Online Appendix

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September 13, 2021

This appendix provides supporting information for the article "The Launch of EMU and German Export Interests". Table A1 summarizes the empirical estimates of the price elasticity of German exports in the literature. The review surveys 34 studies that provide in total 70 estimates. The large majority of estimates reports a statistically significant, negative relationship between price changes and changes in exports. Moreover, most of the estimated coefficients are below 1. Comparing these results to studies that look at a large number of countries, both the direction and the size of the German estimates are roughly in line with the average price elasticity of exports reported across countries (see, for instance, Bussière, Gaulier, and Steingress, 2020).

Most of the contributions reviewed in Table A1 do not explicitly account for non-price competitiveness (NPC) factors, which might imply that they suffer from an omitted variable bias. Thus, Table A2 surveys studies that examine the role of the NPC of German exports, with a focus on those studies that compare the results for NPC with the results for the PC of German exports. These studies underscore the high technological sophistication of Germany's exports and their high NPC elasticity, suggesting that NPC is more important for German exports than PC. However, some studies that focus on the post-reunification period (until the Great Recession) find that there was a relative decline in NPC over this period and that the export boom since the mid-1990s is therefore explained by relative improvements in PC and not by NPC.

A cautionary note: Both tables show that the estimates stem from a great variety of empirical approaches that use different statistical specifications, measures, and time periods. A qualitative assessment of these different approaches or a more sophisticated meta-analysis goes beyond the scope of this study. Thus, I simply draw conclusions based on the consistency of empirical results across the various empirical approaches.

Table A1: Review of empirical estimates of price elasticity of German exports.

Article	Frequency	Time period	Estimator	Estimate	Measurement
Magnier and Toujas-Bernate (1994)	Annual	1979-1987	ECM	-0.77	RPEXP
Amable and Verspagen (1995)	Annual	1970-1991	ECM	NS	RULC
Aiginger (1997)	Annual	1992	OLS	EU: -0.82; USA: -1.25	UVexp/UVimp
Deutsche Bundesbank (1997)	Quarterly	1975q1-1995q4	ECM	-0.87	Px/Pm
Clostermann (1998)	Quarterly	1975q1–1995q4	ECM	-0.74	Px/GDP deflator
Deutsche Bundesbank (1998)	Quarterly	1975q1–1997q2	ECM	-0.70	Deflators of total sales
Strauß (2000)	Quarterly	1975q1–1999q4	ECM	-0.58; -0.39	CPI
Carlin, Glyn, and Reenen (2001)	Annual	1976-1992	FD	-0.12; -0.24	RULC
Stephan and Vega-Gordaliza (2002)	Quarterly	1985q3-2001q3	ECM	EU: -1.04	REER/CPI
Meurers (2004)	Quarterly	1975q1-1999q4	VECM	-0.69	Px/CPI
Allard et al. (2005)	Quarterly	1992q3-2004q3	ECM	-0.32; -0.81	MULC/GDP deflators; CPI/GDP deflators
Stephan (2005)	Quarterly	1981q1-2003q2	ECM	EU: -1.05	CPI
	Quarterly	1981q1-2003q2	ECM	EU: -0.37	REEVpifc
	Quarterly	1981q1-2003q2	ECM	EU: -0.69	REEVpimeq
Deutsche Bundesbank (2006)	Annual	1981-2005	ECM	-1.02	Deflators of total sales
Stahn (2006)	Quarterly	1980q1–2004q3	ECM	EU: -0.92; -0.63	REER/deflators of total sales
	Quarterly	1993q1–2004q3	ECM	EU: NS; -0.30	REER/deflators of total sales
Danninger and Joutz (2008)	Quarterly	1993q1–2005q4	VECM	-0.42; -0.14	REER/ULC
OECD (2010)	Annual	1994-2007	Dynamic OLS	-1.94	RULC (DV: EXPC/EXPMC)
	Annual	1994-2007	Dynamic OLS	-1.24	RULC (DV: EXPNC/EXPMNC)
	Annual	1994-2007	Dynamic OLS	-5.34	RPEXP (DV: EXPC/EXPMC)
	Annual	1994-2007	Dynamic OLS	-3.48	RPEXP (DV: EXPNC/EXPMNC)
Stockhammer, Hein, and Grafl (2011)	Annual	1970–2005	FD	-0.78	Px/Pm
	Annual	1970–1987	FD	-0.67	Px/Pm
	Annual	1987–2005	FD	-1.24	Px/Pm
Onaran and Galanis (2012)	Annual	1971–2007	FD	-0.43	Px/Pm
Storm and Naastepad (2012)	Annual	1960–2000	FD	-0.12	RULC
Thorbecke and Kato (2012)	Quarterly	1980q2–2011q1	Dynamic OLS	-1	REER/CPI
	Quarterly	1980q2–2009q3	Dynamic OLS	-0.64	REER/CPI

Breuer and Klose (2013)	Quarterly	1995q1–2012q2	SURE ECM	-0.82	REER/ULC
European Commission (2014)	Quarterly	1994q1–2014q1	Fractional VECM	-0.81	REER/export prices
Lebrun and Ruiz (2014)	Quarterly	1995q1-2013q3	Fully modified OLS	-0.24	Deflators of total sales
Onaran and Galanis (2014)	Annual	1971-2007	ECM	-0.43	Px/Pm
Aiello, Bonanno, and Via (2015)	Quarterly	1990q1-2012q1	MGE	-0.67	REER
Storm and Naastepad (2015)	Quarterly	1996q2–2008q4	FD	NS	RULC
Giordano and Zollino (2016)	Quarterly	1993q2-2012q4	ECM	-0.26; -0.24	PPI; (control: RTFP)
	Quarterly	1993q2-2012q4	ECM	-0.32; -0.30	CPI; (control: RTFP)
	Quarterly	1993q2-2012q4	ECM	-0.26; -0.24	GDP deflators; (control: RTFP)
	Quarterly	1993q2-2012q4	ECM	-0.37; -0.34	MULC; (control: RTFP)
	Quarterly	1993q2-2012q4	ECM	-0.32	ULC
Onaran and Obst (2016)	Annual	1960-2013	ECM	-0.38	Px/Pm
Baccaro and Benassi (2017)	Annual	1971-2014	FD	-0.86; -0.40	Px/Pm; REER/ULC
Horn and Watt (2017)	Quarterly	1980q1-2016q2	ECM	-0.51	Export goods deflators
Bussière, Gaulier, and Steingress (2020)	Annual	1995-2012	FD	-0.36	Bilateral NEER
	Annual	1995-2012	FD	-0.39	Bilateral NEER (fixed effects)
	Annual	1995-2012	FD	-0.35	Bilateral NEER (2-step approach)
	Annual	1995-2012	FD	-0.44	Bilateral NEER (control: inflation)
Frenkel and Zimmermann (2020)	Quarterly	1992q1-2016q4	VECM	-0.43	REER/RMULC
	Quarterly	1992q1-2016q4	VECM	-0.75	REER/RMULC (control: R&D)
	Quarterly	1992q1-2016q4	VECM	-0.68	REER/RMULC (control: EP)
	Quarterly	1992q1-2016q4	VECM	-0.69	REER/RMULC (control: FDI)
	Quarterly	1992q1-2016q4	VECM	-0.60	REER/RMULC (control: DVA)
	Quarterly	1992q1-2016q4	VECM	-0.43	REER/RMULC (control: EP, DVA)
Neumann (2020)	Quarterly	1995q1-2014q1	ECM	EU: NS; -0.70	REER/ULC (control: $GFCF_{t-1}$)
	Quarterly	1995q1-2014q1	ECM	EU: 0.61; -0.52	REER/ULC (control: GDP_{t-1})
Baccaro and Tober (2021)	Annual	1999-2014	FD	EU: -0.84	Relative nominal wages

Notes: Trade with rest of world if not stated otherwise. CPI=consumer price index; DV=dependent variable; DVA=domestic value added as a percentage of total production; (V)ECM=(vector) error correction model; EP=energy prices; EXPC=capital goods exports; EXPMC=export market for capital goods; EXPMNC=export market for non-capital goods; EXPNC=non-capital goods exports; FD=first differences; GDP=gross domestic product; GFCF=gross fixed capital formation; NS=not significant; MGE=mean group estimator; NEER=nominal effective exchange rate; OLS=ordinary least squares; PPI=producer-price indicators; Pm=import prices; Px=export prices; R&R=research and development expenditure; REER=real effective exchange rate; REEVpifc=real effective external value based on prices of investment in fixed capital; REEVpimeq=real effective external value based on prices of investment in machinery and equipment; RPEXP=relative export prices; SURE=seemingly unrelated regression equations; (R)TFP=(relative) total factor productivity; (R/M)ULC=(relative/manufacturing) unit labor costs; UV(exp/imp)=unit value (exports/imports).

Table A2: Review of empirical estimates of non-price competitiveness (NPC) vs. price competitiveness (PC) of German exports.

Article	Time period	Measure of NPC	Finding
Magnier and Toujas-Bernate (1994)	1979-1987	R&D1, IR	NPC is more important for export gains than PC. Model results suggest that "significant efforts in R&D and investment would cause gains of +2.2 percent and +1.5 percent, respectively, while the contribution of price competitiveness would only reach +0.7 percent" (p. 515).
Amable and Verspagen (1995)	1970-1991	RPAT1, IN	Study finds neither statistically significant long-run effects of NPC nor PC for Germany. Analysis suggests, however, sectoral differences (across countries), with statistically significant results for PC in supplier- and some science-based sectors and NPC (mainly RPAT1) across a broader range of sectors.
Deutsche Bundesbank (2006)	1981-2005	FDIA, RPAT2	NPC played a statistically significant (only FDIA; RPAT2 not statistically significant) but negligible role for Germany's real world market shares. In contrast, improvements in PC explain a large share of the export boom since 1995. For the relative contributions of NPC and PC, see the figure on page 31.
OECD (2010)	1994-2007	RPAT2	NCP explains about two-fifths of the increase in capital good exports between 1993 and 2000. Since 2000, however, NPC did not contribute to export increases and even declined in relative terms since 2003, contributing to a decline in capital good exports. In contrast, Germany made significant improvements in PC between 2000 and 2007. Thus, "[i]mprovements in the cost-competitiveness of German firms contributed to growing exports in recent years, which was more than offset by losses in non-price-competitiveness" (p. 113). For the relative contributions of NPC and PC on an annual basis, see Figure 5.4 on page 114.
Giordano and Zollino (2016)	1993q1-2012q4	RTFP	The elasticity of NPC is larger than 1, which is larger than in Italy (approximately 1), but lower than in Spain (approximately 3). The elasticity of PC is also statistically significant but smaller. Hence, both PC and NPC explain German exports, but NPC is the more important determinant.

Frenkel and Zimmermann (2020)	1992q1-2016q4	FDIO; R&D2	NPC is not a statistically significant predictor of German exports. In contrast, PC is a highly statistically significant and important driver of Germany's exports.
Gräbner et al. (2020)	1999/2000-2016/7	ECI, PCI	Germany has highest absolute value of NPC among euro countries and a strong focus on complex high-tech products, which it exports disproportionally relative to the country's share in total world trade. Germany has sustained technologically dominant role over time.
Xifré (2021)	2000-2018	Unexplained residuals in export growth equations	Germany has improved its NPC in absolute terms, in particular in the period before the Great Recession (2008). Most gains were made in the production of capital goods. However, Germany is not exceptional in this regard. The gains in NPC before 2008 were even larger in Italy, the Netherlands, and Spain (but weaker in France).

Notes: For measure and estimate of PC, see Table A1. ECI=index of economic complexity; FDIA=direct investment abroad as percentage of global direct investment stocks; FDIO=Germany's outward foreign direct investment stock deflated by the GDP deflator of euro area; IN=ratio of investment to production divided by the average value of this ratio for all countries; IR=investment rate (gross fixed capital formation/value added, in current prices) of Germany divided by the average investment rate of France, Japan, UK, and USA (weighted by their respective exports towards OECD), smoothed by averaging on the three last years; PCI=production complexity index; R&D1=research and development expenditures of Germany (in current prices and converted into a common currency using purchasing power parity exchange rates) divided by the total of of France, Japan, UK, and USA, smoothed by averaging on the three last years; R&D2=Germany's gross expenditure on research and development as a percentage of GDP relative to gross expenditure on R&D as a percentage of GDP of OECD total; RPAT1=share of each country in the total patents for each sector relative to the mean of all countries' shares; RPAT2=number of new patents registered by German firms in comparison with that of the rest of the world; RPAT3=relative patents per million population (3-year moving average); RTFP=relative total factor productivity.

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