PRELIMINARY DRAFT

A Comparative Study on the Role of Non-Price Competitiveness for European Countries

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Abstract

The export performance of an industrial economy is influenced by its competitive position in terms of price and non-price factors. However, operationalizing and understanding non-price competitiveness (NPC) poses challenges. Moreover, existing empirical evidence on the impact of NPC remains inconclusive and fragmented. This study aims to address these issues by examining the consistency and validity of established empirical measures of NPC within a European context. I employ both indirect approaches and NPC proxy measures to econometrically assess the NPC contribution to explaining export growth. The analysis is based on a dataset encompassing 10 major European countries over the period 1995-2019, using the workhorse model of the empirical export equation. Through this investigation, I find that a mathematically derived and residual-based indicator proves to be valuable due to its ability to consistently separate price and non-price effects on exports. The Economic Complexity Index emerges as the only NPC proxy measure that significantly contributes to explaining exports, while other proxies demonstrate their usefulness primarily in a descriptive and complementary manner.

Keywords: non-price competitiveness, export equation

JEL classification: C670, F120, F410, L160

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1. INTRODUCTION

Huge trade imbalances represent one of the key symptoms of the economic crisis in the Eurozone starting back in 2008.[1] The search for the deep-rooted causes and appropriate recovery strategies revived the already long-standing competitiveness debate (Krugman, 1994). Conceptually, competitiveness is divided into two parts: the first one is price or cost competitiveness expressed by the real effective exchange rate adjusted by export prices or by unit labour cost (D'Adamo, 2017). The second component is referred to as non-price competitiveness (NPC), which encompasses "the sum of all factors other than prices and cost that impact on trade performance" (Balta et al., 2009, p.21). This concept covers manifold supply and demand side characteristics, which, in their entirety, cannot be observed in a direct way. Since there is no single overarching indicator, NPC is mostly considered as that residual part of export dynamics, that cannot be explained by changes in cost competitiveness (Emlinger et al., 2019).

Given that already the theoretical concept and the empirical assessment is not straightforward, the factor frequently got neglected (Xifré, 2021). Researchers are often left to narratives built around indirect evidence obtained from empirical export functions. Such indirect NPC indicators include income elasticities (Thirlwall, 1986; Bottega & Romero, 2021) and residual-based measures (Żogola, 2010; Xifre, 2021). Other attempts to account for NPC focus on identifying statistical powerful proxy measures (Fagerberg, 1988; Athanasoglou & Bardaka, 2010; Giordano & Zollino, 2016; Romero & McCombie, 2018; Bottega & Romero 2021). Although these approaches provide additional information in specific cases, the overall evidence appears to be scattered and far from conclusive. Moreover, methodological contributions on how to empirically approach the matter are scarce.

I address this topic by reviewing different indicators and generating comparative evidence. For this purpose, I reproduce several established macroeconomic measures of non-price competitiveness for a set of 10 Eurozone countries over the period 1995 - 2019. The study generates new evidence on how the export performance of individual countries has been influenced by differences in non-price competitiveness. By doing so I show how single NPC approaches contribute to form a consistent narrative and how valuable these measures are in the overall assessment. The specific contribution is to analyse whether there are preferred methods to account for a country's non-price competitiveness in empirical tasks.

The paper is divided into four chapters. In chapter 2 surveys how NPC is conceptualised and operationalised in recent empirical literature and checks the logical consistency of the individual approaches. Chapter three presents econometric evidence.

[1] The various interpretations of the Eurozone crisis are already well documented and described. For a recent overview see the introductive section in Xifré (2021).

The first part of this chapter focusses mainly on estimated and calculated indirect measures of NPC on country basis while direct proxies of NPC and their statistical power are analysed in the second part. These proxies of NPC will be introduced as additional arguments in a panel regression model of the standard export equation. Chapter 4 aims to connect the outcomes of the different empirical tasks, providing an extensive survey on the NPC stance of major European countries. A recap of the main findings and an outlook are presented in the concluding Chapter 5.

2. NON-PRICE COMPETITIVENESS

2.1 Conceptualisation

Non-price competitiveness is defined as the multi-dimensional entirety of factors not connected to prices that shapes the demand as well as the supply side of the economy.[2] Many researchers identify the technological dimension as the decisive one (Fagerberg, 1996; D'Adamo, 2018). For example, McCombie & Thirlwall (1994) report survey findings indicating that technological factors are the most important features of non-price competitiveness, particularly for the export of manufactured goods. These factors include product and production-related characteristics such as quality, durability, practicality, reliability, design, innovativeness, adaptivity, uniqueness, efficiency, and after-sales services. The underlying assumption is that importers and foreign consumers have a preference for superior technological attributes, which is reflected in their tastes. Thus, the idea of NPC is directly connected to the concept of utility and the resulting willingness to pay. Many of the factors contributing to non-price competitiveness are subjectively valued and are challenging to directly observe at an aggregated macroeconomic level. Another dimension of non-price competitiveness encompasses structural factors that impact productive activities, such as research and development expenditure, management capabilities, human capital, infrastructure, taxation, education, and financial conditions (German Council of Economic Experts, 2022). Unlike prices and costs, non-price competitiveness cannot be directly observed. Inferences about the level of non-price competitiveness or its effect on exports are often drawn from indirect approaches. For example, the portion of market share changes or export movements not explained by changes in cost competitiveness is interpreted as the impact of non-price competitiveness. Since no single econometrically effective indicator has been identified to capture the entirety of relevant factors, non-price competitiveness is often operationalized as a residual.

[2] Though highlighting different dimensions and features, NPC is commonly defined only in contrast to price competitiveness. For a standard definition see, for instance, D'Adamo (2017).

2.2 Established Indicators

The standard export demand functions commonly serve as empirical workhorse model to analyse the trade performance and its main determinants. This model considers the impact of foreign income and relative costs but does not explicitly incorporate non-price factors:

$$X_t^i = FI_t^{i\,\delta_1^i} * REER_t^{i\,\delta_2^i}. \tag{1}$$

Consequently, δ_1 and δ_2 denote the export elasticities with respect to foreign income (FI) and to prices or cost ($REER$), respectively. An established regularity from empirical applications is that the average long-run export elasticity of major European countries with respect to cost changes is roughly -0.8 (D'Adamo, 2017). Estimates for the income elasticities, however, range from 1.0 to 2.0 (Keil, 2022a). Authors such as Thirlwall (1986), Krugman (1989) and Bottega & Romero (2021) argue, that NPC factors are reflected in the income elasticity. Therefore, a higher level of non-price competitiveness would result in a higher magnitude of elasticity, and a country's exports would benefit more from increases in foreign income.[3]

The idea that the standard export equation accounts for a country's non-price competitiveness in an indirect way is not limited to the interpretation of apparent elasticities. For instance, Żogola (2010) argues that the regression's residual catches non-price effects provided that for relative cost and for foreign demand is appropriately controlled. On similar logical lines, Xifre (2021) proposes a mathematical factor for NPC by rearranging an export equation and solving for an unknown non-price factor given an exogenous price elasticity.[4] Other scholars, however, state that the standard export equations suffer from omitted variable bias (Bottega & Romero, 2021), which renders the simple interpretation of the estimated trade elasticities and resulting residuals insufficient. As a remedy, NPC proxy measures are introduced to the export function. For instance, Fagerberg (1988, 1996) argues that technological competitiveness is of utmost importance and considers measures such as R&D spending or the number of patents as suitable proxies, reflecting the sense of innovative

[3] Some authors claim that the price and cost elasticity magnitude gives an indication of the NPC, too. According to Gräbner et al. (2020), more advanced high-tech industries face lower price competition compared to low-tech industries. Empirical evidence contests this claim, since the exports of sectors producing high technological content are found to possess a relatively high price elasticity. See, for instance, Ederer & Reschenhöfer (2018) and Keil (2022b).

[4] Though methodologically different, this can be considered as a macroeconomic variant of the export quality indicator calculated by Hummels & Klenow (2005) and later by Benkovskis & Wörz (2016). The idea is that the export dynamics not explained by the price effect must be due to changes in NPC factors such as quality.

ability and adaptive capacity.[5] Athanasoglou & Bardaka (2010) consider a capital stock measure based on investment in machinery and buildings as an appropriate proxy for product quality and variety. Giordano & Zollino (2016) and Romero & McCombie (2018) point to the efficiency of the economic system, which includes the effectiveness of R&D, innovations and the quality of the business environment. The authors use multi-factor productivity as a proxy in the export equations. More recently, Bottega & Romero (2021) also used a patent stock measure to account for innovativeness and technological competitiveness. Aside from the proxy measures, a rather generic competitiveness indicator of economic complexity gained attention. This index reflects the ubiquity and the diversity of a country's product range and is conceptually based on Balassa's revealed comparative advantage index (for a summary see Hidalgo, 2021). It is considered to be an extensive proxy for non-price competitiveness and was recently introduced in the standard export equation by Pariboni & Paternesi Meloni (2022). All the indicators provided additional insights into the importance of NPC and were statistically significant in the individual setting. The general evidence, however, remains scattered and not conclusive. There is no consensus on whether a preferable proxy exists for empirical exploration or on the strength of the non-price competitiveness impact on exports compared to the cost effect. In some cases, the introduction of additional non-price competitiveness arguments has led to the insignificance of the cost variable, indicating that non-price factors are of higher importance than cost factors (Romero & McCombie, 2018).

2.3 The Challenging Detection of Individual Effects

The challenge of determining "true" causal effects is reflected in the divergent empirical results, particularly regarding the price and cost elasticity. Hence, a significant body of literature has emerged discussing this price vs. non-price conundrum, which represents one of the major unresolved questions in the field.[6] Summarizing this earlier debate, McCombie and Thirlwall (1994, p. 300) state that "non-price factors are of much greater importance than price competition" and consider the price and cost impact to be relevant only in the short-run. Detecting the relative importance of NPC compared to cost competitiveness is particularly relevant for industrial policy considerations. For instance, Milberg and Houston (2005) contrast different ways to industrial success on international markets.[7] Focussing economic

[5] Frenkel & Zimmermann (2020) recently tested R&D spending and found the variable not contribute significantly to explaining German exports.

[6] For an overview on the earlier debate see McCombie & Thirlwall (1994). Over the recent decade, significant efforts have been made to establish narratives regarding the main determinant of the trade performance of single countries. An emblematic case is the discussion on the Eurozone trade imbalances and their determinants. For an extensive survey see Pariboni & Paternesi Meloni (2022).

[7] According to Milberg & Houston (2005), cost competition is considered the *low road* towards industrial success in the international economy. Policies strengthening a country's productivity and fostering high-

policy on structural improvements instead of seeking cost competitiveness appears to be appealing, since such an industrial upgrading strategy promises far-reaching welfare gains. By contrast, the enhancement of cost competitiveness as a substitute bears the risk of wage squeezes, an international race to the bottom and, thus, welfare losses. From this simplistic point of view, the former way of industrial upgrading appears to be preferable. Regardless of how desirable this would be, empirical evidence still detects significant long-run cost elasticities of a considerable magnitude. even for industries and countries characterized as competing based on quality and innovativeness.[8] Therefore, none of the factors can be disregarded when considering industrial policy implications.

Furthermore, it is important to consider the potential interdependency of NPC and cost factors, which further complicates the determination of individual effects. One potential direct connection is that prices and cost already account for technological differences, since a higher technological level, i.e., quality, implies higher production cost.[9] Furthermore, operationalising the cost variable by the REER deflated by unit labour cost already takes into account labour productivity differences, which can be considered an important aspect of non-price competitiveness. However, the presence of increasing returns to scale poses a significant challenge in disentangling price and non-price effects. For example, if a non-price advantage leads to significantly higher export sales, which accelerates productivity growth over time. In turn, this would result in slower growth rates of unit labour cost and subsequently improve price and cost competitiveness. Therefore, a non-price advantage can effectively translate into a price advantage. Conversely, higher demand for a country's exports due to gains in cost competitiveness may translate into macroeconomic improvements in non-price factors, such as increased innovative efforts. These processes make it difficult to estimate "true" long-run causal effects, particularly when one factor, such as non-price competitiveness (NPC), cannot be comprehensively accounted for.

3. EMPIRICAL EVIDENCE

3.1 General method

This chapter is divided into two separate parts based on their data structure and research objectives. The objective of the first part is to obtain evidence on the NPC stance of different European countries within a framework, that accounts only indirectly

quality production represent the *high road*. Another salient example is the contribution by Krugman (1994), who called the focus on (cost) competitiveness a dangerous obsession.

8 Ederer & Reschenhöfer (2018) detected relatively high cost elasticities among the most innovative manufacturing sectors.

9 See D'Adamo (2018) for a survey and discussion on how quality shapes prices.

for it. This will be done by regression techniques as well as by calculating an indirect NPC variable using quarterly time series data. The second part focuses on examining whether individual NPC factors can contribute to explaining export volumes within a panel setting. Both attempts rely on versions of the empirical export equation in levels:

$$X_t^i = C^i + \delta_1^i FI_t^i + \delta_2^i REER_t^i + \epsilon_t^i. \tag{2}$$

In equation 2, *X* represents the volume of the real export of goods expressed in US-Dollar. The foreign income or demand variable FI represents the volume of the real GDP of 35 countries denoted in fixed PPP US-Dollar.[10] The variable REER stands for cost competitiveness, which is proxied by the real effective exchange rate deflated by unit labor cost. To handle the time series characteristics of the variables involved, recent investigations suggest using autoregressive distributed lag (ARDL) models (Pesaran et al., 2001).[11] Using this combination of an autoregressive and a distributed lag model, a non-stationary variable can be regressed on stationary or other non-stationary variables via OLS. The general reliability of the estimation is examined by structural or residual-based cointegration tests. However, the outcome has to be interpreted with caution, since the estimation procedure and estimates are affected by the data properties, which often cannot be detected unambiguously by standard unit root tests. Thus, different unit root test will be used in conjunction. Special attention is given to the left-hand side variable of exports, as cointegration techniques strongly require the dependent variable to have a unit root.

The assumed long-run relationship can be represented by the cointegrating equation (3) employing the level variables. The long-run coefficients (δ) are calculated using the estimated coefficients ($\delta = -(\eta/\alpha)$) from the corresponding unrestricted error correction mechanism, which in (4) is expressed as an ARDL (2,1,1,1).

$$X_t^i = C^i + \delta_1^i FI_t^i + \delta_2^i REER_t^i + \delta_3^i NPCF_t^i + \nu_t^i, \tag{3}$$

$$\begin{aligned}\Delta X_t^i = {} & C^i + \alpha^i X_{t-1}^i + \eta_1^i FI_{t-1}^i + \eta_2^i REER_{t-1}^i + \eta_3^i NPCF_{t-1}^i + \beta_1^i \Delta X_{t-1}^i + \\ & \beta_2^i \Delta FI_{t-1}^i + \beta_3^i \Delta REER_{t-1}^i + \beta_4^i \Delta NPCF_{t-1}^i + \epsilon_t^i.\end{aligned} \tag{4}$$

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[10] Due to the objective of comparability of FI measures and the limited availability of double export weights, the country sample is restricted to 35 mostly OECD countries. Several tests showed, that the use of the FI accounting for 35 countries increased the coefficient of determination in comparison to a broader measure (FI of 43 or 46 countries with smaller time dimension). The most severe caveat against this measure is the absence of quarterly data from China, which potentially biases the results. The geographical composition of single variables is reported in the statistical appendix B1.

[11] This implies the non-stationarity of exports as dependent variable and the potential fractional integration of the REER.

The NPCF variable proxies a countries relative NPC stance and is only employed in the panel approach. The factors used are measures proposed in recent literature (see section 3.3). Their calculation was done following the original source's schemes and the original idea as closely as possible, with adaptations made to accommodate the characteristics of the geographical sample and the availability of data. The sample consists of 10 European countries[12], spanning from 1995q1 to 2019q4 in the quarterly case and from 1995 to 2019 in the annual sample. Additionally, the empirical exercise considers two subperiods, 1995q1 to 2008q3 and 2009q3 to 2019q4. This division is due to the potential structural break reflected in the sharp export contraction from 2008q4 to 2009q2. Since the dynamics before and after this slump differ, the long-run relationship is expected to change as well. The geographical and time period restrictions are chosen to ensure data comparability.[13] Information on the calculation details and data sources are given in section 3.3.1 as well as in the statistical appendix. Since all variables are expressed in logs, the δ 's denote the respective long-run export elasticities.

3.2. Indirect measures of non-price competitiveness

3.2.1 Setup

In many cases, the assessment of a country's NPC is conducted by interpreting key parameters of the standard export function, which does not directly account for NPC factors. There are three different approaches which will be applied to a common quarterly dataset. Firstly, estimated income elasticities may incorporate information on the level of a country's competitiveness. Secondly, a residual-based approach aims at quantifying NPC's contribution to past export growth. Thirdly, the export equation is rearranged and a simple measure of NPC is obtained by calculation. Here, the results will be commented briefly, while its implication will be discussed more thoroughly in chapter 4.

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[12] Countries: Austria, Belgium, Finland, France, Germany, Ireland, Italy, Spain and Portugal. The case of Ireland raises doubts on the reliability of the its macroeconomic data (see, for instance, Honoham, 2021). Though omitted from the analysis, the respective empirical evidence is kept in the results survey.

[13] NPCF is constructed as a relative variable that serves as a proxy for assessing competitive relations. However, the availability of data on competitor countries varies depending on the chosen indicator. Each variant of NPCF includes the maximum number of competitor country data based on the availability specific to that indicator. The maximum possible number of competitor countries included in the analysis is determined by the availability of double export weights provided by the Directorate-General for Economic and Financial Affairs of the European Commission, which is 42. However, in this study I did not prioritize achieving overall harmonization of the country sample for each variable. If such harmonization were pursued, it would result in a significant reduction in the number of countries considered (maximum of 23) or time units, which would represent a significant loss of information.

The general validity of the ARDL estimation will be determined by the bounds procedure with critical values for the F and t tests derived from Kripfganz and Schneider (2018). The AIC criterion is used for selecting the optimal lag structure. Additionally, it is crucial to determine the order of integration of the three variables involved. Specifically, it needs to be clarified whether the dependent variable has a clear unit root or not. If not, cointegration techniques aren't appropriate. Problems arise when a time series is not an exact but close to unit root process - then the Augmented Dickey Fuller (ADF) test suffers from low power. Thus, a Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test is additionally employed to assert that the left hand side variable is non-stationary. The results of the ADF test, as reported in Table 1, show ambiguous indications of a unit root process in one-third of the cases.[14] However, according to the KPSS test, the hypothesis that the export time series are stationary can be rejected for all countries except Finland during the second period. With few ambiguous cases, the dependent variables are determined to be integrated of order 1, while the independent variables are not integrated of order 2.

Table 1: Unit Root Test of Real Exports of Goods

	Augmented Dickey Fuller			KPSS		
	95-19	95-08	09-19	95-19	95-08	09-19
AUT	-2,67*	-2.28	-2.41+	1,93***	1,26***	1,11***
BEL	-1,76	-3.60**	-1.79	1,90***	1,27***	1,05***
ESP	-2,37+	-2.15	-3.21**	1,97***	1,23***	1,27***
FIN	-2,95**	-2.08	-2.32+	0,99***	0,86***	0,23
FRA	-2,36+	-1.24	-2.37+	1,36***	0,86***	0,82***
GER	-1,93++	-2.44	-3.60**	1,47***	0,90***	0,83***
IRE	-0,84	-0.88	-0.02	1,36***	0,93***	0,83***
ITA	-1,58	-2.24	-3.06**	1,33***	0,78***	0,70**
NDL	-1,66	-2.50	-2.84*	1,42***	0,82***	0,89***
PRT	-1,58	-4.10**	-1.78	1,47***	0,88***	0,90***

Note: Quarterly data. 95-19: 1995q1-2019q4. 95-08: 1995q1-2008q3. 09-19: 2009q2-2019q4. Augmented Dickey-Fuller test with constant, H0: I(1) non stationarity. KPSS: Kwiatkowski–Phillips–Schmidt–Shin test, H0: I(0) stationarity. Lag length selection criteria: AIC.

3.2.2 Income Elasticities (IE)

The standard export equation (SEE) is specified according to the version of Houthakker & Maggee (1969). According to Keil (2022a), the estimated income coefficient is expected to approximate the ratio of the growth rates of exports to foreign

[14] The possibility of trend stationarity of the export variable is taken additionally into consideration. Detailed results are presented in the statistical appendix. The presence of a deterministic trend in the long-run, however, causes difficulties, which will be discussed below.

income (henceforth: X/FI) and, hence, reflects to what extent a country's exporters benefit from gains in foreign income. This coefficient indicates the extent to which a country's exporters benefit from increases in foreign income and provides an initial impression of their competitive positions. The estimation of reliable income elasticities is based upon the export function (1) turned into an ARDL model (3 & 4). In 8 out of 10 cases a long-run relationship of the three variables was detected (Table 2).[15] As anticipated, the estimated income elasticities closely align with the X/FI growth ratio in almost all cases. Cost competitiveness was found to be important in all cointegrated cases, except for Italy. The cost elasticity magnitudes ranges from -0.4 to -2.5.[16] However, no cointegration was found for the Netherlands and Finland according to the F and t tests. It should be recalled that the Finnish exports are not clearly characterized as a unit root time series. Conversely, a robust cointegrating relationship was observed for the Dutch case in both subperiods (see Table A3), indicating the relevance of the structural break in 2008/2009.

Table 2: Long run estimates from ARDL model (1995q1 – 2019q4), SEE specification,

SEE	X/FI	δ_1^i (FI)		δ_2^i (REER)		F	t	ARDL
AUT	2.12	2.088***	(0.034)	-1.279***	(0.132)	8.550***	-4.904***	3.1.3
BEL	1.51	1.478***	(0.043)	-2.468***	(0.633)	6.404**	-4.184***	3.3.3
ESP	2.12	1.900***	(0.071)	-0.384**	(0.171)	5.620**	-3.885**	1.3.0
FIN	1.64	1.114**	(0.506)	-3.868**	(1.938)	2.239	-1.780	3.2.0
FRA	1.55	1.436***	(0.053)	-1.020***	(0.206)	5.734**	-4.020**	2.2.1
GER	2.22	2.025***	(0.119)	-1.057***	(0.306)	5.186***	-2.634	3.3.2
IRE	3.66	1.953***	(0.584)	-1.328***	(0.477)	4.164*	-2.058	2.0.2
ITA	1.05	1.276***	(0.081)	-0.216	(0.167)	6.108**	-3.924**	1.4.0
NDL	2.05	2.012***	(0.056)	-0.181	(0.222)	3.568	-3.071	4.4.1
PRT	2.11	1.906***	(0.043)	-0.526***	(0.134)	9.512***	-5.244***	2.2.2

Note: 1995q1-2019q4, n=100-l. Bounds procedure (F and t Test) for cointegration test. Null hypothesis: No long-term relationship exists. Critical values depend on lag structure choice: 1% ***; 5% **; 10% *. Long term coefficients FI (foreign income) and REER (Cost competiveness) from cointegrating equation. Model lag length (l) according to AIC minimisation. Standard errors in brackets.

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[15] When improving the outcome in terms of the cointegration robustness and the R^2, the REER relative to 27 partner countries was employed instead of that relative to 37 partner countries (see Appendix Table A3). This indicates, that though being a measure relative to a weighted average, the actual relevance for individual countries can differ across countries. The number of partner countries was not harmonized with the FI variable as the variables capture different phenomena. The FI serves as a proxy for potential demand, while the REER represents a competitive relation. As a result, the geographic composition of relevant target markets can differ from that of competitor industries.

[16] Where significant, the introduction of a deterministic trend distorts the effect size of the trade elasticities in an unrealistic way and impedes comparability. For instance, the income elasticity of Belgium jumps from 1.5 (matching exactly its X/FI ratio of 1.5) to 2.5 in the trend specification. Though being reported in the results (Appendix Table A3) for the sake of transparency, the further analysis and discussion will refrain from the trend specification, since comparability of the results is a major objective.

3.2.3 Export Equation Residual (RS)

The residual of a slightly different export equation interpreted as the contribution of NPC represents another indirect approach (Monteagudo, 2010; Żogola, 2010).[17] For logical consistence, an important condition should be met: The foreign income coefficient should estimate the true long-run income elasticity and no competitive effects. Thus, a commonly applied theoretical constraint, based on the logic underlying gravity models of trade, is that this elasticity equals unity (Ca'Zorzi & Schnatz, 2010).[18] Consequently, if exports grow faster or slower than foreign income, this deviation must be fully attributed to competitiveness effects.[19] Within a gravity model export equation (GEE) an export-weighted volume of real foreign imports (FD) is chosen instead of foreign income. Due to its construction, this time series grows roughly in a relation of 1:1 to the export time series if export market shares are stable. Thus, the corresponding regression coefficient (which is not a true income elasticity anymore) will approach unity. Once the cost competitiveness effect is controlled for appropriately, the residuum catches the effects on exports not explained by income growth or relative cost.

Turning to the results of the ARDL estimation for the entire period (Table 3), a robust long-run relationship is less likely than in the SEE case mentioned above. At a significance level of 10% of the F-test or the t-test, Cointegration was found in 6 cases (excluding Ireland). However, cointegration can be unambiguously detected at a high level of significance in only three cases. Similar to the SEE estimation, the export elasticity with respect to foreign import demand (ID) approaches the respective X/ID growth ratio. If exports grew faster or slower than ID, which is the case when the growth ratio is not unity, the elasticity will also deviate from unity. Consequently, obtaining a 'true' long-run income elasticity of unity in some cases is a statistical artefact caused by the construction of the ID time series, which coincidentally grows 1:1 with exports. This makes interpretation difficult and casts doubt on the entire approach, as the assumption that the ID coefficient captures only the income effect is not met. It appears that the coefficient also accounts for competitive effects. However, the cost elasticity is found to be significant in all cointegrated cases. Effect sizes are detected in a wider range from -0.5 to -2.8.

Multiplying the estimated coefficients by the growth rates of the variables, yields the individual factor's contributions to export growth (Table 4). The remaining part of export growth not explained by movements in foreign demand and the REER is

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[17] The investigation in the European Commission's Quarterly Report on the Euro Area by Żogola (2010) serves as model case and their specification will be followed as closely as possible. For a more recent application of this approach to the case of France see Cezar & Cartellier (2019).

[18] The theoretic reference of this empirical approach are Gravity trade models incorporating the Armington hypothesis. For an introduction see Costinot et al. (2014).

[19] Analytically, this approach is tantamount to a market share analysis of the form $\mathrm{X/FI}_0^{\mathrm{i}} = \delta_0^{\mathrm{i}} + \mathrm{REER}_0^{\mathrm{i}} + \epsilon_0^{\mathrm{i}}$ given that the FI coefficient out of GEE estimations is unity.

attributed to the influence of NPC. Positive values indicate a positive NPC contribution to the export dynamics expressed in percentage points. The results will be discussed in detail and set into relation in the following chapter.

Table 3:Long run estimates from ARDL model (1995q1 – 2019q4), GEE specification

GEE	X/I	δ_1^i (FID)		δ_2^i (REER)		F	t	ARDL
AUT	0.98	0.976***	(0.013)	-0.597***	(0.119)	8.007***	-4.758***	4.1.0
BEL	0.80	0.829***	(0.018)	-0.709	(0.541)	4.696*	-3.614**	1.1.2
ESP	1.01	0.886***	(0.022)	-0.681***	(0.136)	9.239***	-4.550***	3.1.0
FIN	0.90	0.785***	(0.044)	-2.847***	(0.522)	7.023***	-4.099	4.2.0
FRA	0.84	0.813***	(0.023)	-0.638	(0.174)	2.654	-2.782	1.3.2
GER	1.17	1.258***	(0.079)	-0.603	(0.556)	3.461	-2.179	1.1.1
IRE	2.25	2.755***	(0.537)	-1.940***	(0.488)	11.782***	-3.678*	2.0.1
ITA	0.52	0.751***	(0.108)	-0.641**	(0.302)	5.528**	-2.533	3.1.1
NDL	1.08	1.043***	(0.036)	-1.216**	(0.585)	1.931	-2.096	2.2.3
PRT	1.04	1.139***	(0.063)	-1.424***	(0.314)	5.324**	-2.965	4.1.2

Note: 1995q1-2019q4, n=100-l. Bounds procedure (F and t Test) for cointegration test. Null hypothesis: No long-term relationship exists. Critical values depend on lag structure choice: 1% ***; 5% **; 10% *. Long term coefficients FID (foreign import demand) and REER (Cost competiveness) from cointegrating equation. Model lag length (l) according to AIC minimisation. Standard errors in brackets.

Table 4: Contribution of trade determinants to export growth, quarterly growth rates

	Quarterly Growth			Contributions		
	X	FID	REER	FID	REER	UNEXPL
AUT	+1.10%	+1.14%	-0.07%	+1.11pp	+0.04pp	-0.04pp
BEL	+0.88%	+1.12%	-0.05%	+0.93pp	+0.04pp	-0.07pp
ESP	+1.11%	+1.10%	+0.04%	+0.98pp	-0.03pp	+0.17pp
FIN	+1.02%	+1.14%	-0.08%	+0.90pp	+0.24pp	-0.10pp
FRA	+0.92%	+1.11%	-0.08%	+0.90pp	+0.05pp	-0.02pp
GER	+1.27%	+1.10%	-0.17%	+1.38pp	+0.11pp	-0.20pp
IRE	+2.47%	+1.11%	-0.26%	+3.06pp	+0.51pp	-1.06pp
ITA	+0.57%	+1.12%	+0.10%	+0.84pp	-0.06pp	-0.20pp
NDL	+1.18%	+1.10%	+0.03%	+1.15pp	-0.03pp	+0.07pp
PRT	+1.14%	+1.09%	+0.07%	+1.24pp	-0.11pp	+0.00pp

Note: 1995q1-2019q4.

3.2.4 Reinterpretation of Trade Frictions (TF)

On similar conceptual lines as the residual-centred NPC approach, Xifre (2021) proposed a NPC measure calculated by rearranging an augmented export function. This is derived from a gravity trade model, where trade frictions are interpreted as NPC. The respective export function can be formulated and rearranged as follows:

$$\mathrm{X}_t^i = \mathrm{FD}_t^{i\,1} * \mathrm{REER}_t^{i\,-\delta} * \mathrm{NPCF}_t^{i\,\delta}, \tag{5}$$

$$\mathrm{NPCF}_t^i = (\mathrm{XS}_t^i * \mathrm{REER}_t^{i\,\delta})^{\frac{1}{\delta}} \text{ with } \mathrm{XS}_t^i = \mathrm{X}_t^i/\mathrm{FD}_t^i \tag{6}$$

In this case, the variables are expressed as linear quantities rather than logarithms. By assuming that non-price competitiveness (NPC) has the same effect magnitude as the cost elasticity, the export function can be rearranged so that the unknown NPC factor becomes the explained variable (5 & 6). Given an assumed cost elasticity δ, export market share movements not explainable by changes in cost competitiveness are attributed to NPC. The crucial exogenous parameter is the cost elasticity, which, in accordance with recent estimates, is set to unity.[20,21]

The approach was adopted for the quarterly dataset used in this paper and, hence, a purely macroeconomic version of it has been calculated for 9 countries.[22] Figure 1 depicts the development of the NPC factor (NPC of one country relative to its entire range of competitors), where the calculated value of the year 1996 was set to 100. According to the calculations, Italy, France and Belgium suffered significant losses in terms of NPC (values below 100). The dynamics of other countries are more ambiguous, in particular with respect to the different periods. For instance, the NPC of the German and Austrian economy declined until 2001 and improved steadily afterwards. The Netherlands, Spain, Portugal and Finland recorded strong

Figure 1: NPC as Trade Frictions (TF)

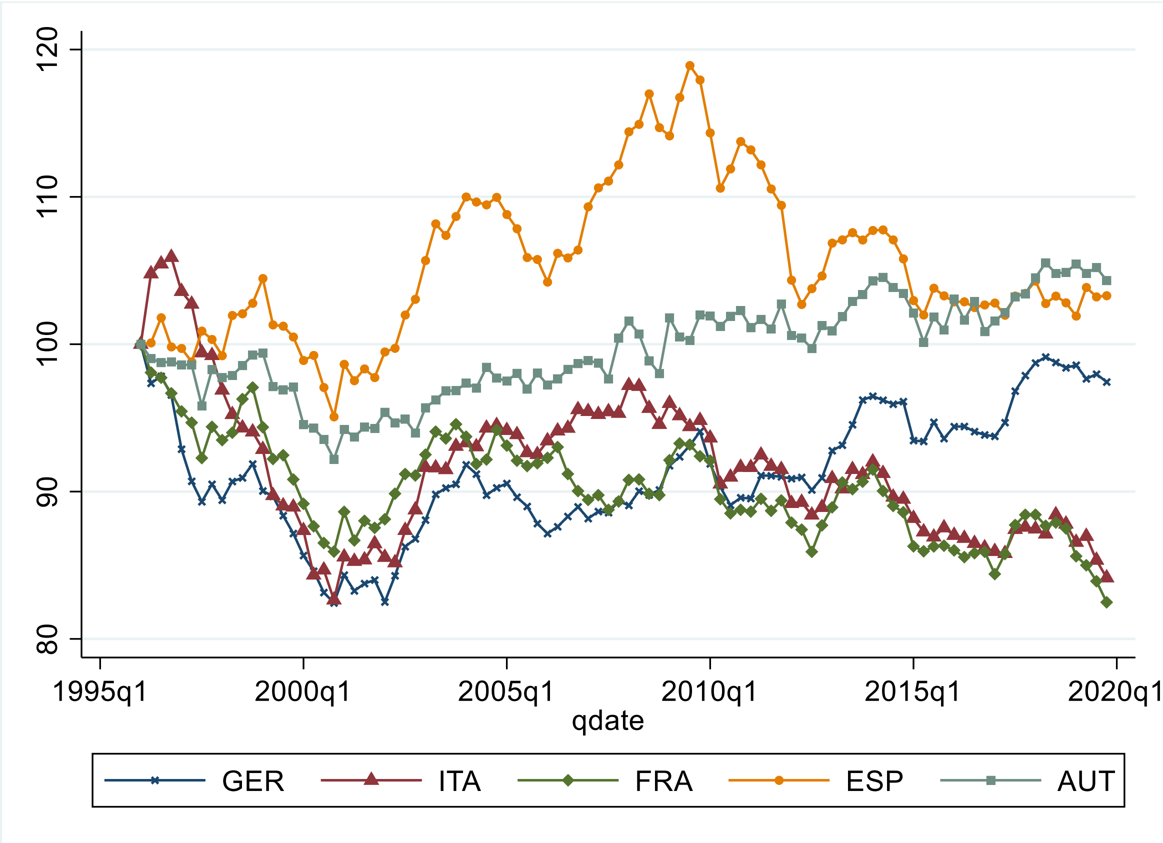
[20] Altering the elasticity magnitude leads to a re-scaling of the explained variable, but does not change the general outcome.

[21] An implicit assumption is that cost and non-price factors have the same elasticity magnitude. This assumption implies that consumers perceive these factors as substitutes. If the magnitude of the non-price competitiveness (NPC) elasticity is lower, it indicates that importers are more responsive to changes in relative prices than to NPC factors such as quality. Conversely, a higher NPC coefficient would suggest a strong incentive for technological upgrading and quality enhancement, even if it results in higher production costs and subsequent losses in cost competitiveness. Therefore, in empirical investigations, an appropriate and realistic NPC proxy should not only make a statistically significant contribution but also yield a similar magnitude of elasticity as the cost variable.

[22] The dynamics of Irish exports have a significant impact on the export market shares of the other nine countries, leading to distorted results and changing the signs of the NPC measure. Therefore, Ireland was excluded from the TF sample due to its unreliable macroeconomic data.

improvements until 2008. After that, performances differ. An outstanding example is Finland, whose NPC deteriorated strongly from 2008 to 2019.

Note: An enlarged version of this chart (encompassing all 9 countries) is provided in Appendix A.



3.3. Accounting for NPC factors

3.3.1 NPC Factors

In contrast to the indirect approaches discussed earlier, this section focuses on various proxy measures of non-price competitiveness (NPC) that can be used as additional controls in the export function.[23] These measures will be recalculated for the country sample and timespan used in this analysis. By doing so, a comprehensive survey is conducted to determine if different NPC measures are mutually correlated and whether the overall European picture derived from these measures is coherent from a descriptive perspective. When these NPC factors are added as arguments in the standard export function, the analysis examines whether they contribute to explaining export

[23] Only measures which can be expressed as continuous variables suitable for the quantification of marginal long-run effects will be considered. This basically excludes rank measures such as the export quality rank employed by Vandenbussche (2014) and D'Adamo (2018).

dynamics and whether they have an impact on the significance and effect size of the other coefficients.[24]

Macroeconomic and structural NPC indicators can be considered as the tide that lifts or lowers the position of all businesses, belonging to a country and affecting their product range. The first category of NPC factors includes investment-related indicators: the investment to GDP ratio (II41) and the capital stock (CS29). The second category comprises innovation-related indicators, including the number of patents (PS41) and the gross R&D expenditure to GDP ratio (RD28). Lastly, a category of more generic indicators covers measures such as multi-factor productivity (MFP24) and the index of economic complexity (ECI).[25] While the ECI metric is inherently relative in its nature, all other calculated factors are expressed relative to a geometric average of the values of the major competitor countries using the fixed double export weighting scheme.

By observing the correlation matrix (Table 5), a strong positive correlation of +0.64 is noticeable between the innovation-related variables, PS41 and RD28. They also exhibit positive correlations with the ECI, with coefficients of +0.66 and +0.71, respectively. Additionally, a strong positive relationship is observed between CS29 and PS41, with a correlation coefficient of +0.92. Furthermore, the export volume (X) demonstrates positive correlations with CS29 (+0.73) and (+0.79).

Table 5: Correlation Matrix

	ECI	PS41	RD28	CS29	II41	MFP24	X
ECI	+1.00	+0.66	+0.71	+0.56	-0.05	-0.19	+0.33
PS41		+1.00	+0.64	+0.92	-0.33	+0.07	+0.79
RD28			+1.00	+0.45	-0.11	-0.20	+0.18
CS29				+1.00	-0.33	+0.17	+0.73
II41					+1.00	-0.01	-0.32
MFP24						+1.00	-0.03
X							+1.00

3.3.2 Specification

The relevance of individual NPC indicators is tested using the baseline model (2) outlined in the previous section. Apart from the option of interpolation used by Giordano & Zollino (2016), the construction of relative NPC indicators on macroeconomic level is viable on an annual base only. However, this limitation

[24] The econometric exploration in this section primarily aims to identify relationships in terms of correlations. This initial exploration provides a foundation from which further topics, such as causal analysis, can be investigated.

[25] For the calculation of the NPC proxies, I followed the procedure of the respectively cited work as closely as possible The individual calculation approach and data sources are reported in detail in Appendix B.

significantly restricts the time dimension (t=24) for this empirical exercise and virtually impedes the use of approaches to test for long-run relationships on a single country basis. To obtain reliable and efficient results in this case, pooling becomes a necessity. Thus, a multi-country panel ARDL estimation method in levels is chosen. However, there is a central caveat with pooling: it potentially ignores structural differences across the panel units. To address this concern, two intermediate estimators that allow for a certain degree of heterogeneity without losing the general pooling advantage are employed in conjunction.

A dynamic fixed effects model (DFE) is employed first. This estimator allows for heterogeneous intercept and adjustment terms while long as well as short-run coefficients are homogenous (Weinhold, 1999). If, however, slope heterogeneity is the case among the short-run regressors, the preferable technique is the pooled mean group model (PMG) introduced by Pesaran & Smith (1995). The long-term coefficients are assumed to be homogenous, the short-term dynamics, error variance as well as intercepts are allowed to vary.[26] Both models share the same long-run equation:

$$X_t^i = C^i + \delta_1 FI_t^i + \delta_2 REER_t^i + \delta_3 NPCF_t^i + \nu_t^i. \tag{6}$$

The estimation of the DFE and PMG will be carried out by means of ordinary least squares. In addition, the maximum likelihood method will be used to estimate the PMG. This can enhance the efficiency of the outcome in case heteroscedasticity and serial correlation are present. To address these issues in the PMG model, robust standard errors were calculated as suggested by Westerlund et al. (2019). However, an important issue when using macro-panels is that of unobservable common factors across panel units (i). If they are correlated to the explanatory variables, estimates become biased and inconsistent.[27] As a remedy, cross-sectional averages (CSA) were added to the error correction model. In doing so, the general baseline model becomes a dynamic common correlated effects model (CCEPMG) as proposed by Chudik & Pesaran (2015). The ECM in its pooled mean group version including a lagged CSA then becomes

[26] If total panel heterogeneity is assumed, the Mean Group estimator (MG), allowing for heterogeneity of all regression parameters in the error correction model, is the efficient one. However, in this case, the MG estimator is equivalent to simply averaging the coefficients of individual countries, neglecting the advantages of panel data. When full heterogeneity is considered, pooling the data loses its advantages, and estimation may become less precise due to the limited degrees of freedom. Therefore, the Mean Group estimator will not be considered in this analysis.

[27] The CD test by Pesaran (2015) is employed to test for the presence of weak cross-sectional dependence (CSD). Given the small time dimension of the sample, the addition of further controls, such as cross sectional averages and their lagged values, may introduce problems due to the limited degrees of freedom available. Therefore, the model specification process should carefully consider cross-sectional dependence while also taking into account the potential loss of test power and estimation precision.

$$\Delta X_t^i = C^i + \alpha X_{t-1} + \eta_1 FI_{t-1} + \eta_2 REER_{t-1} + \eta_3 NPCF_{t-1} + \beta_1^i \Delta X_{t-1}^i + \beta_2^i \Delta FI_{t-1}^i + \beta_3^i \Delta REER_{t-1}^i + \beta_4^i \Delta NPCF_{t-1}^i + \beta_5^i CSA_{t-1} + \epsilon_t^i \tag{7}$$

Choosing an appropriate lag structure of the ARDL model is carried out by applying a general to specific approach starting from an ARDL (2.2.2.2). To assess the validity of the estimated long-run relationship, two different cointegration techniques will be used. The first one is the residual-based approach by Pedroni (2004) using the following types of unit root tests: The Augmented Dickey Fuller test and the Phillips-Perron test. The second approach is the Westerlund test (Westerlund & Edgerton, 2007), which can take heterogeneity and CSD into account. This test bases on the t statistics of the individual coefficients out of an error correction framework.

3.3.3 Results

Table 6 summarizes the results of this task and shows the estimated long-run elasticities δ. The tested models (rows) differ according to their NPC variable, their estimator and the ARDL lag structure. The long-run coefficients from the baseline panel specification (SEE) confirm the results of the time-series estimation in section 3.2. The income elasticity estimates approach 1.6 and are, thus, below but close to the sample X/FI ratio of 1.8. However, the cost elasticity results are higher with values between -1.4 and -1.5. These effect magnitudes are not affected fundamentally when introducing various NPC arguments. The economic complexity (EC) variable consistently shows a positive correlation with export volume across all estimation techniques. The estimated semi-elasticities range from 0.1 to 0.3, which aligns with recent findings by Pariboni & Paternesi Meloni (2022). However, interpreting the effect sizes can be challenging due to the metric of the ECI. For example, improving a country's ECI by 10 index points (which can be considered a substantial change) is associated with an export volume increase between 1% and 3%. In the PMG setting, two other indicators that are mutually correlated and also correlated with the ECI show significant results: the number of patents (PAT41) and the expenditure for research and development (RD28). The estimated elasticities range from +0.09 to +0.13, indicating a modest impact on export volume. However, the indicators of capital stock (CS29), investment intensity (II41), and multi-factor productivity (MFP24) do not contribute in a clear-cut way, as the results are not robust across estimation techniques, different specifications, or lag length structures. Notably, the multi-factor productivity measure shows negative signs and significantly affects the other trade elasticities. This is expected, as the ULC-adjusted real effective exchange rate already incorporates information on productivity levels.

Table 6: Long-run estimates from Panel ARDL model (1995-2019), SEE specification

MDL	EST	δ_1 (FI)	δ_2 (REER)	δ_3 (NPCF)	α	ARDL
SEE	DFE (OLS)	+1.696***	-1.584***	-/-	-0.181***	2.2.2
		(0.134)	(0.286)		(0.051)	
	PMG (MLM)	+1.513***	-1.495***	-/-	-0.274**	2.2.2
		(0.015)	(0.083)		(0.120)	
	PMG (OLS)	+1.674***	-1.459***	-/-	-0.204***	1.1.1
		(0.000)	(0.000)		(0.000)	
PAT41	DFE (OLS)	+1.700***	-1.589***	-0.005	-0.186***	2.2.2.2
		(0.096)	(0.270)	(0.072)	(0.032)	
	PMG (MLM)	+1.608***	-1.510***	+0.088***	-0.333***	2.1.1.2
		(0.023)	(0.104)	(0.019)	(0.006)	
	PMG (OLS)	+1.771***	-1.165***	+0.098***	-0.117***	2.2.2.2
		(0.018)	(0.012)	(0.002)	(0.008)	
RD28	DFE (OLS)	+1.688***	-1.588***	+0.069	-0.176***	2.1.2.1
		(0.103)	(0.260)	(0.105)	(0.030)	
	PMG (MLM)	+1.617***	-1.595***	+0.095***	-0.365***	2.1.1.2
		(0.022)	(0.100)	(0.025)	(0.112)	
	PMG (OLS)	+1.642***	-1.313***	+0.133***	-0.174***	2.1.2.2
		(0.029)	(0.016)	(0.015)	(0.015)	
CS29	DFE (OLS)	+1.816***	-1.841***	-0.044	-0.149***	1.1.1.1
		(0.119)	(0.325)	(0.174)	(0.031)	
	PMG (MLM)	+1.527***	-1.298***	-0.129*	-0.309***	2.1.1.1
		(0.023)	(0.150)	(0.065)	(0.092)	
	PMG (OLS)	+1.710**	-1.362***	-0.349	-0.189	1.1.1.2
		(0.054)	(0.015)	(0.352)	(0.026)	
II41	DFE (OLS)	+1.718***	-1.562***	0.185+	-0.181***	2.1.2.1
		(0.100)	(0.253)	(0.124)	(0.030)	
	PMG (MLM)	+1.607***	-1.635***	-0.156***	-0.288***	1.1.1.1
		(0.022)	(0.144)	(0.050)	(0.086)	
	PMG (OLS)	+1.676***	-1.448***	+0.071**	-0.229***	2.1.1.1
		(0.068)	(0.019)	(0.032)	(0.031)	
MFP24	DFE (OLS)	+1.574***	-1.850***	-0.945	-0.154***	2.1.1.1
		(0.172)	(0.346)	(0.767)	(0.033)	
	PMG (MLM)	+1.535***	-2.137***	-0.692***	-0.243***	1.1.1.1
		(0.032)	(0.160)	(0.247)	(0.066)	
	PMG (OLS)	+1.712***	-1.440***	0.034	-0.136***	2.2.2.2
		(0.051)	(0.011)	(0.057)	(0.020)	
ECI	DFE (OLS)	+1.837***	-1.680***	+0.279*	-0.168***	2.1.2.1
		(0.132)	(0.261)	(0.164)	(0.030)	
	PMG (MLM)	+1.693***	-1.452***	+0.179***	-0.283***	1.1.1.1
		(0.031)	(0.131)	(0.046)	(0.081)	
	PMG (OLS)	+1.891***	-1.689***	+0.359**	-0.204***	2.1.2.2
		(0.052)	(0.023)	(0.026)	(0.024)	

Note: 1995-2019, n=24-l. MDL: Model. EST: Estimator. Critical values: 1% ***; 5% **; 10% *. Long term coefficients FI (foreign income) and REER (Cost competiveness) from cointegrating equation. α denotes the adjustment coefficient. Standard errors in brackets below the coefficient.

4. DISCUSSION

4.1 Non-price factors

Indirect factors: The standard export function model provides various analytical options to distinguish between cost and non-price effects. The relative income elasticity is often considered an indirect reflection of non-price competitiveness. However, as the estimation results have shown, its effect size closely approximates the observed X/FI growth ratio, which reflects the overall competitive position. This raises doubts about whether the magnitude of the elasticity solely captures non-price effects. Therefore, the income elasticity can be seen more as a generic competitiveness indicator rather than a specific non-price measure. However, another indirect approach, namely the residual-based NPC assessment using a gravity model export function, did not prove useful. This is mainly due to the fact, that a cointegrating relationship for this type of export function was detected only in few cases. Furthermore, it is conceptually unclear whether non-price effects are solely reflected by the residual or also by other regression parameters. Based on the same type of function, the mathematically derived TF indicator provides more consistent insights on how NPC factors affect export growth. This is hardly surprising, since its calculation approach is capable of separating cost from non-price effects, once the cost structure is considered appropriately. Export market share changes not explained by changes in cost competitiveness are attributed to shifts in terms of NPC. This conceptual rigour distinguishes it from other NPC measures.

NPC factors: Employing non-price proxies as additional arguments represents another option to gain insights into which factors shape export dynamics and, hence, represent valid NPC proxies. The index of economic complexity is the only measure contributing to the explanation of exports in a robust way. Though proving its significance in econometric terms, the ECI semi-elasticity (0.1-0.3) appears too low to serve as a universal NPC indicator. All other measures did not contribute in a conclusive and unambiguous way. Thus, the tested NPC proxies cannot represent more than a complement to the NPC assessment, since a reliable econometric contribution in the explanation of exports was not found. However, the innovation-related factors show very similar dynamics to the TF and are highly correlated with the ECI. Accordingly, they can provide useful additional information. By contrast, the investment-related capital stock factor shows very strong co-movement with other NPC factors, but the econometric outcome does not indicate a meaningful contribution in explaining exports. Using multi-factor productivity in the regression model does produce very ambiguous evidence. This can be due to the fact, that the cost competitiveness variable does already account for labour productivity.

Indeed, a comprehensive analysis of a country's non-price competitiveness necessitates the consideration of multiple indicators, each offering distinct insights. Some measures provide insights on the level of overall competitiveness, while others inform on the periodical NPC contribution to exports dynamics. A useful starting point can be a descriptive analysis of export growth, changes in export market shares and movements in cost competitiveness into account. Another indication on a country's overall competitive stance is given by the index of economic complexity and the income elasticities. Both appear to be measures of export success, regardless of whether this performance is built upon advantages in relative cost or structural non-price factors. By combining different indicators and approaches, researchers can obtain a more comprehensive understanding of a country's non-price competitiveness, allowing for a more nuanced analysis of its export performance and the factors that contribute to it.

4.2 European Evidence

Until 2008q3, average real exports of the European country sample (weighted average) experienced strong growth, with an average quarterly growth rate of 1.51%. In comparison, real GDP of 35 partner countries grew at an average quarterly rate of 0.70%. By the second quarter of 2009, an initially strong recovery began, but soon entered a phase of comparatively slower growth (X/FI: 2.00; export growth: 1.05%; GDP growth: 0.52%).[28] Table 7 provides a comprehensive and simplified survey of the empirical results of this study for each country under scrutiny. The growth ratio of exports to foreign demand (X/FI) is the key figure, from which the overall competitiveness assessment starts.[29] This ratio is expected to be roughly reflected by the estimated income elasticities. Among the countries with stronger export growth in relation to foreign demand were Germany (2.22), Austria (X/FI: 2.12), Spain (2.10), Portugal (2.11) and the Netherlands (2.05). However, Finland (1.64), France (1.55), Belgium (1.51) and, in particular, Italy (1.05) recorded below average export dynamics.

How can these different performances, which reflect fundamental differences in international competitiveness, be explained? The aim is to evaluate the coherence of the different direct and indirect indicators. To accomplish this, we will compare them with the observed dynamics and the findings from the estimations presented in the previous section. This analysis seeks to provide insights and determine whether these individual factors contribute to forming a comprehensive and cohesive assessment of each country's competitive position.

Austria: Austria belongs to the group of strong exporters, recording a X/FI ratio of 2.12 and experiencing gains in export market shares and cost competitiveness. According to the SEE estimation, Austria exhibits an income elasticity of 2.1 and a cost elasticity of -1.3. Surveying the NPC factor dynamics does not allow to draw clear conclusions on the matter. Improvements in innovation-related factors contrast the worsening of the investment intensity and of the economic complexity index.

[28] The strong export contraction in the period from 2008q3 – 2009q1 is not considered in the two subperiods, but in the sample covering the whole time span.

[29] Table 7 serves as a simplified summary of the results. Detailed estimation results can be found in Table A3 and A4. Additionally, Table A5 presents the quarterly growth rates of exports, import demand, and relative cost

Nevertheless, the TF indicator suggests a modest but consistent improvement in NPC over time. In summary, Austria's strong export performance is mainly attributed to slower growth in unit labour cost, reflected by a decrease in the REER, and a favourable position across some NPC factors.

Belgium: Despite experiencing an increase in cost competitiveness, Belgium has recorded one of the weakest export performances (X/FI: 1.51) among the sample countries. Accordingly, losses in NPC must be expected. However, the dynamics of various indicators do not unconditionally confirm this expectation. While there are gains in investment-related factors and R&D expenditure, they are contrasted by losses in patents, productivity, and the economic complexity index. The TF measure indicates a strong negative NPC contribution to export growth.

Finland: The Finish export dynamics differ substantially across the two subperiods. The export to foreign demand growth ratio of 2.90 coincided with strong gains in cost competitiveness as well as in almost all NPC dimensions from 1995q1 to 2008q3. After the slump, however, the Finish stance in terms of the entire range of cost and non-price factors worsened and the X/FI ratio fell to 0.97.

France: The exports of the French economy grew at a relatively slow rate (X/FI: 1.55) through the entire period. Even though recording a REER improvement, France lost export market shares to a considerable extent. According to the SEE estimation and the resulting cost elasticity of -1.0, these cost competitiveness gains acted as an important pillar supporting the overall slow export growth. Except from the investment-related factors, France recorded a strong decline of its overall NPC, which is consistently reflected by the TF and the ECI dynamics.

Germany: The relatively fast growing exports (X/FI: 2.22) indicate a high level of international competitiveness of the German economy. The estimated SEE income elasticity of 2.03 (2.32 and 1.93 for the subsamples) matches the X/FI ratio. The REER decreased on average by 0.17% on quarterly base and the highly significant cost elasticity of –1.05 indicates that those cost competitiveness gains are translated into strong additional export growth. The importance of cost competitiveness was high or even increasing over time according to the estimates (see Table A3). This indicates that the slight REER appreciation in the second period lowered the competitive advantage of German exports significantly, which is reflected by reduction in the IE. Surveying the changes of the different German NPC proxies does confirm the picture described so far. Until 2008, Germany suffered losses in all relevant NPC categories. Accordingly, the outstanding export performance was predominantly fuelled by significant gains in cost competitiveness in this first period. After the period (1995q1-2008q3) characterised by the strong REER depreciation, a partly reversal of this advantage took place. While gains in some NPC categories were recorded, the innovation-related factors continued to detoriate.

Italy: The Italian economy experienced by far the slowest export growth. From 1996q1 to 2008q3 (as data for Italian goods exports is available only from 1996q1) exports grew at a rate of only 1.21 times that of potential foreign demand, while simultaneously recording substantial losses in cost competitiveness. However, the Italian cost elasticity does not appear to be of considerable magnitude until 2008 (see Table A3). Following the 2008/09 crisis, the REER moderately improved, leading to a considerable increase in the X/FI ratio to 1.73. Throughout the entire period, these dynamics were accompanied by a significant decline across almost all NPC factors, as evidenced by the TF indicator depicting strong negative trends.

Spain: An ambiguous case is that of Spanish exports. Despite a fast growth rate (X/FI: 2.10) and overall market share gains, there was a worsening of cost competitiveness until 2008, contrasted by significant improvements in the post-crisis period. The main NPC indicators exhibited opposite dynamics in the two subperiods. However, overall, the NPC contribution to export growth was beneficial, as indicated by the positive signs of the TF and ECI measures.

The Netherlands: The volume of the Dutch exports of goods grew at a comparatively high rate (X/FI: 2.05) which is reflected by export market share increases. A slight and steady improvement in terms of the REER supported this performance given the cost elasticities of about -0.7 However, the dynamics exhibited by NPC factors differ. In the first period, innovation-related measures indicate a fall behind, but a reversal can be observed afterwards. Taking the TF indicator as the most comprehensive proxy, the overall Dutch NPC improved and represented an important pillar of the strong export performance.

Portugal: Portugal's export performance needs to be analysed separately for different subperiods due to contrasting dynamics. Until 2008q3, exports grew at a ratio of 1.93 in relation to foreign income. During this period, export market shares and cost competitiveness deteriorated, while the relative position in terms of several NPC factors improved significantly. However, during the second subperiod, most NPC factors show a negative contribution, indicating a decline in non-price competitiveness, while the cost position improved. Overall, the NPC contribution appeared strongly positive throughout the entire period, as indicated by the positive TF measure and the improvement in innovation-related factors.

Table 7:Results Survey

	AUT			BEL			ESP			FIN			FRA		
	95-19	95-08	09-19	95-19	95-08	09-19	95-19	95-08	09-19	95-19	95-08	09-19	95-19	95-08	09-19
X/FI	2.12	2.46	2.15	1.51	1.74	1.80	2.10	2.21	2.24	1.64	2.90	0.97	1.55	1.71	1.65
IE	2.09	2.18	1.16	1.53	1.82	1.21	1.90	2.12	1.30	1.11	2.55	0.13	1.44	1.65	1.40
XS	++	++	-	--	--	-	++	0	++	--	++	--	--	--	-
REER37	--	--	+	--	--	0	-	++	--	--	--	+	--	-	-
RS	-0.04	-0.13	0.00	-0.07	-0.03	0.00	0.17	0.34	-0.02	-0.10	0.12	0.08	-0.02	0.06	-0.20
TF	+	+	+	--	--	-	+	++	--	--	++	--	--	--	--
ECI	--	--	+	--	--	0	--	--	--	--	--	--	--	--	--
RD28	++	++	-	++	--	++	+	++	--	--	++	--	--	--	--
PAT41	+	--	++	--	--	--	++	++	++	--	++	--	--	--	--
CS29	0	+	-	++	++	++	++	++	--	++	++	-	++	++	+
II41	--	--	++	++	++	0	--	++	--	++	++	0	++	++	+
MFP24	+	+	0	--	--	-	--	--	+	++	++	-	-	-	0

	GER			IRE			ITA			NDL			PRT		
	95-19	95-08	09-19	95-19	95-08	09-19	95-19	95-08	09-19	95-19	95-08	09-19	95-19	95-08	09-19
X/FI	2.22	2.54	2.27	3.66	2.82	4.04	1.05	1.21	1.73	2.05	2.12	2.14	2.11	1.93	2.67
IE	2.03	2.32	1.93	1.95	3.67	0.90	1.28	1.96	0.98	2.01	2.24	1.72	1.91	1.47	2.13
XS	++	++	+	0.00	0.00	0.00	--	--	--	++	0	++	++	--	++
REER37	--	--	++	--	++	--	++	++	-	-	-	0	+	++	--
RS	-0.20	-0.12	0.41	-1.06	0.54	-1.27	-0.20	-0.02	0.00	0.07	-0.09	-0.12	0.00	0.03	-0.01
TF	-	--	++	n.a.	n.a.	n.a.	--	-	--	++	0	++	++	++	+
ECI	--	--	+	+	++	--	--	--	-	--	--	+	++	++	--
RD28	--	--	-	--	--	--	0	-	+	--	--	++	++	++	--
PAT41	--	--	--	++	++	++	--	--	--	--	-	--	++	++	++
CS29	--	--	+	++	++	++	--	+	--	++	++	-	--	++	--
II41	--	--	++	++	++	++	--	+	--	--	0	--	--	--	--
MFP24	+	-	+	++	++	++	--	--	-	-	+	-	--	--	-

Note: ++/-- denotes changes >5%; +/- denotes changes from 1%-5%, 0 denotes changes <1%. In case of the ECI, changes are considered in index points instead of in percentages.

5. CONCLUSION

On a theoretical level, non-price competitiveness is a broad and elusive concept, which can only by defined in contrast to price and cost-related factors that shape export dynamics. Empirical assessment using conventional export functions should acknowledge this complexity and consider multiple indicators instead of relying solely on single measures. Two indicators, the estimated income elasticity and the index of economic complexity, can provide a useful descriptive starting point. However, both indicators are not capable of distinguishing cost from non-price effects. If cost competitiveness is accounted for in an appropriate way, the non-price side can be reflected indirectly by the unexplained and residual part of an export function. In this regard, the calculated TF measure, derived from rearranging the equation, has shown conceptual consistency and can serve as a powerful indication. Conversely, the residual-based estimation approach to NPC did not yield robust evidence. Apart from these indirect indicators, the introduction of additional NPC arguments to the standard export equation revealed that the index of economic complexity correlates significantly with the export volume. However, its corresponding low semi-elasticity ($0.1 - 0.3$) does not indicate that the ECI can serve as an overarching indicator. Other additional NPC arguments introduced to the standard export equation, such as patent stock, R&D expenditure, capital stock, investment intensity, and multi-factor productivity, did not demonstrate significant effects in this context, or the evidence was ambiguous. Furthermore, the introduction of these additional arguments did not significantly affect the income and cost elasticities in terms of effect magnitudes and significance. It is worth noting that despite their limited significance in the econometric exercise, these factors can still provide descriptive insights into changes within the economic macro structure.

Analysing the obtained estimates and the movements of the individual factors provides strong evidence that changes in non-price competitiveness have shaped trade flows of European countries. For instance, Germany, often regarded as having a competitive edge due to improved cost competitiveness from 1995 to 2019, shows a decline in residual-based NPC indicators, as well as in the index of economic complexity (ECI) and other innovation-related measures, indicating a significant decrease in non-price competitiveness. This assessment holds true for the entire period but is particularly pronounced during the period characterized by the build-up of trade imbalances until 2008. A similar steady deterioration of major non-price competitiveness factors can be observed for France and, particularly, Italy. On the other hand, Portugal stands out as a country that has consistently improved its structural non-price stance throughout the period. The evidence for Belgium, Finland, Spain, and the Netherlands, however, is less conclusive.

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APPENDIX A

Table A 1: Time Series Unit Root Test (ADF)

	FI 95-19	FI 95-08	FI 09-19	FID 95-19	FID 95-08	FID 09-19	REER 95-19	REER 95-08	REER 09-19
AUT	-1.861	-1.298	-2.140	-2.245	-1.290	-2.245	-2.659*	-3.030**	-1.774
BEL	-1.862	-1.321	-2.144	-2.382+	-1.356	-2.382+	-3.070**	-2.353	-3.251**
ESP	-1.824	-1.288	-2.039	-2.370+	-1.411	-2.370+	-1.507	-0.490	-1.382
FIN	-1.856	-1.289	-2.156	-2.276	-1.312	-2.276	-2.997**	-3.049**	-2.910**
FRA	-1.836	-1.291	-2.101	-2.442+	-1.743	-2.442+	-2.758*	-2.049	-2.511
GER	-1.993	-1.358	-2.201	-2.488+	-1.915	-2.481+	-3.388**	-2.576	-3.472**
IRE	-1.887	-1.289	-2.199	-2.605*	-2.141	-2.605*	-0.602	-0.558	-0.616
ITA	-1.861	-1.285	-2.155	-2.422+	-1.564	-2.442+	-2.433	-1.906	-2.392
NDL	-1.863	-1.301	-2.103	-2.314+	-1.294	-2.314	-1.848	-1.726	-2.130
PRT	-1.859	-1.289	-2.199	-2.554+	-1.354	-2.554+	-1.753	-1.250	-1.774

Note: Quarterly data. 95-19: 1995q1-2019q4. 95-08: 1995q1-2008q3. 09-19: 2009q2-2019q4. Augmented Dickey-Fuller test with constant, H0: I(1) non stationarity. Lag length selection criteria: AIC.

Table A 2: Panel Unit Root Test (IPS)

Variable	Z-t-tilde-bar	p-value	Variable	Z-t-tilde-bar	p-value
X	-1.512	0.065	ΔX	-7.915	0.000
FI	2.924	0.998	ΔFI	-6.246	0.000
REER	-2.194	0.014	ΔREER	-9.058	0.000
PAT41	3.448	0.999	ΔPAT41	-4.245	0.000
RD28	-0.318	0.375	ΔRD28	-3.588	0.000
II41	-1.164	0.122	ΔII41	-5.648	0.000
CS29	-0.034	0.486	ΔCS29	-1.425	0.077
MFP24	-1.488	0.068	ΔMFP24	-5.465	0.000
ECI	-0.070	0.472	ΔECI	-8.456	0.000

Note: 1995-2019. Annual panel data. Im-Pesaran-Shin test, H0: I(1) non stationarity of all panels.

Table A 3: Long-run elasticities, SEE specification

SEE	X/FI	FI		REER		F	t	ARDL	REER
1995q1-2019q4									
AUT	2.12	2.088***	(0.034)	-1.279***	(0.132)	8.550***	-4.904***	3.1.3	ULC37
BEL	1.51	1.532***	(0.078)	-0.486	(0.379)	3.423	-3.180	3.1.0	ULC37
BEL (t)	1.51	2.468***	(0.075)	-0.136	(0.156)	9.501***	-5.171***	2.1.0	ULC37
BEL	1.51	1.478***	(0.043)	-2.468***	(0.633)	6.404**	-4.184***	3.3.3	ULC27
ESP	2.12	1.900***	(0.071)	-0.384**	(0.171)	5.620**	-3.885**	1.3.0	ULC37
FIN	1.64	1.114**	(0.506)	-3.868**	(1.938)	2.239	-1.780	3.2.0	ULC37
FIN (t)	1.64	5.923***	(0.819)	-0.788	(0.517)	4.243	-3.244	3.2.0	ULC37
FRA	1.55	1.436***	(0.053)	-1.020***	(0.206)	5.734**	-4.020**	2.2.1	ULC37
GER	2.22	2.151***	(0.081)	-1.093***	(0.282)	4.847*	-2.709	2.2.4	ULC37
GER	2.22	2.025***	(0.119)	-1.057***	(0.306)	5.186***	-2.634	3.3.2	ULC27
IRE	3.66	1.953***	(0.584)	-1.328***	(0.477)	4.164*	-2.058	2.0.2	ULC37
IRE (t)	3.66	7.647***	(1.272)	-1.584***	(0.248)	7.856***	-3.937*	2.2.2	ULC37
ITA	1.05	1.276***	(0.081)	-0.216	(0.167)	6.108**	-3.924**	1.4.0	ULC37
ITA (t)	1.05	1.957***	(0.288)	-0.289**	(0.127)	6.677**	-4.468***	3.4.0	ULC37
NDL	2.05	2.012***	(0.056)	-0.181	(0.222)	3.568	-3.071	4.4.1	ULC37
PRT	2.11	1.906***	(0.043)	-0.526***	(0.134)	9.512***	-5.244***	2.2.2	ULC37
1995q1-2008q2									
AUT	2.46	2.178***	(0.070)	-1.036***	(0.166)	5.115**	-3.620**	1.3.0	ULC37
BEL	1.74	1.818***	(0.024)	-0.164**	(0.068)	15.338***	-6.114***	2.2.2	ULC37
ESP	2.21	2.122***	(0.189)	-0.917***	(0.262)	6.046**	-2.983	2.2.0	ULC37
FIN	2.90	2.551***	(0.036)	-1.113***	(0.084)	26.821***	-8.923***	1.1.0	ULC37
FRA	1.71	1.653***	(0.037)	-1.035***	(0.080)	10.824***	-5.115***	1.3.1	ULC37
GER	2.54	2.323***	(0.090)	-0.393***	(0.139)	7.497***	-4.493***	1.0.1	ULC37
IRE	2.82	3.672***	(0.256)	-1.698***	(0.267)	8.133***	-3.920**	2.0.0	ULC37
ITA	1.21	1.959	(0.875)	-0.527	(0.730)	1.727	-0.939	1.2.1	ULC37
NDL	2.12	2.244**	(0.057)	-0.706***	(0.162)	7.156***	-4.591***	2.0.1	ULC37
PRT	1.93	1.465***	(0.274)	0.464	(0.573)	6.020**	-3.529*	2.3.3	ULC37
2009q2-2019q4									
AUT	2.15	1.616***	(0.211)	-1.021*	(0.590)	8.382***	-3.816**	1.2.1	ULC37
BEL	1.80	1.210***	(0.178)	-1.981**	(0.763)	7.037***	-3.674**	1.1.3	ULC37
ESP	2.24	1.303***	(0.239)	-1.087***	(0.279)	5.599**	-4.080**	2.3.3	ULC37
FIN	0.97	0.132	(0.392)	-1.302***	(0.366)	12.954***	-6.179***	1.1.1	ULC37
FRA	1.65	1.404***	(0.934)	-0.237	(0.577)	6.924**	-3.855**	1.4.4	ULC37
GER	2.27	1.927***	(0.195)	-1.242***	(0.340)	6.194**	-3.469*	2.3.3	ULC37
IRE	4.04	0.903	(2.275)	-2.698**	(1.064)	1.595	-1.663	2.0.1	ULC37
ITA	1.73	0.977***	(0.218)	-0.951*	(0.549)	5.202*	-3.135*	1.2.1	ULC37
NDL	2.14	1.716***	(0.095)	-0.663**	(0.280)	5.964**	-3.755**	3.2.2	ULC37
PRT	2.67	2.133***	(0.048)	-0.698***	(0.071)	17.090***	-7.066***	1.2.3	ULC37

Note: Bounds procedure (F and t Test) for cointegration test. Null hypothesis: No long-term relationship exists. Critical values depend on lag structure choice: 1% ***; 5% **; 10% *. Long term coefficients FI (foreign income) and REER (Cost competitiveness) from cointegrating equation. REER: Real effective exchange rate adjusted by unit labour cost relative to 27 or 37 countries. Model lag structure (l) according to AIC minimisation. Standard errors in brackets. The presence of a deterministic trend (significant on 95% confidence level) is signalled by (t).

Table A 4: Long-run elasticities, GEE specification

GEE	EX/FID	FID		REER		F	t	ARDL	REER
1995q1-2019q4									
AUT	0.98	0.976***	(0.013)	-0.597***	(0.119)	8.007***	-4.758***	4.1.0	ULC27
BEL	0.80	0.829***	(0.018)	-0.709	(0.541)	4.696*	-3.614**	1.1.2	ULC27
ESP	1.01	0.886***	(0.022)	-0.681***	(0.136)	9.239***	-4.550***	3.1.0	ULC27
FIN	0.90	0.785***	(0.044)	-2.847***	(0.522)	7.023***	-4.099	4.2.0	ULC27
FRA	0.84	0.813***	(0.023)	-0.638	(0.174)	2.654	-2.782	1.3.2	ULC37
GER	1.17	1.258***	(0.079)	-0.603	(0.556)	3.461	-2.179	1.1.1	ULC37
IRE	2.25	2.755***	(0.537)	-1.940***	(0.488)	11.782***	-3.678*	2.0.1	ULC27
ITA	0.52	0.751***	(0.108)	-0.641**	(0.302)	5.528**	-2.533	3.1.1	ULC37
NDL	1.08	1.043***	(0.036)	-1.216**	(0.585)	1.931	-2.096	2.2.3	ULC27
PRT	1.04	1.139***	(0.063)	-1.424***	(0.314)	5.324**	-2.965	4.1.2	ULC37
1995q1-2008q3									
AUT	1.04	0.901***	(0.049)	-1.055***	(0.290)	14.458***	-6.171***	1.0.1	ULC37
BEL	0.80	0.798***	(0.022)	-0.517	(0.610)	7.787***	-4.293***	3.0.1	ULC37
ESP	0.97	0.973***	(0.123)	-1.012*	(0.546)	6.640**	-3.278*	2.1.0	ULC37
FIN	1.19	1.073***	(0.023)	-0.543**	(0.136)	12.737***	-6.153***	1.4.0	ULC37
FRA	0.81	0.773***	(0.011)	-0.699***	(0.058)	15.372***	-6.430***	1.1.1	ULC37
GER	1.15	0.865***	(0.075)	-0.970***	(0.237)	14.801***	-6.031***	2.0.4	ULC37
IRE	1.71	1.896***	(0.114)	-1.346***	(0.268)	13.068***	-4.708***	2.0.0	ULC37
ITA	0.46	0.795***	(0.230)	-1.306	(1.150)	3.558	-1.863	4.1.2	ULC37
NDL	0.87	0.933***	(0.016)	-0.163*	(0.092)	6.122**	-4.276**	1.3.1	ULC37
PRT	0.79	0.856***	(0.064)	-0.497	(0.323)	6.087**	-4.258	2.0.0	ULC37
2009q2-2019q4									
AUT	0.95	1.040***	(0.023)	-0.796***	(0.132)	75.500***	-14.555***	1.0.0	ULC37
BEL	0.91	0.875***	(0.037)	-1.664***	(0.552)	4.594*	-3.242*	1.1.2	ULC37
ESP	1.07	0.956***	(0.036)	-0.389***	(0.076)	27.241***	-8.923***	3.0.2	ULC37
FIN	0.74	0.486***	(0.039)	-1.508***	(0.184)	21.299***	-7.925	1.2.3	ULC37
FRA	0.87	1.013***	(0.043)	-0.304	(0.230)	16.402***	-6.432***	1.3.0	ULC37
GER	1.17	0.813***	(0.072)	-1.108***	(0.232)	2.544	-2.561	1.0.1	ULC37
IRE	2.30	0.796	(1.521)	-2.174*	(1.211)	3.820	-1.714	2.1.1	ULC37
ITA	0.85	0.780***	(0.360)	-0.377*	(0.204)	5.605**	-3.606**	3.1.0	ULC37
NDL	1.06	1.164***	(0.044)	-0.109	(0.299)	6.073**	-4.160**	1.3.3	ULC37
PRT	1.43	1.391***	(0.050)	-0.452**	(0.173)	6.310**	-4.314**	1.3.2	ULC37

Note: Bounds procedure (F and t Test) for cointegration test. Null hypothesis: No long-term relationship exists. Critical values depend on lag structure choice: 1% ***; 5% **; 10% *. Long term coefficients FID (foreign import demand) and REER (Cost competiveness) from cointegrating equation. REER: Real effective exchange rate adjusted by unit labour cost relative to 27 or 37 countries. Model lag structure (l) according to AIC minimisation. Standard errors in brackets.

Table A 5: Contributions to Export Growth

	Quarterly Growth Rates			Contributions to Export Growth		
	X	FID	REER	FID	REER	UNEXPL
1995q1-2019q4						
AUT	1.10%	1.14%	-0.07%	+1.11pp	+0.04pp	-0.04pp
BEL	0.88%	1.12%	-0.05%	+0.93pp	+0.04pp	-0.07pp
ESP	1.11%	1.10%	0.04%	+0.98pp	-0.03pp	+0.17pp
FIN	1.02%	1.14%	-0.08%	+0.90pp	+0.24pp	-0.10pp
FRA	0.92%	1.11%	-0.08%	+0.90pp	+0.05pp	-0.02pp
GER	1.27%	1.10%	-0.17%	+1.38pp	+0.11pp	-0.20pp
IRE	2.47%	1.11%	-0.26%	+3.06pp	+0.51pp	-1.06pp
ITA	0.57%	1.12%	0.10%	+0.84pp	-0.06pp	-0.20pp
NDL	1.18%	1.10%	0.03%	+1.15pp	-0.03pp	+0.07pp
PRT	1.14%	1.09%	0.07%	+1.24pp	-0.11pp	+0.00pp
1995q1-2008q3						
AUT	1.65%	1.59%	-0.33%	+1.43pp	+0.35pp	-0.14pp
BEL	1.27%	1.58%	-0.08%	+1.26pp	+0.04pp	-0.04pp
ESP	1.51%	1.56%	0.35%	+1.52pp	-0.36pp	+0.35pp
FIN	2.00%	1.68%	-0.14%	+1.80pp	+0.08pp	+0.12pp
FRA	1.29%	1.59%	0.00%	+1.23pp	-0.00pp	+0.06pp
GER	1.88%	1.63%	-0.60%	+1.41pp	+0.58pp	-0.12pp
IRE	2.75%	1.60%	0.62%	+3.04pp	-0.84pp	+0.55pp
ITA	0.81%	1.78%	0.44%	+1.41pp	-0.58pp	-0.02pp
NDL	1.47%	1.69%	0.06%	+1.57pp	-0.01pp	-0.09pp
PRT	1.27%	1.61%	0.29%	+1.38pp	-0.14pp	+0.03pp
2009q2-2019q4						
AUT	1.09%	1.14%	0.13%	+1.18pp	-0.10pp	+0.00pp
BEL	0.99%	1.10%	-0.02%	+0.96pp	+0.03pp	+0.00pp
ESP	1.16%	1.08%	-0.38%	+1.03pp	+0.15pp	-0.02pp
FIN	0.81%	1.10%	-0.13%	+0.53pp	+0.20pp	+0.08pp
FRA	0.95%	1.09%	-0.18%	+1.10pp	+0.06pp	-0.21pp
GER	1.21%	1.04%	0.05%	+0.84pp	-0.05pp	+0.42pp
IRE	2.46%	1.07%	-1.34%	+0.85pp	+2.91pp	-1.30pp
ITA	0.95%	1.11%	-0.22%	+0.87pp	+0.08pp	+0.00pp
NDL	1.18%	1.11%	-0.09%	+1.29pp	+0.01pp	-0.12pp
PRT	1.50%	1.05%	-0.10%	+1.46pp	+0.05pp	-0.01pp

Note: Underlined values signal not reliable figures due to the absence of cointegration and/or insignificant coefficients (observable in Table A4).

Table A 6: Panel Cointegration Test (Westerlund test)

	SEE	PAT41	RD28	II41	CS29	MFP24	ECI
statistic	-1.746	-1.797	-2.228	-1.205	-1.935	-1.921	-1.31
p-value	0.040	0.036	0.012	0.114	0.026	0.027	0.095

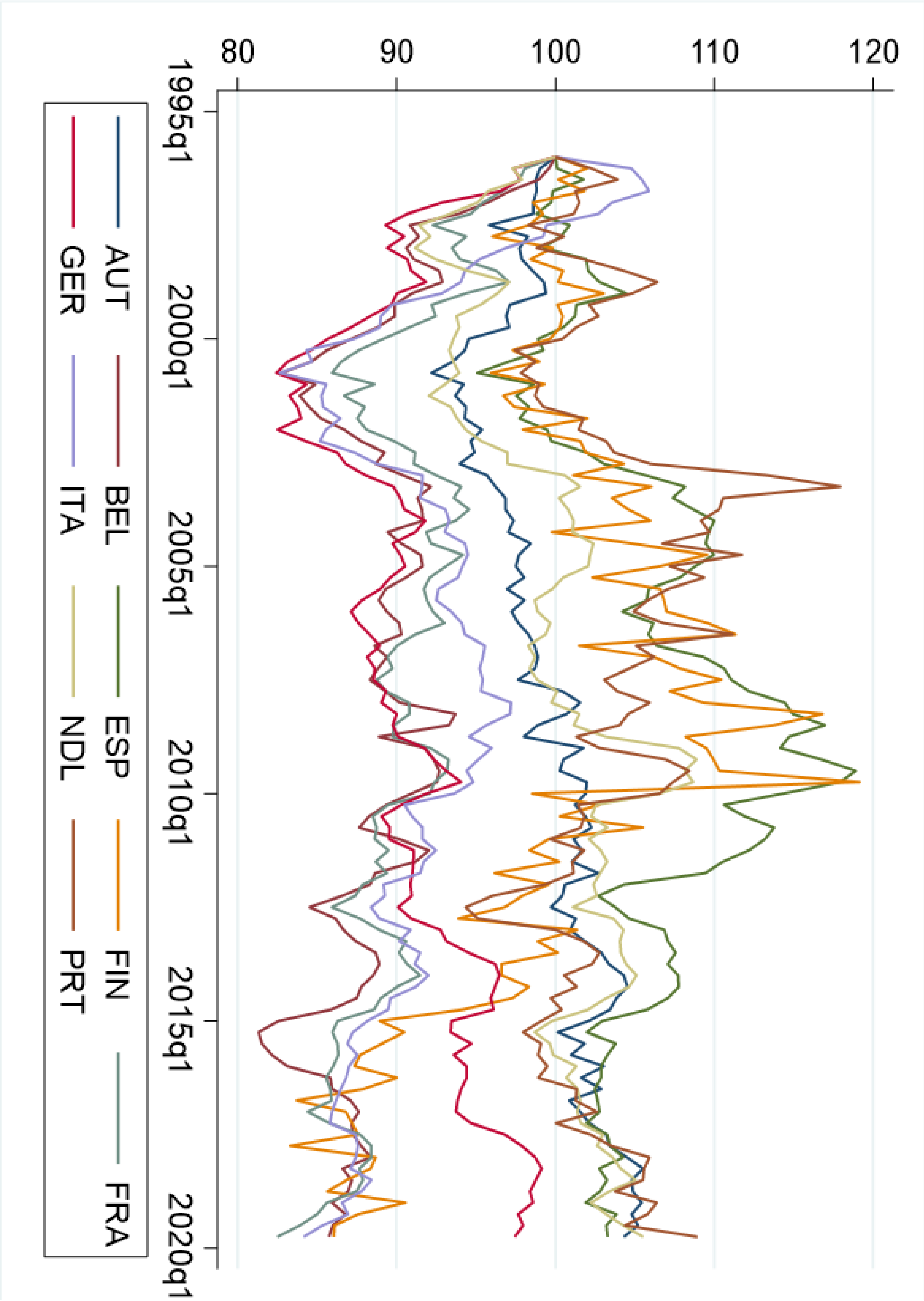
Note: Westerlund test for cointegration. H0: No cointegration Ha: Some panels are cointegrated. AR parameter and cointegrating vector are panel specific.

Table A 7: Rank Matrix

	AUT	BEL	ESP	FIN	FRA	GER	IRE	ITA	NDL	PRT
CS29	7	6	4	8	2	1	10	3	5	9
ECI	2	7	9	3	4	1	5	6	8	10
RD28	3	5	8	1	4	2	7	9	6	10
II41	2	4	3	5	7	9	1	10	8	6
IE	2	7	5	10	9	1	5	8	3	4

Note: Rank built upon arithmetically averaged values per country.

Figure 2: NPC as Trade Frictions (TF)



APPENDIX B

Export Equation Variables

Export volume (X_i): Real export of goods expressed in € (base year 2015) from the Eurostat national accounts database.

Cost competitiveness (P_i): Real effective exchange rate adjusted by nominal unit labour cost. The REER is relative to 37 partner countries. The weighting scheme is based on fixed export weights. Data is taken from the Price and Cost competitiveness database of the European Commission.

Foreign demand ($FD35_i$): Real gross domestic product (base year 2015, fixed PPP adjusted) of 34 OECD partner countries expressed in €. Data is taken from the OECD national accounts database.

Foreign import demand ($FID35_i$): Real imports of goods (base year 2015, fixed PPP adjusted, export weighted) of 34 OECD partner countries. Data is taken from the OECD national accounts database.

Non-price Competitiveness Variables

Patent stock ($PS41_i$): Patent stock relative to 40 competitor countries. Patent stock calculation according to the perpetual inventory method (depreciation rate $\delta = 0{,}15$) as applied by Bottega & Romero (2018). Number of patent grants (P_t) at the USPTO taken from the OECD Patents statistics database.
Formula $PST_t = P_t + (1 - \delta)PST_{t-1}$.

R&D expenditure ($RD28_i$): Gross domestic expenditure on R&D (GERD) as a percentage of GDP relative to 27 competitor countries. GERD time series taken from OECD Main Science and technology indicators database.

Capital stock ($CS29_i$): Capital stock relative to 28 competitor countries. Calculation according to the perpetual inventory method (assumed $N = 20$ years of service life for machinery: $\delta = 2{,}5/N$) as applied by Athanasoglou & Bardaka (2010). Real gross capital formation in € (base year 2015) taken from Eurostat national accounts database.
Formula: $CST_t = INV_t + (1 - \delta)CST_{t-1}$.

Investment intensity ($II41_i$): Gross fixed capital formation to GDP ratio relative to 40 competitor countries. Time series expressed in current prices in the national currencies. Data taken from the OECD national accounts database.

Multi-factor productivity ($MFP24_i$):
MFP volumes relative to 23 competitor countries as proposed by Giordano & Zollino (2016). MFP growth rates for 23 countries were taken from the OECD database. The source of Chinese MFP is FRED.

Economic complexity index (ECI_i): ECI taken from the Harvard Growth Lab. No transformation in logs.

Trade Friction NPC (TF_i): Unexplained factor within an Gravity Model export equation accounting for the Armington Hypothesis. Cost elasticity is assumed to be -1. Alterations of this cost elasticity affect the strength of the NPC effect, but not the relative tendencies.

General weighting scheme: Weights calculated on individual shares of export partner countries (95-19 average). Data is taken from the Price and Cost competitiveness database of the European Commission.

The calculation scheme for the indicators of Patents, R&D expenditure, capital stock, investment, multi-factor productivity, mark-up measure follows the approach of the REER: A weighted geometric average. $NPC_i = \prod_{j=1}^{n}(\frac{T_i}{T_j})^{\omega}$.

Table B 1: Geographical Composition of Variables

FI35, FID35	AUS, AUT, BEL, BUL, CAN, CHE, CZE, DNK, ESP, EST, FIN, FRA, GBR, GER, GRC, HUN, IRE, ITA, JAP, KOR, LTU, LTV, LUX, MEX, NDL, NEZ, NOR, POL, PRT, ROM, RUS, SVK, SWE, TUR, USA
REER27	AUT, BEL, BUL, CYP, CZE, DNK, ESP, EST, FIN, FRA, GER, GRC, HRV, HUN, IRE, ITA, LTU, LTV, LUX, MAL, NDL, POL, PRT, ROM, SLO, SVK, SWE
REER37	AUS, AUT, BEL, BUL, CAN, CHE, CYP, CZE, DNK, ESP, EST, FIN, FRA, GBR, GER, GRC, HRV, HUN, IRE, ITA, JAP, LTU, LTV, LUX, MAL, MEX, NDL, NEZ, NOR, POL, PRT, ROM, SLO, SVK, SWE, TUR, USA
PAT41	AUS, AUT, BEL, BRA, BUL, CAN, CHE, CHI, CYP, CZE, DNK, ESP, EST, FIN, FRA, GBR, GER, GRC, HRV, HUN, IRE, ITA, JAP, KOR, LTU, LTV, LUX, MAL, MEX, NDL, NEZ, NOR, POL, PRT, ROM, RUS, SLO, SVK, SWE, TUR, USA
RD28	AUT, BEL, CAN, CHI, CZE, DNK, ESP, FIN, FRA, GBR, GER, HUN, IRE, ITA, JAP, KOR, LTU, LTV, MEX, NDL, POL, PRT, ROM, RUS, SLO, SVK, TUR, USA
CS29	AUT, BEL, BUL, CHE, CYP, CZE, DNK, ESP, EST, FIN, FRA, GBR, GER, GRC, HRV, HUN, IRE, ITA, LTU, LTV, LUX, NDL, NOR, POL, PRT, ROM, SLO, SVK, SWE
II41	AUS, AUT, BEL, BRA, BUL, CAN, CHE, CHI, CYP, CZE, DNK, ESP, EST, FIN, FRA, GBR, GER, GRC, HRV, HUN, IRE, ITA, JAP, KOR, LTU, LTV, LUX, MAL, MEX, NDL, NEZ, NOR, POL, PRT, ROM, RUS, SLO, SVK, SWE, TUR, USA
MFP24	AUS, AUT, BEL, CAN, CHE, CHI, DNK, ESP, FIN, FRA, GBR, GER, GRC, IRE, ITA, JAP, KOR, LUX, NDL, NEZ, NOR, PRT, SWE, USA