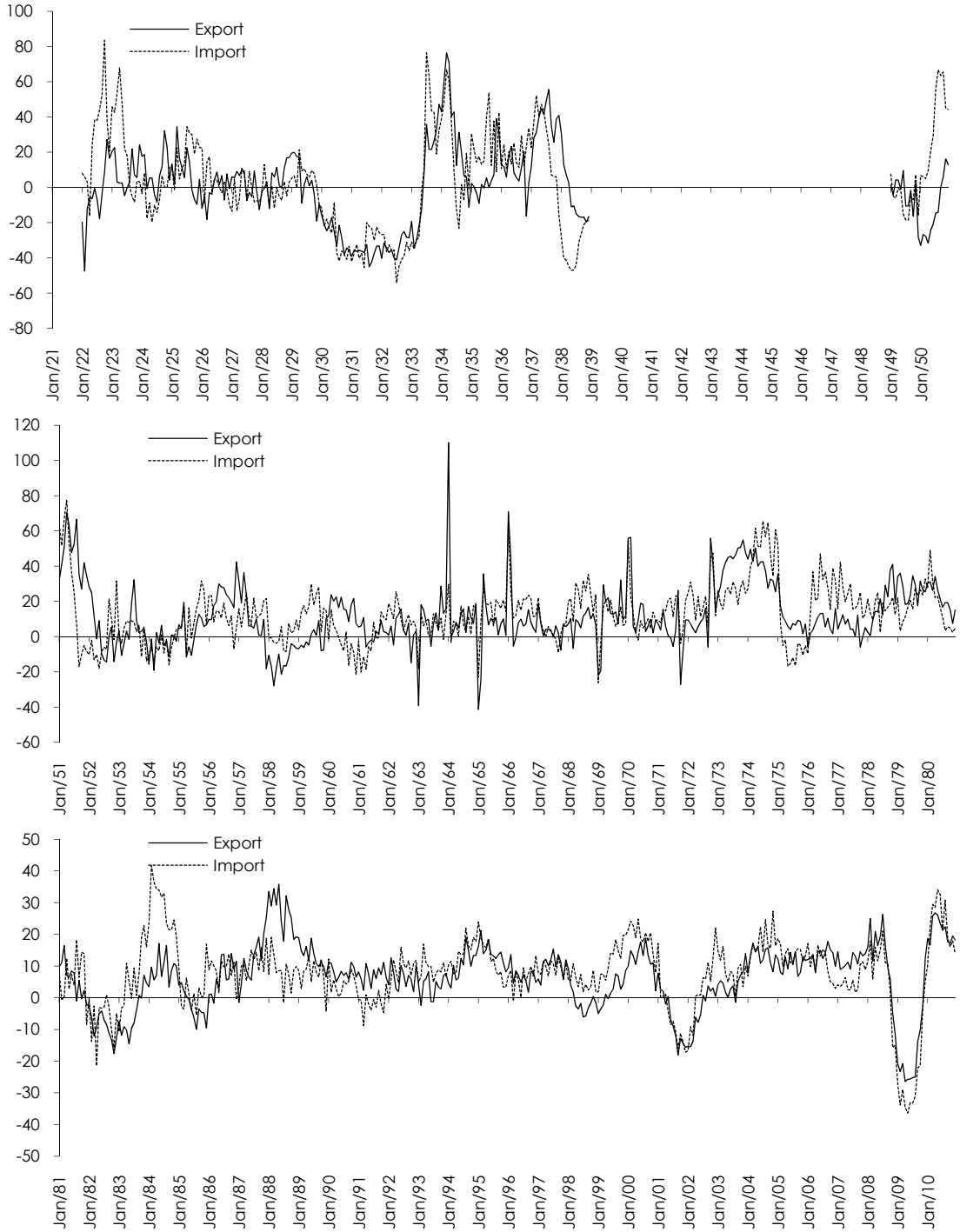
Source: See Table 2.1.

Figure AI.22: Development of monthly foreign trade – United Kingdom
Percentage change against the previous year



Source: See Table 2.1.

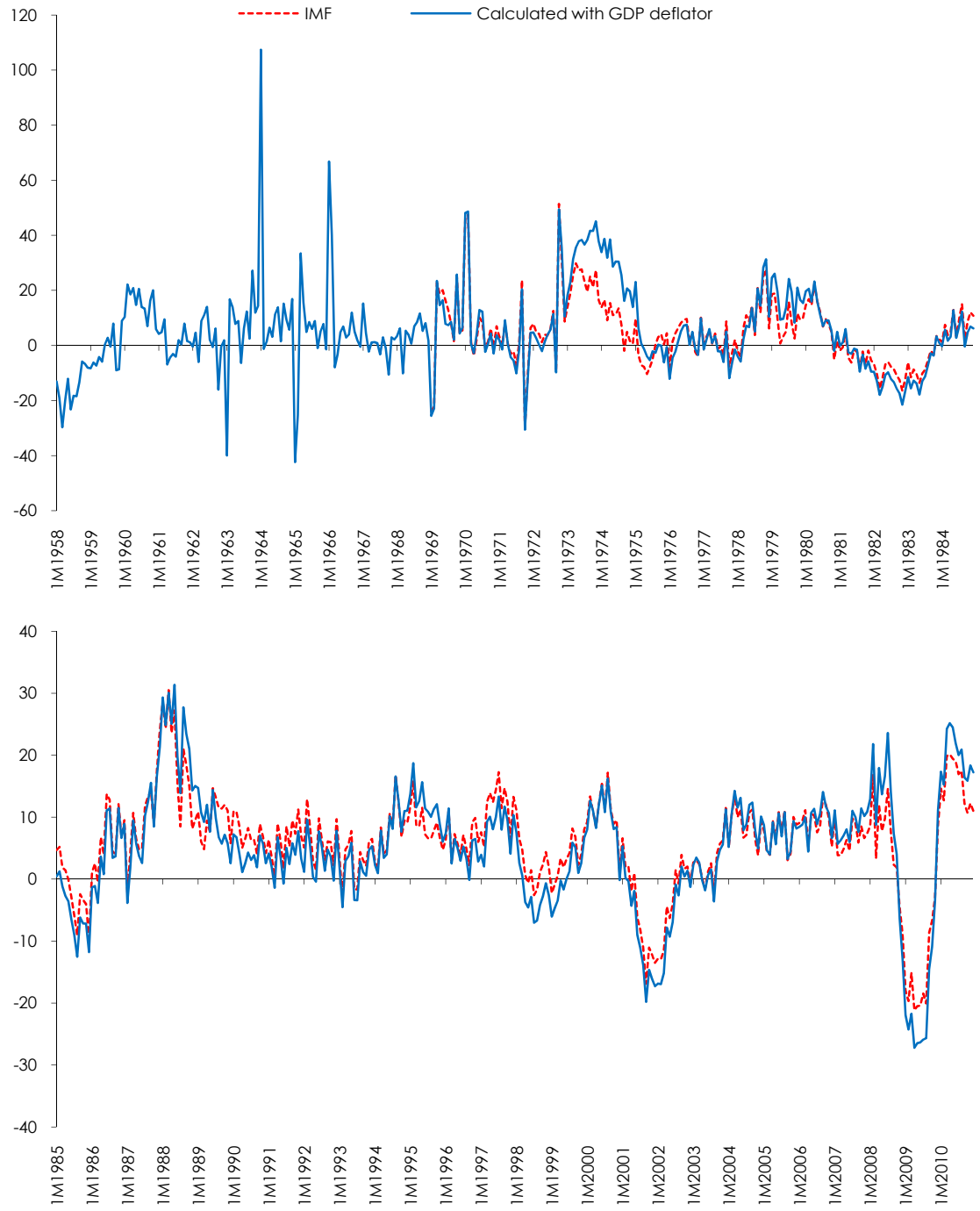
Figure AI.23: Development of monthly foreign trade - USA
Percentage change against the previous year



Source: See Table 2.1.

Appendix II: A first application – the synchronisation of foreign trade

Figure AII.1 Real export growth calculated using the GDP deflator compared to IMF real export growth (percentage change)
USA



Source: See Table 2.1, IMF, WIFO calculations.

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