The determinants of German exports – an analysis of intra- and extra-EMU trade

Henriette Heinze*

30. October 2017

Abstract

Since the early 2000s German exports and net exports have grown persistently generating huge current account surpluses. These surpluses have added to immense current account imbalances within and outside the European Monetary Union (EMU). Contributing to the economic policy debate of whether it is foreign demand or 'world-beating' price competitiveness driving German exports the present paper econometrically investigates the determinants of German intra- and extra-EMU exports for the period 1995 to 2014. Therefore the long-term relationship between real exports, foreign activity and the real effective exchange rate using different explanatory variables is estimated in an error correction framework. We obtain three significant models for intra- and extra-EMU exports each. The results show that German exports are very sensitive to foreign activity. Germany has benefited from growth dynamics of trading partners and high income elasticities of demand for exports indicate strong non-price competitiveness. However, relative prices matter as well although the estimated coefficients vary with chosen variable and differ between intra- and extra-EMU exports. We find that the real exchange rate only explains 12% to 28% of our predicted export growth. Moreover, taking into account quantity and price effects caused by changes in the real exchange rate we observe contrary effects on real and nominal exports. Thus for the German economy it cannot simply be concluded that the real exchange rate is *the* indicator to focus on in explaining German export success.

Keywords: German exports, current account imbalances, competitiveness, single equation error correction model

JEL CLASSIFICATION SYSTEM: C22, E12, F14, F41, F43

---

*Contact: henrietteheinze@posteo.de. I would particularly like to thank Sabine Stephan, Eckhard Hein and Achim Truger for supervising my master's thesis and support.

1 Introduction

Having casted off the image of the 'sick man of the euro' (The Economist 1999) in the course of the recovery from the Great Recession, the German economy has become the outstanding example in the European Monetary Union (EMU) with above-average growth rates, a low unemployment rate and a high level of net exports. However, from the early 2000s until the financial and economic crisis 2008/09, Germany followed a neo-mercantilist strategy, characterised by low wage growth, weak domestic demand, rapidly rising trade openness, and a high contribution of net exports to GDP growth.[1] The country became highly dependent on foreign activity and moreover, has largely contributed to the development of massive and persistent current account imbalances in the euro area and in the world economy, both before and after the recent crises.

Explaining these imbalances and German current account surpluses, the focus has been in particular on international price and cost competitiveness, which many economists have rooted in diverging nominal unit labour costs (ULC) (Flassbeck/Lapavitsas 2013; Lapavitsas et al. 2010; Sinn 2014; Stockhammer 2011; Stockhammer/Onaran 2012). According to these views, current account surplus countries, Germany being the role model, have successfully improved their price competitiveness by wage moderation and/or high productivity growth. And excessive ULC growth has deteriorated price competitiveness and led to the accumulation of current account deficits in the counterpart countries. With respect to economic policy implications dealing with current account imbalances in the EMU, Stockhammer/Onaran (2012) suggest "inflationary rebalancing" which means that in the medium-term nominal wages in deficit countries should grow in line with the European Central Bank's inflation target of 2% whereas wages in surplus countries should grow well above this benchmark in order to share the adjustment burden. This would require higher overall inflation targets for the euro area. However, Sinn (2014) considers austerity policy and "open devaluation" as inevitable in order to (re-)install price competitiveness in Southern EMU member states, and also in France, which, according to him, have become too expensive since the introduction of the euro. In the core economies he proposes to let market forces work as to generate a demand boom and inflationary growth. The adjustment of inflation rates would thus structurally improve current account imbalances in the euro area. With respect

1 For a definition see Becker/Raza (2007).

to deficit countries also the European Commission (cf. 2010; 2011) or the International Monetary Fund (IMF) (cf. 2013; 2017) encourage cuts in nominal wages levels, reduce nominal wage growth and implement supply-side oriented structural reforms in order to improve price competitiveness and to reduce imbalances by promoting exports. EU members characterised by current account surpluses should in turn ensure that their export success also translates into stronger domestic demand in order to increase import demand (EU Commission 2010; 2017). In the Macroeconomic Imbalances Procedure (MIP) introduced in 2011 the EU Commission (2016) refers to a broad set of indicators, two indicators assessing the external performance of an economy focus on price competitiveness (real effective exchange rate and nominal unit labour cost index).

While the so-far mentioned authors predominately stress the relevance of price competitiveness and in particular of nominal unit labour costs in explaining export and import performances, a growing number of researchers (Danninger/Joutz 2007; Horn/Watt 2017; Schröder 2015; Simonazzi et al. 2013; Stockhammer/Hein/Grafl 2011; Storm/Nastepaad 2014) argues that non-price factors, domestic expenditure and foreign demand dynamics have played a far more important role in determining the development of trade balances and current accounts, particularly in Germany. According to them, demand for German (manufacturing) goods on the one hand and weak German import demand on the other hand, have largely contributed to the accumulation of the country's current account surplus. Even if relative prices were relevant too, it has been questioned whether the focus on nominal unit labour costs is suitable, because they are only one determining factor in firms' price setting (Feigl/Zuckerstätter 2012; Simonazzi et al. 2013; Storm/Nastepaad 2014). Moreover, if price elasticities were rather small or insignificant the Marshall-Lerner condition would not be fulfilled and the current account would not react normally to a change in the real exchange rate. This might limit or even reverse the effect of wage and exchange rate policies intended to combat current account imbalances.

Against the background of this debate the present paper seeks to shed some light on the determinants of German exports. There has been a variety of empirical work on German trade elasticities, but only a few early studies by Stahn (2006) and Stephan (2005) have estimated German exports distinguishing exports to EMU and to non-EMU countries. The current paper follows this approach and covers a more recent time period.

It investigates the impact of the real effective exchange rate and of foreign demand on German exports to countries in- and outside of the euro area for the period from 1995 to 2014. The regional breakdown allows identifying structural differences between the two trading regions. We suppose demand patterns and dynamics to be different between German trading partners in and outside the EMU, because the latter includes former Eastern bloc nations, as well as China and Brazil. These economies have rapidly built up their capital stock in the period under consideration and therefore should have increased demand in markets for which German production is highly specialised. Thus income elasticities of demand for German exports to these countries are expected to be very high. EMU member states share historical, cultural and economic commonalities and produce more comparable products or substitutes (Federal Statistical Office Germany 2010). We therefore assume relative prices to be more relevant for trade among EMU members, a result which was found by Stahn (2006) for German exports and by Bayoumi (2011) for an aggregate of euro area member countries. In addition to the econometric analysis we use our estimated elasticities and the actual growth of the relevant variables and calculate the contributions of foreign demand and the exchange rate to our predicted export growth in order to better identify the driving forces behind German exports in the period under consideration.

The paper is structured as follows. Section 2 takes a look at the development of key macroeconomic indicators between 1995 and 2014 and provides an overview of the German economic performance as compared to those of its most important trading partners. Section 3, reviews the empirical literature on German export equations before we present and discuss our estimation results and the contributions of demand and relative prices to the development of German exports to the EMU and extra-EMU countries. Section 4 concludes.

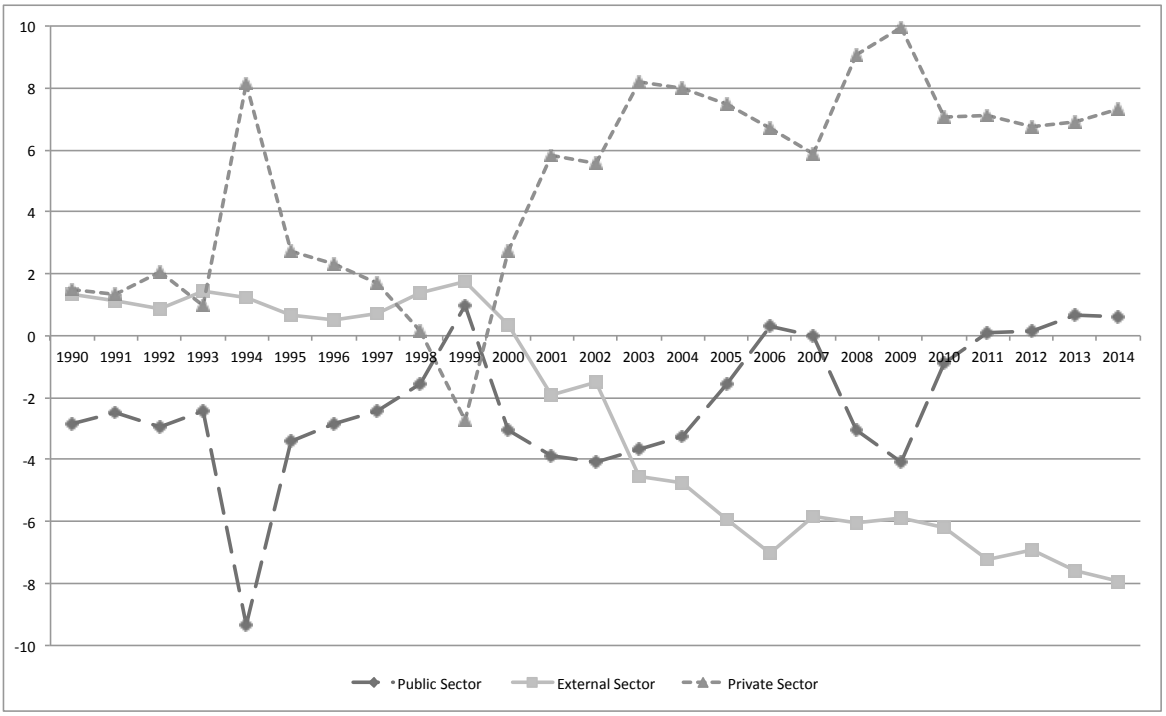
2 Macroeconomic indicators for imbalances of Germany in the world economy

This section first presents the development of the sectoral financial balances in Germany and secondly gives a brief overview of the German economic performance compared to that of the aggregated two trading groups consisting of EMU members on the one and

extra-EMU countries on the other hand. Hereby, the focus is on the period 1995 to 2014, the one also considered in the econometric estimations in section 3.

At first Figure 1 shows the characteristic development of sectoral financial balances of a country that has followed a mercantilist growth strategy since the introduction of the euro in 1999. The German private sector as a whole has accumulated net-savings indicated by a positive financial balance whereas foreign countries have gone into deficit since 2000, represented by a negative financial balance of the external sector. Weak private domestic investment activities, firms' accumulated retained earnings facilitated by extensive tax reforms in the early 2000s, wage moderation and a shrinking wage share, as well as a restrictive fiscal policy and rising net exports characterised the economic environment from 2000 until the financial and economic crisis 2008/09.[2] Since 1990 the public sector balance has been negative with the exception of 1999 and 2006/07 but has become positive since 2011 after the government had made use of its stabilising function during the recent crisis.

Figure 1 German sectoral financial balances as percentage of nominal GDP, 1990-2014.



Source: European Commission (2015), own calculations.

2 For more details on the causes of these developments and on the German macroeconomic strategy see for instance Detzer/Hein (2014); Dodig et al. (2016); Hein/Truger (2009).

Having sketched the development of the German sectoral financial balances in what follows the average growth rates of selected macroeconomic indicators are displayed in Table 1. It covers the overall time period for our examination, 1995-2014, and three sub-periods; the first is from 1995 to 1998, the second from 1999 the year of the introduction of the euro to 2007 the year preceding the financial and economic crisis, and the third period covers the years 2008 to 2014. As destinations for German exports we include the 23 most important trading partners in- and outside the EMU with a share in German exports of at least 1% (excluding United Arab Emirates; status as of 2014, Federal Statistical Office Germany 2015). Moreover, five additional euro area members with a share of less than 1% in German exports are taken into account.[3] In 2014, these 28 countries covered 85% of German exports of goods. In the period 1995 to 1998 the shares of exports to the EMU and extra-EMU countries were 44.4% and 40.3% respectively. From 1999 to 2007 and from 2008 to 2014 the share of exports to the EMU declined from 44.1% to 38.9% whereas the extra-EMU countries amounted to 42.7% and 45.9% respectively.

Table 1 Macroeconomic indicators for imbalances, average growth rates, 1995-2014.

	Germany	EMU	Extra-EMU
1995 - 2014			
Real GDP growth, %[1)]	1.31	1.64	2.73
Growth contribution of net exports to nominal GDP growth, percentage points[2)]	0.44	0.21	0.10
Net exports as share of nominal GDP, %[1)]	3.65	2.50	1.19
Growth of nominal unit labour costs, %	0.76	1.69	3.28
Inflation (growth rate of CPI), %	1.49	1.95	3.70
Growth rate of the nominal effective exchange rate, %	0.07	0.15	-0.88
Growth rate of the real effective exchange rate, (CPI-based) %[3)]	-0.92	0.01	0.47
1995 – 1998			
Real GDP growth, %[1)]	1.61	2.49	2.83
Growth contribution of net exports to nominal GDP growth, percentage points[2)]	0.21	0.09	-0.13
Net exports as share of nominal GDP, %[1)]	0.95	2.95	0.84
Growth of nominal unit labour costs, %	-0.20	0.94	4.84
Inflation (growth rate of CPI), %	1.42	1.99	5.70
Growth rate of the nominal effective exchange rate, %	-1.48	-0.69	-0.95
Growth rate of the real effective exchange rate, (CPI-based) %[3)]	-3.14	-1.17	2.69

3 The EMU aggregate consists of the following countries, whereas (a) signifies the five additional EMU-countries with less than 1 % share in German exports: Austria, Belgium, Finland (a), France, Greece (a), Ireland (a), Italy, Luxemburg (a), Netherlands, Portugal (a), Slovakia and Spain. The extra-EMU aggregate consists of: Brazil, China, Czech Republic, Denmark, Hungary, Japan, Norway, Poland, Romania, Russia, South Korea, Sweden, Switzerland, Turkey, United Kingdom and the United States of America.

Table 1 continued

1999 – 2007			
Real GDP growth, %[1)]	1.69	2.59	3.20
Growth contribution of net exports to nominal GDP growth, percentage points[2)]	0.82	0.12	0.13
Net exports as share of nominal GDP, %[1)]	3.65	2.36	0.85
Growth of nominal unit labour costs, %	-0.06	1.96	3.53
Inflation (growth rate of CPI), %	1.51	2.16	3.67
Growth rate of the nominal effective exchange rate, %	0.68	0.49	-1.24
Growth rate of the real effective exchange rate, (CPI-based) %[3)]	-0.34	0.57	0.20
2008 - 2014			
Real GDP growth, %[1)]	0.60	-0.19	1.99
Growth contribution of net exports to nominal GDP growth, percentage points[2)]	0.07	0.39	0.21
Net exports as share of nominal GDP, %[1)]	5.44	2.42	1.93
Growth of nominal unit labour costs, %	2.22	1.66	2.29
Inflation (growth rate of CPI), %	1.51	1.76	2.88
Growth rate of the nominal effective exchange rate, %	-0.04	0.08	-0.39
Growth rate of the real effective exchange rate, (CPI-based) %[3)]	-0.71	-0.20	0.19

Source: OECD (2015a), IMF (2015), World Bank (2015) from Macrobond; own calculations; Note: Greece weights since 2000; [1)] 1995-2013; [2)] extra-EMU 1996-2014; [3)] excluding Romania and Russia; Brazil since 1996. Information on data construction is provided in the appendix.

From Table 1 we get that the German economy has grown more slowly as compared to the two trading groups. In particular the extra-EMU aggregate including China, Brazil and former Eastern bloc economies with high rates of growth outperformed Germany and the EMU. Since the recent economic crisis, overall growth rates have been declining, particularly in the EMU. Although the growth contribution of net exports to GDP has been reduced and Germany has switched towards more domestic demand, during the whole period under consideration Germany's GDP growth was exceptionally dependent on foreign trade.[4] Notably, in the period after the introduction of the euro until the economic crisis, domestic demand has contributed little to GDP growth but net exports have to more than 0.8 percentage points on average. A similar pattern can be observed in the development of net exports as share of nominal GDP which has mostly been higher for Germany compared to its trading partners. In 2014 the share of German net exports in GDP exceeded the long-term average and was well above EMU and extra-EMU averages.

4 See Schröder (2015) for an analysis on the contribution of expenditures and expenditure switching to the imbalances in the EMU.

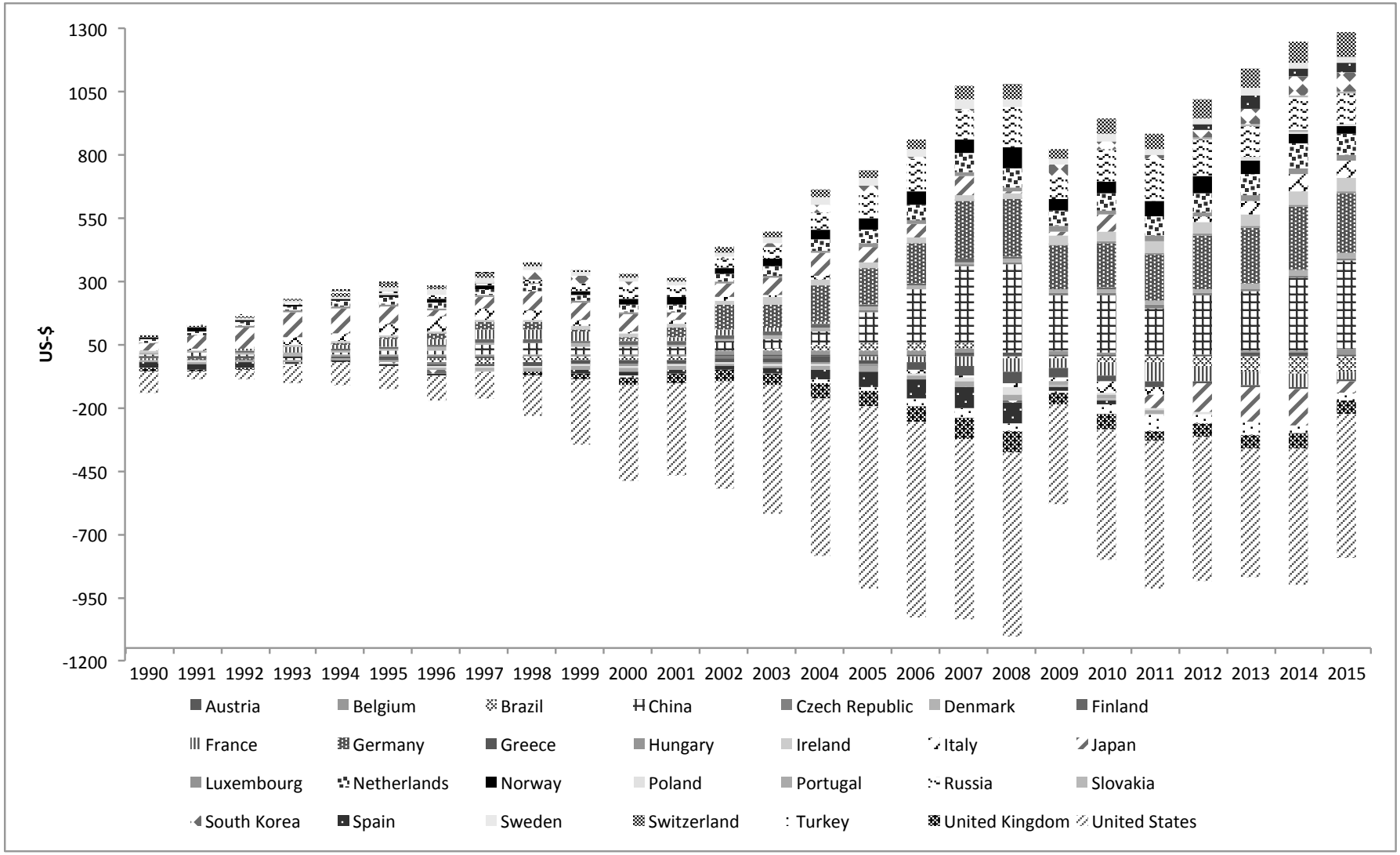
However, austerity policy in the course of the economic crisis has deteriorated domestic demand and import expenditure growth in many EMU member countries (Schröder 2015), so that their net export share in and growth contribution to GDP have increased. A similar development applies to the extra-EMU aggregate whose reliance on export growth has increased as well. Taking a look at Figure 2 that represents net exports of the here-considered economies shows indeed that trade deficits have been reduced since the recession and despite lasting imbalances among them there has been a shift towards positive net exports. However, this implies nothing else than a shift of deficits towards economies that are not taken into account here and global imbalances remain.

The development of Germany's nominal ULC reflects its mercantilist growth strategy. From 1995 until 2007 the average growth rate was negative and inflation fell short of the European Central Bank's target of below but close to 2%. Only since 2008 ULC growth has been positive, almost equal to the extra-EMU average and stronger than the EMU average. Deep wage cuts in EMU deficit countries in order to follow the above-mentioned goal of (re-)installing price competitiveness have decreased ULC growth.[5] (Dodig 2016; Hein et al. 2011; Horn/Watt 2017)

The short analysis has stressed that the EMU and extra-EMU aggregates, with faster ULC growth and higher contribution of domestic demand to GDP, have outperformed Germany with respect to GDP growth. The German growth strategy characterised by a high share of net exports in GDP and a high contribution to growth by net exports has made the country highly dependent on the external sector and economic performance of the trading partners. Particularly, this has become clear in 2008/09 when real GDP dropped by 5.6% and net exports shrank by 24.5% (IMF 2015; OECD 2015) in the course of the crisis. The real depreciation as measured by the CPI-based real effective exchange rate and relatively low ULC growth hint to improved price competitiveness in the period 1999 to 2007 which is in line with the arguments raised by advocates of the German competitiveness miracle. However, moderate wage growth and the positive private and now public sector balance are rather indicative for weak consumption demand and investment activity having resulted in modest import demand and which in turn has contributed to the accumulation of the German current account surplus.

5 Horn/Watt (2017) show that for the period 2000 to 2016 wages and not productivity dominated ULC movements.

Figure 2 Germany and trading partners, net exports to the rest of the world, 1990 – 2014, in billion US-Dollar



Source: OECD (2015), own representation. Note: Slovakia since 1992, Hungary since 1993, Greece, Russia since 1994, Brazil since 1995, Romania not included.

3 Estimating demand for German intra- and extra-EMU exports

Before turning to our own estimations of German intra- and extra-EMU exports we take a closer look at the empirical literature on key determinants of German export demand. Table 2 provides an overview of studies which together cover a long time horizon from 1960 to 2016 and reports the long-term income and price elasticities of demand for exports, the econometric method and region.

Generally, the results show a high sensitivity of German exports to foreign activity although the coefficients strongly vary with observation period, chosen variables, region or method. High income elasticities of demand for exports reflect strong non-price competitiveness and are characteristic for countries with product differentiation and specialisation in high-technology and complex products (McCombie 2011). Storm/Nastepaad (2014) identify non-price competitiveness as main contributor to Germany's export success. However, from Table 2 we also get that the impact of the real exchange rate approximated by various cost or price indices has mostly been found significant. However, again the magnitude highly depends on period and underlying variable.[6] Models including a real exchange rate based on relative ULC often provide lower price elasticities than models with an exchange rate based on a broader price index such as the CPI or GDP deflator that also cover other cost factors and the mark-up. At first sight this seems to support the argument that relative ULC might be less sound in explaining the performance of German exports.

6 Bayoumi et al. (2011) show the great divergence across different price measures in- and outside the euro area.

Table 2 Long-term elasticities of demand for German exports

Author (publication)	Frequency and period	Method	Region	Explained variable	Foreign demand	$\left(\frac{p_d}{p_f e}\right)$	Deterministic trend/ trade intensity
Clostermann (1998)	Quarterly 1975:1 – 1995:4	SEECM	RoW	G	world trade volume **0.79**	P_x/GDP deflator **-0.74**	
Bundesbank (1998)	Quarterly 1975:1 – 1997:2	SEECM	RoW	G	world trade volume **0.88**	deflators of total sales **-0.70**	
Strauß (2000)	Quarterly 1974:2 – 1999:4	SEECM	RoW	G + S	industrial production **1.55**	CPI **-0.58**	linear **0.002**
					GDP **1.34**	CPI **-0.39**	linear **0.003**
Strauß (2003)	Quarterly 1974:2 – 1999:4	SEECM	RoW	G +S	industrial production **1.34**	CPI **-1.00**	world trade intensity **0.41**
Meurers (2003)	Quarterly 1975:1 – 1999:4	JOH	RoW	G	industrial production **1.65**	P_x/CPI **-0.69**	
Allard et al. (2005)	Quarterly 1992:3-2004:3	SEECM	RoW	G	GDP **2.24**	ULC_m /GDP deflator **-0.32**	
				S	GDP **1.0**	CPI /GDP deflator **-0.81**	$start_{1991:1}$, $break_{2001:3}$ **0.003** **0.002**
Stephan (2005)	Quarterly 1981:1 – 2003:2	SEECM	Intra-EMU	G	industrial production **2.03**	CPI **-1.05**	
					fixed capital formation **0.72**	$REEV_{PIFC}$ **-0.37**	trade **0.57**
					investment in machinery and equipment **0.71**	$REEV_{PIMEQ}$ **-0.69**	trade **0.39**
Stahn (2006)	Quarterly 1980:3 - 2004:3	SEECM	Intra-EMU	G + S	export market trend **0.88**	deflators of total sales **-0.92**	
	Quarterly 1993:1 – 2004:3	SEECM	Intra-EMU	G + S	export market trend **0.98**	deflators of total sales **-0.32** (in)	
	Quarterly 1980:3 - 2004:3	SEECM	Extra-EMU	G + S	export market trend **0.81**	deflators of total sales **-0.63**	
	Quarterly 1993:1 – 2004:3	SEECM	Extra-EMU	G + S	export market trend **0.99**	deflators of total sales **-0.30**	

Table 2 continued

Danninger/ Joutz (2007)	Quarterly 1993:1 – 2005:4	JOH	RoW	G	global export demand/global investment **2.36**	ULC_m **-0.27**	
					global export demand / value added **0.77** / **-4.0**	ULC_m **-0.19**	
Stockhammer (2011)	Annual 1970 – 2005	SEECM	RoW	G + S	GDP **2.02**	P_x/P_m **-0.78**	
Storm/Nastepaad (2012)	Annual 1960 – 2000	OLS Cochrane-Orcutt AR(1)	RoW	G + S	world trade **0.99**	ULC **-0.12**	
Breuer/Klose (2013)	Quarterly 1995:1 – 2012:4	SURE system ECM	RoW	G + S	world demand **1.75**	GDP deflators **-0.82**	
					world demand / ULC / e **2.17** / **-0.77** / **-1.06**		
					world demand / CPI / e **2.47** / **0.36** (in) / **-0.82**		
Lebrun/Ruiz (2014)	Quarterly 1995:1 – 2013:3	Fully Modified OLS	RoW	-	export market trends **0.75**	deflators of total sales **-0.24**	linear **0.003**
Onaran/Galanis (2014)	Annual 1971 – 2007	SEECM	RoW	-	GDP **1.78**	P_x/P_m **-0.43**	
Storm/Nastepad (2014)	Quarterly 1996:2 – 2008:4	OLS Prais-Winsten AR(1)	RoW	-	GDP **2.79**	ULC **0.14 (in)**	
Onaran/Obst (2016)	Annual 1960 – 2013	SEECM	RoW	-	GDP **2.14**	P_x/P_m **-0.38**	
Horn/Watt (2017)	Quarterly 1980:1 – 2016:2	SEECM	RoW	G	global trade **1.1**	export goods deflators **-0.51**	

Note: German data prior to 1991 for West-Germany; AR(1): autoregressive model of order 1; CPI: consumer price index; e: nominal exchange rate; ECM: error correction model; G: goods; GFCF: gross fixed capital formation; in: insignificant elasticity; JOH: Johansen approach; OLS: ordinary least squares; P_d: domestic prices; P_x: export prices; P_m: import prices; $REEV_{PIFC}$: real effective external value based on prices of investment in fixed capital; $REEV_{PIFC}$: real effective external value based on prices of investment in machinery and equipment; RoW: rest of the world; S: services; SEECM: single equation error correction model; ULC: unit labour costs; ULC_m: unit labour costs in manufacturing.

Carlin et al. (2001) have examined the impact of ULC-based relative costs on the export market share for 14 OECD countries and concluded that German exports have been relatively insensitive to costs. Although the country has experienced an increase in relative prices, it has been able to enhance its export market shares. Apparently, Germany is an example of the 'Kaldor paradox' which was recently approved by Storm/Naastepad (2014). Storm/Nastepaad (2014) have estimated an insignificant ULC elasticity of only 0.14. As compared with other studies the price elasticity is very small. The authors assume a share of relative ULC in gross output prices of only 25 percent. They have calculated an average ULC elasticity based on different former research and argue that in the period 1996 to 2008 the development of relative ULC accounted to less than one percent of the actual increase in real exports. Likewise Danninger/Joutz (2007), two economists of the IMF, who have investigated the improvement of Germany's export market share since the 2000s vis-à-vis other industrialised economies, discover that the German competitive advantage due to low production costs has played a minor role. They have also obtained comparably low price elasticities based on relative ULC in manufacturing and argue that Germany's external performance has rather benefited from relations to fast growing trading partners and from a trend towards regionalised manufacturing in the export sector. In contrast, Breuer/Klose (2013), who have investigated German exports depending on different price indices and have decomposed the real exchange rate into a relative price term and the nominal exchange rate, have found a significant impact of relative ULC on exports which in magnitude is comparable with price elasticities provided in studies that include broader price measures.

Given these contradictory results, we want to compare directly the impact of the ULC- based exchange rate and an exchange rate based on a broader price index, the CPI. As mentioned before the CPI covers additional input costs and the mark-up and is therefore expected to explain more of the increase in German exports than relative ULC. Similar to Storm/Nastepaad (2014) we estimate the effect of the real effective exchange rate and calculate its share in explaining German export growth for a more recent time period. However, unlike Storm/Nastepaad we apply the commonly used error correction

method to determine the long-term relationship between exports, income and the real exchange rate in levels and not in growth rates.[7]

Furthermore, we are interested in structural differences in the equations for intra- and extra-EMU exports. Since there are only a few studies making this regional distinction for German exports (Stahn 2006; Stephan 2005) we seek to provide further and more recent estimation results.[8] Taking a look at Stahn's (2006) estimates for the long sample, the real exchange rate is significant and exports to the EMU react more sensitively to changes in relative prices than exports to non-EMU countries (-0.92 and -0.63 respectively). This is in line with the analysis by Bayoumi et al. (2011) who have tested extra- and intra- EMU exports for the aggregated euro area. Shortening the time period Stahn (2006) proves exports to be less price elastic. The effect of the exchange rate on intra-EMU exports even becomes insignificant. The author concludes that this is evidence for the dominance of EMU export market growth in determining German exports in the 1990s whose income elasticities are close to unity in the short and about 0.8 in the long sample. Taking export market trend as proxy for foreign demand Stahn (2006) has obtained income elasticities that do not differ much between the two trading regions. This is not what we expect insofar that varying structures in the demand pattern should be reflected in different income elasticities. Therefore we further investigate this issue in our own estimations.

Econometric Procedure, Unit Root and Cointegration Analysis

Likewise a large part of the empirical research (Table 2) we use error correction models to estimate the long-run relationship between exports, foreign demand and the real effective exchange rate. If two or more time series are co-integrated they can be modelled in an error correction framework representing meaningful economic behavioural relationships (Engle and Granger 1987).

Thus in a first step, Unit Root (UR) tests examine whether the time series are integrated of order one (I(1)). Provided the series have a UR, in a second step they are tested for co-integration. Primarily, the static two-step Engle-Granger approach is applied to find out whether the dependent (exports) and independent variables (GDP, gross fixed

7 In a recent study Boggio/Barbieri (2016) show that "export growth depends on levels of competitiveness factors […] rather than on their growth." (p.17)
8 Anderton et al. (2005), Bayoumi et al. (2011), Dieppe/Warmedinger (2007), Herrmann/Joebges (2008) have estimated intra- and extra- EMU imports or exports for the aggregated euro area.

capital formation, REER) form a long-run relationship.[9] As a second step, error correction models are used to estimate the long-term relationship between the dependent and the explanatory variables in levels and the short-run dynamics simultaneously. All variables are transformed into logs and so the coefficients can be interpreted as elasticities.[10] The estimation starts with four lags. Further lagged differences are added until autocorrelation is eliminated from the residuals. The Akaike information criterion is used for choosing lag length and impulse dummiesto account for outliers.[11] Since the co-integration relation is estimated non-linearly, the coefficients/elasticities can be interpreted directly and we obtain the correct t-statistics (Stephan 2005, chap. 4).

The Augmented Dickey Fuller tests indicate that all the time series under consideration are I(1). With regard to German exports of goods the two-step co-integration tests finds a long-term relationship between real exports, GDP or GFCF respectively. However, when adding the ULC-based REER the relationship does not necessarily persist. In these cases the CPI-based REER is chosen instead, for which the tests suggest a cointegration relationship. All test results are provided in the appendix (Table 5, Table 6).

Finally, we conduct different stability and specification tests for our estimation models. Besides the adjusted R^2 and the standard error of the regression we present the Durban-Watson statistic as indicator for autocorrelation, [12] the Jarque-Bera test for normal distribution of residuals (H_0: normally distributed residuals), the Cusum and Cusum^2 stability tests checking for parameter stability and two specification tests – the White test for heteroskedasticity and Ramsey RESET (Regression Specification Error Test) as general miss-specification test. In both cases H_0 must not be rejected.

Data

In the present paper quarterly data for the period 1995q1 to 2014q1 is used[13]. For most EMU members longer time series are available but not for all extra-EMU countries. Missing data were interpolated. Nominal exports of goods were deflated by an index of

9 A graphical representation of the development of exports, imports, foreign and domestic GDP and the ULC-based REER differentiating between the two trading groups can be found in the appendix.
10 EViews 8.0 was used for the econometric analysis.
11 Impulse dummies take on a value of one for the corrected quarter and zero otherwise.
12 DW≈2 means no or little autocorrelation, DW≈4 perfectly positive autocorrelation and DW≈0 perfectly negative autocorrelation.
13 If only annual data was available, the time series has been transformed into quarterly data in EViews.

export prices. With respect to EMU exports (X_{EMU}) a chained price index was constructed by using the index of export prices to EU members prior to the introduction of the Euro in 1999 and to EMU members afterwards. Likewise, a chained index of export prices to non-EU and extra-EMU countries was created for exports to the extra-EMU aggregate ($X_{Extra\text{-}EMU}$, $M_{Extra\text{-}EMU}$). The time series for exports are seasonally unadjusted whereas the explanatory variables are seasonally adjusted. The data were seasonally adjusted because for some countries only adjusted time series are available and because seasonal patterns differ between countries[14]. Centred seasonally dummies account for the seasonal pattern in real exports. Foreign demand is approximated by an export-weighted geometric GDP index for both EMU and extra-EMU countries. Additionally, to check the robustness of the results, a disaggregated activity variable based on gross fixed capital formation[15] was chosen, because a large part of German exports consists of capital goods and the variable was often used in previous estimations (Table 2). We expect a positive relationship between exports and foreign activity because growing export markets should increase the former. The real effective exchange rate (REER) based on relative ULC and the nominal effective exchange rate (NEER) approximates the development of relative prices. We estimate the effect of an increasing REER on exports (real appreciation) and assume a negative relationship between real exports and the REER. ULC are chosen as proxy since we assume prices to be determined by adding a mark-up on ULC in incompletely competitive goods markets. Moreover, relative ULC is the indicator mostly referred to in the debate on international price competitiveness as pointed out earlier. Moreover, a REER based on the broader CPI[16] ($REER_{CPI}$), was created. As mention above the CPI does not only account for additional input costs and the mark-up, and serves as indicator for international inflation differentials, moreover there is better data availability than for ULC. Data sources and the construction of variables can be found in the appendix.

Export Equations

In Table 3 we present the estimation results of three models for German goods exports to the EMU and the extra-EMU each that reproduce the cointegration reationship between German goods exports (X_{EMU}, $X_{Extra\text{-}EMU}$), foreign demand (GDP^{EMU}, $GFCF^{EMU}$, $GDP^{extra\text{-}}$

14 The time series have been seasonally adjusted in EViews with Census X-12.
15 China had to be excluded from the index due to a lack of data. Therefore new weights have been calculated in order to obtain the correct activity and price variable.
16 Due to a lack of data the non-harmonised CPI had to be chosen.

^{EMU}, $GFCF^{extra\text{-}EMU}$) and a real effective exchange rate based on CPI or ULC ($REER_{CPI,}$ $REEV_{ULC}$). In case of a significant trend, that accounts for the increasing division of labour belongs to the cointegration relationship, it is displayed too. The adjustment coefficient that has to be negative and significant for a cointegration relationship to prevail, is also reported. The short-term dynamics are not reported because we are interested in long-run relations. Table 4 presents the respective test statistics for our models.

Table 3 Long-term estimation results for German exports to the EMU and extra-EMU countries and test statistics

	Model 1 EMU	Model 2 EMU	Model 3 EMU	Model 1 extra-EMU	Model 2 extra-EMU	Model 3 extra-EMU
Adjustment coefficient	-0.87 (-8.14)	-0.81 (-8.14)	-0.72 (-5.79)	-0.42 (-5.43)	-0.52 (-5.33)	-0.45 (-4.9)
ln GDP_{t-1}	2.62 (24.09)			1.76 (22.8)		
ln $GFCF_{t-1}$		1.38 (25.64)	1.18 (18.42)		0.95 (6.32)	1.18 (7.19)
ln $REEV_{ULCt-1}$		0.61 (3.66)		-0.70 (-4.92)	-0.74 (-6.29)	
ln $REEV_{CPIt-1}$	-3.06 (-4.78)		-1.13 (-1.55)			-0.68 (-4.76)
trend	-0.006 (7.3)	0.007 (13.69)			0.006 (7.47)	0.006 (6.37)
Adjusted R^2	0.9	0.89	0.9	0.71	0.69	0.65
Standard error of regression	0.017	0.017	0.022	0.024	0.020	0.026
Durban-Watson statistic	2.1	2.01	1.84	2.33	2.18	2.07
Test on normality of residuals (Jarque-Bera)	[0.27]	[0.86]	[0.89]	[0.3]	[0.44]	[0.64]

Table 3 continued

White test	[0.05]	[0.79]	[0.12]	[0.66]	[0.53]	[0.22]
RESET test	[0.90]	[0.45]	[0.83]	[0.11]	[0.03]	[0.001]
CUSUM/CUSUM^2	stable	stable	stable	stable	stable	stable

Note: t-values are presented in parenthesis. The marginal significance levels are reported in square brackets. GDP: gross domestic product; GFCF: gross fixed capital formation; $REER_{ULC}$: unit labour cost based real effective exchange rate; $REER_{CPI}$: consumer price index based real effective exchange rate

First of all, it has to be acknowledged that our observation period is quite short. Besides the limitation of 77 observations, the period was characterised by two economic crises – the burst of the dot-com bubble in March 2000 and the deep financial and economic crisis starting in 2008/2009 – that produced many outliers.

However, our estimation models explain the data quite well. According to the Durban-Watson and Jarque-Bera criteria our residuals are free from autocorrelation and almost normally distributed. The CUSUM tests indicate parameter stability. In Model 1 on intra-EMU exports the White test rejects the H_0 of no heteroskedasticity/homoscedasticity at the 5 % significance level causing inefficient estimators and wrong standard errors. This might be a reason for the very high elasticities, in particular the implausible price elasticity and the negative trend in this model. In Model 2 on extra-EMU exports the RESET test rejects H_0 at the 5 % level and in Model 3 the RESET test indicates model misspecification of general type. However, we report the estimation output because the results are in line with other models.

The six estimation models have a negative and highly significant adjustment coefficient. The error correction mechanism ensures that 42% to 90% of the adjustment has taken place after one quarter. Likewise previous research our point estimates vary largely in dependence on incorporated variables.

The impact of foreign demand on German exports

The activity variables are highly significant and have the correct sign. With regard to German goods exports to the EMU the income elasticities (ε) range from 1.18 to 2.62. The more fluctuating GFCF expresses the long-term relationship between exports and demand of the EMU better than GDP. This is in line with Stephan (2005) who has also compared a set of different explanatory variables. However, our income elasticity with respect to EMU GFCF is somewhat higher also in comparison to the results found by Stahn (2006). For German exports to the group of extra-EMU countries ε varies from 0.95 to 1.76. For extra-EMU exports a long-run relationship between exports and GDP could be modelled more easily. This might be due to the fact that in this group of countries GDP has grown more dynamically than in the EMU (Table 1). Approximating foreign demand by GFCF our income elasticity of demand for extra-EMU exports is comparable to those provided by Stahn (2006). Interestingly and in line with Stahn's study, we do not identify considerably differing income elasticities for intra- and extra-EMU exports. This is particularly true comparing Model 3 on EMU exports and Model 3

on extra-EMU exports that incorporate the same explanatory variables. For the here-considered observation period we cannot verify our initial assumption that income elasticities differ due to different trade structures and dynamics when ε is approximated by gross fixed capital formation.

However, overall we confirm other studies and highlight that German exports are dominated by foreign demand. The models incorporating GFCF approve that German exports are very sensitive to foreign demand for capital goods (Stephan 2005). Moreover, if we take income elasticities as indicator for specialisation in goods for which world demand is growing fastest (McCombie 2011), German manufacturers with their specialisation in highly complex and high-quality products and relations to dynamically growing trading partners seem to have a strong competitive advantage. Storm/Nastepaad (2014) have used an alternative method by conducting a constant market share analysis and come to similar conclusions. German non-price competitiveness is reflected by the high structural effect and according to the authors exporters have "concentrated on building up manufacturing non-price competitiveness" (Storm/Nastepaad 2014, p. 14).

Impact of the real exchange rate on exports

Model 1 and 3 on German exports to the EMU show the expected negative relation between real exports and the CPI-based REER and take on values of -3.06 and -1.13 whereby relative prices in Model 3 have no significant impact on exports. Moreover, the first model provides an unreasonably high coefficient of -3.06 which is not in line with any other study. Aggregation problems could account for this due to the use of GDP as activity variable together with a broad price index like the CPI (Stephan 2005; 2007). However, the CPI has been used frequently for econometric modelling and has never produced such high elasticities. Our Model 3 also contains the CPI-based exchange rate and together with GFCF as proxy for foreign activity provides an appropriate result. Model 2 on intra-EMU exports shows a positive long-term relationship between exports and the ULC-based REER which is not reasonable. Storm/Nastepaad (2014) have also estimated a positive elasticity of 0.14 which is however insignificant and very small, whereas Breuer/Klose (2013) in their decomposed treatment of the real exchange rate have found a positive influence of the relative consumer price index but also a stronger negative effect of the nominal exchange rate. Certainly, the ULC-based exchange rate is not the most suitable variable for modelling German goods exports to the EMU.

Sometimes no cointegration relationship could be detected or has been destroyed when the variable was added or we obtain the wrong sign (Model 2). This might be due to the fact, that in Germany other costs are more important for firms' price setting than ULC particularly in the manufacturing sector (Storm/Nastepaad 2014; Feigl/Zuckerstätter 2012).

However, turning to German exports to the extra-EMU all estimated price elasticities are significant and range from -0.68 to -0.74. Given that the price elasticities are lower than one, nominal exports increase by roughly 0.3%, positively affecting the current account, ceteris paribus. Seemingly there is a quite stable relationship between real goods exports to this group of countries irrespective of whether the exchange rate is based on relative ULC or the CPI. Our estimated values are broadly in rage with the estimates provided by Stahn (2006) for extra-EMU exports in the long sample. We also find exports to the extra-EMU to be less price elastic than exports to the EMU. However, compared to other studies using an ULC-based exchange rate (Allard et al. 2005; Danninger/Joutz 2007; Storm/Nastepaad 2014) our elasticity is somewhat higher.

In order to better evaluate the impact of demand and the exchange rate in the following part we calculate their shares in our predicted export growth and compare it to former research results.

The contributions of demand and prices to export growth

Table 4 now displays the contributions of foreign demand and the real effective exchange rate to our predicted export growth. The underlying assumption of our calculation is that only these two factors explain exports and other factors are omitted so that the shares add to 100%. This is not very realistic but in first place we want to figure out the relative strength of the two influencing variables in determining German exports because they are in the centre of the economic policy debate described before.

Table 4 Percentage shares of real income and the real effective exchange rate in predicted growth of German exports, 1995q1 – 2014q1.

Destination	Actual export growth, volume in %	Model	Explanatory variables (x_1, x_2)	Predicted increase in exports, volume in %	Share of x_1 and x_2 in predicted exports, in %	
					x_1	x_2
EMU	96.2	1	GDP, $REER_{CPI}$	126.4	71.8	28.2
		3	GFCF, $REER_{CPI}$	36.5	100.0	in.
Extra-EMU	204.2	1	GDP, $REER_{ULC}$	135.2	87.5	12.5
		2	GFCF, $REER_{ULC}$	72.3	75.2	24.8
		3	GFCF, $REER_{CPI}$	77.9	86.7	13.3

Note: in.: insignificant variable; x_1: activity variable; x_2: real effective exchange rate; actual growth of variables in volume terms is provided in the appendix Table 7.

Table 4 shows that our predicted export growth underestimates the actual development. However, we get an insight about the relative relevance of the two explanatory variables and confirm that German exports to both trading regions are dominated by the development of foreign demand. The real exchange rate explains only about 28% of our predicted export growth to the EMU and 13% to 25% of exports to the extra-EMU countries. Given the fact that we exclude other determining factors these shares are higher than those calculated by Danninger/Joutz (2007). They show that total demand explains 65% of their predicted export growth whereas the exchange rate based on relative ULC only amounts to 1.8% and the rest is explained by domestic value added. According to Storm/Nastepaad (2014) relative ULC account for less than one per cent of the development in actual not the predicted export growth to the rest of the world. If we calculated the contribution of our real exchange rates to the actual development of exports to the EMU we would obtain a share of 37% and shares of 5% to 9% for extra-EMU exports.[17] This further indicates that the exchange rate is more relevant for intra-EMU exports and matters only marginally for extra-EMU exports. Our analysis shows that it can be useful to make a regional distinction between intra- and extra-EMU trade.

17 We should keep in mind that our estimated price elasticity with respect to exports to the EMU is quite high and that our overall model overestimates the actual development. The actual contribution of the exchange rate is therefore supposed to be smaller.

4 Conclusions

The present analysis of Germany's economic performance and its exports in particular has questioned the obsession with price competitiveness in international trade. In order to adequately analyse the relevance of relative prices for the German export success we have estimated the long-term relationship between goods exports, foreign activity and the real exchange rate. Together with the actual development of the relevant variables we have calculated their contribution to the predicted export growth to the EMU and the extra-EMU aggregate. We have shown that estimated elasticities are quite sensitive to the underlying indicator and according to our observation the focus on ULC seems misleading when it comes to the evaluation of the German competitive advantage vis-à-vis trading partners in the EMU. Moreover, in Model 3 on intra-EMU exports we obtain an insignificant price elasticity, although we have included a broader price measure. In contrast to exports to the EMU, we identify a quite stable relationship between German exports to the extra-EMU and the real exchange rate irrespective of the chosen indicator. However, given that our price elasticities are lower than unity, nominal exports positively affect the German current account, ceteris paribus. So if the Marshall-Lerner condition was not or only barely fulfilled, exchange rate policies would not have the desired effects on the current account. Moreover, having calculated the shares of the real exchange rate in our predicted export growth to the EMU and the extra-EMU we figured out that it only contributed 28% to German intra-EMU goods exports and even less, 12% to 24%, to German extra-EMU exports. Hence, improved price competitiveness explains the German export miracle only to a quite limited extent. Furthermore, we support previous studies by showing that the real exchange rate is less relevant for German exports to trading partners outside the EMU. Thus in order to adequately evaluate the impact of the real exchange rate on exports, it can be useful to make a regional distinction.

On the contrary, we demonstrate that German exports are predominantly determined by foreign income demand and have benefitted from growth dynamics of its trading partners in- and outside the EMU. The high income elasticities of demand for exports reflect strong non-price competitiveness of German exporters given their specialisation in technologically advanced and high-quality products for which world demand was growing fast. Nevertheless, opposing our initial assumption, differing demand patterns of the two trading regions are not reflected in our income elasticities of demand for German exports.

Finally the example of the German economy and its export success highlights the relevance of accounting for both, price and non-price factors, and for a country's capability to meet demand for products characterised by a high income elasticity of demand for exports. The sole focus on price competitiveness is not justified given its limited explanatory power of the German export performance.

References

Allard, C., Catalan, M., Everaert, L., Sgherri, S. (2005): Explaining differences in external sector performance among large Euro area countries, IMF Country Report No. 05/401, International Monetary Fund, Washington D.C.

Anderton, R., di Mauro, F., Moneta, F. (2004): Understanding the impact of the external dimension on the euro area: trade, capital flows and other international macroeconomic linkages, ECB Occational Paper Series No. 12/April 2004, European Central Bank: Frankfurt a. Main.

Bayoumi, T., Harmsen, R., Turunen, J. (2011): Euro area export performance and competitiveness, IMF Working Paper 11/140, International Monetary Fund, Washington D.C.

Becker, J., Raza, W. (2007): Zur Einführung: was ist Neo-Merkantilismus heute?, Kurswechsel: Zeitschrift für gesellschafts-, wirtschafts- und umweltpolitische Alternativen, 3-7.

Boggio, L., Barbieri, L. (2017): International competitiveness in post-Keynesian growth theory: controversies and empirical evidence, Cambridge Journal of Economics, 41 (1), 25-47.

Breuer, S., Klose, J. (2013): Who gains from nominal devaluation? An empirical assessment of Euro-area exports and imports, Working Paper 04/2013, German Council of Economic Experst, Wiesbaden.

Carlin, W., Glyn, A., van Reen, J. (2001): Export market performance of OECD

countries: an empirical examination of the role of cost competitiveness, The

Economic Journal, 111(468), 128-162.

Clostermann, J. (1998): Folgt der deutsche Außenhandel einer J-Kurve?, Allgemeines Statistisches Archiv, Zeitschrift der Deutschen Statistischen Gesellschaft, 82 (2): 198-219.

Danninger, S., Joutz, F. (2007): What explained Germany's rebounding export market share?, IMF Working Paper 07/24, International Monetary Fund, Washington D.C.

Deutsche Bundesbank (1998): Wechselkursabhängigkeit des deutschen Außenhandels, Monatsbericht Januar 1998: 49-60.

Detzer, D., Hein, E. (2014): Financialisation and the financial and economic crisis –The case of Germany, IPE Working Paper 44/2014, Institute for International and Political Economy, Berlin.

Dodig, N., Hein, E., Detzer, D. (2016): Financialisation and the financial and economic crises: theoretical framework and empirical analysis for 15 countries, in: Hein, E., Detzer, D. Dodig, N. (eds.) Financialisation and the Financial and Economic Crises: Country Studies, Cheltenham: Edward Elgar.

The Economist (2013): Dissecting the miracle, from 15.06.2013, accessed on 03.09.2017, available at: http://www.economist.com/news/special-report/21579145-ingredients-german-economic-success-are-more-complex-they-seem-dissecting.

Engle, R.F., Granger, C.W.J. (1987): Co-integration and error correction: representation, estimation, and testing, Econometrica, 55(2), 251-276.

European Commission (2010): Surveillance of intra-euro-area competitiveness and imbalances, Directorate General for Economic and Financial Affairs No. 1, Brussels.

European Commission (2011): Schlussfolgerungen der Staats- und Regierungschefs der Mitgliedsstaaten des Euro-Währungsgebiets vom 11. März 2011.

European Commission (2016): The macroeconomic imbalance procedure – rationale, process, application: a compendium, Institutional Paper 039, European Commission, Brussels.

European Commission (2017): Country report Germany 2017, Including an in-depth review on the prevention and correction of macroeconomic imbalances, Comission staff working document, SWD (2017) 71 final, European Commission, Brussels.

Feigl, G., Zuckerstätter, S. (2012): Wettbewerbs(des)orientierung, Materialien zu Wirtschaft und Gesellschaft, no. 117, Chamber of Labour (AK), Wien.

Flassbeck, H., Lapavitsas, C. (2013): The Systematic Crisis of the Euro – true causes and effective therapies, Studien der Rosa-Luxemburg-Stiftung, Berlin.

Federal Statistical Office Germany (2010): Export, Import, Globalisierung. Deutscher Außenhandel und Welthandel 1990 bis 2008, Federal Statistical Office (destatis), Wiesbaden.

Federal Statistical Office Germany (2015): Außenhandel, Rangfolge der Handelspartner im Außenhandel der Bundesrepublik Deutschland 2014, Federal Statistical Office (destatis), Wiesbaden.

Hein, E., Truger, A. (2009): How to fight (or not to fight) a slowdown, Challenge, 52(3): 52-75.

Hein, E., Truger, A., van Treeck, T. (2011): The European financial and economic crisis: alternative solutions from a (post-) Keynesian perspective, IMK Working Paper 9/2011, Macroeconomic Policy Institute (IMK), Düsseldorf.

Herrman, E., Joebges, H. (2008): Euro area exports and imports: Do determinants of intra- and extra-EMU trade differ?, IMK Working Paper 8/2008, Macroeconomic Policy Institute, Düsseldorf.

Horn, G., Watt, A. (2017): Wages and nominal and real unit labour cost differentials in EMU, 2017 Fellowship Initiative Papers, Discussion Paper 059, European Commission, Brussels.

International Monetary Fund (2013): Spain, 2013 Article IV Consultation, IMF Country report 13/244, International Monetary fund, Washington D.C., accessed on 13.6.2015, available at: https://www.imf.org/external/pubs/ft/scr/2013/cr13244.pdf.

International Monetary Fund (2017): Multi country report. 2017 external sector report – individual economy assessment, July 2017, International Monetary Fund (IMF), Washington, D.C.

Lapavitsas, C., Kaltenbrunner, A., Lindo, D., Michell, J., Painceira, J.P., Pires, E., Powell, J., Stenfors, A., Teles, N. (2010): Eurozone crisis: beggar thyself and thy neighbour, RMF Research on Money and Finance, March 2010.

Lebrun, I., Ruiz, E.P. (2014): Demand patterns in France, Germany, and Belgium: can we explain differences?, IMF Working Paper 14/165, International Monetary Fund, Washington D.C.

McCombie, J.S.L. (2011): Criticisms and defences of the balance-of-payments constrained growth model: some old, some new, PSL Quarterly Review, 64 (259): 353-392.

Meurers, M. (2003): Estimating supply and demand functions in international trade: a multivariate cointegration analysis for Germany, Journal of Economics and Statistics, 224(5).

Onaran, Ö., Galanis, G. (2014): Income distribution and growth: a global model, Environment and Planning, A 2014(46).

Onaran, Ö., Obst, T. (2016): Wage-led growth in the EU15 member-states: the effects of income distribution on growth, investment, trade balance and inflation, Cambridge Journal of Economics 2016(40).

Schröder, E. (2015): Eurozone imbalances: measuring the contribution of expenditure switching and expenditure volumes 1990-2013, The New School for Social Research Working Paper 08/215, New School for Social Research, New York.

Simonazzi, A., Ginzburg, A., Nocella, G. (2013): Economic relations between Germany and southern Europe, Cambridge Journal of Economics, 37 (3), 653-675.

Sinn, H.-W. (2014): Austerity, Growth and Inflation: Remarks on the Eurozone's Unresolved Competitiveness Problem, The World Economy, 37(1), 1-13.

Stahn, K. (2006): Has the impact of key determinants of German exports changed? Results from estimations of Germany's intra euro-area and extra euro-area exports, Economic Studies, Discussion Paper 07/2006, Deutsche Bundesbank, Frankfurt a. Main.

Stephan, S. (2005): Modellierung von Mengen und Preisen im deutschen Außenhandel, Dissertation, Freie Universität Berlin.

Stirböck, C. (2006): How strong is the impact of exports and other demand components on German import demand? Evidence from euro-area and non-euro-area imports, Discussion Paper 39/2006, Series 1: Economic Studies, Deutsche Bundesbank, Frankfurt a. Main.

Stockhammer, E. (2011): Peripheral Europe's debt and German wages. The role of wage policy in the euro area, Research on Money and Finance, Discussion Paper 29.

Stockhammer, E., Hein, E., Grafl, L. (2011): Globalization and the effects of changes in functional income distribution on aggregate demand in Germany, International Review of Applied Economics, 25(1): 1-23.

Stockhammer, E., Onaran, Ö. (2012): Rethinking wage policy in the face of the euro crisis. Implications for the wage-led demand regime, International Review of Applied Economics, 26(2), 191-203.

Storm, S., Naastepad, C.W.M. (2012): OECD demand regimes, in: Macroeconomics Beyond the NAIRU, Cambridge, Mass.: Harvard University Press, chap. 5, 112 – 166.

Storm, S., Naastepad, C.W.M. (2014): Crisis and recovery in the German economy: the real lessons, Working Group on the Political Economy of Distribution Working Paper No. 2, Institute for New Economic Thinking.

Strauß, H. (2000): Eingleichungsmodelle zur Prognose des deutschen Außenhandels, Kiel Working Paper 987, The Kiel Institute of World Economics.

Strauß, H. (2003): Globalisierung und die Prognose des deutschen Außenhandels, Journal of Economics and Statistics, 223(2): 176-203.

Appendix

Data sources and construction of variables

Section 2

The macroeconomic indicators for the EMU (excluding Germany) and extra-EMU aggregates are calculated as geometric indexes or weighted averages. Growth contribution of net exports of goods and services to nominal GDP growth and net exports of goods and services as share of nominal GDP are weighted averages. The aggregates of real GDP, NEER, REER, CPI (inflation) are geometric indexes. The weights are based on total sales (X+M). Statistical series are on annual basis, except for the ULC which were converted from quarterly data.

Net exports	OECD (2015a), EO 97, net exports of goods and services, value, National Accounts.
Real GDP	IMF (2015), IFS, National Accounts, expenditures/real GDP, volume, constant prices; WB WD, economic policy & debt, National Accounts, US$ at constant 2005 prices, Aggregate Indicators, GDP, Constant Prices, USDI: BR, CN, CZ, RU, SK, GE
Growth contribution of net exports to GDP growth	OECD (2015a), EO 97, net exports, contribution to growth in GDP, estimate
Net exports as share of nominal GDP	WB (2015), WDI, National Accounts, external balance as share of GDP
Inflation, CPI growth rate	WB (2015), WDI, CPI, 2010=100
REER, CPI	IMF (2015), IFS, exchange rate, fund position & intern. liquidity, exchange rates, NEER from INS; OECD, EO, REER, constant trade weights, estimate: TR;
NEER	IMF (2015), IFS, exchange rate, fund position & intern. liquidity, X-Rates, NEER from INS
ULC	see sources variables chapter 4

Section 3

For data comparability and consistency for the construction of a variable data was preferably used from one source. If only annual data was available, the time series was transformed into quarterly data in EViews. The variables/time series for Germany, the EMU and extra-EMU aggregates are calculated as geometric indexes.

The ULC-based REER for exports is measured as German nominal ULC relative to export-weighted foreign nominal ULC multiplied by the export-weighted nominal effective exchange rate (NEER foreign currency/€). In case of imports foreign and German ULC interconvert and the NEER is import-weighted. If data for ULC was not available a WPI (BR, RU) or PPI (CN, RU, TR) was used instead. The CPI-based REER is constructed the same way.

Exports of goods	German Federal Statistical Office (destatis), Foreign Trade, Countries, Exports in EUR
GDP, EMU, extra-EMU	IMF (2015), IFS, national accounts, expenditures/real GDP volume; OECD (2015b), MEI, GDP constant prices, 2010 price levels & PPPs, USD: IR; National Statistics Office Romania, GDP, total, constant prices: Ro
GFCF	OECD (2015b), MEI, gross fixed capital formation, index (2010=100); OECD, EO, GFCF, estimate, index: CZ, SK, TR; OECD (2014), EO 96, GFCF, estimate, constant prices, RUB: RU; Eurostat (2015), AMECO, GDP main components (ESA 2010), volumes, GFCF: GR, IR, RO; WB, WDI, economic policy & debt, national accounts, local currency at constant prices, expenditure on GDP, GFCF, BRL: BR
ULC	OECD (2015b), MEI, early estimates of ULC total economy; OECD (2015), EO 97, ULC in total economy, estimate: AT, CH, CZ, BE, IR, NL, PL
WPI	OECD (2015), MEI, Wholesale price index total economy: BR; WB, WDI, exchange rate & prices: RU
PPI	OECD (2015), MEI, domestic PPI, industrial activities: CN, RU, TR
CPI	OECD (2015), MEI, CPI all items; OECD, EO CPI: BR; DG ECFIN, AMECO, consumption, CPI: RO
NEER	IMF (2015), IFS, exchange rate, fund position & intern. liquidity, exchange rates, NEER from INS
Export price index	Federal Statistical Office (2004) (2015), foreign prices, provided by Statistical Office, department Außenhandelspreise.

Table 5 Augmented Dickey-Fuller test

	Levels			First Differences		
Variables	Deterministic	Lags	Test Statistics	Deterministic	Lags	Test Statistics
ln X_{EMU}	C, t, csd	2, 9	-1.58	C, csd	1	-4.58***
ln $X_{Extra-EMU}$	C, t, csd	1, 9	-2.37	C, csd	9	-6.12***
ln REER, exports, EMU	C, t	2	-0.81	C	1	-4.93***
ln REER, exports, Extra-EMU	C, t	1, 3	-3.5	-	1, 3	-6.48***
ln GDP, EMU	C, t	1, 4, 8	-0.14	C	-	-3.62***
ln GDP, Extra-EMU	C, t	1,4,5	-2.99	C	4, 8	-5.07***
ln GFCF, EMU	C, t	1, 3, 8	-1.22	C	3	-4.23***
ln GFCF, Extra-EMU	C, t	1	-2.67	C	-	-5.07***
Ln REER, exports, Extra-EMU, excl. CN	C, t (no t)	1, 3	-3.39 (-3.41)	C (no c)	3	-6.53*** (-6.49)***
ln $REER_{CPI}$, exports, EMU	C, t, csd	6	-0.45	C, csd	2	-6.17***

*** (**,*) significance at a 1% (5%, 10%) level; Note: c: constant, csd: centred seasonal dummies, t: deterministic trend.

Table 6 Co-integration test

explained variable	explaining variable	URT residuals	
		lag	t-value
ln X_{EMUt}	ln GDP_t, csd, t	2	-4.69***
	+ ln $REER_t$	1	**-2.93**
	ln GDP_t, csd, t, ln $REER_{CPIt}$	2	-4.69***
	ln $GFCF_t$, csd, t	1	-4.47**
	+ ln $REER_t$	2	-4.59**
	ln $GFCF_t$, csd, t, ln $REER_{CPIt}$	2	-4.45**
ln M_{EMUt}	ln GDP_t csd (t)	1, 4	**-2.55 (-2.6)**
	+ ln $REER_t$	1, 4	**-2.82**
	ln GDP, csd, t, ln $REER_{CPIt}$	1, 4	**-2.57**
	ln X_t, csd, t, ln $REER_t$	7	-5.13***
	ln $EQUIP_t$, csd, t	2, 4	-5.26***
	+ ln $REER_t$	1, 4	-2.8
ln $X_{EXTRA-EMUt}$ (incl. CN)	ln GDP_t, t, csd	2	-3.93**
	+ln $REER_t$	4	-4.43**
ln $X_{EXTRA-EMUt}$ (excl. CN)	ln $GFCF_t$, ln $REER_t$, t csd	4	-4.31**
ln M_{EXTRA_EMUt}	ln GDP_t, t, csd	1	**-1.57**
	+ln $REER_t$	2	-4.65**
	ln GDP_t, csd, ln $REER_{CPIt}$	2, 6	-4.54**
	ln $EQUIP_t$, csd, t, ln $REER_t$	2, 3, 4	-6.48***
	ln $EQUIP_t$, csd, t, ln $REER_{CPIt}$	2, 3, 4	-6.47***
	X_t, ln $REER_t$, csd	2, 6	-4.91***
	X_t, ln $REER_{CPIt}$, t, csd	2, 6	-4.87***

***(**) indicate significance at the 1% (5%) level

Table 7 Growth of exports, GDP, GFCF and REER from 1995 q1 to 2014 q1, volumes, in %.

	EMU	Non-EMU
German exports of goods	96.2	204.2
GDP	34.6	67.2
GFCF	31.0	57.2
$REER_{ULC}$, export-weighted	-20.2	-24.2
$REER_{CPI}$, export-weighted	-11.7	-17.1