This page intentionally left blank

INTERNATIONAL MONETARY FUND

KINGDOM OF THE NETHERLANDS—NETHERLANDS

Selected Issues

Prepared by Wendly Daal, Francisco Nadal De Simone (both EUR),
and Alain Kabundi (University of Johannesburg)

Approved by the European Department

April 28, 2008

Contents Page

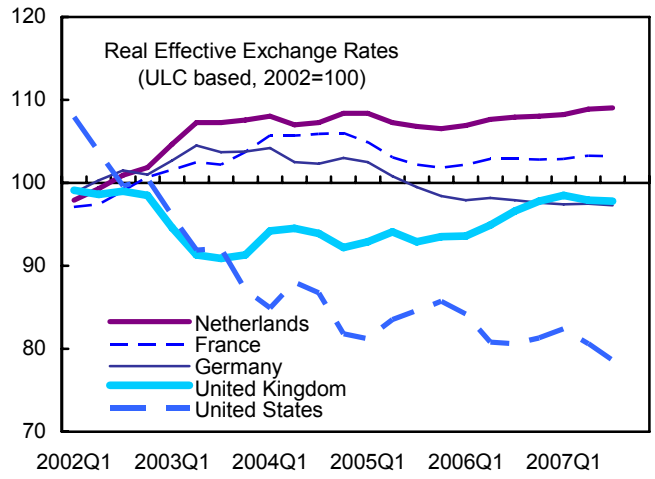
Tables

Figures

I. Maintaining Competitiveness in the Global Economy: Dutch Export Performance[1]

A. Introduction

1. **Overall competitiveness of the Dutch economy seems adequate, but domestically produced exports have lost market share recently.** With a large current account surplus, robust exports, and strong growth, external Dutch competitiveness would appear to be satisfactory. In addition, the external sector is contributing positively to economic growth. After the sizable real appreciation in 2001-03, REER measures based on different price indices have been relatively stable, although ULC-based measures suggest a growing gap with some competitors.[2] Manufacturing unit labor costs have fallen for the last four years, but at a lower pace than for some trading partners. Yet, multilaterally-consistent measures of equilibrium exchange rates suggest that the real exchange rate for the Netherlands is broadly in equilibrium. Domestically produced exports' growth was in line with adjusted market growth until 2000.[3] Afterward, the Dutch market share declined. With foreign trade representing about 80 percent of GDP, the loss of market share has raised concerns about Dutch competitiveness.



2. **Past staff analysis indicated that, while aggregate measures of competitiveness showed no sign of worsening, disaggregated trade data suggested some deterioration.**[4] More recently, some other observers have also suggested that the country has not benefited

[1] Prepared by Alain Kabundi and Francisco Nadal De Simone.

[2] Low inflation has limited the increase in the CPI-based REER.

[3] Mellens, M.C., H.G.A. Noordman, and J.P. Verbruggen, 2007.

[4] See IMF Country Report No 05/225.

fully from the opportunities offered by the rapid economic growth of emerging Asia and the enlargement of the EU. A flexible economy should be able to reorient the destination of its exports and product mix toward fast-growing economies and sectors. In addition, staff also found that TFP growth in the Netherlands was associated with certain structural features of the labor market. In particular, Dutch TFP growth decelerated as the secular fall in the ratio of the minimum wage to the median wage and in union density tapered off after 1998.[5] Similarly, staff analysis found a strong negative effect of changes in the ratio of the minimum wage to the median wage and in union density on TFP growth, both key features of the Dutch labor market.

3. **Building on past staff research, this paper performs a descriptive analysis of Dutch export data and also analyzes quantities and price developments following shocks to the economy.** The analysis of export behavior is done using data by destination and by SITC, Revision 3, product classification. Notably, this analysis distinguishes between the cyclical and the trend components of the series. Next, this chapter analyzes the behavior of prices and quantities following a domestic and a foreign shock to the Dutch economy. In particular, the paper compares and contrasts the reaction of Dutch and German macro and trade variables to shocks to unit labor costs in manufacturing and to terms of trade.

4. **Over the past three decades, globalization has greatly influenced economies as countries have become more integrated**. Integration has occurred through intensive trade of goods and services (Imbs, 2004), and financial services (Brook et al, 2003). Economies have benefited from trade and foreign direct investment (FDI). However, globalization can make countries more vulnerable to external shocks as well as crises can be severe and contagion can spread rapidly. The high degree of economic and financial integration, stresses the importance of product- and factor-market flexibility. Economies' ability to absorb domestic- and foreign-origin shocks takes paramount importance, even more so when countries' policy menu is restricted , for example by participation in a currency area. Not surprisingly, competitiveness issues have been taken to the front line of the economic and political debate in Europe.

5. **Empirical studies on business cycles synchronization and transmission of shocks among countries have provided conflicting results.** Most findings show increasing synchronization of economic variables across countries (Nadal De Simone, 2002, Bordo and Helbling, 2003, Kose et al, 2005). According to an alternative view, however, despite large increases in trade and financial openness, G-7 business cycles may have become less synchronized , for instance, because trade flows lead to increased specialization of production. (Stock and Watson, 2003, Kose and Yi, 2006). Other studies have emphasized the sources of shocks, their spillovers, and channels of their transmission from one country or region to another. Recent examples include the study of the monetary transmission mechanism in the Euro area by Ciccarelli and Rebucci (2006), and Canova, Ciccarelli, and

[5] See IMF Country Report No 06/284.

Ortega (2007). Similarly, Canova and Ciccarelli (2006) find a positive and significant effect of U.S. GDP growth shocks on France and Italy, but a negligible effect on German GDP growth. Given that the VAR methodology used in those studies has some limitations—the most conspicuous being that it cannot accommodate a large panel of series without the risk of running short of degrees of freedom—Stock and Watson (2002) use the approximate structural dynamic factor model on a large panel of developed countries' variables and, like Kabundi and Nadal De Simone (2007) and Eickmeier (2007), find that U.S. demand shocks and EU supply shocks have a positive and significant effect on French and German output (Appendix II).

6. **In its descriptive part, this study concludes that Dutch export competitiveness is not a problem so far.** However, (1) Dutch exports trend has been somewhat below Germany's in the 2000s. (2) Dutch traditional lead over Germany in exports of manufactured goods, machinery and transport equipment was lost in the 2000s.

7. **In its analytical part, this study finds that the Netherlands is relatively more exposed to supply-driven shocks while Germany is more exposed to demand-driven shocks.** Following an increase in unit labor costs in manufacturing (ULCM), the adjustment in the Netherlands is comparatively less flexible than in Germany. The Netherlands adjusts relatively less via price and wage changes, and more via employment changes. (4) The same features are also evident when the two countries are faced with an upward, supply-driven, terms of trade (TOT) shock. (5) The Netherlands profits relatively less from a demand-driven increase in the TOT, but accordingly, suffers a relatively lower output fall following a demand-driven ULCM increase.

8. **The remainder of the paper is as follows.** Next section discusses the data and the procedure adopted to make them stationary. Section III describes the cyclical and trend behavior of trade variables; section IV discusses the behavior of major macro and trade variables following a shock to ULCM and to the TOT. Section V summarizes the paper and draws policy implications.

B. Data and Treatment of Non Stationarity

9. **This study uses two large data panels.** The first one comprises 396 quarterly macroeconomic series and 106 series of trade by country (for a total of series $N = 502$). Trade series include imports and exports to the euro area, the EU, accession countries, Canada, the United States, the United Kingdom, Japan, China, Asia, Latin America, and the rest of the world. The second data panel contains 396 quarterly macroeconomic series and 110 series of trade by SITC, Revision 3, category of products (for a total of series $N = 506$). The sample period is 1981:Q1–2006:Q4 (i.e., $T = 104$). The countries are France, Germany, Japan, the Netherlands, the United Kingdom, and the United States. In addition, a set of global variables is included, containing such items as crude oil prices, a commodity industrial inputs price index, world demand, and world reserves. Variables have been seasonally adjusted.

10. **For estimation purposes, series are treated as covariance-stationary.** Instead of applying unit roots tests to determine the degree of integration of the series and then difference or detrend them depending respectively on whether they are I(1) or I(0) with a deterministic trend, the Corbae-Ouliaris Ideal Band-Pass Filter was used to make the series stationary (Corbae and Ouliaris, 2006).[6] There are several reasons for this approach. First, available unit root tests have low power and often the decision on the degree of integration of the series has to be based on subjective judgment. Second, first differencing removes a significant part of the variance of economic time series. Third, the Corbae and Ouliaris filter is consistent, is not subject to end-point problems, and has no finite sampling error.

C. Stylized Facts

11. **Dutch and German exports display a similar cyclical behavior by destination and by product, although Germany's is more volatile.** The business cycle in main trading partners correlates well with exports. The U.S. driven early-1980s recession, the European 1993 recession, and the bursting of the stock market "bubble" at the end of the 1990s are clearly correlated to exports behavior (IMF Country Report No 05/401). In general, the Dutch export cyclical component is less volatile than Germany's, which may be associated with the product composition of both countries exports; in other words, German exports have a higher short-term elasticity with respect to output. Divergences in recent trade performance between both countries seem unrelated to the cyclical part of trade flows. Instead, albeit recent, export trend growth developments, in both export destination and product composition, may suggest that the Dutch economy would need to become more flexible to preserve its relative competitive position.

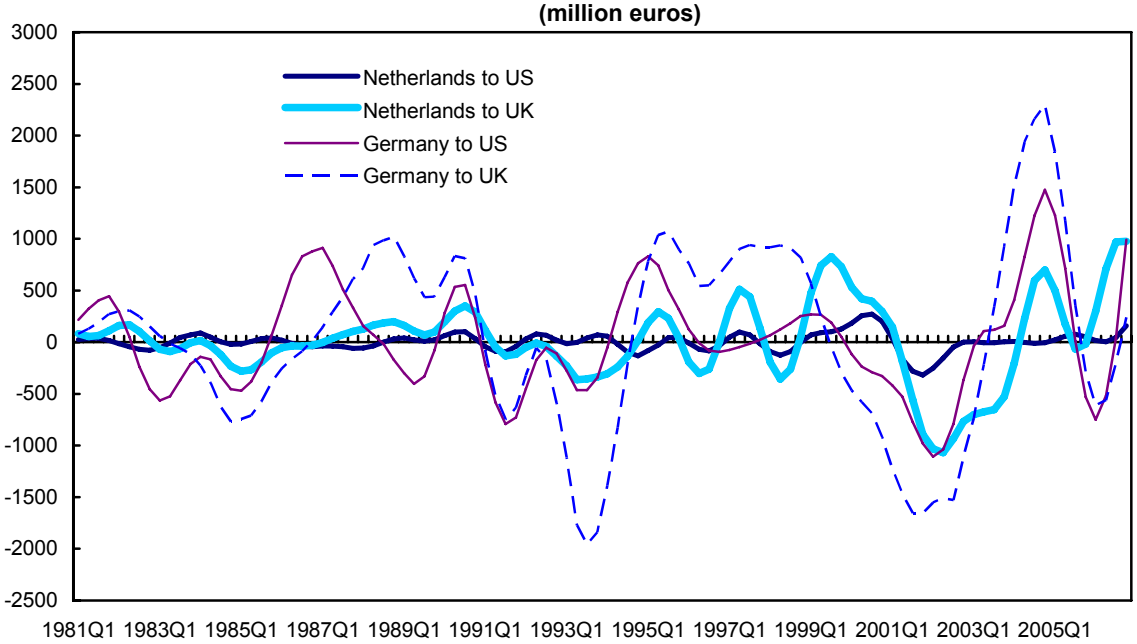
12. **Dutch competitiveness in the 2000s has had divergent trends in terms of both geographic distribution and product composition.** Starting in 2003-04, the Netherlands lost its trade export growth advantage over Germany vis-à-vis the euro area, the EU, Japan, and the UK. In contrast, and against some observers' views, it seems that the Netherlands has taken advantage of the eastward expansion of the EU starting in 2000 and of Chinese rapid growth after 2003 (Table I-1). Finally, the Netherlands has lost its traditional growth advantage over Germany in manufactured goods starting in 2000, and machinery and transport equipment, miscellaneous manufactured goods, and crude materials except fuels, starting in 2003 (Table I-2). With the exception of animal and vegetable oils, fats and waxes, a similar pattern is present in all other SITC, Revision 3, categories.

13. **In sum, the descriptive analysis suggests that there has been since 2000-03 an underperformance of Dutch exports relative to its own past and relative to Germany.** The change in export performance is recent, but raises some questions about the future competitiveness of the Dutch economy. Importantly, these developments seem unrelated to

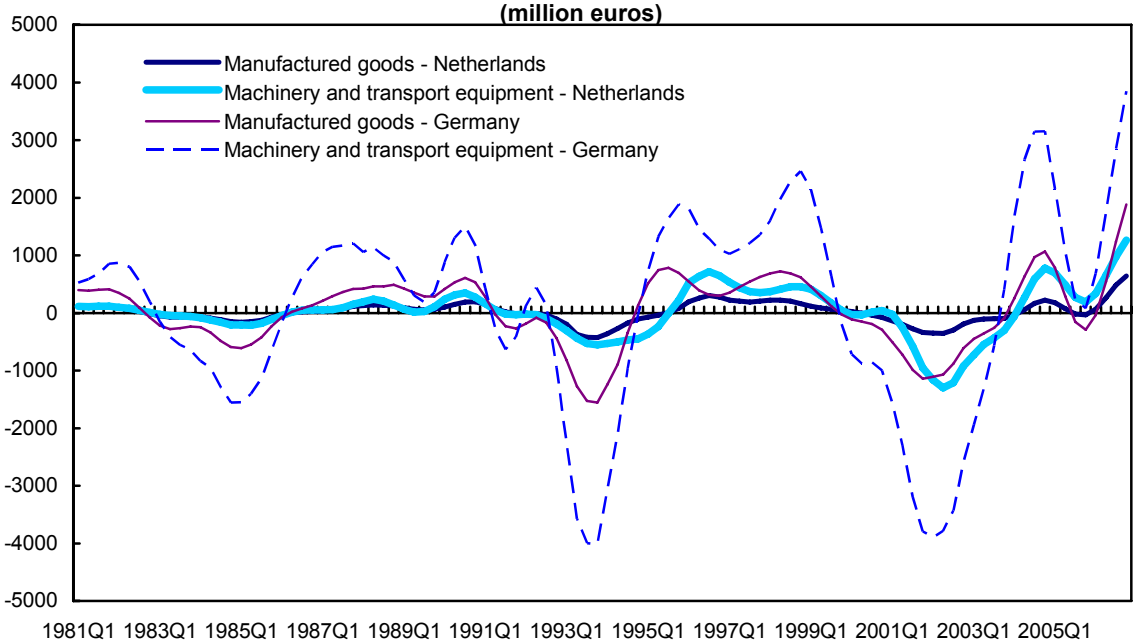
[6] See Appendix I for a technical description.

the exchange rate given the growth deceleration pattern observed in terms of export destination.

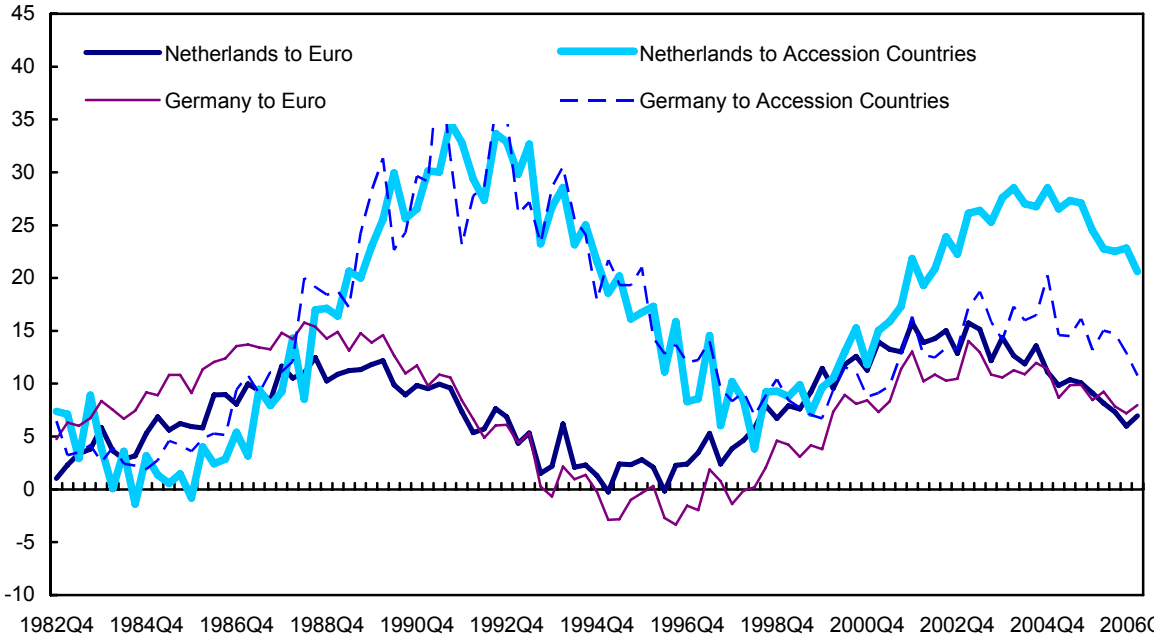
Cyclical Exports from the Netherlands and Germany to the US and the UK (million euros)



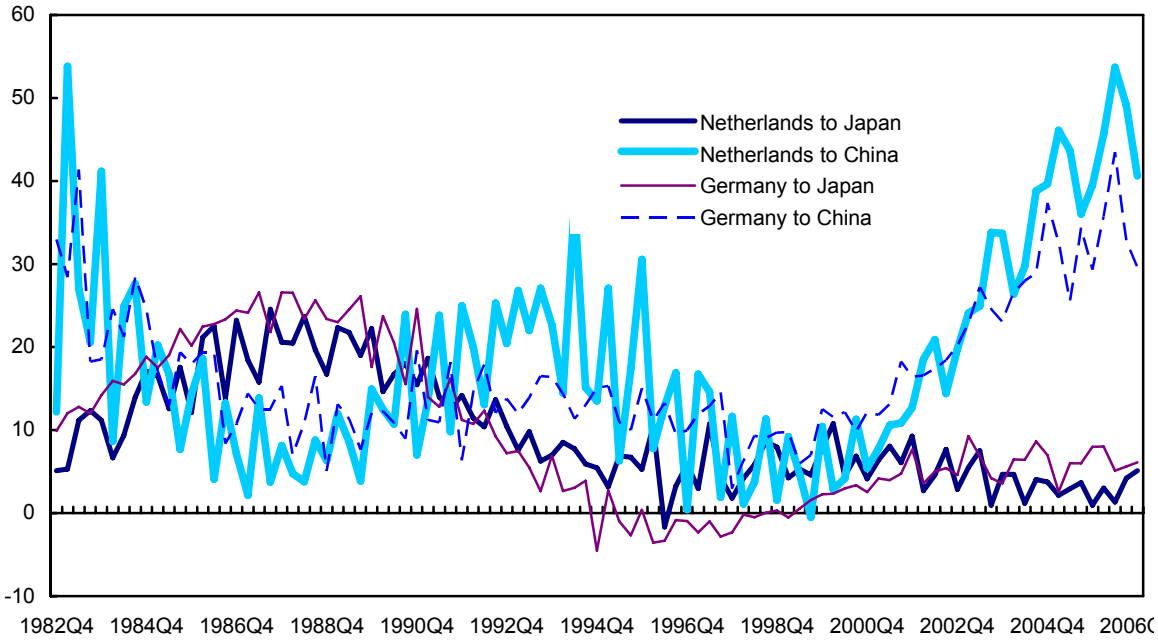
Cyclical Exports from the Netherlands and Germany: Manufactured Goods, and Machinery and Transport Equipment (million euros)



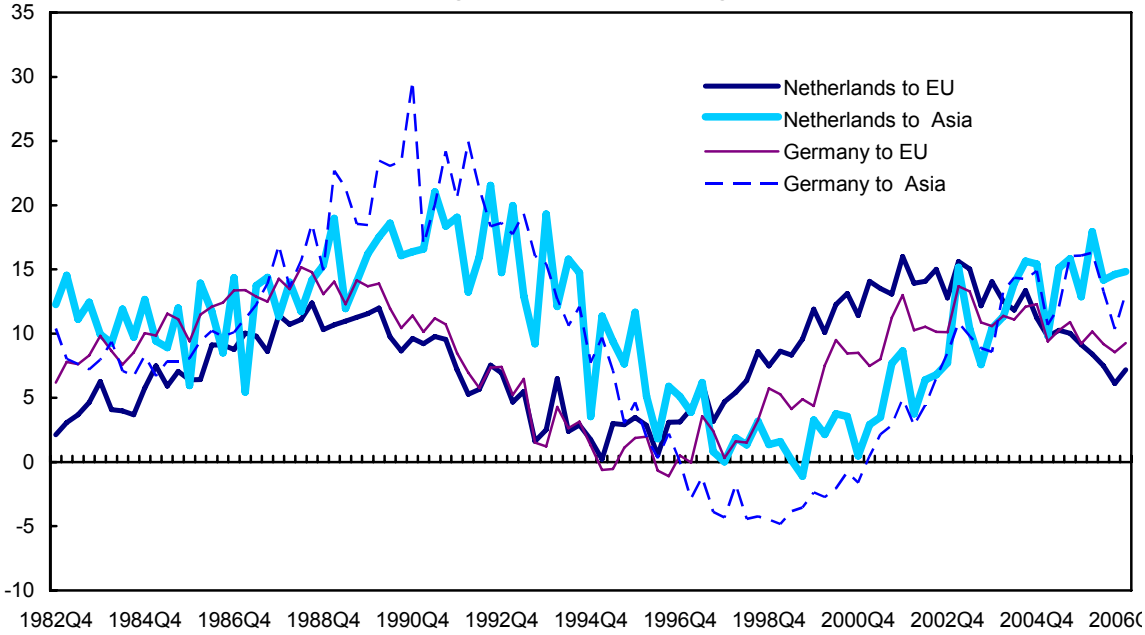
Trend Exports from Netherlands and Germany to Euro Area and Accesion Countries (average annual percent change)



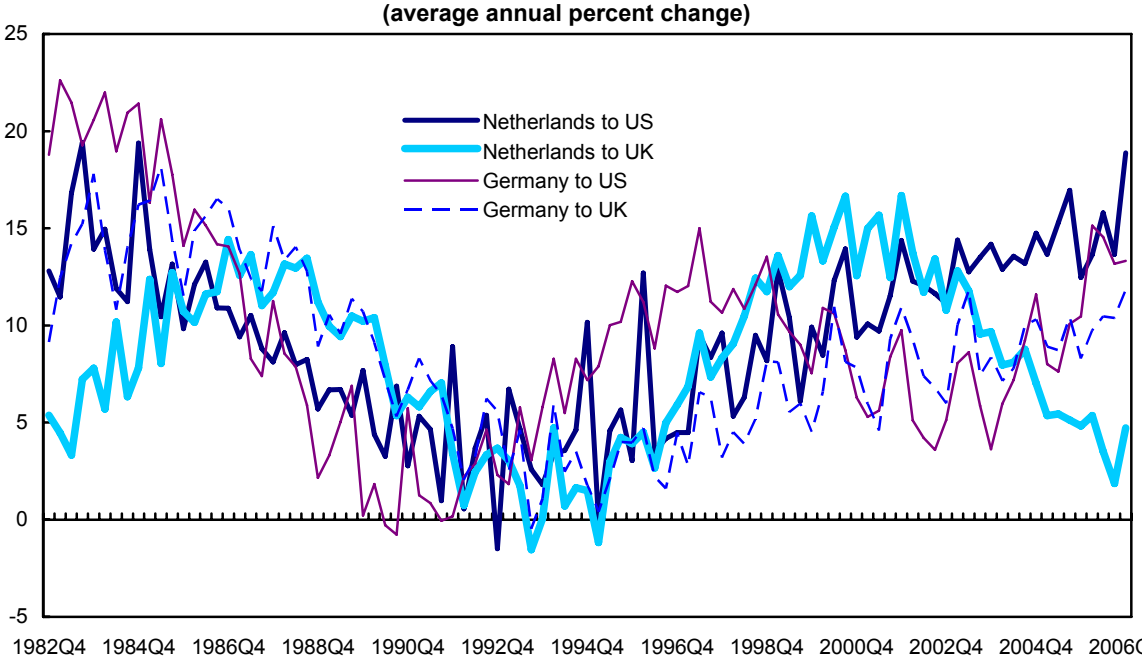
Trend Exports from Netherlands and Germany to Japan and China (average annual percent change)



Trend Exports from Netherlands and Germany to the EU and Asia
(average annual percent change)



Trend Exports from Netherlands and Germany to the US and the UK
(average annual percent change)



D. Dynamic Behavior

The model and shocks identification procedure

14. **To gain further insight into the dynamic behavior of the Dutch economy, this study uses a large dimensional approximate dynamic factor model in the tradition of Stock and Watson (2002).** See Appendix II for description of the model.[7] The intuition behind the approximate dynamic factor model analysis is simple and can be summarized as follows. A vector of time series can be represented as the sum of two latent components, a common component and an idiosyncratic component. The common component, which is a linear combination of common factors, is driven by few common shocks, which are the same for all variables. Nevertheless, the effects of common shocks differ from one variable to another due to different factor loadings. In contrast to standard common component analysis, the idiosyncratic component is driven by idiosyncratic shocks, which are specific to each variable. The static factor model used here differs from the dynamic factor model in that it treats lagged or dynamic factors as additional static factors. Thus, common factors include both lagged and contemporaneous factors.

15. **The estimation process comprises estimating the common components and identifying a reduced number of structural shocks that explain the common components of the variables of interest.** The identification of structural shocks is done by focusing on the reduced form VAR residuals. Following Eickmeier (2007), the identification scheme has three features: (1) it maximizes the explained variance of the forecast error of the chosen variable and calculates impulse-response functions; (2) it assumes that identified shocks are linearly correlated to a vector of fundamentals; and (3) it identifies orthogonal shocks by rotation using a sign-identification strategy that imposes inequality restrictions on the impulse-response functions of variables based on a typical aggregate demand and aggregate supply framework.[8] Only those shocks that have a structural meaning are chosen.

16. **Given recent Dutch ULCM developments and that the Netherlands is the quintessential case of a small open economy, the dynamics of shocks to ULCM and to TOT is analyzed.** The choice of shocks seems also relevant given the discussion in the previous section. As in standard macroeconomic models, an increase in ULCM can be interpreted as the result of a fall in labor productivity or an increase in labor compensation. The former is going to be interpreted as a supply shock and the latter as a demand shock. This is consistent with the empirical observation that real wages are procyclical. Similarly, a rise in the TOT can result from a deterioration of the country's competitiveness related to

[7] The model is closely related to the factor models of Sargent and Sims (1977) and Geweke (1977), except that it admits serial correlation and weakly cross-sectional correlation of idiosyncratic components, as Chamberlain (1983). Similar models have been used by Giannone et al (2002), Forni et al (2005), and Eickmeier (2007).

[8] See Peersman (2005) for more technical details.

structural factors, or alternatively, from strong world demand for the country's products. If the shock is persistent, it will result in an increase in consumption (and investment) and the current account will move into deficit. Instead, if the TOT increase is due to strong world demand for the small country's products, given the transient nature of the shock, consumers will largely save the windfall and the current account will move into surplus. The table above displays the sign restrictions for shock identification, imposed contemporaneously and during the first year after the shock.

Identification inequalities

	Increase in ULCM	
	supply shock	demand shock
ULCM	≥ 0	≥ 0
Output	≤ 0	≥ 0
Real wages	≤ 0	≥ 0
	Increase in Terms of Trade	
	supply shock	demand shock
Terms of trade	≥ 0	≥ 0
Consumption	≥ 0	≤ 0
Current account	≤ 0	≥ 0

Estimation

17. **The estimation procedure comprises several steps.** The first step of the estimation is the determination of the number of factors. As mentioned above, the series are assumed to follow an *approximate* dynamic factor model. Using Bai's and Ng's (2002) selection criteria, four factors were chosen. The identification of the structural shocks followed the approach of the structural VAR literature. No identification technology is completely foolproof. While the identification technology is flexible enough not to require special restrictions to disentangle *common shocks* from the *contemporaneous transmission of regional or country-specific shocks*, it does require additional work to confirm the nature and source of shocks. The study does not restrict the impact effect of the shock. In addition, after identifying two shocks and giving them an economic interpretation, the same analysis was done on a data set containing *only* Dutch variables. It showed that the resulting impulse-responses are similar to those of the broader data set, supporting the identification of the shocks.

18. **Only two structural shocks could be identified for each variable of interest (ULCM and TOT).** The identification procedure proposed by Uhlig (2003) was applied to the common components of the Netherlands's and Germany's ULCM and TOT. The objective was to find a reduced number of structural shocks that maximize the explanation of its forecast error variance over 20 periods. As noted above, sign restrictions on impulse response functions were used to provide economic meaning to the structural shocks. Following Peersman (2005), sign restrictions were applied to the first two principal component shocks taking pairs of shocks: a supply shock and a demand shock. The bootstrap

was done with the objective of removing the possible bias in the VAR coefficients which can arise from the small sample size. The impulse-response functions are calculated for the first five years to display the cyclical pattern associated with the structural shocks.[9] Both the median response and a 90 percent bootstrapped confidence band are estimated.[10]

Results

19. **Econometric results are presented in the form of variance decomposition.**[11] Tables I-3 to I-6 show the variance decomposition and the forecast error variance of the common components (henceforth, error variance) of Dutch and German variables explained by the two identified shocks to ULCM and TOT, respectively. These two shocks suffice to explain 99 percent of the error variance of the common components of Dutch and German ULCM and TOT over 20 quarters. The variance shares of ULCM common components are high, as they reach about 68 percent and 73 percent for the Netherlands and for Germany, respectively. In contrast, the variance shares of TOT common components are smaller, especially for the Netherlands: up to 20 percent and 43 percent for the Netherlands and Germany, respectively. This indicates that Dutch TOT are more heavily influenced by idiosyncratic factors than Germany's. As in Kabundi and Nadal De Simone (2008), the TOT are relatively less significant channels of shock transmission.

20. **The main result of the econometric exercise is that the Netherlands is relatively more exposed to supply-driven shocks, while Germany is more exposed to demand-driven shocks.** In addition, supply shocks to ULCM are relatively more important than demand shocks; the opposite is true for TOT shocks. That feature is consistent with the real business cycles literature that stresses the importance of productivity-driven shocks as the most significant source of business cycle fluctuations. Thus, the effect of supply shocks is more persistent.[12]

21. **Following a supply-driven (productivity) increase in ULCM, Dutch output falls driven by the decline in consumption, investment and exports, a fall that is larger than in Germany.** This is the result of a larger appreciation of the real exchange rate and a milder fall in the CPI in the Netherlands than in Germany. Real compensation of employees is stable in the Netherlands, while it falls in Germany. Dutch total employment falls for a longer

[9] Economic time series have had their high frequency component removed.

[10] Confidence intervals for the impulse-responses constructed using bootstrapping account for biases in the VAR coefficients and the agnostic nature of the model. As a result, they are large, and sometimes they cover both sides around zero. In order to test whether the impulse-response median results for the first 1-2 years are statistically significant, as suggested to us by Peter Phillips, if one worked with the asymptotic theory for the impulse responses, it would be possible to take the median impulse response, compute the asymptotic distribution of this statistic, and use it for testing. This was not done in this paper.

[11] Refer to Kabundi and Nadal De Simone, IMF, *working paper*, forthcoming, for impulse-response analysis.

[12] Results are broadly in agreement with those of Kabundi and Nadal De Simone (2007) and Eickmeier (2007).

period of time than German employment. The dollar value of exports to all destinations increases more in Germany than in the Netherlands; the value of Dutch exports to China actually falls. The same results apply in terms of the euro value of exports per product, especially for mineral fuels and lubricants, and chemicals and related products (Figure I-1, for the Netherlands, and Figure I-2 for Germany).

22. **Therefore, following an increase in unit labor costs in manufacturing (ULCM), the Netherlands displays less flexibility to adjust than Germany**. This is especially the case if the increase in ULCM is due to a fall in productivity (supply-driven). The Netherlands adjusts relatively less via price and wage changes, and more via employment and output changes. There seems to be a relatively larger downward rigidity of wages in the Netherlands. The same features are also evident when the two countries are faced with an upward, supply-driven, TOT shock—not shown here to conserve space.

23. **The Netherlands profits relatively less from a demand-driven increase in the TOT (accordingly, it enjoys a relatively lower fall in output following a demand-driven increase in ULCM).** This is the result of a larger appreciation of the real exchange rate and a smaller fall in the CPI in the Netherlands than in Germany. In addition, while real compensation to employees falls in Germany, it actually increases in the Netherlands and this despite the fall in labor productivity. Accordingly, total employment increases relatively less in the Netherlands. The dollar value of Dutch exports by destination increases, except the value of exports to China. The increase in exports values is, however, larger for Germany. The euro value of Dutch exports increases less than the value of German exports, especially in animal and vegetable oils and fats, chemicals and related products, manufactured goods, and machinery and transport equipment. The value of Dutch exports of fuels and lubricants actually falls, while it is flat for Germany. See Figure I-3 for the Netherlands and Figure I-4 for Germany.

24. **Summarizing, overall, the Netherlands adapts less quickly to upward output pressures due to strong world demand.** Following an increase in demand-driven TOT, the Netherlands is relatively less flexible to adjust than Germany; it has to undergo a larger change in quantities as prices and wages seem more rigid downward.

Figure I-1: ULCM, the Netherlands

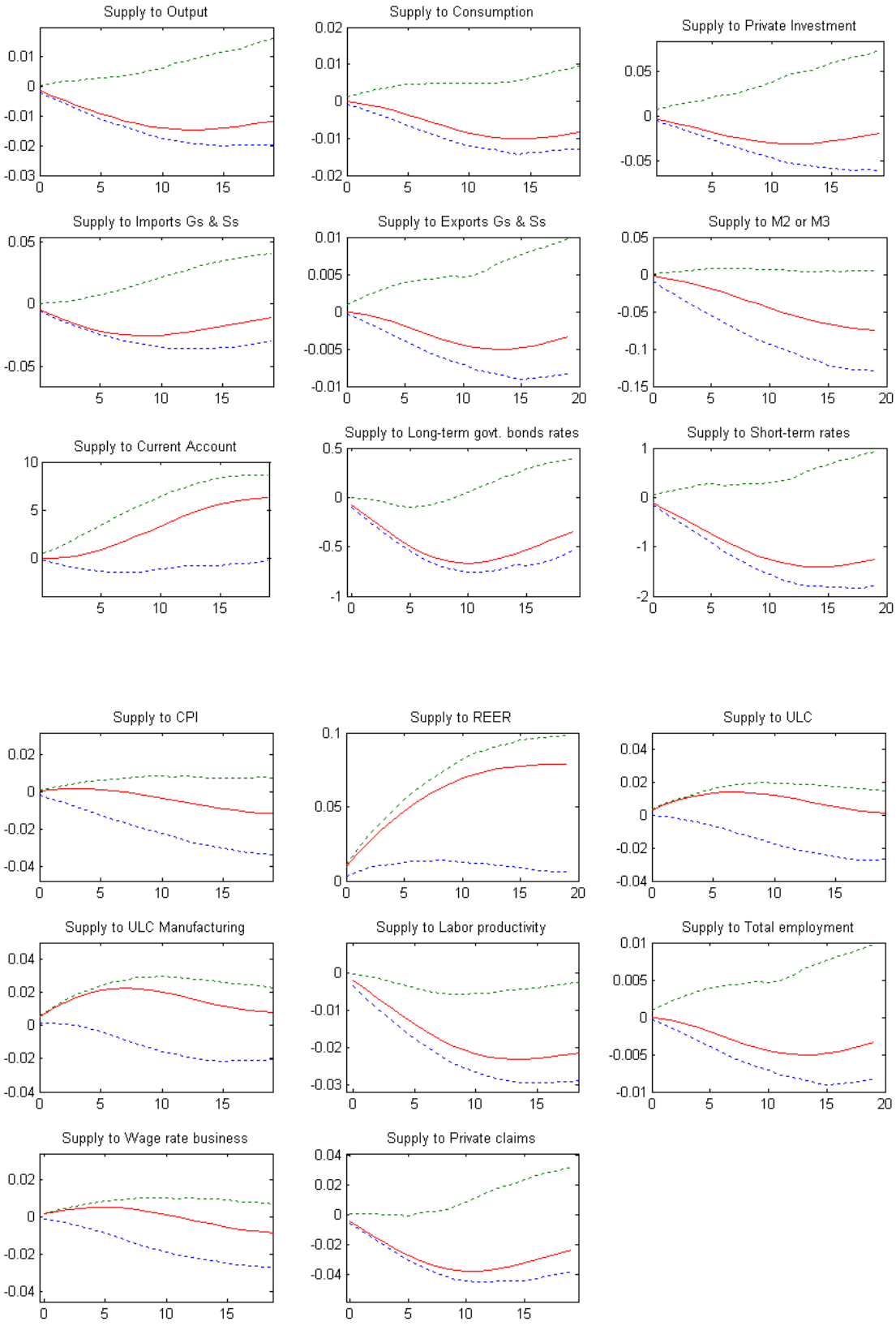


Figure I-1: ULCM, the Netherlands (concluded)

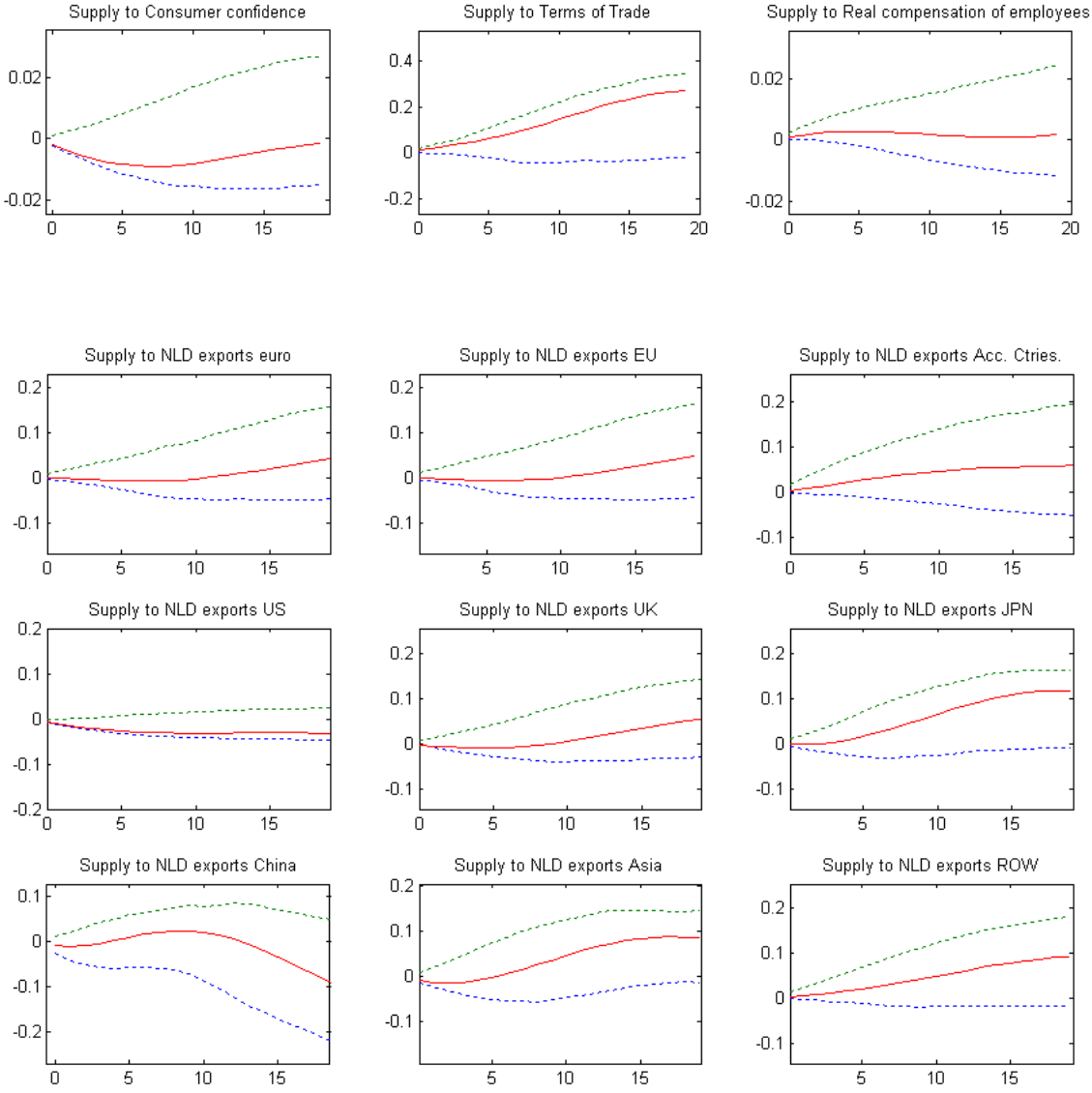


Figure I-2: ULCM, Germany

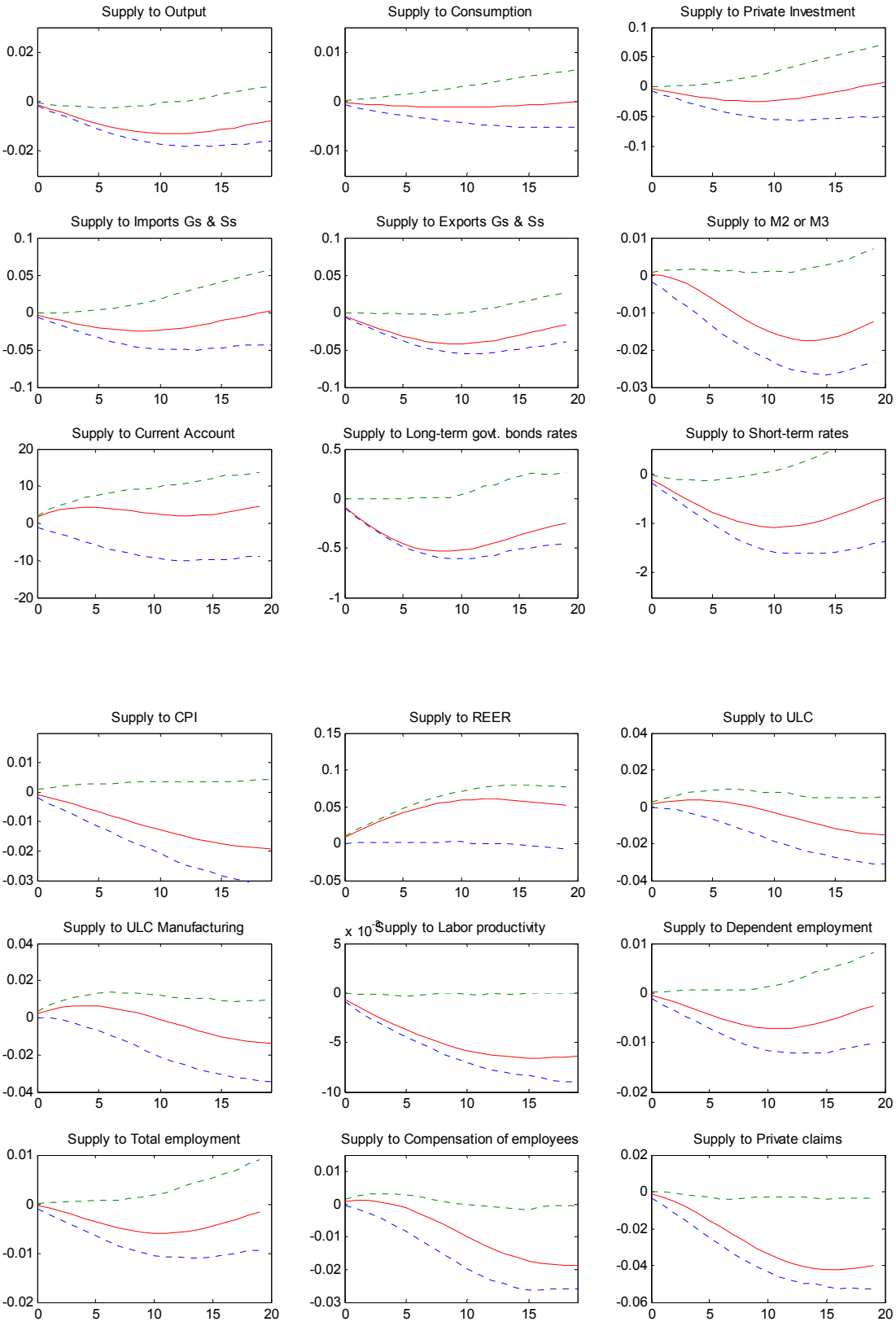


Figure I-2: ULCM, Germany (concluded)

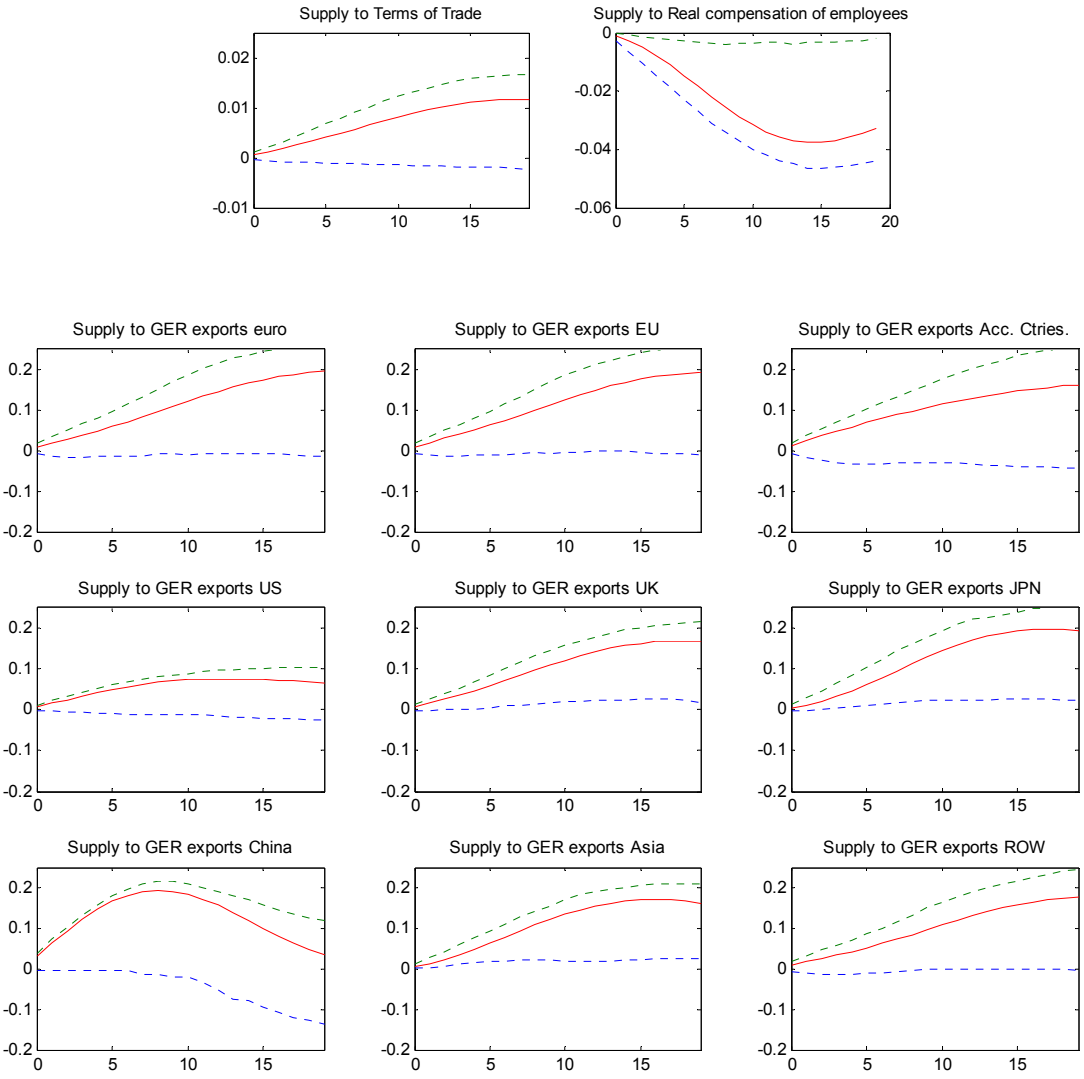


Figure I-3: TOT, the Netherlands

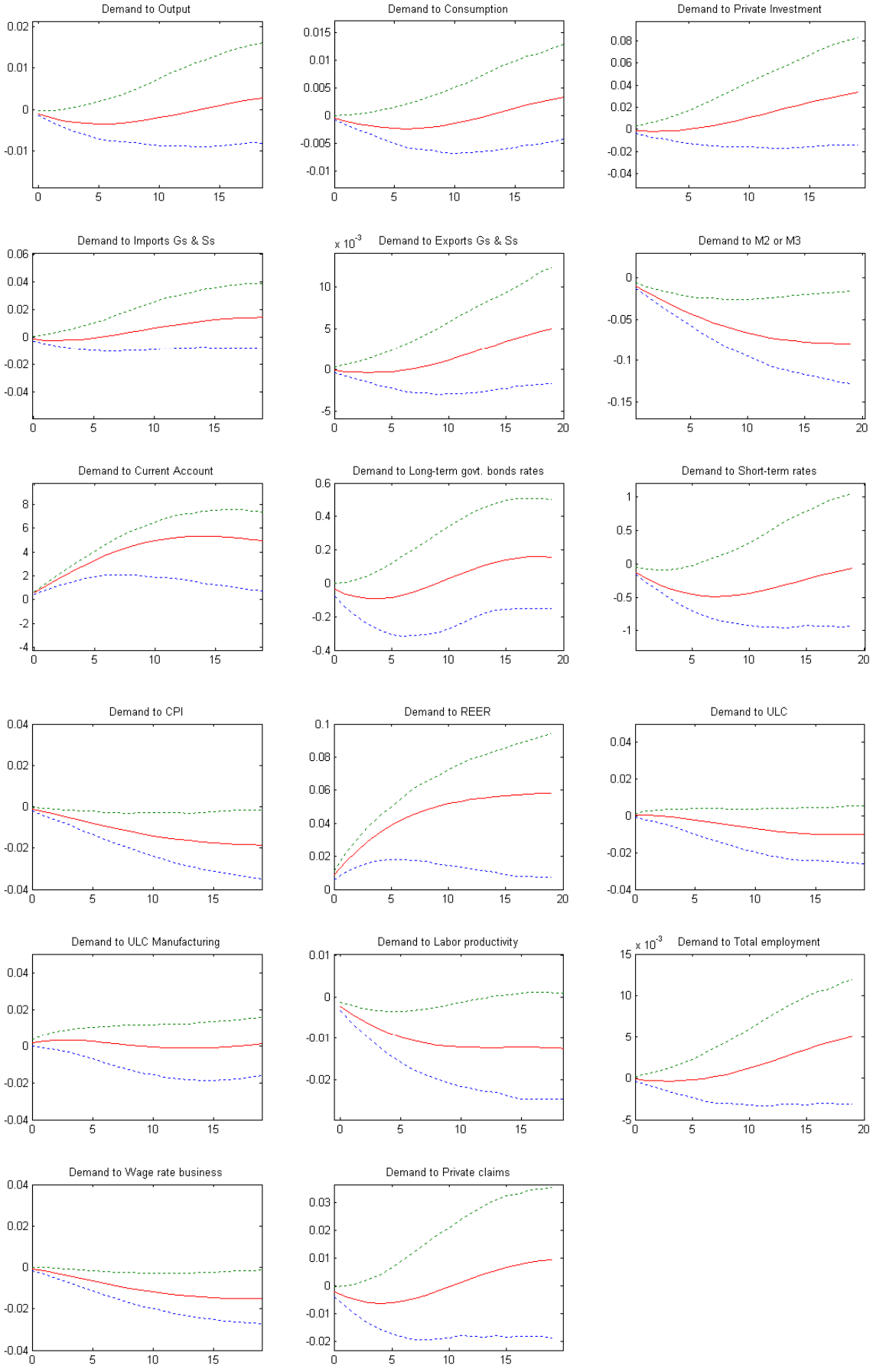


Figure I-3: TOT, the Netherlands (concluded)

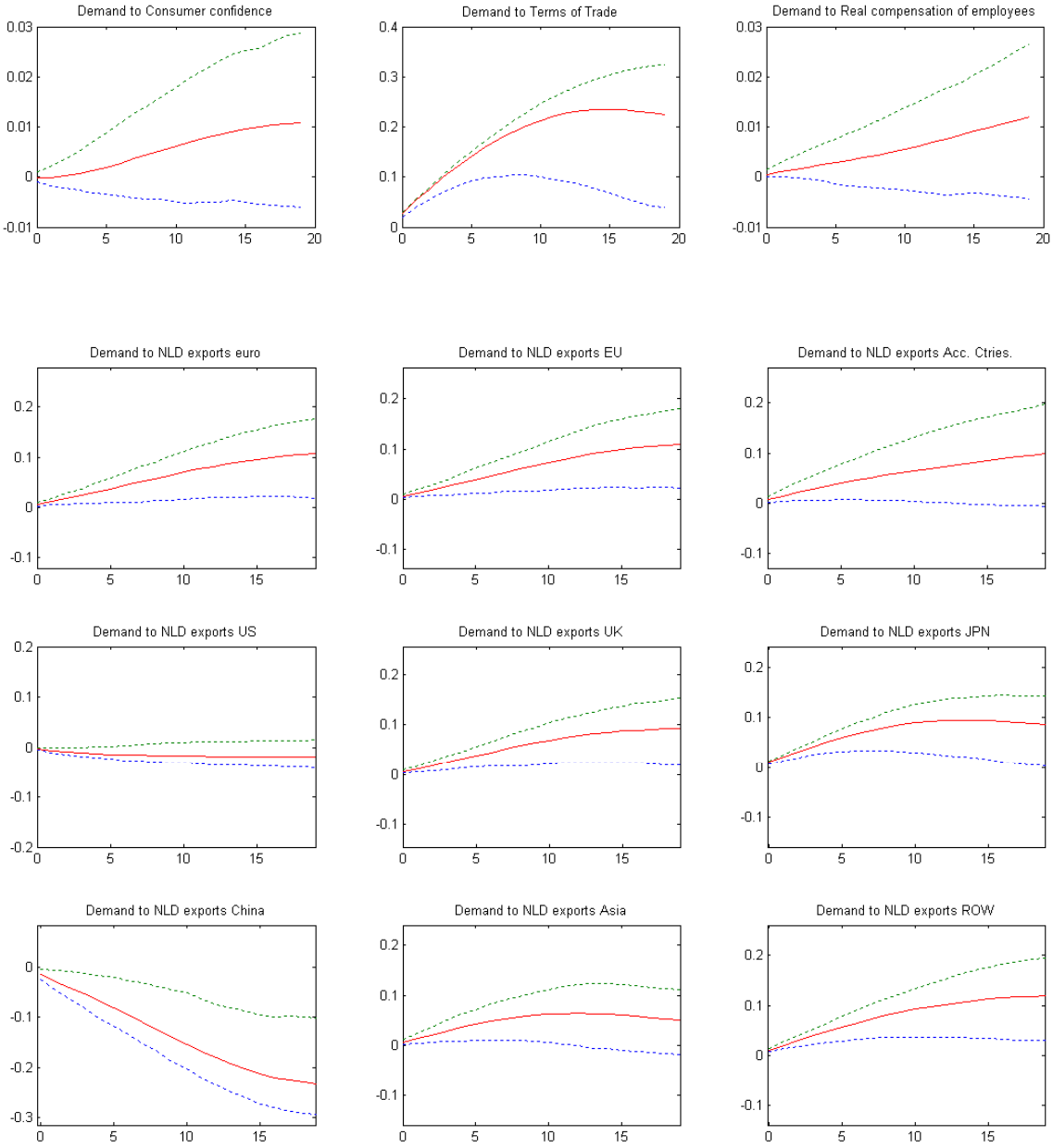


Figure I-4: TOT, Germany

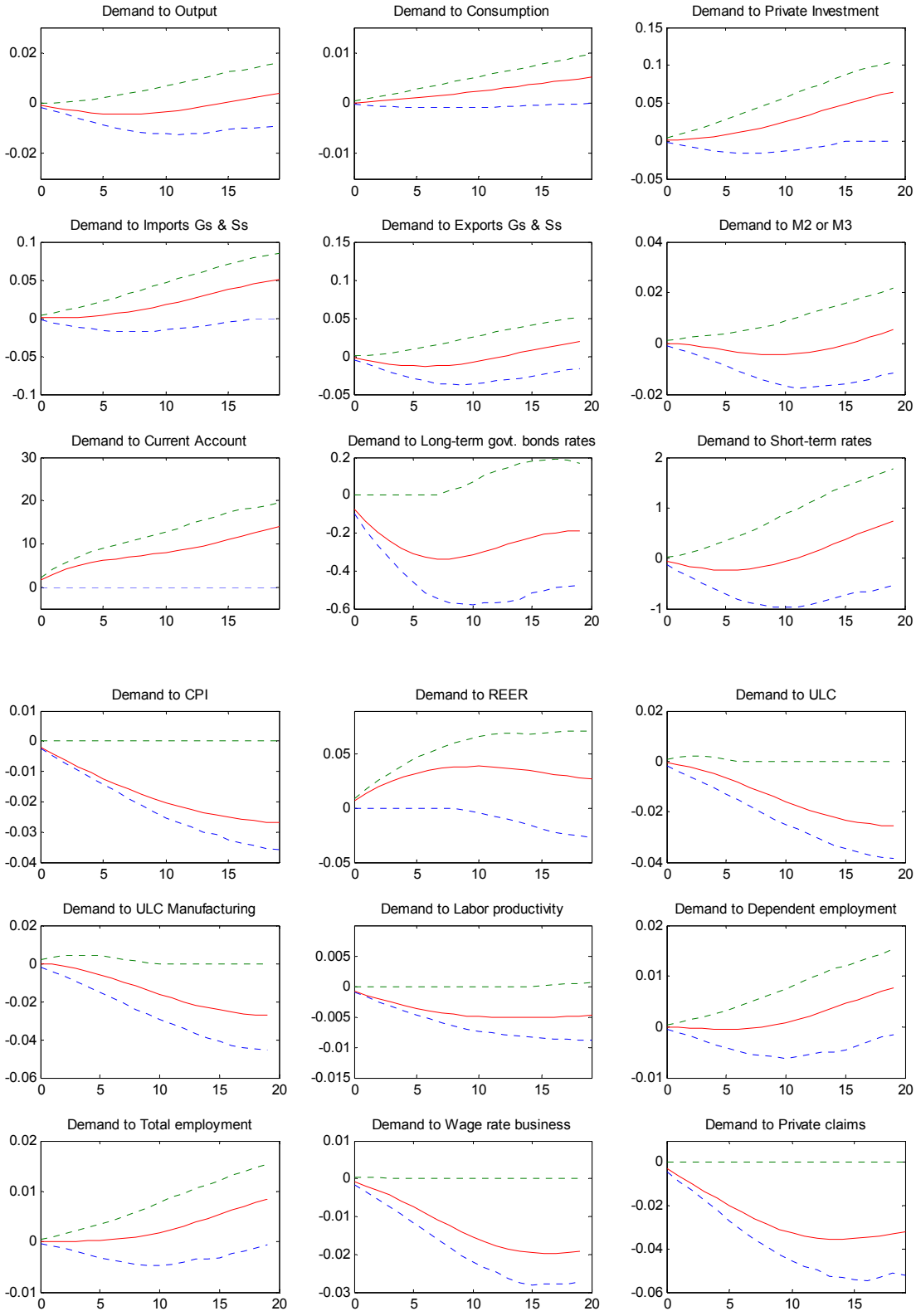
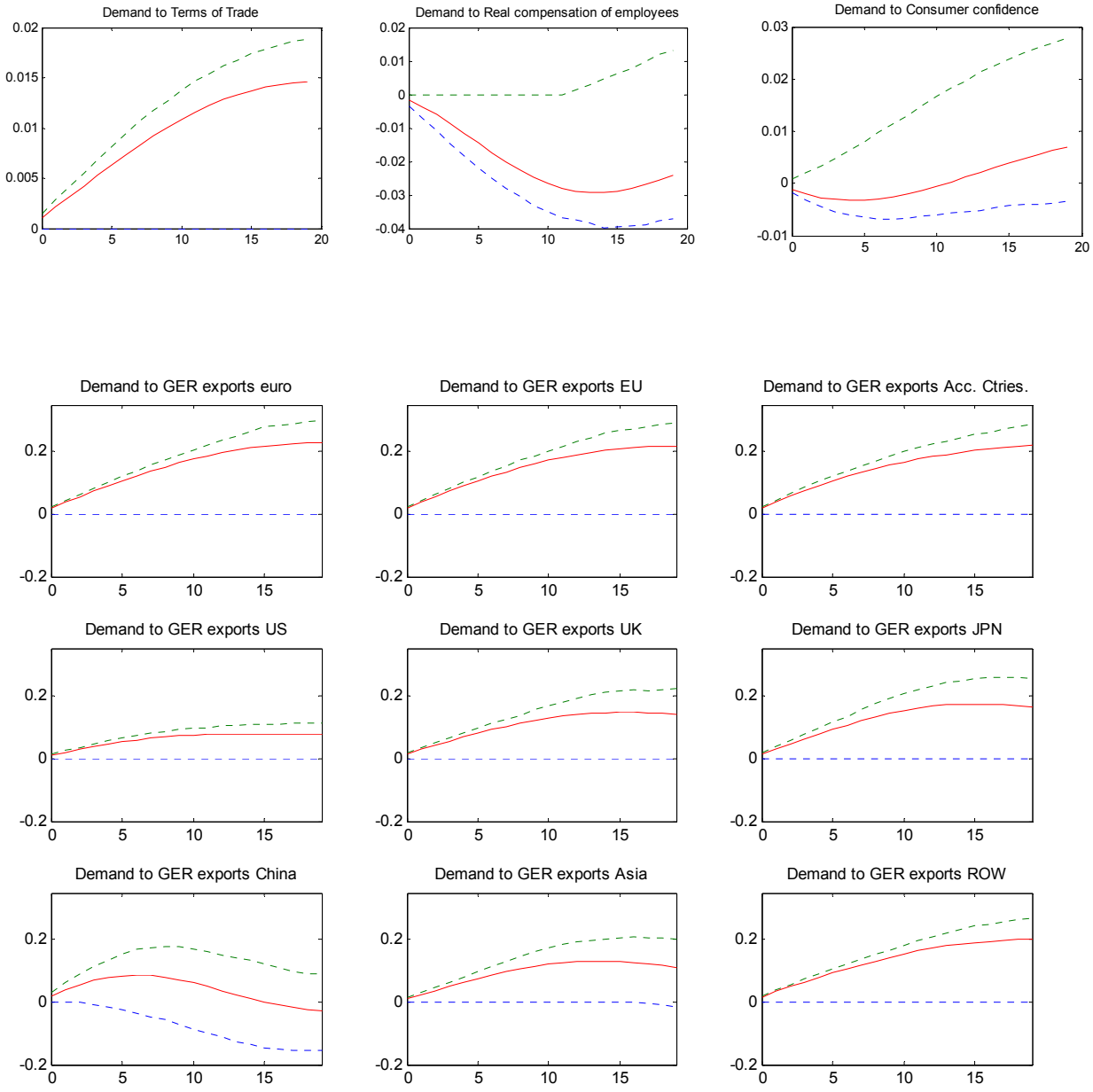


Figure I-4: TOT, Germany (concluded)



E. Conclusion and Policy Implications

25. **The Dutch economy is significantly affected by economic activity in the rest of the world.** In recent years, its export performance relative to a major trading partner, Germany, has deteriorated somewhat. The question posed in this paper is whether the Netherlands may be suffering from a competitiveness problem. The short answer is no. However, the analysis suggests that while the loss of market share in the 2000s has been contained, competitiveness problems may appear in the near future to the extent that labor, product and service markets require more flexibility to cope with foreign and domestic shocks in an increasingly globalized economy.

26. **Export competitiveness is not a problem so far.** However, the recent underperformance of the Dutch economy in certain products, and regarding some export market destinations, does not seem to be related to the economy's relative cyclical position, but to the trend growth of its exports. While the Dutch trend overall export growth is somewhat below Germany's in the 2000s, the Netherlands has preserved its relative advantage in terms of trend export growth vis-à-vis Germany in animal and vegetable oils, fats and waxes. It lost its traditional lead over Germany in exports of manufactured goods, machinery and transport equipment. So policies to prevent erosion of the competitive position of the Dutch economy may be required.

27. **The analysis indicates that the Netherlands is relatively more exposed to supply-driven shocks; Germany is instead more exposed to demand-driven shocks.** Following an increase in ULCM, the Netherlands is less flexible in adjusting than Germany, especially if the increase in ULCM is due to a fall in productivity (namely, supply-driven shock). The Netherlands adjusts relatively less via price and wage changes, and more via employment and output changes. The same features are also evident when the two countries are faced with an upward, supply-driven, TOT shock. Finally, the Netherlands profits relatively less from a demand-driven increase in the TOT; accordingly, it suffers a lower fall in output following a demand-driven increase in ULCM.

28. **It is difficult to overestimate the relevance of product and factor markets flexibility for the open Dutch economy.** The importance of trade flows and relative price changes in the international transmission of disturbances, as well as the policy constraints imposed by the euro area, highlight the relevance of product and factor markets flexibility. The Netherlands will benefit from further structural reforms that increase good, service, and labor markets flexibility. In particular, from policies that boost productivity via research and development, that reduce its relatively high EPL, and raise labor market participation.

Table I-1. Trend Exports per Region 1/
(Average annual percent change)

		1980-2006	1980-1989	1990-1999	2000-2006	2003-2006
Netherlands	Netherlands to EU	2.0	1.8	**1.4**	**2.8**	2.2
	Netherlands to Asia	2.4	**2.7**	**2.1**	2.4	2.9
	Netherlands to Japan	**2.3**	**3.9**	**1.8**	0.9	0.6
	Netherlands to China	**3.9**	**3.5**	**3.8**	**6.1**	**6.9**
	Netherlands to Euro	**1.9**	1.8	**1.3**	**2.8**	2.2
	Netherlands to Accession Countries	**3.9**	**2.4**	**4.5**	**5.3**	**5.5**
	Netherlands to United States	**2.4**	**2.8**	1.5	**3.2**	**3.4**
	Netherlands to United Kingdom	**2.0**	2.3	**1.5**	**2.4**	1.7
	Netherlands to ROW	1.5	0.4	**1.0**	**3.5**	3.3
Germany	Germany to EU	1.9	2.5	0.9	2.2	2.4
	Germany to Asia	2.3	2.6	1.1	2.7	4.2
	Germany to Japan	2.2	3.9	0.3	1.5	2.1
	Germany to China	3.7	3.2	2.5	5.3	6.3
	Germany to Euro	1.8	2.5	0.6	2.1	2.2
	Germany to Accession Countries	3.2	2.1	4.4	3.0	3.1
	Germany to United States	2.3	2.8	1.9	2.0	2.9
	Germany to United Kingdom	2.0	3.0	1.2	1.9	2.0
	Germany to ROW	1.6	1.3	0.6	3.2	3.9

1/ Numbers in bold indicate a higher growth rate of Dutch trend exports.

Table I-2. Trend Exports per Product SITC 1/
(Average annual percent change)

		1980-2006	1980-1989	1990-1999	2000-2006	2003-2006
Netherlands	Total	1.8	1.7	**1.6**	2.3	2.3
	Food and live animal - SITC 0	1.3	1.6	**0.8**	1.7	1.7
	Beverages and tobacco - SITC 1	2.0	2.0	**2.2**	1.2	1.7
	Crude materials, inedible, except fuels - SITC 2	**2.0**	**2.4**	**1.2**	2.6	2.7
	Mineral fuels, lubricants and related materials - SITC 3	1.1	**-1.0**	**0.8**	4.3	4.0
	Animal and vegetable oils, fats and waxes - SITC 4	**1.5**	**0.8**	**1.8**	**2.0**	**3.3**
	Chemicals and related products - SITC 5	1.9	2.1	**1.4**	2.5	2.4
	Manufactured goods - SITC 6	**1.6**	**2.1**	**0.9**	1.8	2.3
	Machinery and transport equipment - SITC 7	**2.5**	**2.7**	**2.4**	2.0	1.7
	Miscellaneous manufactured articles - SITC 8	**2.3**	**3.1**	**1.9**	1.9	1.7
	Commodities and transactions - SITC 9	0.9	-1.1	1.3	**2.9**	3.7
Germany	Total	1.9	2.3	1.0	2.5	2.8
	Food and live animal - SITC 0	1.5	1.8	0.7	2.1	1.9
	Beverages and tobacco - SITC 1	2.1	2.3	1.4	3.2	3.6
	Crude materials, inedible, except fuels - SITC 2	1.8	2.1	0.5	2.8	3.4
	Mineral fuels, lubricants and related materials - SITC 3	1.3	-1.3	0.6	4.7	4.7
	Animal and vegetable oils, fats and waxes - SITC 4	0.7	0.5	1.1	0.7	1.7
	Chemicals and related products - SITC 5	2.0	2.3	1.1	2.8	3.1
	Manufactured goods - SITC 6	1.6	2.0	0.6	2.4	2.9
	Machinery and transport equipment - SITC 7	2.0	2.5	1.1	2.4	2.5
	Miscellaneous manufactured articles - SITC 8	2.0	2.9	0.7	2.5	2.6
	Commodities and transactions - SITC 9	3.0	1.3	3.5	2.9	4.5

1/ Numbers in bold indicate a higher growth rate of Dutch trend exports.

Table I-3. Forecast Error Variance of the Common Components of Netherlands Variables Explained by the Supply and Demand Shock to Unit Labor Costs in Manufacturing, 1981-2006 1/

	Variance Shares of the Common Components	Supply Shocks	Confidence Intervals		Demand Shock	Confidence Intervals	
			Lower Bound	Upper Bound		Lower Bound	Upper Bound
1 GDP	0.87	0.49	0.02	0.77	0.03	0.02	0.63
2 Personal consumption expenditure	0.78	0.40	0.02	0.66	0.02	0.02	0.57
3 Private investment	0.83	0.38	0.02	0.72	0.05	0.00	0.43
4 Employment	0.68	0.36	0.02	0.65	0.02	0.01	0.42
5 Productivity	0.74	0.37	0.01	0.58	0.62	0.19	0.91
6 Unit labor cost of the manufacturing sector	0.68	0.66	0.06	0.93	0.33	0.05	0.84
7 Government savings	0.77	0.41	0.01	0.75	0.01	0.01	0.55
8 Consumer confidence	0.64	0.40	0.02	0.78	0.22	0.01	0.52
9 Consumer prices	0.92	0.15	0.02	0.75	0.57	0.01	0.70
10 Short-term interest rates	0.73	0.48	0.02	0.74	0.02	0.02	0.70
11 Long-term interest rates	0.60	0.65	0.07	0.82	0.16	0.08	0.86
12 M2 or M3	0.50	0.02	0.01	0.64	0.75	0.03	0.82
13 Stock prices	0.76	0.44	0.01	0.76	0.01	0.01	0.62
14 Real compensation of employees	0.79	0.18	0.00	0.57	0.12	0.00	0.49
15 Exports total	0.84	0.36	0.02	0.65	0.02	0.01	0.42
16 Imports total	0.87	0.53	0.05	0.80	0.14	0.02	0.60
17 Terms of trade	0.20	0.21	0.01	0.58	0.19	0.04	0.76
18 Real effective exchange	0.70	0.45	0.00	0.70	0.25	0.05	0.88
19 Current account balance	0.47	0.15	0.03	0.73	0.55	0.05	0.86
20 FDI out	0.09	0.49	0.02	0.80	0.07	0.01	0.64
21 FDI in	0.28	0.51	0.02	0.78	0.03	0.02	0.79
22 Exports to Euro	0.71	0.22	0.01	0.65	0.24	0.00	0.56
23 Exports to EU	0.74	0.20	0.01	0.67	0.28	0.00	0.59
24 Exports to EU accession ctrys	0.81	0.09	0.00	0.60	0.39	0.00	0.64
25 Exports to United States	0.24	0.48	0.02	0.80	0.06	0.01	0.73
26 Exports to United Kingdom	0.65	0.18	0.03	0.73	0.47	0.01	0.69
27 Exports to Japan	0.63	0.16	0.04	0.76	0.59	0.04	0.88
28 Exports to China,P.R.: Mainland	0.60	0.12	0.01	0.46	0.09	0.02	0.42
29 Exports to Asia	0.51	0.11	0.05	0.86	0.80	0.05	0.89
30 Exports to ROW	0.88	0.03	0.00	0.64	0.61	0.01	0.76
31 EXP SITC Total	0.91	0.24	0.01	0.60	0.27	0.01	0.56
32 EXP SITC 0: Food and live animal	0.91	0.15	0.00	0.44	0.47	0.01	0.71
33 EXP SITC 1: Beverages and tobacco	0.71	0.04	0.00	0.35	0.54	0.03	0.69
34 EXP SITC 2: Crude materials, inefible, except fuels	0.91	0.22	0.01	0.58	0.39	0.01	0.68
35 EXP SITC 3: Mineral fuels, lubricants and related materials	0.50	0.09	0.05	0.76	0.75	0.09	0.87
36 EXP SITC 4: Animal and vegetable oils, fats and waxes	0.28	0.49	0.04	0.66	0.15	0.05	0.46
37 EXP SITC 5: Chemicals and related profucts, n.e.s	0.91	0.31	0.01	0.63	0.42	0.02	0.68
38 EXP SITC 6: Manufactured goods	0.96	0.23	0.01	0.58	0.34	0.01	0.63
39 EXP SITC 7: Machinery and transport equipment	0.91	0.20	0.01	0.56	0.32	0.01	0.61
40 EXP SITC 8: Miscellaneous manufactured articles	0.86	0.11	0.00	0.46	0.28	0.01	0.56
41 EXP SITC 9: Commodities and transactions n.e.c	0.47	0.07	0.00	0.39	0.63	0.02	0.82

1/ Forecast horizon is 20 quarters and refers to the levels of the series. Confidence intervals are constructed using bootstrapping methods. The bootstrap was made up of 500 draws. The bootstrap is done with the objective of removing the possible bias in the VAR coefficients which can arise from the small sample size.

Table I-4. Forecast Error Variance of the Common Components of Germany Variables Explained by the Supply and Demand Shock to Unit Labor Costs in Manufacturing, 1981-2006 1/

		Variance Shares of the Common Components	Supply Shocks	Confidence Intervals		Demand Shock	Confidence Intervals	
				Lower Bound	Upper Bound		Lower Bound	Upper Bound
1	GDP	0.70	0.13	0.01	0.83	0.82	0.11	0.86
2	Personal consumption expenditure	0.34	0.02	0.00	0.51	0.84	0.20	0.85
3	Private investment	0.93	0.05	0.02	0.58	0.86	0.28	0.90
4	Employment	0.77	0.05	0.01	0.69	0.79	0.11	0.83
5	Productivity	0.36	0.30	0.03	0.89	0.45	0.01	0.62
6	Unit labor cost of the manufacturing sector	0.74	0.34	0.00	0.62	0.66	0.35	0.96
7	Government savings	0.71	0.01	0.01	0.62	0.88	0.20	0.88
8	Consumer confidence	0.32	0.02	0.01	0.51	0.89	0.36	0.93
9	Industrial confidence	0.54	0.25	0.04	0.48	0.62	0.30	0.87
10	Consumer prices	0.92	0.69	0.02	0.86	0.03	0.01	0.77
11	Short-term interest rates	0.76	0.07	0.02	0.77	0.88	0.15	0.89
12	Long-term interest rates	0.54	0.38	0.04	0.76	0.43	0.02	0.64
13	M2 or M3	0.47	0.30	0.01	0.79	0.51	0.05	0.62
14	Stock prices	0.69	0.01	0.01	0.55	0.87	0.22	0.86
15	Real compensation of employees	0.53	0.61	0.03	0.89	0.31	0.04	0.50
16	Exports total	0.69	0.15	0.01	0.79	0.81	0.14	0.87
17	Imports total	0.84	0.04	0.01	0.60	0.89	0.28	0.91
18	Terms of trade	0.42	0.70	0.06	0.91	0.05	0.02	0.75
19	Real effective exchange	0.74	0.21	0.03	0.88	0.61	0.02	0.81
20	Current account balance	0.16	0.05	0.01	0.62	0.01	0.02	0.38
21	FDI out	0.52	0.32	0.01	0.60	0.40	0.11	0.85
22	FDI in	0.15	0.01	0.01	0.60	0.86	0.20	0.88
23	Exports to Euro	0.88	0.52	0.06	0.87	0.10	0.01	0.60
24	Exports to EU	0.90	0.52	0.07	0.87	0.12	0.01	0.56
25	Exports to EU accession ctrys	0.64	0.57	0.02	0.85	0.04	0.00	0.62
26	Exports to United States	0.49	0.84	0.06	0.91	0.02	0.01	0.51
27	Exports to United Kingdom	0.87	0.44	0.04	0.87	0.28	0.02	0.42
28	Exports to Japan	0.81	0.63	0.04	0.92	0.19	0.03	0.48
29	Exports to China,P.R.: Mainland	0.69	0.22	0.01	0.64	0.47	0.07	0.72
30	Exports to Asia	0.75	0.56	0.03	0.90	0.29	0.03	0.44
31	Exports to ROW	0.92	0.48	0.05	0.86	0.13	0.01	0.54
32	EXP SITC Total	0.92	0.37	0.05	0.82	0.44	0.01	0.46
33	EXP SITC 0: Food and live animal	0.92	0.38	0.03	0.81	0.36	0.00	0.42
34	EXP SITC 1: Beverages and tobacco	0.58	0.37	0.01	0.79	0.21	0.00	0.32
35	EXP SITC 2: Crude materials, inefible, except fuels	0.81	0.36	0.06	0.87	0.57	0.03	0.66
36	EXP SITC 3: Mineral fuels, lubricants and related materials	0.64	0.08	0.02	0.55	0.86	0.41	0.92
37	EXP SITC 4: Animal and vegetable oils, fats and waxes	0.41	0.28	0.01	0.66	0.21	0.04	0.44
38	EXP SITC 5: Chemicals and related profucts, n.e.s	0.89	0.47	0.07	0.86	0.41	0.01	0.46
39	EXP SITC 6: Manufactured goods	0.91	0.40	0.06	0.84	0.45	0.01	0.50
40	EXP SITC 7: Machinery and transport equipment	0.89	0.37	0.03	0.81	0.39	0.00	0.41
41	EXP SITC 8: Miscellaneous manufactured articles	0.91	0.36	0.03	0.81	0.36	0.00	0.41
42	EXP SITC 9: Commodities and transactions n.e.c	0.09	0.09	0.01	0.68	0.68	0.03	0.74

1/ Forecast horizon is 20 quarters and refers to the levels of the series. Confidence intervals are constructed using bootstrapping methods. The bootstrap was made up of 500 draws. The bootstrap is done with the objective of removing the possible bias in the VAR coefficients which can arise from the small sample size.

Table I-5. Forecast Error Variance of the Common Components of Netherlands Variables Explained by the Supply and Demand Shock to Terms of Trade, 1981-2006 1/

		Variance Shares of the Common Components	Supply Shocks	Confidence Intervals		Demand Shock	Confidence Intervals	
				Lower Bound	Upper Bound		Lower Bound	Upper Bound
1	GDP	0.87	0.39	0.05	0.82	0.03	0.00	0.33
2	Personal consumption expenditure	0.78	0.64	0.14	0.89	0.05	0.00	0.32
3	Private investment	0.83	0.25	0.03	0.77	0.10	0.00	0.43
4	Employment	0.68	0.38	0.05	0.83	0.12	0.00	0.41
5	Productivity	0.74	0.37	0.03	0.67	0.12	0.02	0.66
6	Unit labor cost of the manufacturing sector	0.68	0.08	0.00	0.57	0.00	0.00	0.36
7	Government savings	0.77	0.41	0.04	0.84	0.02	0.01	0.28
8	Consumer confidence	0.64	0.06	0.01	0.62	0.08	0.00	0.46
9	Consumer prices	0.92	0.05	0.01	0.58	0.20	0.01	0.65
10	Short-term interest rates	0.73	0.58	0.10	0.87	0.02	0.01	0.30
11	Long-term interest rates	0.60	0.36	0.00	0.81	0.06	0.00	0.41
12	M2 or M3	0.50	0.16	0.00	0.48	0.29	0.11	0.78
13	Stock prices	0.76	0.42	0.04	0.82	0.03	0.01	0.37
14	Real compensation of employees	0.79	0.10	0.00	0.80	0.13	0.00	0.45
15	Exports total	0.84	0.38	0.05	0.83	0.12	0.00	0.41
16	Imports total	0.87	0.14	0.02	0.67	0.07	0.00	0.43
17	Terms of trade	0.20	0.62	0.00	0.80	0.37	0.19	0.91
18	Real effective exchange	0.70	0.41	0.00	0.74	0.29	0.06	0.75
19	Current account balance	0.47	0.56	0.00	0.67	0.26	0.14	0.88
20	FDI out	0.09	0.19	0.01	0.72	0.02	0.00	0.35
21	FDI in	0.28	0.57	0.06	0.87	0.06	0.01	0.48
22	Exports to Euro	0.71	0.05	0.02	0.58	0.35	0.04	0.71
23	Exports to EU	0.74	0.04	0.01	0.57	0.35	0.05	0.71
24	Exports to EU accession ctrys	0.81	0.00	0.00	0.79	0.14	0.00	0.54
25	Exports to United States	0.24	0.16	0.01	0.71	0.09	0.01	0.46
26	Exports to United Kingdom	0.65	0.08	0.01	0.47	0.32	0.08	0.74
27	Exports to Japan	0.63	0.57	0.00	0.69	0.21	0.10	0.86
28	Exports to China,P.R.: Mainland	0.60	0.13	0.01	0.32	0.78	0.31	0.89
29	Exports to Asia	0.51	0.43	0.01	0.68	0.07	0.01	0.66
30	Exports to ROW	0.88	0.10	0.00	0.50	0.35	0.12	0.79
31	EXP SITC Total	0.91	0.08	0.01	0.31	0.75	0.41	0.94
32	EXP SITC 0: Food and live animal	0.91	0.19	0.01	0.49	0.73	0.37	0.93
33	EXP SITC 1: Beverages and tobacco	0.71	0.27	0.01	0.60	0.63	0.22	0.86
34	EXP SITC 2: Crude materials, inefible, except fuels	0.91	0.12	0.01	0.41	0.71	0.32	0.92
35	EXP SITC 3: Mineral fuels, lubricants and related materials	0.50	0.70	0.08	0.92	0.05	0.00	0.30
36	EXP SITC 4: Animal and vegetable oils, fats and waxes	0.28	0.28	0.06	0.70	0.09	0.00	0.37
37	EXP SITC 5: Chemicals and related profucts, n.e.s	0.91	0.19	0.03	0.48	0.73	0.41	0.93
38	EXP SITC 6: Manufactured goods	0.96	0.10	0.01	0.36	0.74	0.38	0.94
39	EXP SITC 7: Machinery and transport equipment	0.91	0.09	0.01	0.36	0.74	0.37	0.93
40	EXP SITC 8: Miscellaneous manufactured articles	0.86	0.06	0.00	0.36	0.76	0.30	0.92
41	EXP SITC 9: Commodities and transactions n.e.c	0.47	0.27	0.01	0.61	0.62	0.20	0.83

1/ Forecast horizon is 20 quarters and refers to the levels of the series. Confidence intervals are constructed using bootstrapping methods. The bootstrap was made up of 500 draws. The bootstrap is done with the objective of removing the possible bias in the VAR coefficients which can arise from the small sample size.

Table I-6. Forecast Error Variance of the Common Components of Germany Variables Explained by the Supply and Demand Shock to Terms of Trade, 1981-2006 1/

		Variance Shares of the Common Components	Supply Shocks	Confidence Intervals		Demand Shock	Confidence Intervals	
				Lower Bound	Upper Bound		Lower Bound	Upper Bound
1	GDP	0.70	0.46	0.08	0.92	0.26	0.01	0.43
2	Personal consumption expenditure	0.34	0.03	0.01	0.80	0.55	0.01	0.63
3	Private investment	0.93	0.09	0.04	0.88	0.73	0.02	0.73
4	Employment	0.77	0.27	0.06	0.88	0.53	0.01	0.63
5	Productivity	0.36	0.30	0.01	0.79	0.36	0.05	0.82
6	Unit labor cost of the manufacturing sector	0.74	0.06	0.03	0.74	0.76	0.07	0.81
7	Government savings	0.71	0.09	0.02	0.86	0.55	0.01	0.60
8	Consumer confidence	0.32	0.02	0.01	0.85	0.57	0.01	0.62
9	Industrial confidence	0.54	0.23	0.05	0.69	0.21	0.01	0.52
10	Consumer prices	0.92	0.04	0.00	0.30	0.93	0.64	0.98
11	Short-term interest rates	0.76	0.32	0.07	0.91	0.44	0.01	0.53
12	Long-term interest rates	0.54	0.16	0.07	0.78	0.14	0.02	0.61
13	M2 or M3	0.47	0.54	0.08	0.82	0.13	0.01	0.36
14	Stock prices	0.69	0.07	0.02	0.84	0.58	0.01	0.63
15	Real compensation of employees	0.53	0.70	0.07	0.84	0.12	0.04	0.71
16	Exports total	0.69	0.54	0.12	0.91	0.33	0.01	0.48
17	Imports total	0.84	0.11	0.05	0.89	0.71	0.02	0.69
18	Terms of trade	0.42	0.11	0.01	0.43	0.88	0.56	0.99
19	Real effective exchange	0.74	0.39	0.04	0.86	0.09	0.03	0.64
20	Current account balance	0.16	0.15	0.01	0.43	0.53	0.06	0.70
21	FDI out	0.52	0.02	0.01	0.65	0.88	0.22	0.91
22	FDI in	0.15	0.07	0.01	0.88	0.45	0.00	0.51
23	Exports to Euro	0.88	0.10	0.01	0.40	0.86	0.53	0.97
24	Exports to EU	0.90	0.12	0.01	0.44	0.84	0.47	0.96
25	Exports to EU accession ctrys	0.64	0.03	0.00	0.31	0.93	0.62	0.96
26	Exports to United States	0.49	0.11	0.01	0.52	0.67	0.27	0.92
27	Exports to United Kingdom	0.87	0.33	0.02	0.67	0.42	0.15	0.88
28	Exports to Japan	0.81	0.42	0.02	0.69	0.44	0.20	0.88
29	Exports to China,P.R.: Mainland	0.69	0.26	0.09	0.85	0.01	0.01	0.42
30	Exports to Asia	0.75	0.54	0.04	0.80	0.27	0.09	0.82
31	Exports to ROW	0.92	0.12	0.01	0.42	0.81	0.46	0.95
32	EXP SITC Total	0.92	0.05	0.01	0.51	0.89	0.36	0.96
33	EXP SITC 0: Food and live animal	0.92	0.03	0.00	0.48	0.89	0.38	0.96
34	EXP SITC 1: Beverages and tobacco	0.58	0.02	0.00	0.46	0.79	0.24	0.93
35	EXP SITC 2: Crude materials, inefible, except fuels	0.81	0.05	0.02	0.65	0.89	0.23	0.94
36	EXP SITC 3: Mineral fuels, lubricants and related materials	0.64	0.25	0.05	0.80	0.69	0.05	0.78
37	EXP SITC 4: Animal and vegetable oils, fats and waxes	0.41	0.20	0.04	0.77	0.08	0.00	0.31
38	EXP SITC 5: Chemicals and related profucts, n.e.s	0.89	0.04	0.01	0.56	0.89	0.26	0.96
39	EXP SITC 6: Manufactured goods	0.91	0.05	0.01	0.55	0.88	0.31	0.96
40	EXP SITC 7: Machinery and transport equipment	0.89	0.05	0.01	0.49	0.87	0.39	0.96
41	EXP SITC 8: Miscellaneous manufactured articles	0.91	0.04	0.00	0.47	0.89	0.38	0.96
42	EXP SITC 9: Commodities and transactions n.e.c	0.09	0.19	0.01	0.62	0.79	0.33	0.95

1/ Forecast horizon is 20 quarters and refers to the levels of the series. Confidence intervals are constructed using bootstrapping methods. The bootstrap was made up of 500 draws. The bootstrap is done with the objective of removing the possible bias in the VAR coefficients which can arise from the small sample size.

Appendix I

29. Let us assume that X_t is an I(1) process with $\Delta X_t = v_t$ such that v_t has a Wold representation. The spectral density of v_t is $f_{vv}(\lambda)>0,$ for all λ. The discrete Fourier transform of X_t for $\lambda_t \neq 0$:

$$w_X(\lambda_s) = \frac{1}{1-e^{i\lambda_s}} w_v(\lambda_s) - \frac{e^{i\lambda_s}}{1-e^{i\lambda_s}} \frac{(X_n - X_0)}{n^{1/2}},$$

where $\lambda_s = \frac{2\pi s}{n}$, s = 0, 1, …, n-1, are the fundamental frequencies. The second term makes it clear that the Fourier transform is not asymptotically independent across fundamental frequencies because the second term is a deterministic trend in the frequency domain with a random coefficient $\frac{(X_n - X_0)}{n^{1/2}}$. Unless that term is removed, it will produce leakages into all frequencies $\lambda_t \neq 0$, even in the limit as $n \to \infty$. Sacrificing a single observation, instead of estimating the random coefficient a-la-Hannan (1970), Corbae and Ouliaris (2006) show that by imposing that $(X_n - X_1) = (X_n - X_0)$ will produce an estimate that will have no finite sampling error, has superior endpoint properties, and has much lower mean-squared error than popular time-domain filters such as HP or B-K. In addition, in contrast to B-K, it is consistent. This is the ideal band-pass filter used in the paper.

Appendix II

30. This study uses a large dimensional approximate dynamic factor model in the tradition of Stock and Watson (1998 and 2002). In contrast to the models of Sargent and Sims (1977) and Geweke (1977), it admits the possibility of serial correlation and weakly cross-sectional correlation of idiosyncratic components, as in Chamberlain (1983) and Chamberlain and Rothschild (1983). Similar models have recently been used by Giannone, Reichlin, and Sala (2002), Forni and others (2005), and Eickmeier (2007).

31. A vector of N time series $Y_t = (y_{1t}, y_{2t}, ..., y_{Nt})'$ with T observations can be represented as the sum of two latent components, a common component $X_t = (x_{1t}, x_{2t}, ..., x_{Nt})'$ and an idiosyncratic component $\Xi_t = (\varepsilon_{1t}, \varepsilon_{2t}, ..., \varepsilon_{Nt})'$

$$\begin{aligned} Y_t &= X_t + \Xi_t \\ Y_t &= CF_t + \Xi_t \end{aligned} \tag{1}$$

where $F_t = (f_{1t}, f_{2t}, ..., f_{rt})'$ is a vector of r common factors, and $C = (c_1', c_2', ..., c_N')'$ is a $N \times r$ matrix of factor loadings, with $r << N$.[13] The common component X_t, which is a linear combination of common factors, is driven by few common shocks, which are the same for all variables. Nevertheless, the effects of common shocks differ from one variable to another due to different factor loadings. The idiosyncratic component is driven by idiosyncratic shocks, specific to each variable. The static factor model used here differs from the dynamic factor model in that it treats lagged or dynamic factors F_t as additional static factors. Thus, common factors include both lagged and contemporaneous factors.[14]

32. Using the law of large number (as T, $N \to \infty$), the idiosyncratic component, which is weakly correlated by construction, vanishes; and therefore, the common component can be easily estimated in a consistent manner by using standard principal component analysis. The first r eigenvalues and eigenvectors are calculated from the variance-covariance matrix $cov(Y_t)$ and define the $N \times r$ matrix V; and since the factor loadings $C = V$, equation (1) becomes,

$$F_t = V'Y_t, \tag{2}$$

and the common component X_t can be written as,

$$X_t = VV'Y_t. \tag{3}$$

[13] The N time series with T observations are the macroeconomic and trade variables of the panel data described in section II; main series are listed on Tables I-3–I-6.

[14] This is why the model is referred to as approximated dynamic factor model in the text.

From (1), the idiosyncratic component is,

$$\Xi_t = Y_t - X_t. \tag{4}$$

33. From all the more or less formal criteria to determine the number of static factors r, the Bai and Ng (2002) information criteria was followed. As in Forni and others (2005), F_t was estimated by an autoregressive representation of order 1[15]:

$$F_t = BF_{t-1} + u_t, \tag{5}$$

where B is a $r \times r$ matrix and u_t a $r \times t$ vector of residuals.

34. Once a decision is taken on the process followed by the common factors, structural shocks have to be identified by focusing on the reduced form VAR residuals of (5). Following Eickmeier (2007), the identification scheme has three steps. First, maximize the explained variance of the forecast error of the chosen variable and calculate impulse-response functions. Of interest here are unit labor costs in manufacturing (ULCM) and terms of trade (TOT). So, using ULCM as an example, a few major shocks driving them are identified.[16] This implies maximizing the explanation of the chosen variance of the *k*-step ahead forecast error of ULCM with a reduced number of shocks.[17] To this end, k -step ahead prediction errors u_t are decomposed into k mutually orthogonal innovations using the Cholesky decomposition of the variance-covariance matrix of the u_t residuals. The lower triangular Cholesky matrix A is such that $u_t = Av_t$ and $E(v_t v_t') = I$. Hence,

$$\text{cov}(u_t) = AE(v_t v_t')A' = AA'. \tag{6}$$

35. The impulse-response function of y_{it} for the identified shock in period k is obtained as follows:

---

[15] VAR(1) provides a dynamic representation which is parsimonious and quite general (for more details, see Gianonne, 2005). The residuals u_t were white noise and thus an autoregressive process of order 1 was chosen.

[16] Uhlig (2003) shows that two shocks are sufficient to explain 90 percent of the variance at all horizons of real U.S. GNP.

[17] If, for example, two orthogonal shocks are identified, it is incorrect to identify the first shock as the one corresponding to the first eigenvalue and the second orthogonal shock as the one corresponding to the second eigenvalue (see Uhlig, 2003). The two orthogonal shocks identified generate *together* the total variation, the explanation of which is being maximized. However, there are multiple possible combinations of those orthogonal shocks, all of which will still explain the total variation chosen: as an illustration, and measuring angles in degrees, the pairings of orthogonal shocks with rotation angles {0,90} or {30,120} or {60,150} would be equally acceptable. The grid of the angle of rotation can be different, of course. This paper uses a grid of 30 degrees.

$$R_{ik} = c_i B^k A, \tag{7}$$

with c_i the *ith* row of factor loadings of C and with a corresponding variance-covariance matrix $\sum_{j=0}^{k} R_{ij} R_{ij}'$ for y_{it} or the *k*–step ahead prediction error of y_{it}.

36. Second, the identified shocks are assumed to be linearly correlated to a vector of fundamentals. These fundamental forces $\omega_t = (\omega_{1t}, \omega_{2t}, ..., \omega_{rt})'$ behind Dutch ULCM are correlated to the identified shocks through the $r \times r$ matrix Q[18]. Thus,

$$v_t = Q\omega_t. \tag{8}$$

37. The intuition behind the procedure is to select Q in such a way that the first shock explains as much as possible of the forecast error variance of the Netherlands' ULCM *common component* over a certain horizon k, and the second shock explains as much as possible of the remaining forecast error variance. Focusing on the first shock, the task is to explain as much as possible of its error variance

$$\sigma^2(k) = \sum_{j=0}^{k} (R_{ij} q_1)(R_{ij} q_1)', \tag{9}$$

where i is, in our example, the Dutch ULCM, and q_1 is the first column of Q. The column q_1 is selected in such a way that $q_1' \sigma^2 q_1$ is maximized, that is

$$\begin{aligned} \sigma^2(k) &= \sum_{j=0}^{k} (R_{ij} q_1)(R_{ij} q_1)' \\ &= q_1' S_{ik} q_1 \end{aligned}$$

where $S_{ik} = \sum_{j=0}^{k} (k + 1 - j) R_{ij}' R_{ij}$.

38. The maximization problem subject to the side constraint $q_1' q_1 = 1$, can be written as the Lagrangean,

$$L = q_1' S_{ik} q_1 - \lambda(q_1' q_1 - 1), \tag{10}$$

where λ is the Lagrange multiplier. From (10), q_1 is the first eigenvector of S_{ik} with eigenvalue λ and, therefore, the shock associated with q_1 is the first principal component

[18] As an illustration, a "fundamental force" behind a supply shock to Dutch ULCM is labor productivity.

shock. Q is the matrix of eigenvectors of S, ($q_1, q_2, \ldots, q_r$), where q_l ($l=1,...,r$) is the eigenvector corresponding to the l^{th} principal component shock. Along the lines of Uhlig (2003), Eickmeier (2007), and Altig and others (2002), in this paper it is posed: $k=0$ to $k=19$, i.e., five years, which covers short- as well as medium-run dynamics.

39. Up to now, the principal component orthogonal shocks are identified up to a rotation using a Monte Carlo technique. If two shocks are identified, for example, following Canova and de Nicoló (2003), the orthogonal vector of fundamental forces $\omega_t = (\omega_{1t}, \omega_{2t})'$ is multiplied by a 2×2 orthogonal rotation matrix P of the form:

$$P = \begin{pmatrix} \cos(\theta) & -\sin(\theta) \\ \sin(\theta) & \cos(\theta) \end{pmatrix},$$

where θ is the rotation angle; $\theta \in (0, \pi)$, produces all possible rotations and varies on a grid. If θ is fixed, and $q=5$, there are $q(q-1)/2$ bivariate rotations of different elements of the VAR. Following the insights of Sims and Zha (1999), and as in Peersman (2005), Canova and de Nicoló (2003), Eickmeier (2007), Kabundi and Nadal De Simone (2007), the number of angles between 0 and π is assumed to be 12—as explained in footnote 16, this paper uses a grid of 30 degrees. This implies 6,191,736,421x10^{10} (12^{10}) rotations. Hence, the rotated factor $w_t = P\omega_t$ still explains in total all the variation measured by the first two eigenvalues. This way the two principal components ω_i are associated to the two structural shocks w_i through the matrix P, and the impulse-response functions of the two structural shocks on all the fundamental forces can be estimated.

40. A sign-identification strategy is followed to identify the shocks. The method was developed by Peersman (2005). This strategy imposes inequality sign restrictions on the impulse response functions of variables based on a typical aggregate demand and aggregate supply framework.[19] Only those rotations among all possible $q \times q$ rotations that have a structural meaning are chosen.[20] The following table displays the sign restrictions for the identification of shocks that are imposed contemporaneously and during the first year after the shock.

[19] See Peersman (2005) for more technical details.

[20] A rotation is accepted when it produces plausible results in terms of impulse response functions and variance decompositions.

Identification inequalities		
	Increase in ULCM	
	supply shock	demand shock
ULCM	≥ 0	≥ 0
Output	≤ 0	≥ 0
Real wages	≤ 0	≥ 0
	Increase in Terms of Trade	
	supply shock	demand shock
Terms of trade	≥ 0	≥ 0
Consumption	≥ 0	≤ 0
Current account	≤ 0	≥ 0

References

Altig, D., L.J. Christiano, M. Eichenbaum, and J. Linde, 2002, "Technology Shocks and Aggregate Fluctuations," manuscript.

Bai, J., and S. Ng, 2002, "Determining the Number of Factors in Approximate Factor Models," *Econometrica*, 70(1), pp. 191–221.

Bordo, M.D., and T. F. Helbling, 2004, "Have National Business Cycles become more synchronized?" in Siebert, Horst (ed.) *Macroeconomic Policies in the World Economy*, Springer Verlag (Berlin and Heidelberg).

Brooks R., K. Forbes, and A. Mody, 2003, "How strong are Global Linkages?" *Manuscript,* http://www.imf.org/external/np/res/seminars/2003/global/pdf/over.pdf.

Canova, F. and M. Ciccarelli, 2006, "Estimating Multi-Country VAR Models," ECB Working Paper 603.

Canova, F., M. Ciccarelli, and E. Ortega, 2007, "Similarities and Convergence in G-7 Countries," *Journal of Monetary Economics,* 53(3), pp. 850-878.

Canova, F., and G. de Nicoló, 2003, "On the Sources of Business Cycles in the G-7," *Journal of International Economics,* 46, pp. 133–66.

Chamberlain, G., 1983, "Funds, Factors, and Diversification in Arbitrage Pricing Models," *Econometrica* 51, pp. 1281–304.

Chamberlain, G., and M. Rothschild, 1983, "Arbitrage, Factor Structure and Mean-Variance Analysis in Large Markets," *Econometrica* 51, pp. 1305–24.

Ciccarelli, M. and A. Rebucci, 2006, "Has the transmission mechanism of European monetary policy changed in the run-up to EMU?" *European Economic Review*, 50(3), pp. 737-776.

Corbae, D., and Ouliaris, S., 2006, "Extracting Cycles from Nonstationary Data," *Econometric Theory and Practice: Frontiers of Analysis and Applied Research,* Cambridge University Press, D. Corbae, S. Durlauf and B. Hansen, eds.

Daal, Wendly, Francisco Nadal De Simone, and Sibel Yelten, 2006, *Kingdom of the Netherlands—Netherlands: Selected Issues*, IMF Country Report No. 06/284 (Washington: International Monetary Fund).

Eickmeier, S., 2007, "Business Cycle Transmission from the U.S. to Germany—A Structural Factor Approach," *European Economic Review*, 51, pp. 521-551.

Eickmeier, S., and J. Breitung, 2006, "How synchronized are new EU member states with the euro area? Evidence from a structural factor model," *Journal of Comparative Economics*, Vol. 34(3), pp. 538-563.

Forni, M., D. Giannone, M. Lippi, and L. Reichlin, 2005, "Opening the Black Box: Structural Factor Models with Large Cross-Sections," manuscript.

Geweke, J., 1977, "The Dynamic Factor Analysis of Economic Time Series," in *Latent Variables in Socio-Economic Models;* edited by D.J. Aigner and A.S. Golberger (Amsterdam: North-Holland), p. 19.

Giannone, D., L. Reichlin, and L. Sala, 2002, "Tracking Greenspan: Systematic and Unsystematic Monetary Policy Revised," CEPR Working Paper 3550.

Hannan, E.J., 1970, "Multiple Time Series", New York: Wiley.

Hofman, David, Francisco Nadal De Simone, and Mark Walsh, 2005, *Kingdom of the Netherlands—Netherlands: Selected Issues*, IMF Country Report No. 05/225 (Washington: International Monetary Fund).

Imbs, J., 2004, "Trade, Finance, Specialization and Synchronization," *Review of Economics and Statistics*, 86(3), pp. 723–34.

IMF, 2005, "France, Germany, Italy, and Spain: Explaining Differences in External Sector Performance Among Large Euro Area Countries," IMF Country Report No 05/401.

Kabundi, A. and Nadal De Simone, 2007, "France in the Global Economy: A Structural Approximate Dynamic Factor Model Analysis," IMF Working Paper WP/07/129.

Kabundi, A. and Nadal De Simone, 2008, "Recent French Export Performance: Is There a Competitiveness Problem?," IMF Working Paper, forthcoming.

Khan, T., "Productivity Growth, Technological Convergence, R&D, Trade and Labor Markets: Panel Data Evidence from the French Manufacturing Sector," *International Monetary Fund,* Working Paper, WP/06/230.

Kose, M.A., C. Otrok, and C.H. Whiteman, 2003, "International Business Cycles: World, Region, and Country-Specific Factors," *American Economic Review*, 93(4), pp. 1216–39.

Kose, M.A., C. Otrok, and C.H. Whiteman, 2005, "Understanding the Evolution of World Business Cycles," *International Monetary Fund*, WP/05/211.

Kose, M.A., and K. Yi, 2006, "Can the Standard International Business Model Explain the Relation between Trade and Comovement?" *Journal of International Economics*, 68, pp. 267-295.

Mellens, M.C., H.G.A. Noordman, and J.P. Verbruggen, 2007, "Wederuitvoer: Internationale Vergelijking en Gevolgen voor Prestatie-Indicatoren," CPB Document No. 143.

Nadal De Simone, F., 2002, "Common and Idiosyncratic Components in Real Output: Further International Evidence," *International Monetary Fund,* WP/02/229.

Peersman, G., 2005, "What Caused the Early Millennium Slowdown? Evidence Based on Vector Autoregressions," *Journal of Applied Econometrics*, 20, pp. 185–207.

Sargent, T.J., and C.A. Sims, 1977, "Business Cycle Modeling without Pretending to have too Much a Priori Economic Theory," in *New Methods in Business Research,* edited by C.A. Sims (Minneapolis: Federal Reserve Bank of Minneapolis).

Sims, C.A. and T. Zha, 1999, "Error Bands for Impulse Responses," *Econometrica* 67(5), pp. 1113–55.

Stock, J.H., and M.H. Watson, 1998, "Diffusion Indexes," NBER Working Paper 6702.

Stock, J.H., and M.H. Watson, 2002, "Macroeconomic Forecasting Using Diffusion Indexes," *Journal of Business & Economic Statistics*, 20(2), pp. 147–162.

Stock, J.H., and M.H. Watson, 2003, "Has the Business Cycle Changed? Evidence and Explanations," in *Monetary Policy and Uncertainty,* FRB of Kansas City, pp. 9–56.

Uhlig, H., 2003, "What Moves Real GNP?" manuscript.

II. The Fiscal Implications of International Tax Competition for the Netherlands[21]

A. Introduction

41. **International tax competition is raising fears of a "race to the bottom" in the Netherlands**. The accession of the new EU member states (NMS) has created new concerns about governments competing to undercut each others' corporate income tax (CIT) rates to attract mobile tax bases. These concerns are borne out by the sharp decline in statutory CIT rates in the Netherlands and the rest of EU countries in the period 2000–06 (Table II-1). However, the average CIT rate in the new EU member states (NMS) is still about 8 percentage points lower than in the Netherlands. In addition, there are indications that tax competition from the European countries of the Commonwealth of Independent States (CIS) and the transition economies of Southeastern Europe (SEE) may lead to further tax cuts in the NMS in the near future and ultimately in the Netherlands.

42. **Despite the cuts in CIT rates, CIT revenue—both as a share of GDP and of total tax revenue—in the Netherlands shows a slightly upward trend since the early 1980s.** This well-known CIT rate-revenue puzzle has cast some doubts about whether a "race to the bottom" is actually taking place. Explaining this puzzle is also critical for understanding future developments in CIT revenues. The latter is particularly important from the perspective of longer-term fiscal sustainability, in light of population aging.

43. **The main conclusion of this paper is that tax competition within the EU has led to a race to the bottom and can have significant medium-term fiscal implications for the Netherlands.** The study shows that base-broadening CIT reform—e.g., by means of reduced investment tax credits, loss-offset rules, interest deductibility, and fiscal depreciation—is unlikely to have offset the ex-ante revenue losses from rate reduction. Indeed, part of the ex-ante revenue losses was offset by a shift between personal and corporate income taxes. Lower corporate tax rates may have induced entrepreneurs to incorporate, thereby broadening the corporate tax base. Therefore, CIT rate cutting will tend to erode personal income tax revenue. In addition, the Netherlands may have benefited from international profit shifting to compensate part of the ex-ante revenue losses. With respect to medium-term fiscal implications, this study finds that tax competition with the NMS may result in a decline of CIT revenue by ½–1½ percentage point of GDP.

44. **The paper is organized as follows.** The next section assesses the interaction between the Netherlands and other western European countries on CIT rate setting. Section C provides an analysis of the CIT rate-revenue puzzle. Section D assesses the potential fiscal and policy implications of the international tax competition for the Netherlands. Section D concludes.

---

[21] Prepared by Wendly Daal.

B. Interaction between European and Dutch CIT Rate Setting

45. **Developments in the last two decades suggest that EU member states have been interacting in setting CIT rates**. The statutory CIT rates in the Netherlands and several other western European countries declined substantially over the period 1982–2006, from about 50 percent in 1982 to about 30-35 percent in 2006.[22] [23] Two other measures of CIT rates that account for base broadening—the effective average corporate tax rate (EATR) and the effective marginal corporate tax rate (EMTR) [24]—also show downward trends (Figure II-1). This implies that these countries have not used base-broadening measures to offset fully the rate cuts.

46. **Literature on tax competition found evidence of interaction within the western European countries and among the industrialized OECD countries.**[25] For example, the study of Devereux, Lockwood, and Redoano (2004) for the industrialized OECD countries over the period 1982–99 estimated that a 1 percentage point reduction in the average statutory CIT rates of other countries would tend to reduce the rate in the home country by 0.7–0.8 percentage points. They also established that industrialized OECD countries compete more over tax rates, and not so much over tax allowances, that is, a frequent form of base broadening. Redoano (2007) studied CIT interdependency within the western European countries.[26] He found that, for each of the weights used (geographical distance, GDP, per capita GDP, and uniform weight), the parameter estimate for the average CIT rate of the neighboring countries is always positive and significantly above 1, which means that, if neighboring countries in western Europe lower their taxes by 1 percentage point, the home country reacts by lowering its CIT rate by more than 1 percentage point. In particular, his regression results suggest that tax competition occurs in western Europe mainly with respect to big "leader" countries (since the weight that performed better is the GDP weight). In addition, he determined that other factors, such as common trend or yardstick competition (because governments try to please voters), do not significantly explain interest rate setting within western European countries.

---

[22] The selected western European countries are Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom.

[23] The CIT rates for selected western European countries are averages for these countries, based on the size of their economies as measured by their respective GDP. We also calculate average CIT rates for these countries based on their share in Dutch exports and imports.

[24] The EATR plays a role in firms' discrete investment decision. It proxies the tax rate on excess profits (economic rent), i.e., profits over and above the minimum rate of return expected. The EATR is measured as the ratio of future corporate tax liabilities to the pretax corporate profits in present value terms over the duration of the investment project. The EMTR accounts for the relative increase in the cost of capital due to taxation, i.e., it measures the marginal tax burden on investments. The EMTR is measured as the tax wedge between the pre and posttax return on a marginal investment project, which yields only an economic rent.

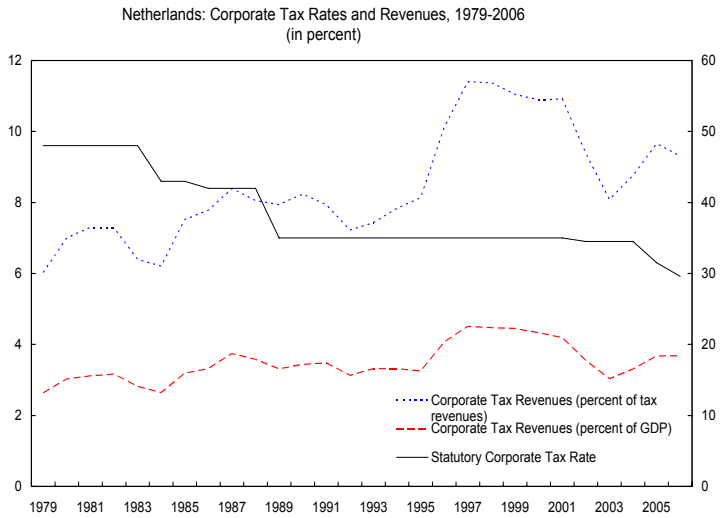
[25] Redoano (2007), Mendoza and Tesar (2005), and Devereux, Lockwood, and Redoano (2004).

[26] He considers Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom.

47. **The empirical results of these studies imply that the cutting of CIT rates in the Netherlands is largely due to tax competition within western European countries.** Specifically, they imply that a 1 percentage point reduction in the average CIT rate in neighboring western European countries could lead to a rate cut of about 0.8–1.0 percentage point in the Netherlands. Furthermore, the empirical results suggest that rate cuts in large neighboring countries, such as Germany and France, could lead the largest reaction in the Netherlands. Next we analyze if this strategic interaction in CIT rate cutting has led to a reduction of CIT revenues in the Netherlands.

C. The CIT Rate-Revenue Puzzle

48. **The cuts in CIT rates have not led to a decline in Dutch CIT revenues, the well-known "CIT rate-revenue puzzle."** CIT revenues—both as a share of GDP and as a share of total tax revenues, including social security contributions—have been volatile, but growing (text figure). Despite the contraction at the beginning of the 2000s, reflecting sluggish economic growth, Dutch CIT revenues have remained much higher than during the 1980s and the first half of the 1990s. This outcome is in sharp contrast with the observed strong reduction in the statutory tax rate to a fairly low level by both historical and European standards.[27] This divergent development between the CIT rate and revenues is the CIT rate-revenue puzzle.

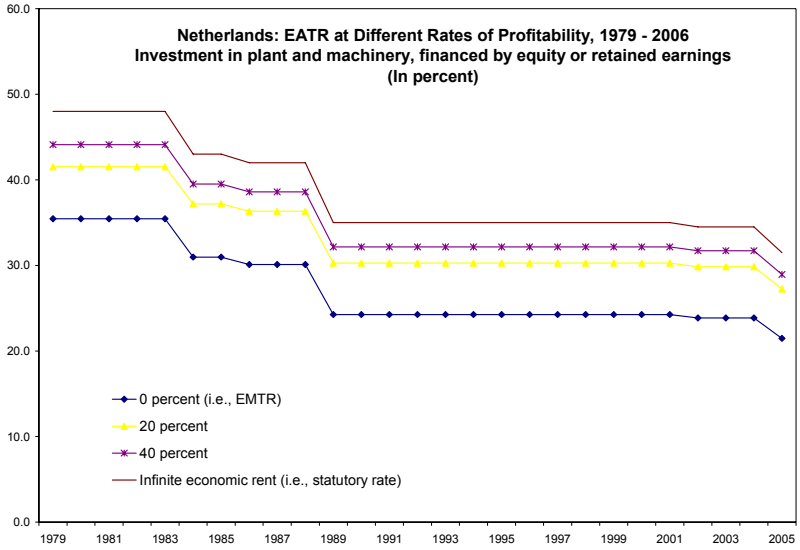


49. **Several factors could account for the CIT puzzle**. Tax reforms that broaden the "legal" CIT base—that is, the tax base as defined by tax legislation—could explain it. A broadening of the "economic" (that is, regardless of statutory changes) CIT base could also have boosted CIT revenues, despite the declining rates. An expanded economic CIT base could have resulted, for example, from increased profitability, enlarged domestic corporate sector (due to increased private investment or income tax base shifting between PIT and CIT), or external factors, such as international profit shifting or foreign direct investment (FDI).

Broadening of the legal CIT base

[27] More recent reforms reduced the corporate tax rate further from 29.6 in 2006 to 25.5 percent in 2007.

50. **There is no clear evidence that the upward trend in corporate tax revenue is due to base-broadening tax reform measures**. Effective CIT rates at all levels of profitability have declined in line with the statutory rates, implying that the legal base for tax collection has remained practically unchanged (text figure). An ex-ante revenue-neutral tax reform—that is, a rate-cutting base-broadening tax reform—would have led to a larger decline in the EATR for more profitable investments and an increase in the EMTR. This is because base-broadening tax measures have a larger impact on marginal investment, as measured by the EMTR, while rate cutting has a larger impact on excess profits, as measured by the EATR.[28]



51. **However, operational definitions of the legal corporate tax base used in empirical studies may underestimate the impact of base-broadening.** The "true" corporate tax base is fairly complex. It involves several categories of tax deductibility, such as allowances for capital depreciation, investment tax credits, loss offset rules, and interest deductibility. A measure of the corporate tax base that captures all of these factors is not feasible. Following the empirical literature of corporate taxation (for example, Devereux, Griffith, and Klemm (2002)), the corporate tax base in this paper is proxied by the present value of depreciation allowances for capital expenditures. This measure does not take into account the broadening of the statutory CIT base due to changes in tax legislation that affect other categories of tax deductibility. Therefore, it may not fully reflect the compensation of revenue losses through base-broadening tax reforms.

Broadening of the economic CIT base

52. **The reduction in corporate tax rates has been offset by an expansion in the economic CIT base**. The latter, as measured by the increase in the share of pretax corporate profits to GDP, expanded from about 11 percent of GDP in 1979 to 16 percent in 2006

---

[28] Following Devereux, Lockwood, and Redoano (2002) we define EMTR and EATR respectively as $EMTR = \tau(1-a)/(1-\tau)$ and $EATR = \tau(F(k)-ark)/(F(k)-rk)$, where τ denotes the statutory CIT rate, *a* captures the rate of the capital depreciation allowance, *k* is the stock of capital, *F(k)* is the output produced, and *r* is the rental rate of capital input.

(Figure II-2). An important question from a tax policy perspective is whether tax reforms have contributed to a broadening of the economic CIT base. In this context, we distinguish between domestic and foreign factors. Domestic factors could broaden the base through improved corporate profitability or an increase in the size of the corporate sector. The latter in turn could occur through increased investment or income shifting between the PIT and CIT bases. From a global perspective, a favorable tax differential or tax regime could have led to profit shifting or increased net FDI inflows, broadening the domestic CIT base. We explore these factors next and conclude that income base shifting partly accounts for offsetting the CIT revenue loss due to rate cutting. International profit shifting—from countries with higher CIT rates than Netherlands, such as Germany and France—may also have offset part of the revenue losses.

Corporate profitability

53. **Profitability is unlikely to explain much of the enlargement of the CIT base**. Indeed, profitability in the Netherlands has been fluctuating around a more or less constant long-term trend (Figure II-2). However, two observations are in order in this regard. First, profitability is generally defined as profits as a share of the stock of capital, but the stock of capital is difficult to measure. We use national accounts data, which value capital at its replacement rate. Some tax literature has used the historical value of capital, which generally overestimates the rate of profitability. Devereux, Griffith, and Klemm (2004) showed that whichever capital valuation is used, profit as a share of the capital stock is a good indicator of profitability. Second, the measure in Figure II-2 accounts only for the profitability of nonfinancial firms. Given the increasing role of the financial sector in the economy, greater profitability there could partly compensate for the broadly constant long-term trend observed in the profitability of the nonfinancial corporate sector. It is unlikely, though, that profitability in the financial sector alone could explain the enlargement of the CIT base.

Corporate investment

54. **Growth of the corporate sector, as measured by its investment, did not contribute to the expansion of the economic CIT base.** This is shown by the decline in the share of nonfinancial corporate investment to GDP (Figure II-2). Investment by financial institutions did not compensate for this drop, despite the rising importance of the financial sector in the economy. On the contrary, financial sector investment weakened in the last five years.

Shift from personal to corporate tax base

55. **A possible explanation of the CIT rate-revenue puzzle is income shifting between personal income and the corporate income tax base.** Some studies support this conclusion.[29] De Mooij and Nicodème (2008) found evidence that the gap between personal

[29] De Mooij and Nicodème (2008), Sørensen (2006), and Weichenrieder (2005).

and corporate tax rates exerts a significant positive effect on the degree of incorporation in the EU. They estimate that about 12 percent of the CIT-to-GDP ratio could be attributed to income shifting in the early 1990s, and that this share has grown to 21 percent in recent years due to the widening gap between the PIT and the CIT rates. Accordingly, income shifting has contributed to stabilization of the CIT-to-GDP ratio by about ¼ percent of GDP since the early 1990s in the EU.

56. **In fact, income tax base shifting appears to have been an important contributor to the stabilization of the CIT-to-GDP ratio in the Netherlands too.** By using the methodology of de Mooij and Nicodème (2008), we calculate that income tax base shifting accounts on average for about 35 percent of CIT revenue in the Netherlands due to a widening of the gap between PIT and CIT. This implies that ex-ante reductions in the CIT rate equivalent to one euro will cost on average only 65 euro cents in terms of CIT revenue lost ex-post; that is, 35 euro cents can be regained through income shifting from the personal to the corporate tax base. In this context, the gain in CIT revenue is eroding PIT revenue.[30]

Foreign direct investment and international profit shifting

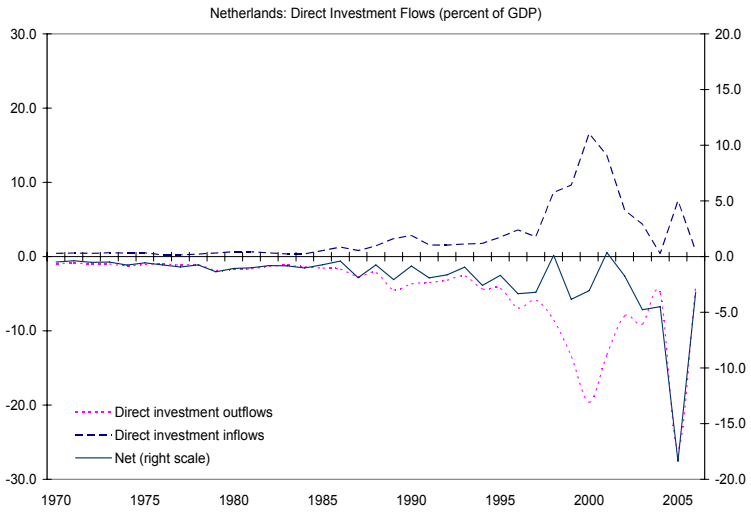
57. **External factors may have contributed to the base broadening, but the evidence is inconclusive.** De Mooij (2005)—using an elasticity of -2.4 for FDI—calculated that a 1 percentage point reduction in the statutory CIT rate in the Netherlands broadens the economic CIT base by 0.8 percent through FDI inflows. This implies that about 25 percent of the ex-ante revenue loss due to rate cutting is regained through FDI. Using an elasticity of -2.0 for international profit shifting, he calculated that 30 percent of the ex-ante revenue loss due to a 1 percentage point reduction in the statutory CIT rate would be regained through international profit shifting. However, data on net FDI flows and the CIT rate differential with other EU countries do not provide evidence that the broadening of the economic corporate tax base could have come from abroad. At the same time, though, the Netherlands may have attracted European multinational companies or profit shifting from these companies given its overall favorable corporate tax regime.

[30] The recent tax reform (2006) in the Netherlands kept the differential between the marginal effective CIT rate and the marginal effective PIT rate unchanged for small and medium enterprises (SMEs) by reducing the tax base for these enterprises by 9 percent, and therefore should prevent further income shifting. However, this implies that tax competition may reduce not only CIT revenue as a percent of GDP, but also PIT revenue as a percent of GDP.

58. **The impact of CIT rate differentials on broadening the economic tax base is mixed.** Both the statutory and the effective CIT rates for the Netherlands are higher than the respective trade-weighted averages for selected European Countries (Figures II-1 and II-3A-D). However, the GDP-weighted average corporate tax rates are higher than in the Netherlands because Germany, France, and Italy have much higher CIT rates and larger weight due to their size. Arguably, the trade-weighted averages are a better measure of "attraction" than the GDP-based ones because they reflect better close economic association with the Netherlands. Thus, favorable CIT rates should have exerted at best a limited influence to induce corporations to shift their investment or profits to the Netherlands.

59. **However, the Netherlands may have benefited from international profit shifting through other aspects of its corporate tax legislation.** In particular, the Netherlands has an attractive holding company tax legislation, which stimulates multinational companies to establish headquarters in the country. As reported by Fynatten (2007), the Netherlands exempts from the CIT dividends and capital gains received from foreign shares and it has no withholding taxes on interest payments. Recent tax reforms—for example, the abolition of the capital duty on capital contributions and the reduction in the general dividend withholding tax rate—have reinforced its attractiveness as a holding company location.

60. **Net FDI flows do not seem to have been a factor in the Netherlands**. Benassy-Quéré, Fontagné, and Revil (2003) showed that, along with market potential, corporate tax differentials play a significant role in driving FDI flows. FDI outflows from the Netherlands have outpaced inflows (text figure).[31] Net FDI outflows, which became increasingly more volatile since the middle of the 1980s, have even increased in the last decade. This trend indicates that the Netherlands has not benefited from the corporate tax rate cuts by attracting more net FDI inflows.

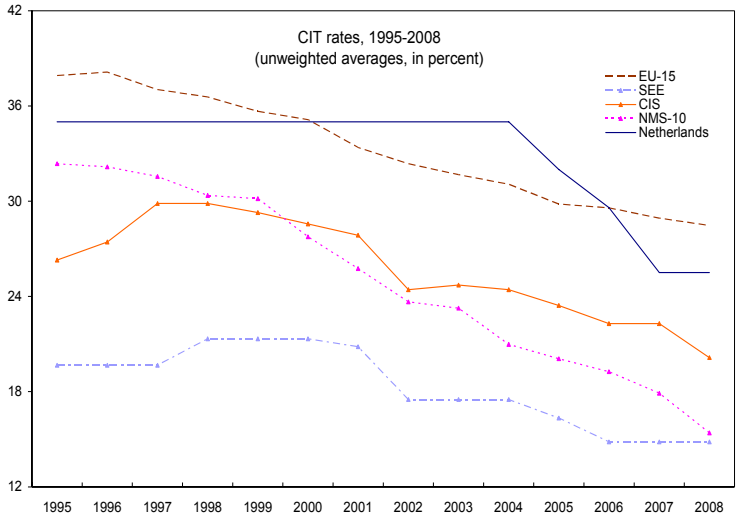


[31] As in the general economic literature, we associate FDI flows with capital allocation. However, FDI flows do not necessarily affect the domestic corporate base because FDI includes not only allocation of capital but also financial flows associated with changes in ownership, such as acquisitions and mergers. Still, we use it here as a proxy for net foreign capital investment.

D. Looking Ahead: Potential Fiscal Implications and Policy Options

Fiscal implications

61. **The recent accession of the NMS has fueled some concerns in the "old" member countries about intensified tax competition in the EU.** In addition, some of the NMS have cut taxes aggressively, introducing, for example, zero rates on retained earnings. While CIT rates in the Netherlands declined from 35 percent to 25.5 percent over the last decade, the average CIT rates for the NMS fell from 32 percent in 1995 to below 18 percent in 2007. As pointed out by Piatkowski and Jarmuzek (2008), the decline in CIT rates in the NMS is likely to continue in the near future, mainly because of CIT competition from the CIS and SEE countries.[32] The expected further decline of the already reduced CIT rates in the NMS presents challenges for the Netherlands, namely, the prospect of either losing CIT revenue to these countries or engaging in a race to cut CIT rates.



Source: PWC Worldwide Tax Summaries. IMF staff reports.

62. **Because of the expected intensified tax competition, CIT rates in the Netherlands are likely to decline further in the medium term.** The above-mentioned parameter estimates for strategic interaction within western European countries implies that a 1 percentage point reduction in the average statutory CIT rates of the other EU countries would tend to reduce the CIT rate in the Netherlands by about 0.8–1 percentage point. Assuming a full convergence in CIT rates in the EU to the average of the NMS, we estimate that the CIT rate in the Netherlands may decline to less than 20 percent in the medium term, which is also consistent with the calculations of Bettendorf, Gorter, and van der Horst (2006).

63. **The expected decline in the CIT rate may seriously weaken CIT revenue in the Netherlands**. With an unchanged tax base, we estimate that the reduced CIT rate will lower the ratio of CIT revenues to GDP from 3.7 percent in 2006 to about 2 percent of GDP in the medium term (text table below). Allowing for base broadening—through income tax base

[32] Piatkowski and Jarmuzek (2008) showed that CIT rates in CIS and SEE countries also declined, and he argued that these rates will probably be reduced further in the near future. For instance, Moldova's planned tax reform includes cutting the CIT rate to zero in 2008.

shifting, international profit shifting, and FDI—the fall in the CIT ratio could be limited to about 3 percent of GDP.

Netherlands: CIT-to-GDP Ratio
(In percent)

	2006	Medium-Term
CIT ratio (unadjusted)	3.7	3.2
Gain from international profit shifting	0.6	0.6
CIT ratio (adjusted for profit shifting)	3.1	2.6
Gain from income shifting	0.6	0.6
CIT ratio (adjusted for income and profit shifting)	2.5	2.0

Source: Staff estimates.

64. **In particular, the scope for international profit shifting to the Netherlands will likely be reduced by the ongoing CIT harmonization process within the EU.** The European Commission has confirmed its intention to adopt a directive introducing a common consolidated corporate tax base (CCCTB) in 2008 for income produced by multinational groups operating in the EU. Phode (2007) points out that after consolidation, the overall tax base shall be shared by all the interested member states through the application of a sharing mechanism and member states shall be able to apply their own income tax rate on the apportioned tax base, thus maintaining their "sovereignty" in the setting of tax rates. Harmonization of the CIT tax base, including holding company tax regimes, will limit Netherlands ability to attract multinational companies and therefore limit the gains from international profit shifting.

65. **If the tax differential with the NMS persists, the revenue offset from international profit shifting could be diminished by two factors.** First, profit shifting or investment relocation to the NMS by large Dutch multinational companies that already operate in these countries may increase. Second, the revenue "gain" from profit shifting that the Netherlands has been receiving from neighboring countries with higher CIT rates—in particular, from countries such as Germany—may also deteriorate. For instance, large German multinational companies may prefer to relocate their investments or profits to the NMS for tax purposes. The size of the potential revenue loss from profit shifting and investment relocation to these countries is, however, difficult to assess.

Policy options

Policy options in a global context

66. **Formal CIT rate harmonization in the EU, a possible way to cope with international tax competition, is difficult**. It would require standardization of the system of corporate income taxation. At present, this is not a realistic option. Brøchner and others (2006) argued that the gains from CIT rate harmonization are likely to be small, because many important forms of saving and investment outside the corporate sector would continue to be subjected to widely diverging national tax rules, just as personal tax rates on corporate

source income continue to differ. In this light, it is unlikely that the member states of the EU would be prepared to give up a substantial part of their residual tax sovereignty. Doing so would limit the ability of governments to use the instrument of corporate taxation to implement social and economic policies. In practice, the extension of tax harmonization in the EU from the value-added tax (VAT) and excises to corporate taxation would mean that, on average, less than one-third of tax revenues would remain under the control of national governments. Furthermore, this would inevitably require some harmonization of budgetary expenditures as well, because of the constraints imposed on the revenue side.

Domestic policy options

67. **Decisions on the structure of taxation in the medium term must be seen against the background of the demographic impact of aging population.** Productivity will have to become the predominant source of growth because of the shrinking working-age population, leading (with unchanged policies) to a fall in potential growth. A key challenge will be to introduce reforms in the tax system aimed at increasing labor supply that guarantee the long-term sustainability of public finances in the face of these demographic changes. The main question in this regard is whether the Netherlands should rely on labor taxes to compensate for the expected revenue loss from further CIT rate cuts.

68. **The authorities will have to explore a number of avenues to offset the expected revenue loss from CIT rate cuts.** Raising the PIT (or social payroll contributions) is not the optimal strategy. In particular, the tax burden on labor in the Netherlands is still high by international standards. Reforms to ease further the tax burden on labor will likely be a priority over the medium term, along with reducing labor market rigidities to increase both the supply and demand of labor and boost economic growth. Thus, the expected loss of CIT revenue (and desirable easing of labor taxes) may have to be paid for by cuts in primary expenditure. However, this possibility is limited, as aging costs will put upward pressure on public spending in the medium to long term. An alternative would be to shift more of the burden onto other tax bases. Taxes on consumption or property are natural candidates.

69. **The most obvious option is to raise consumption taxes**. In general, reliance on consumption taxes is likely to (i) minimize economic efficiency losses; (ii) be relatively neutral toward saving and investment decisions; (iii) avoid discriminating between imports and locally produced goods; (iv) preserve external competitiveness; and (v) provide a symmetric treatment of labor and capital income, thereby reducing disincentives to work and better meeting the criteria for intergenerational equity than income taxes.[33] Thus, with a VAT rate that is slightly below the EU average, the Netherlands could probably raise consumption taxes (Table II-2). Increasing the VAT by 1–2 percentage points, assuming constant elasticities, would deliver revenues of about ½–1½ percent of GDP, enough to compensate for the expected decline in CIT revenues over the medium term.

[33] It taxes both past and present earnings equally.

70. **The Netherlands can also relax some of the tax privileges granted to specific saving instruments**. Retirement schemes and housing investment benefit from the most generous tax breaks. In both cases, these special treatments are motivated in part by social or economic objectives: alleviating future pressure on public pension schemes and facilitating population access to housing. On average, revenue from property taxes as a share of GDP in the Netherlands has not increased in line with the values of properties over the period 2000-06 (Table II-3). Although some of these tax concessions have recently been lowered, there is still scope for further action that could partially compensate the revenue loss from international tax competition. In addition, higher taxation of property would contribute to improving the neutrality of the tax system toward various forms of wealth (real estate, financial assets, and human capital).

71. **In addition, the Netherlands can rely more on environmental taxes**. Such taxes represent a larger share of GDP in the Netherlands than in most other OECD countries. Motor fuel and vehicle taxes, which were initially introduced for fiscal rather than environmental reasons, account for the bulk of these revenues. Over the last decade, the Netherlands has implemented comprehensive "green tax" reforms to increase the use of economic instruments for pollution control.[34] One of these new initiatives is, for example, that automobile taxation is based to a large extent on their emissions. Further venues may be pursued, in particular against the background of global warming concerns. For example, products could be taxed based on the pollution created by their fabrication process.

E. Conclusions

72. **International tax competition within the EU may erode CIT revenue in the Netherlands in the medium term**. There is strong evidence of international tax competition within western European countries, including the Netherlands: parameter estimates for the strategic interaction are highly significant and positive. We found that part of the decline in CIT revenue due to rate-cutting has been compensated with a shift from PIT to CIT revenue, explaining the CIT puzzle. Therefore, international tax competition is reducing PIT instead of CIT revenue. In addition, international profit shifting also may have contributed to the growing CIT revenue. Looking further ahead, the accession of the NMS will intensify tax competition in the EU and this may erode CIT revenue in the Netherlands. The size of the potential impact of this competition on CIT revenue depends on income tax base shifting and international profit shifting. In this context, international profit shifting will be the most critical factor for the Netherlands, as it determines whether total tax revenue will decline or not.

73. **Policy options must be evaluated against the challenges of aging.** Population aging will raise fiscal spending while lowering the potential of labor-based taxes. The best strategy to address the potential decline in revenue as a share of GDP in the medium term is to broaden the tax base. With the increased mobility of capital and high-skilled workers within

[34] An efficient green tax is one that deters polluting activities instead of collecting revenues.

the EU, this is best accomplished with a shift away from mobile tax bases and more reliance on consumption and property taxes. The former will likely reduce deadweight losses, while the latter will improve the neutrality of the tax system towards different sources of wealth. Environmental taxes could also play a larger role.

Table II-1. European Union: CIT Rates, 2000-06
(In percent)

	01-Jan-00	01-Jan-01	01-Jan-02	01-Jan-03	01-Jan-04	01-Jan-05	01-Jan-06
Austria	34	34	34	34	34	25	25
Belgium	40.17	40.17	40.17	33.99	33.99	33.99	33.99
Cyprus		28	28	15	15	10	10
Czech Republic	31	31	31	31	28	26	24
Denmark	32	30	30	30	30	28	28
Estonia						24	23
Finland	29	29	29	29	29	26	26
France	36.66	35.33	34.33	34.33	34.33	33.83	33.33
Germany	51.6	38.36	38.36	39.58	38.29	38.31	38.34
Greece	40	37.5	35	35	35	32	29
Hungary	18	18	18	18	16	16	16
Ireland	24	20	16	12.5	12.5	12.5	12.5
Italy	41.25	40.25	40.25	38.25	37.25	37.25	37.25
Latvia						15	15
Lithuania						15	15
Luxembourg	37.45	37.45	30.38	30.38	30.38	30.38	29.63
Malta						35	35
Netherlands	**35**	**35**	**34.5**	**34.5**	**34.5**	**31.5**	**29.6**
Poland	30	28	28	27	19	19	19
Portugal	37.4	35.2	33	33	27.5	27.5	27.5
Slovak Republic		29	25	25	19	19	19
Slovenia						25	25
Spain	35	35	35	35	35	35	35
Sweden	28	28	28	28	28	28	28
United Kingdom	30	30	30	30	30	30	30
Average CIT rate	33.9	32.0	30.9	29.7	28.3	26.1	25.8

Source: KPMG's Corporate Tax Rate Survey.

Table II-2. VAT Rates in the EU, 2006
(In percent)

	Super Reduced Rate	Reduced Rate	Standard Rate
Belgium	-	6	21
Czech Republic	-	5	19
Denmark	-	-	25
Germany	-	7	16
Estonia	-	5	18
Greece	4.5	9	19
Spain	4	7	16
France	2.1	5.5	19.6
Ireland	4.4	13.5	21
Italy	4	10	20
Cyprus	-	5/8	15
Latvia	-	5	18
Lithuania	-	5/9	18
Luxembourg	3	6	15
Hungary	-	5/15	20
Malta	-	5	18
Netherlands	**-**	**6**	**19**
Austria	-	10	20
Poland	3	7	22
Portugal	-	5/12	21
Slovenia	-	8.5	20
Slovak Republic	-	-	19
Finland	-	8/17	22
Sweden	-	6/12	25
United Kingdom	-	5	17.5
EU			19.4

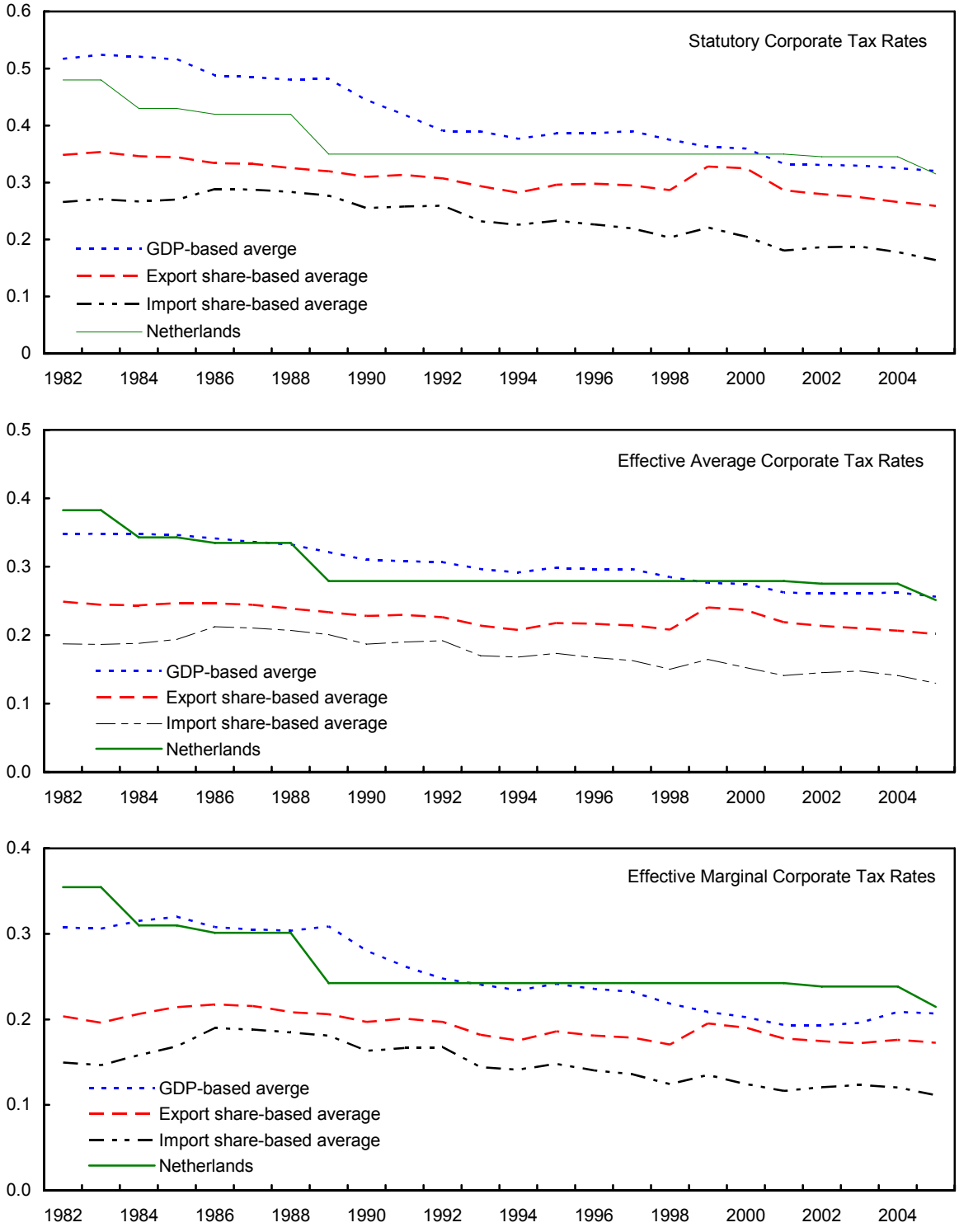
Source: OECD.

Table II-3. Selected Countries: Taxes on Property
(As percent of GDP)

	2000	2001	2002	2003	2004	2005	2006
Austria	0.6	0.6	0.5	0.6	0.6	0.6	0.6
Belgium	1.9	1.8	1.8	1.9	2.2	2.2	2.2
Czech Republic	0.5	0.5	0.5	0.5	0.4	0.4	0.4
Denmark	1.6	1.7	1.7	1.8	1.8	1.9	1.9
Finland	1.1	1.0	1.1	1.0	1.1	1.2	1.1
France	3.1	3.1	3.1	3.1	3.3	3.5	3.5
Germany	0.8	0.8	0.8	0.8	0.9	0.9	0.9
Greece	1.8	1.5	1.3	1.2	1.1	1.2	0.1
Hungary	0.7	0.7	0.7	0.8	0.8	0.8	0.8
Ireland	1.7	1.7	1.5	1.9	2.1	2.4	4.4
Italy	2.0	1.8	2.1	3.2	2.5	2.1	2.1
Luxembourg	4.1	3.8	3.1	2.9	3.0	3.3	3.4
Netherlands	**2.1**	**2.0**	**2.0**	**1.9**	**2.0**	**2.1**	**1.9**
Norway	1.0	1.0	1.1	1.1	1.1	1.1	1.2
Poland	1.0	1.2	1.4	1.3	1.3	1.3	-
Portugal	1.1	1.0	1.1	1.0	1.0	1.0	1.0
Slovak Republic	0.6	0.5	0.6	0.6	0.5	0.5	0.5
Spain	2.2	2.2	2.3	2.5	2.8	3.0	3.2
Sweden	1.8	1.6	1.6	1.6	1.6	1.5	1.5
Switzerland	2.8	2.7	2.6	2.4	2.5	2.4	2.4
United Kingdom	4.3	4.3	4.2	4.2	4.3	4.4	4.6
EU15: European Union of fifteen	2.0	1.9	1.9	2.0	2.0	2.1	2.2

Source: OECD.

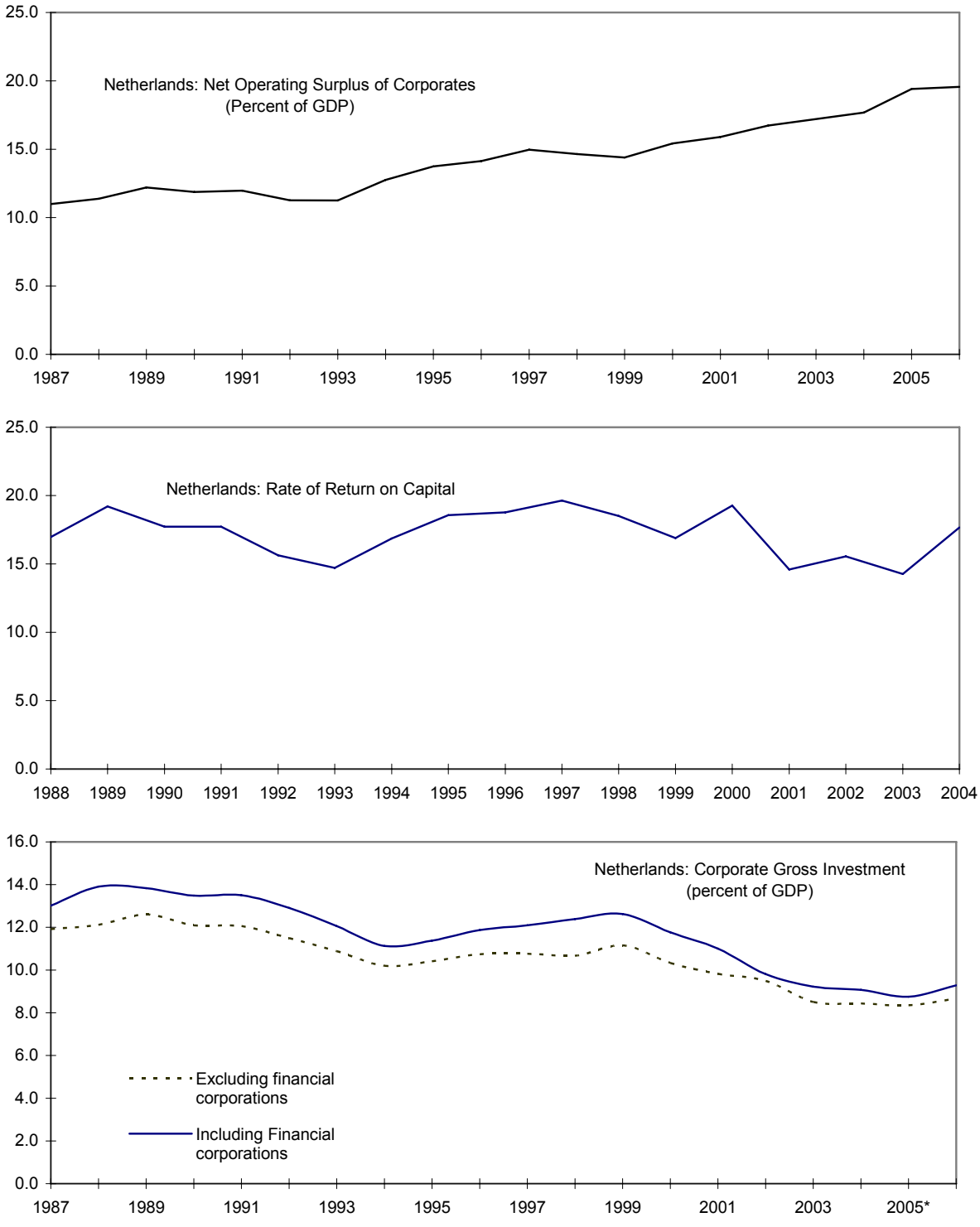
Figure II-1. Netherlands and Average of Selected European Countries: Tax Rates, 1982-2006 (in percent)1/



Source: Institute for Fiscal Studies.

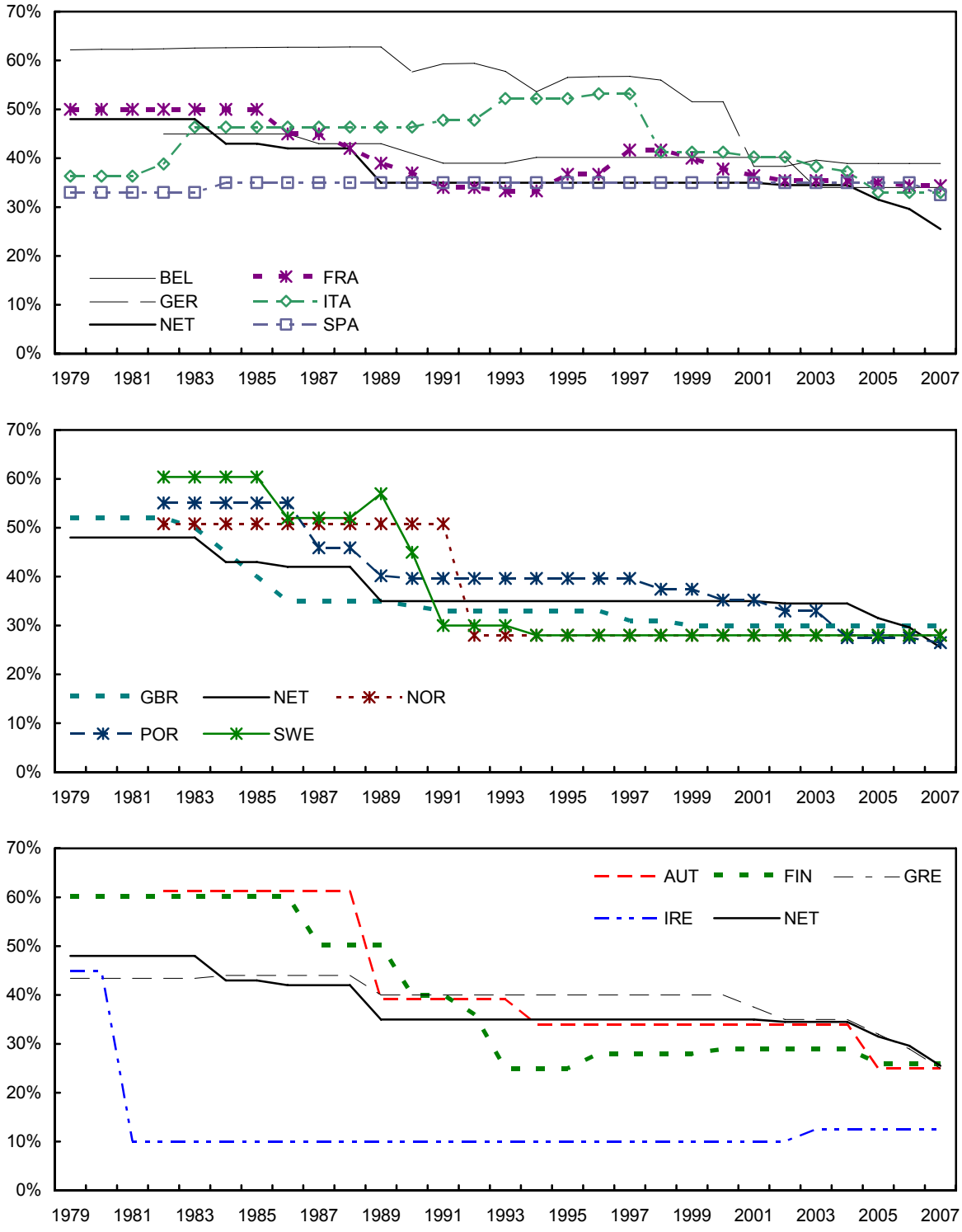
1/ The selected European countries are: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom.

Figure II-2. Netherlands: Factors Affecting Economic Base-Broadening



Source: OECD and Statistics Netherlands (CBS).

Figure II-3A. Selected Countries: Statutory Corporate Tax Rates, 1979-2007



Source: Institute for Fiscal Studies.

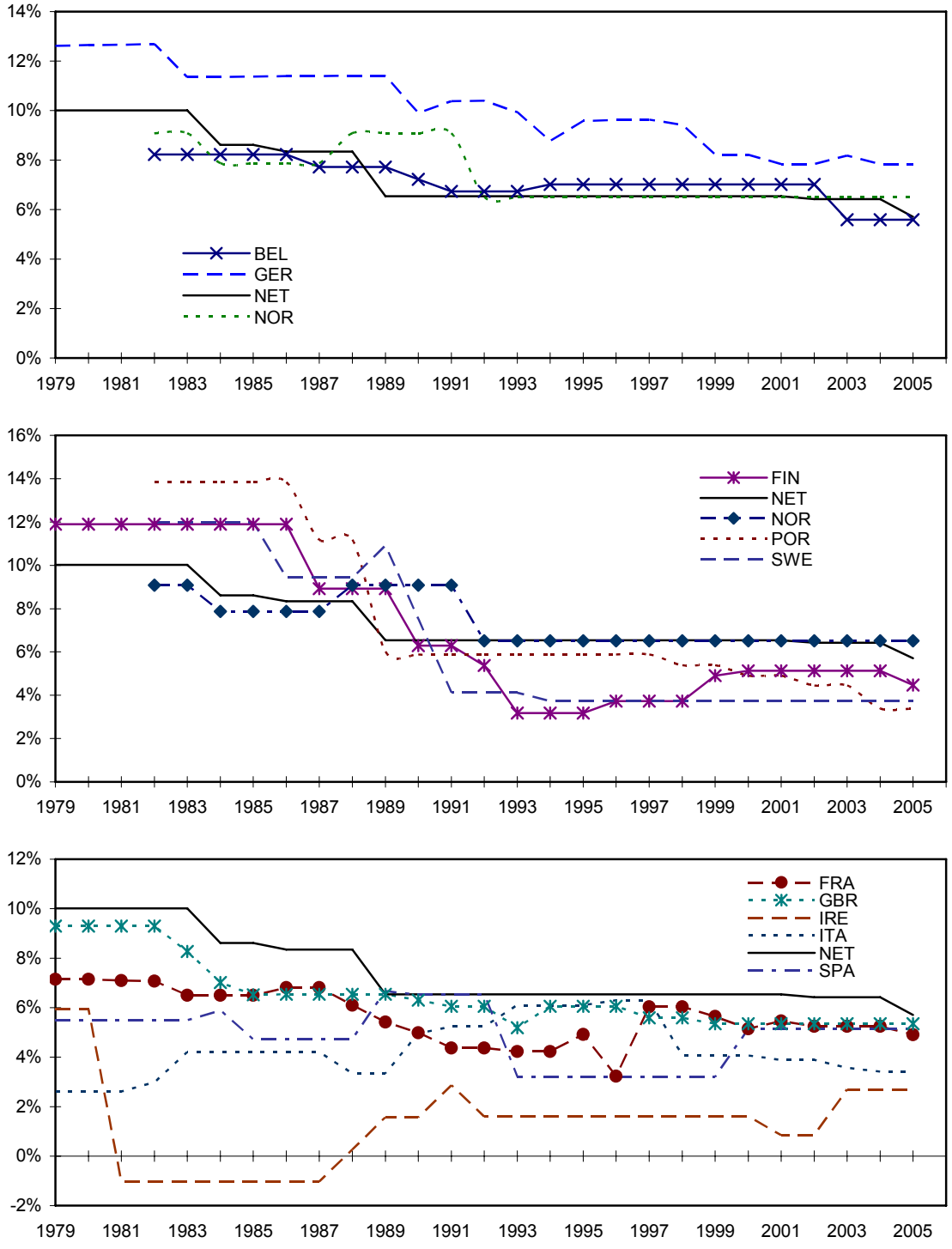
Figure II-3B. Selected Countries: Effective Average Corporate Tax Rate, 1979-2006

Constant prices, investment in plant and machinery, financed by equity or retained earnings.

Source: Institute for Fiscal Studies.

Figure II-3C. Selected Countries: Effective Average Corporate Tax Rate, 1979-2006

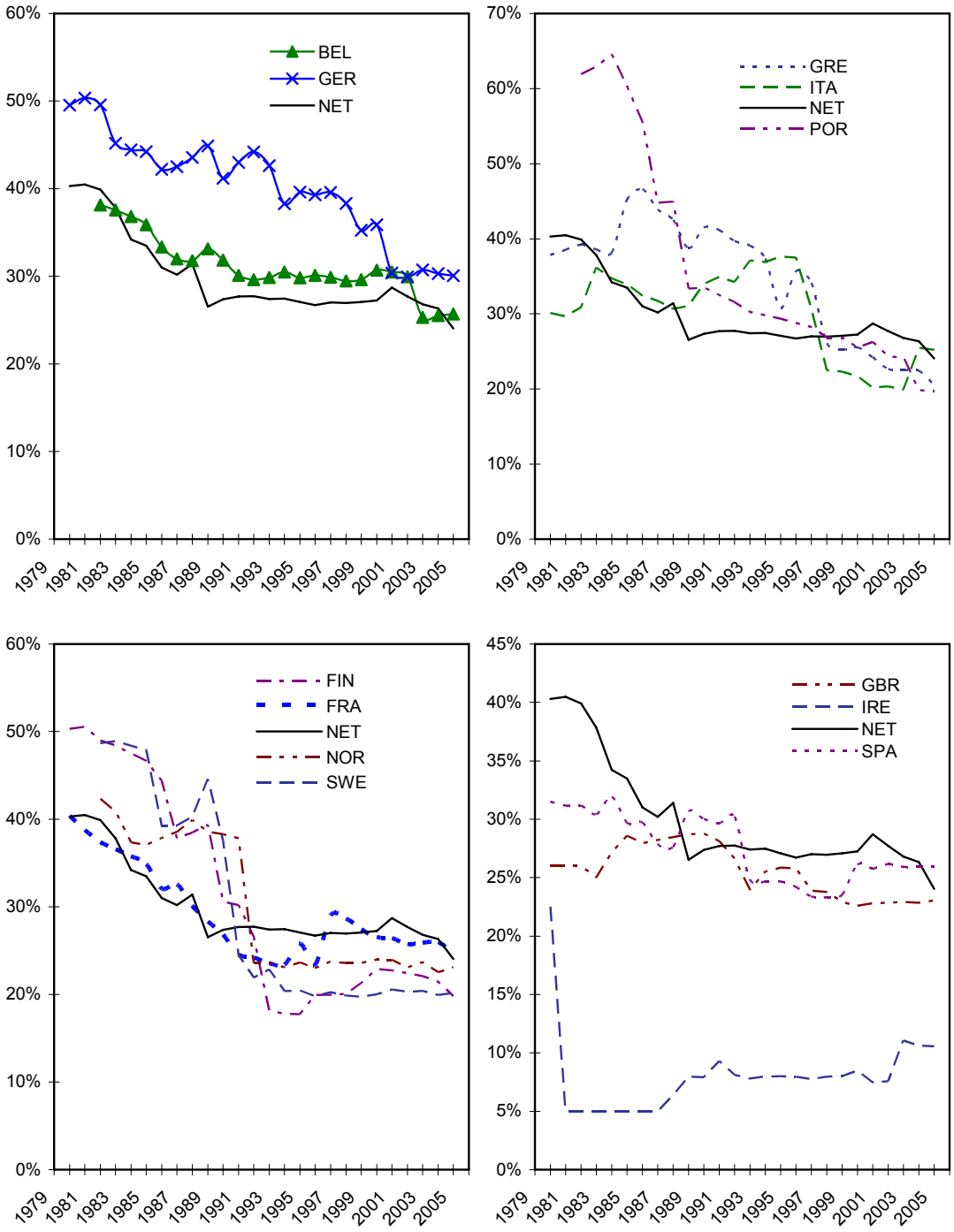
Constant prices, investment in plant and machinery, financed by debt



Source: Institute for Fiscal Studies.

Figure II-3D. Selected Countries: Effective Average Corporate Tax Rate, 1979-2006

Country specific current prices, investment in plant and machinery, financed by equity or retained earnings



Source: Institute for Fiscal Studies.

References

Benassy-Quéré, A. B., L. Fontagné, and A. L. Révil, 2003, "Tax Competition and Foreign Direct Investment," Working Paper No. 2003 – 17, CEPII.

Bettendorf, L., J. Gorter, and A. van der Horst, 2006, "Who Benefits From Tax Competition in the European Union?" CPB Document No. 125, Netherlands Bureau for Economic Policy Analysis (CPB).

Brøchner, J., J. Jensen, P. Svensson, and P. B. Sørensen, 2006, "The Dilemmas of Tax Coordination in the Enlarged European Union," Working Paper No. 1859, CESifo.

de Mooij, R. A., and G. Nicodème, 2008, "Corporate tax policy and incorporation in the EU," Discussion paper No. 97, Netherlands Bureau for Economic Policy Analysis (CPB).

de Mooij, R. A., and S. Ederveen, 2003, "Taxation and Foreign Direct Investment: A Synthesis of Empirical Research," *International Tax and Public Finance*, 10, pp. 673–693.

de Mooij, R.A., 2005, "Will Corporate Income Taxation Survive?" *De Economist,* 153, No. 3, pp. 277–301.

Devereux, M. P., B. Lockwood, and M. Redoano, 2004, "Do Countries Compete over Corporate Tax Rates?" Working Paper, No. 3400, CEPR.

Devereux, M. P., R. Griffith, and A. Klemm, 2002, "Corporate income tax reforms and international tax competition," *Economic Policy* 35, pp. 451–495.

Devereux, M. P., R. Griffith, and A. Klemm, 2004, "Why Has the UK Corporation Tax Raised So Much Revenue?" *Fiscal Studies*, Vol. 25, No. 4, pp. 367–388.

Fynatten, W., 2007, "European Holding Company Tax Regimes: A Comparative Study," *European Taxation*, Vol. 47, No. 12, pp. 562–570.

Haufler, A., and G. Schjelderup, 2000, "Corporate tax systems and cross country profit shifting," Oxford Economic Papers 52, pp. 306–325.

Haufler, A., and I. Wooton, 1999, "Country size and tax competition for direct investment," *Journal of Public Economics* 71, pp. 121–139.

Jacobs, B., R. A. de Mooij, and K. Folmer, 2007, "Analyzing a Flat Income Tax in the Netherlands," Working Paper No. 1890, CESifo.

Janeba, E., 1995, "Corporate income tax competition, double taxation treaties, and foreign direct investment," *Journal of Public Economics* 56, pp. 311–325.

Mendoza, E.G. and L.L. Tesar, 2005, "Why Hasn't Tax Competition Triggered a Race to the Bottom? Some Quantitative Lessons From the EU," *Journal of Monetary Economics* 52, pp. 163–204.

Nicodème, G., 2001, "Computing effective corporate tax rates: comparisons and results," MPRA Paper No. 3808, Munich Personal RePEc Archive.

Piatkowski, M.and M. Jarmuzek, 2008, "Zero Corporate Income Tax In Moldova: Tax Competition and Its Implications for Eastern Europe," Unpublished Working paper, IMF.

Redoano, M., 2007, "Fiscal Interactions Among European Countries. Does the EU Matter?" Working Paper No. 1952, CESifo.

Rhode, A., 2007, "Common Consolidated Corporate Tax Base: The State of the Art," *Tax Planning International Review,* No.11, pp. 9–14.

Sørensen, P. B., 2006, "Can Capital Income Taxes Survive? And Should They?" Working Paper No. 1793, CESifo.

Weichenrieder, A. J., 2005, "Why Do we need Corporate Taxation?" Working Paper No. 1495, CESifo.

Weichenrieder, A. J., 2007, "Profit Shifting in the EU: Evidence from Germany," Working Paper No. 2043, CESifo.