TECHNISCHE UNIVERSITÄT CHEMNITZ

Faculty of Economics and Business Administration

Kaldorian cumulative causation in the Euro area: an empirical assessment of divergent export competitiveness

Sascha Keil
Walter Paternesi Meloni

Chemnitz Economic Papers, No. 063, May 2024

Chemnitz University of Technology
Faculty of Economics and Business Administration
Thüringer Weg 7
09107 Chemnitz, Germany

Phone +49 (0)371 531 26000
Fax +49 (0371) 531 26019
https://www.tu-chemnitz.de/wirtschaft/index.php.en
wirtschaft@tu-chemnitz.de

Kaldorian cumulative causation in the Euro area:

an empirical assessment of divergent export competitiveness

Sascha Keil
Research and teaching assistant
Chemnitz University of Technology
sascha.keil@wiwi.tu-chemnitz.de

Walter Paternesi Meloni
Assistant Professor in Economics
Sapienza University of Rome
walter.paternesimeloni@uniroma1.it

Abstract

Over the past decades, models of circular and cumulative causation, based on the endogenous relations between prices, exports, and labour productivity, have lost prominence in explaining economic dynamics. We argue that, in the absence of counterbalancing mechanisms, the combination of price-sensitive exports and the triggering effect of exports on productivity can enable feedback loops and can significantly shape macroeconomic reality in the short-to-medium run. We apply an adapted export-led model of cumulative causation to 10 major countries belonging the Euro area, a region characterized by divergent wage growth trajectories reflected in divergent export competitiveness and lack of equilibrating mechanisms. Specifically, the model is tested for the period 1995–2020 employing a country-level system of equations (3SLS-ARDL). Our findings indicate that for the majority of the countries examined, this feedback mechanism – comprising price-sensitive exports and export demand affecting productivity growth – exacerbates macroeconomic disparities in terms of labour productivity. While nominal wages act as a potential trigger through their impact on price competitiveness, they also serve as a central factor that retards the feedback mechanism due to the Verdoorn effect of wage-induced demand. Overall, our results affirm the significance of price-induced and export-led theories of cumulative causation while also delineating its limitations, particularly regarding price competitiveness-oriented export-led growth strategies.

Keywords: international trade; export; competitiveness; unit labour cost; wages; productivity; European imbalances.

JEL codes: F16; F41; J30.

Acknowledgments

A preliminary draft of this work has been presented at the 7th International Astril conference (Rome, January 2024) and the 20th annual meeting of the Keynes Gesellschaft (Bamberg, February 2024). We thank all participants for fruitful discussion. Furthermore, we would like to thank Desirée Böhm for her assistance.

1. Background and rationale

Over the past two to three decades, the shift in Europe's macroeconomic landscape has been marked. A mix of fiscal constraints and reduced reliance on borrowing for private consumption has propelled exports to the forefront of growth drivers. In many instances, the export component of aggregate demand is the sole contributor showing a significant growth trend, to the extent that this process is often depicted as 'export-led growth'. Against this backdrop, some countries stand out by capturing a more substantial share of foreign demand, showcasing a heightened level of international competitiveness. Beneath the implied export disparities, differences in terms of wages and productivity were accentuated as well. The related scientific discourse focuses on identifying factors that drive the different – or even divergent – export competitiveness which represents a major aspect of macroeconomic imbalances.

Theories of circular and cumulative causation, such as the export-led growth model by Kaldor (1970), which explain divergent macroeconomic dynamics across trade-related countries, have been somewhat neglected. According to this view, additional export growth induced by a competitive advantage based on lower prices has the potential to stimulate productivity, subsequently fostering price competitiveness further through its impact on unit labour cost (hereafter, ULC). A combination of price sensitive exports and export-induced productivity growth has the potential of enabling a price-export-productivity (PEP) feedback mechanism. This mechanism may aggravate disparities of central macroeconomic quantities increasing the advantage of one country at the expense of its competitors. Despite the theoretical significance, rooted in the seminal works by Verdoorn (1949), Kaldor (1966, 1970) and Dixon and Thirlwall (1975), this mechanism has been increasingly overlooked in the recent literature due to a shifting perspective on the role and behaviour of prices. Initiated by a paradoxical finding by Kaldor (1978), critics have raised doubts about the central role of price competitiveness and emphasised the importance of non-price factors in explaining export dynamics. If these critiques hold, the price channel of the PEP feedback mechanism is effectively blocked, preventing export-induced productivity gains from translating into additional exports through its cost-lowering effect.

However, recent findings suggest that these reservations hold limited validity, since the price channel in the specific case of the Euro area does not appear to be blocked for two reasons. First, empirical studies conducted over the past two decades consistently identify negative and significant price elasticities of exports, even of considerable magnitude (European Commission, 2010; Breuer and Klose, 2015; Keil, 2023). Second, ULC (mainly driven by varying nominal wage movements) and prices across member states diverged for over a decade, indicating that export success breed further success through its potential impact on ULC. The Euro area's unique setting, which lacks nominal exchange rate adjustments and alternative equilibrating mechanisms for this price competitiveness divergence, potentially creates a conducive environment for the PEP feedback mechanism having significant macroeconomic effects. A central role in triggering this divergence in competitiveness is attributed to the persistent differences in nominal wage growth across countries from the introduction of the Euro to the financial and economic crisis starting in 2008 (Baccaro and Tober, 2022; Tober, 2023). Indeed, many observers consider policy-induced wage moderation, particularly in Germany, as a major root cause of these imbalances (Bibow, 2018).

Within the original Kaldorian export-led growth model, nominal wage growth is considered only as a major cost factor that impacts export competitiveness. Accordingly, wage containment potentially enables the feedback mechanism, since low wage growth strengthens price competitiveness, and the subsequent higher exports speed up productivity. Yet, for a comprehensive assessment of such an export-led growth strategy, a look beyond the competitiveness effects through the foreign trade channel is imperative: as a major driving force of internal demand, lower wage growth may impinge on productivity growth (through a domestic demand Verdoorn-type effect), potentially counterbalancing the cost competitiveness channel (through the price elasticity of exports and the export demand Verdoorn-type effect).

This paper enters this controversy and aims at assessing the macroeconomic relevance of the PEP mechanism for the particular setting of the Euro area, spanning from 1995 to 2020. To address potential issues of endogeneity and simultaneity being characteristic to the PEP mechanism, we employ a country-level system of equations employing a 3SLS–ARDL (three stages least squares – autoregressive distributed lags) approach to allow for interpreting the coefficients as effects.

Our empirical inquiry makes a threefold contribution. First, the estimation of the respective effects allows us to measure the individual relevance of the PEP mechanism and to quantify its macroeconomic impact. Second, our empirical model permits the assessment of the double character of wage moderation and its overall effect on the central outcome variable of productivity. Third, by using an econometric technique capable of dealing with endogeneity, we estimate 'genuine' price elasticities of export and export-Verdoorn effects (namely, the triggering effect of export on productivity) at the country level. Specifically, we carefully consider the potential bidirectional relationships between productivity and exports and between exports and prices, as well as the biasing influence of structural non-price factors.

Out of this empirical exercise, some policy hints arise. Our empirical findings support the theoretical relevance of the PEP feedback mechanism: higher competitiveness determined by relatively lower nominal wages may boost the export performance of a country; stronger export, in turn, has a productivity-enhancing effect; consequently, heightened productivity provides an additional cost advantage, and further strengthens price competitiveness. This is particularly true in the case of the Euro area: in the absence of equilibrating mechanisms, international wage growth differences and the resulting differentiated export performances may have exacerbated disparities in productivity dynamics across member countries. This does not mean that wage moderation cannot also have negative macroeconomic consequences. Indeed, our results highlight that strong domestic demand can stimulate labour productivity; therefore, while slowing wage growth may promote exports on one hand, on the other hand, it can slow down productivity *via* reduced wage-induced consumption.

The remaining of the paper goes as follows. Section 2 frames our study and introduce our model of cumulative causation. Section 3 elucidates why and how the Euro area provides a promising field for examining the connections between wages, productivity, prices and exports. Section 4 reviews and discusses the pertinent empirical literature. The focus of the paper then turns to the econometric aspects: Section 5 outlines the methodology and data employed, while in Section 6 findings are presented and discussed. Section 7 concludes with an interpretation of the broader implications.

2. Theoretical framework

2.1 Analytical premise

The complex interplay between the international economic sphere and the domestic economy has long intrigued economists, with particular attention paid to the relationship between international prices, cost and exports. The prevailing view in standard microeconomic theory suggests a negative price effect on exports due to a downward sloping demand curve. This perspective has been adopted by various theoretical and analytical frameworks at the macroeconomic level, without considering further interactions between these variables. However, empirical estimates of the relationship between relative prices and export sales have shown considerable variability since their inception. Already decades ago, Morgan (1970) cautioned against placing too much reliance on estimated price elasticities of exports. Inconclusive empirical findings regarding the sign, significance, and magnitude of the estimated price effect challenged the idea of a simple negative relationship between prices and exports and gave rise to differing interpretations (for a detailed discussion, see Caglayan and Demir, 2019, as well as Blecker, 2023).

An alternative perspective can be derived from export-led growth theory, as proposed by Kaldor (1970). According to this viewpoint, which has been mathematically formulated by Dixon and Thirlwall (1975), the relationship between prices and exports is bidirectional through export-induced productivity growth. First, increasing relative prices are believed to negatively affect export sales in a standard way. Second, the price variable, whose growth is determined by ULC dynamics given a constant profit mark-up, becomes endogenous to exports due to the presence of increasing returns to scale. This is the export-Verdoorn effect (EV, hereafter), where higher export sales drive up output and in so doing stimulate productivity growth (Verdoorn, 1949; Kaldor, 1966). In other words, accelerated (slowing) export growth has a positive (negative) impact on productivity dynamics, which, in turn, leads to reduced (stronger) relative price increases through the channel of ULC. Endogenous productivity and price-sensitive exports enable a PEP feedback mechanism, leading to divergent macroeconomic outcomes. Although empirical estimates of both the price elasticity and the Verdoorn effect are not sufficiently high for a self-reinforcing divergent process, the cumulative effect on the levels can be significant in case of persistent differences in price growth rates over a considerable period due to divergent relative ULC.[1]

However, doubts about the price sensitiveness of exports have led some in the academic community to argue that relative prices and, thus, the just described feedback mechanism have, at most, limited relevance for a country's export competitiveness. A notable example is the paradoxical observation made by Kaldor (1978) himself, where export market shares and relative prices in several industrial economies increased simultaneously. Kaldor concluded that relative prices, whether expressed as export prices or ULCs, were not the drivers of exports but rather consequences of them. This reverse-causality perspective challenged the idea of a PEP feedback mechanism and underscored the concept of non-price competitiveness, suggesting that factors beyond price, such as technological, structural and other hardly measurable features, play a central role in determining trade dynamics on macroeconomic scale. Generally, the relevance of the feedback mechanism diminishes as exports become less price-sensitive. The balance-of-payments-constrained growth

---

[1] According to the stability criteria of the model formalised by Dixon and Thirlwall (1975), the product out of price elasticity and the Verdoorn coefficient has to exceed unity to allow for a self-reinforcing feedback mechanism. As empirical estimates indicate that this criterion is not met, the model predicts stable differences in terms of growth rates of exports, productivity and output across countries.

model (Thirlwall, 1979), which can be regarded as a further development of the Kaldor-Dixon-Thirlwall model acknowledging its central insights, even disregarded the role of relative prices in the long-run growth determining process (Magacho and McCombie, 2020). This is motivated by a sort of 'price elasticity pessimism' considering exports not very sensitive to prices and the assumption of purchasing power parity (PPP), which posits that international prices do not divert in the medium-to-long run (Blecker, 2013). If the price channel is blocked, the PEP feedback mechanism has a very limited impact, meaning that export-induced productivity gains do not translate into further export gains through lower prices in a self-sustaining manner.

Nevertheless, these limitations warrant a closer examination regarding their empirical validity. Despite some inconclusive findings, it is essential to emphasise that the majority of empirical applications recently conducted have consistently identified negative and significant price elasticities of exports, even of considerable magnitude (Baccaro and Tober, 2022; Keil, 2023): this means that potential productivity-induced advantages in relative prices effectively translate into export gains. However, the notion of PPP states that prices will not continuously diverge and are bound by some long-term equilibrium mechanism. Hence, the PEP effects may lead to short-term price gains, which later will be counterbalanced by movements in exchange rates or domestic prices (Thirlwall, 1979). Hence, price advantages, due to productivity gains, will not last. However, Blecker (2013) emphasised that PPP may hold in the long run, but it does not generally hold in the short to medium run. Therefore, if exports are sensitive to changes in international prices and the latter do diverge in the short and medium run, the price channel is not blocked. Thus, the feedback mechanism between prices, export and productivity may represent a considerable driving force behind the observed macroeconomic dynamics and shape a "period of cumulative non-equilibrium growth" (Setterfield, 2002, p. 228).

2.2 A model of cumulative causation

Taking stock of this analytical discussion, in this paper, we empirically examine the relevance of the PEP mechanism for major Euro area countries. Intuitively, the model considered in this work depicts an endogenous feedback mechanism, which potentially represents a significant aspect of reality in international macroeconomics in the medium-run. By focussing exclusively on the core mechanism of the Kaldorian export-led growth theory, namely the PEP nexus, we do not aim explaining overall output growth rates. If the growth of overall output and its domestic demand components is balance-of-payments constrained and, thus tightly linked to its export growth in the long run, is subject to a connected debate.[2] In this regard, we align with the perspective of several scholars who argue that this feedback mechanism is unlikely to govern long-run growth rates for various reasons (Setterfield, 2002), particularly because the resulting winner/looser setting across countries is not sustainable. However, the PEP nexus describes the behaviour of free market forces as the overall macro-structure changes, whereas the connection of exports and output is subject to the economic policy sphere in the longer run. As previously mentioned, we posit that the feedback mechanism can have a substantial impact in the medium run, giving rise to periods of divergent economic dynamics among closely interrelated and trade-dependent countries.

[2] In the context of the Euro area, overall output growth of several member states did not seem to be balance-of-payments constrained until the economic crisis starting in 2008. This suggests the perspective explaining the Euro area crisis as a balance-of-payments crisis (Cesaratto, 2018).

The model features an 'inner' circle of cumulative causation (see Figure 1), comprising three key endogenous variables: price/cost competitiveness (captured by the real exchange rate calculated on the basis of ULC, termed ULC-RER), exports (X), and labour productivity (PROD). In addition to relating to each other, the endogenous PEP variables can be influenced by other exogenous variables outside the circle: in this respect, the adoption of the medium-run perspective is crucial for the precise formulation of the model, since it allows to distinguish into forces being purely endogenous and exogenous, whereas in the long run this definition can differ.

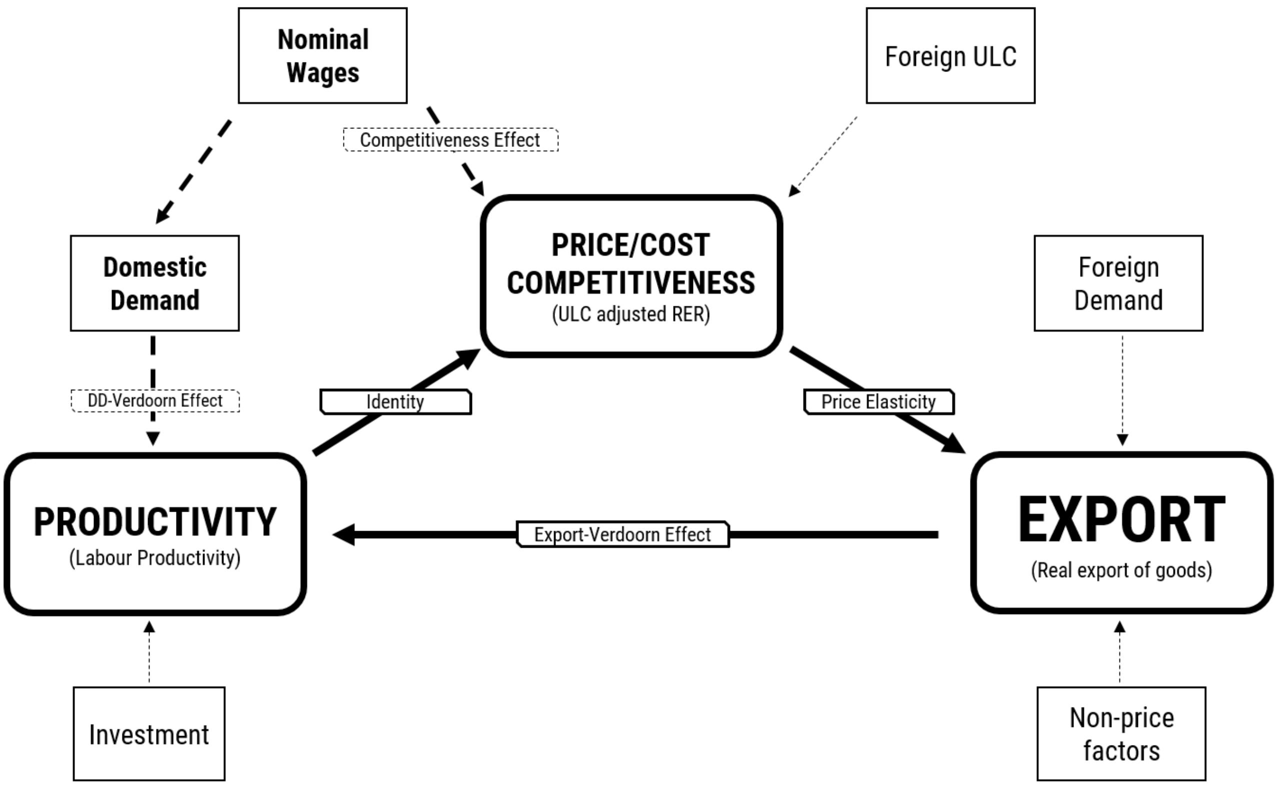

Figure 1. Model of cumulative causation. *Endogenous variables in ovals, exogenous variables in rectangles. Solid arrows describe the endogenous relationships in the 'inner' virtuous circle, while dashed arrows indicate the effects of exogenous variables on the endogenous ones.*

For simplicity, let us begin the explanation of the inner PEP connections by focusing on the price/cost competitiveness variable. ULC-RER is the channel through which the circular causation is transmitted, and which reflects endogenously and exogenously generated competitive gains. It is defined as the ratio of domestic unit labour cost (ULC) to foreign unit labour cost (ULC^f), both expressed in a common currency, and is assumed to govern relative prices of domestically produced goods, given that the profit mark-up is constant. The components of domestic ULC are nominal wages (NW) in the nominator, as major cost driver, and real labour productivity (PROD) in the denominator, as endogenous cost reducing force. Given that the foreign demand for domestic products is price sensitive and, thus, the price elasticity is negative, a decrease in the ULC-RER represents increased price competitiveness, which is expected to affect exports positively. Beside the described price competitiveness effect, export is exogenously affected by foreign demand (FD) and non-price competitiveness factors (NPC), such as product quality and innovativeness. Higher exports are likely to positively affect domestic productivity (PROD) by expanding the production scale and activating learning-by-doing processes, as quantified by the EV effect. The other component leading to Verdoorn effects on productivity is represented by domestic demand: like foreign demand, also higher government spending or wage-induced consumption can stimulate productivity growth inasmuch it corresponds to a larger market size. Furthermore, our model takes investment (INV) in Kaldorian tradition as another driving force of productivity into account. At the same time, PROD affects the ULC-RER negatively, as faster growth in productivity allows to produce the same output by less labour input and, thus, reduces ULC and enhances price/cost competitiveness by definition.

The circular and cumulative causation can be triggered by exogenous forces affecting productivity or price dynamics. In this study, particular emphasis is put on the dual role of internationally different dynamics of nominal wages. Here, they are assumed to be determined by factors being exogenous to the PEP nexus in the short and medium run.[34] Noteworthy, the original export-led-growth model considers domestic demand and its components to be fully tight to the dynamics of export demand. In such a setting, an export-led growth strategy based on nominal wage moderation can only have beneficial effects, as productivity growth is determined by overall demand ultimately governed by exports. Hence, the PEP mechanism will reinforce the price competitiveness differences initiated by differences in nominal wage growth (the competitiveness effect of wages). Despite this, productivity growth may be subject to a scale effect originating from domestic demand. In this regard, wages represent a relevant driver of internal demand sources, such as private consumption and government spending, and may exert a secondary (and contrary) effect on productivity. By opposition, wage moderation slows down the expansion of domestic demand and thus hampers productivity growth (the domestic demand effect of wages), consequently retarding cumulative causation. Which overall effect nominal wages can have on the central outcome variable of productivity is expected to differ significantly across countries. This is due to international differences in the relevance of the PEP mechanism, which depends on the individual macroeconomic structures; hence, the magnitude of export price elasticity and the strength of the EV effect are affected by the export dependence or the sectoral structure of a country.

Although this study focuses on the dual role of nominal wages, there is no single 'trigger variable' that initiates the causation circle. Importantly, the initial push may come also from any other variable.[5] Virtuous circles could also begin from changes other than nominal wages growing persistently slower than in competitor countries. Such a triggering competitive advantage may be the result of a nominal depreciation of the exchange rate, although in the context of the Euro area countries this hypothesis is excluded. Similarly, the virtuous process may begin with an improvement in structural factors (non-price competitiveness), which, in the medium-run, is considered an exogenous element being exogenous to the PEP

---

[3] Several scholars (Reebooting Consensus Authors, 2015; Wyplosz, 2013) stressed the fact, that the within Euro area disparities in nominal wage growth were originally caused by private and public debt-driven demand growth in southern Europe. Moreover, Höpner and Lutter (2018) highlighted the particular importance of differences in political economy and wage bargaining regimes in affecting wage growth in the period between 1999–2008.

[4] In the empirical part, we will further discuss this mechanism and how our estimation tool allow us to capture the two effects (see Section 5).

[5] The econometric model we will estimate in Section 5 is flexible enough to consider potential triggering effects from variables outside the inner circle. However, it's important to clarify that we treat these variables as exogenous since we are presenting a short-to-medium run model. In principle, they could become endogenous in the longer run. For instance, productivity may be influenced by non-price competitiveness, given that higher quality goods often have a higher value added. Yet, both export and domestic demand might influence investment through the accelerator effect, while higher export and productivity could impact the labour market and subsequently influence wages.

mechanism.[6] An enhancement in such non-price factors would ensure the exporting country a competitive advantage based on the superiority of its export goods in terms of quality and innovativeness: due to the subsequent increase in exports, the induced PEP feedback effect can boost productivity and consequently provide a cost advantage. Accordingly, the NPC enhancement triggers feedback effects ultimately favouring this structural advantage by lowering ULC growth (Keil, 2024). A different scenario would apply to an increase in demand from abroad, which, if distributed evenly among all exporting countries, would not trigger a divergent cumulative movement.

Our empirical estimates will be based on the analytical framework outlined above, with a focus on the described features of the just presented model. Particularly, we will achieve this by estimating a model where: i) endogenous and exogenous variables are clearly identified, consistent with this analytical apparatus; ii) the double character of wages will be taken into account; and iii) simultaneity and endogeneity are thoroughly addressed through appropriate modelling and estimation tools. We shall return to this point in Section 5. Before delving into the econometric analysis, however, we find it opportune to discuss why the Euro area serves as a promising context for our examination (Section 3). Additionally, we will reference relevant empirical literature on the subject in Section 4.

3. The Euro area context

Taken together, the described feedback mechanism emphasises that gains in productivity resulting from higher exports lead to price advantages, ultimately resulting in increased export sales. The validity of this sequence depends on three key conditions: (1) exports influence productivity dynamics, (2) exports are sensitive to prices, and (3) relative prices and ULC reflect export-induced productivity gains, with no significant counterbalancing mechanisms in place. The validity of the first two conditions is an empirical matter, while the third condition pertains to the monetary, institutional, and economic policy framework of the studied economic area. In this section, we will explain why the establishment of a common monetary framework among major European economies has created a conducive environment for the PEP feedback mechanism to potentially have a significant impact in the medium run. This is because the third condition has been met over an extended period for a group of closely interconnected European economies that compete in manufacturing exports.

The central premise for this scenario is that the price competitiveness variable ULC, the major determinant of domestic prices and catalysator of the cumulative movement, can vary substantially across countries without corrective actions on nominal wages, labour productivity, or nominal exchange rates. This allows export-induced productivity gains to further enhance a country's price competitiveness. In the Euro area, this is first and foremost made possible by the adoption of a common currency, which prevents nominal adjustments. The Euro area was established in 1999, with member states' exchange rates fixed in 1998. Even before this fixation, the exchange rates of future member countries were pegged to the European currency unit (ECU), limiting floating and discontinuing the counterbalancing of differences in the levels of ULC. Furthermore, due to the absence of robust equilibrating mechanisms at the macroeconomic level, ULC was free to

[6] Proponents of the new developmentalism school of thought view the structural competitiveness of an exporting nation, as being determined in the long run by its price competitiveness (see Missio and Jayme, 2012).

diverge among member states of the currency union. Despite the Maastricht Treaty's initial goal of relative price stability,[7] the relevance of ULC, along with its components of nominal wages and productivity, was neglected until the problematic macroeconomic imbalances became evident following the great financial crisis.[8] Only in 2011, ULC was institutionally recognized and incorporated into the macroeconomic imbalance procedure scoreboard of the Stability and Growth Pact. However, the newly formulated criteria point at avoiding too high ULC growth rates and do not provide neither a common target nor any rebalancing mechanism (Höpner and Seeliger, 2021). In other words: modest but persistent differences in ULC growth rates in accordance with the Euro area rules may cause further divergence in levels.

As anticipated, we focus on 10 major countries belonging to the Euro area, namely Austria (AUT), Belgium (BEL), Finland (FIN), France (FRA), Germany (GER), Greece (GRC), Italy (ITA), Netherlands (NED), Spain (SPA) and Portugal (PRT).

	ULC-RER		ULC		PROD		NW		GOV		X	
	96/08	09/20	96/08	09/20	96/08	09/20	96/08	09/20	96/08	09/20	96/08	09/20
AUT	-6.4%	-1.2%	+13.5%	+5.8%	+15.3%	-1.2%	+30.7%	+28.6%	+25.8%	+12.5%	+92.9%	+46.4%
BEL	+3.1%	+4.8%	+23.5%	+0.3%	+11.9%	+4.8%	+38.1%	+20.7%	+26.1%	+11.7%	+51.9%	+41.5%
FIN	+0.7%	+4.3%	+21.3%	-3.6%	+21.2%	+4.3%	+47.0%	+19.6%	+24.2%	+11.5%	+99.0%	+4.4%
FRA	+1.7%	+3.3%	+21.6%	-2.0%	+12.0%	+3.3%	+36.3%	+17.8%	+17.9%	+15.1%	+55.7%	+24.0%
GER	-13.2%	+6.7%	+7.4%	+6.3%	+7.1%	+6.7%	+14.9%	+32.9%	+16.7%	+30.3%	+92.9%	+46.4%
GRC	+20.5%	-22.6%	+65.0%	-23.7%	+24.0%	-22.6%	+104.6%	-24.6%	+45.3%	-18.3%	+76.3%	+47.1%
ÌTA	+10.6%	-3.0%	+32.3%	-8.7%	-1.2%	-3.0%	+30.6%	+8.0%	+18.0%	-4.3%	+29.9%	+32.0%
NDL	+7.0%	+3.6%	+27.6%	-0.3%	+13.7%	+3.6%	+45.0%	+24.1%	+48.5%	+14.2%	+67.8%	+58.8%
SPA	+18.8%	+4.7%	+43.2%	-13.9%	+2.5%	+4.7%	+46.8%	+12.7%	+73.1%	+11.4%	+67.0%	+51.3%
PRT	+10.6%	+3.8%	+39.4%	-5.5%	+14.5%	+3.8%	+59.5%	+17.2%	+37.3%	-2.9%	+67.8%	+58.8%

Table 1. Percentage changes of central variables. Different time spans (1996q1-2008q4 and 2009q1-2020q4).

Indexing the ULC levels to 100 in 1996, the accumulated disparities across Euro area countries appear significant (see Table 1).[9] Germany can be considered the benchmark in this sample, since its wage moderation policy resulted in an ULC growth of only 7% until the fourth quarter of 2008. This slow growth implies that its price level also increased gradually, contributing to its exports remaining highly competitive in terms of price. In contrast, France, the second-largest European economy, experienced a 22% growth in ULC, which represents a differential of 15 percentage points (p.p.) with Germany. Meanwhile, Italy and Spain saw even higher increases, with growth rates of 32% (25 p.p. higher than in GER) and 43% (36 p.p. higher than in GER), respectively. The highest ULC growth was recorded in Greece, where it surged by a staggering 65% (58 p.p. higher than in GER) over the course of twelve years. In the latter case, this implies that in the relative nominal wage cost incurred by one unit of real output in Greece has been 54% higher than in Germany, comparing the 2008 value to those of 1996. After 2010, however, ULC levels started converging consistently. Due to a process of internal devaluation driven by austerity policies, wage moderation and reduced government spending (GOV) in many

[7] National price level growth was allowed to be 1.5 pp. higher than that of the most price stable countries.

[8] For a discussion on the divergent macroeconomic performances of Eurozone countries, refer to Gräbner et al. (2020).

[9] Year 1996 serves as the starting point of our comparative descriptive analysis. Since then, no more significant adjustments of the nominal exchange rates of the countries under scrutiny have taken place. However, 1995 serves as starting point for the econometric estimates on single country level presented in Section 5, taking advantage of the longer time series producing more precise results. The only exception represents Italy, whose time series start only in 1996, since a last devaluation to the ECU took place.

Mediterranean countries, disparities with Germany, the benchmark, began to diminish. Nonetheless, the disparities did not disappear: at the end of our time span (2020), we still see that France and Italy show ULC levels being 8 p.p. and 10 p.p. higher than in Germany.

Examining the dynamics of the components of ULC reveals the driving forces behind these differences. Baccaro and Tober (2022) note that variations in nominal wage growth rates are significantly more pronounced than those in labour productivity, making them a major determinant of ULC divergence. For instance, the disparity in nominal wages compared to benchmark Germany was 16 p.p. for Italy, 32 p.p. for Spain, and 21 p.p. for France. Yet, in terms of labour productivity, these gaps were only 8 p.p., 5 p.p. and -5 p.p. over the divergence period 1996–2008, respectively. This observation supports Peeters and Dem Reijer's (2014) finding that nominal wage growth rates in Mediterranean Euro area countries did not align with fundamental labour productivity growth up to 2010. Figure 2 illustrates the divergence in the time series of wages, ULC and productivity for ten Euro area countries. We complement this graph with the divergence in prices (GDP deflator) and observe that wage differentials effectively translated into diverging prices. Until 2009–10, divergence was evident in terms of prices, ULC, and wages, whereas the differences in productivity were relatively modest. Following the economic shock in 2008, these disparities decreased but began to rise again after the economic measures taken in response to the Covid-19 pandemic.

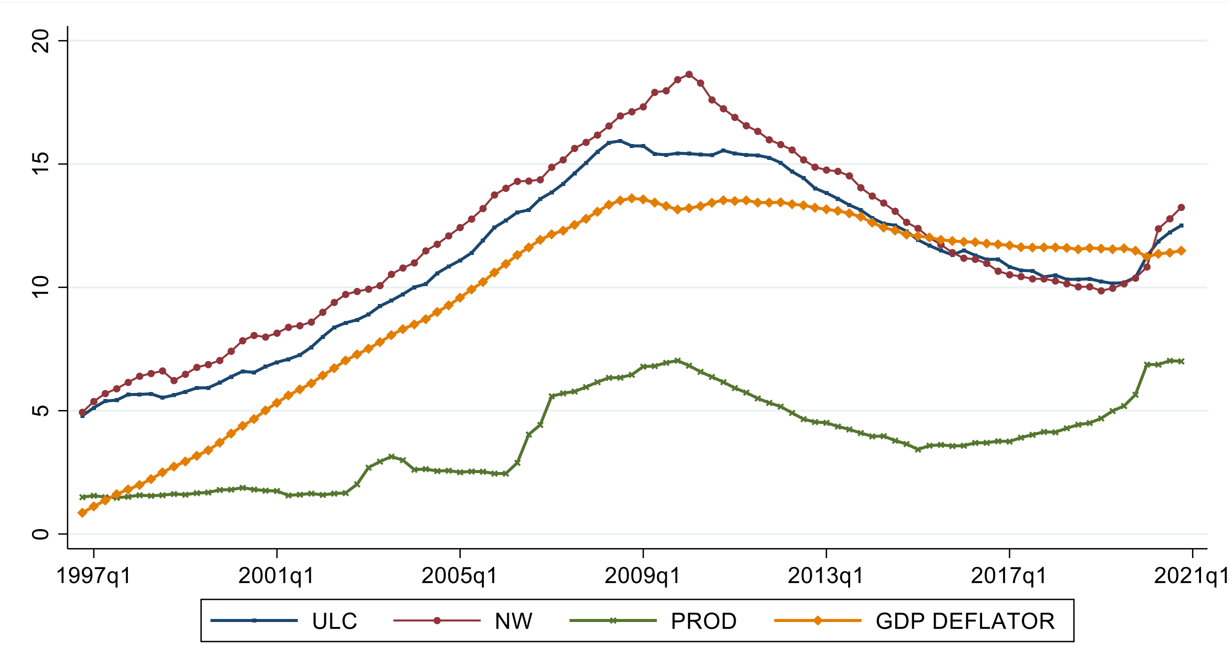

Figure 2. Euro area divergence in cost and prices. *Root mean square deviation (Export weighted, four quarters moving average) of 10 Euro area countries (higher values indicate stronger divergence). Source: authors calculation based on EUROSTAT data.*

Overall, the evidence suggests that the Euro area's institutional setup facilitated the accumulation of significant differences in ULC and prices. Particularly in the first period of the common currency (1997–2010), divergence is the dominant pattern across the countries adopting the common currency of the Euro resulting in sharp contrasts in terms of export competitiveness. On the one hand, this has been possible due to fixed exchange rates and the introduction of a common currency. On the other hand, there has been no substituting mechanisms to rebalance emerging differences in competitiveness. This decade can be considered the medium-term period, during which a cumulative non-equilibrium growth may has occurred. National wage growth, a likely primary driver of ULC divergence, was not governed by any common growth rule. This raises the suspicion, that the institutional setup and the observed wage growth differences enabled the described PEP feedback mechanism. The potential presence of the PEP nexus may have exacerbated these differentials, enhancing the competitiveness of some countries while diminishing others. In the empirical part of this analysis, we want to test: i) whether divergent ULC levels have significantly affected exports; ii) to what extent the resulting export growth patterns impacted labour productivity dynamics; and iii) which has been the overall effect of wage moderation on productivity growth. If significant, the feedback mechanism acted as an aggravating force regarding the emergence of macroeconomic imbalances.

4. Related theoretical and empirical literature

The model proposed and tested in this paper relates to two lines of inquiry. On the one hand, we refer to the literature on the relevance of competitiveness in driving exports: this research stream is reviewed and discussed in Section 4.1. On the other hand, we draw from the so-called Kaldor-Verdoorn perspective, which is surveyed in Section 4.2. We juxtapose the two strands in Section 4.3, emphasizing the empirical literature that supports the positive impact of exports on stimulating productivity growth in the context of models of export-induced cumulative causation.

4.1 The role of competitiveness in driving export

Within the classical models of circular and cumulative causation, the price competitiveness channel represents the central element enabling feedback effects (Magacho and McCombie, 2020). Though the relevance of other non-price competitiveness factors is acknowledged, the immediate research context for our work is the literature that evaluates cost and price competitiveness as key factors influencing a country's export performance. As mentioned in the introductory section, the discussion on the role and facets of competitiveness is lively (see Pariboni and Paternesi Meloni, 2022; Tober, 2023) and not free of controversy. Despite the ongoing debates, some considerable evidence has recently emerged concerning the size and significance of price and cost elasticities (Boggio and Barbieri, 2017; Keil, 2023).

Not by chance, emphasis is put on the German case, the *par excellence* export-led economy in Europe. In this respect, the European Commission (2010) documented a high sensitivity of export to prices prior to 2008 for Germany (−0.73) and other major European countries, namely Austria (−0.82), France (−1.18), Italy (−1.72), Spain (−1.31). Moving to the non-institutional research, Baccaro and Pontusson (2016) estimated a price elasticity of −0.48 for Germany. Similarly, Baccaro and Tober (2022) emphasized the role of (relative) labour costs in driving German export, with elasticities estimated at −0.83 for wages and +0.87 for productivity. Yet, Baccaro and Benassi (2017) find evidence of a negative elasticity for German manufactured items (−0.4 for ULC-RER). Still on Germany, Thorbecke and Kato (2012) and Keil (2023) estimate a long-run elasticity to the ULC-RER of about −1. However, other contributors, such as Storm and Naastepad (2015a, 2015b) detect insignificant price/cost sensitivity, and suggested that the major factors behind German export are technology, product innovation and quality.[10] In a similar vein, Herrero and Rial (2023) recognize a significant wage moderation in German services, but conclude that the main driver of export was the extent and integration of knowledge-intensive business services (which fall under non-price elements).

This debate extends also to Mediterranean countries. Concerning Italy's export, Baccaro and Tober (2017) find an important role for costs and prices, whose elasticity is estimated at −1.5. Negative price/cost elasticities, ranging from −0.8 and −1.5, are also found in Paternesi Meloni (2018), Baccaro and Bulfone (2022), and Keil (2023). By contrast, Breuer and Klose (2015) do not find a significant price effect for Italy's export. Xifré (2021) argued that the recent increase in Spain's export share relates to increased non-price competitiveness, being price competitiveness worsened. The irrelevance of cost and price factors for Spain is also supported by Villanueva et al. (2020). Nevertheless, significant cost and price elasticities for Spanish export arises from Baccaro and Bulfone (2022) and Keil (2023). Multi-layered evidence arises for Greece: according to Athanasoglou and Bardaka (2010), non-price competitiveness plays a vital role in supporting export, but at the same time they estimate a price elasticity of −1. Analogous results also arise for Portugal: Adamczyk and Westmore (2020) find a significant cost and price effect; concurrently, most of the increase in export can be explained by product quality and poor domestic demand.

The relevance of non-price elements in promoting exports is particularly highlighted by the 'structuralist' school of thought. In this perspective, an economy is considered more competitive when it can develop its production structure through the promotion of innovative activities with a higher technological competitiveness and enhance exports through diversification. In this regard, McCombie and Thirlwall (1994) originally argued that technological factors are more pivotal than costs and prices in determining the trade of manufactured goods. Despite the acknowledged importance, there is a relatively limited number of studies directly assessing the role of non-price elements at the empirical level. A measure of complexity, known as the Economic Complexity Index (ECI), inspired by the work of Hausman and Hidalgo (2009), has recently gained traction in applied analysis. This index built on the basis of two aspects, namely diversification and ubiquity. On empirical grounds, Pariboni and Paternesi Meloni (2022) documented the relevance of the ECI (next to ULCs) in shaping exports for OECD countries; analogously, Herrero et al. (2023) emphasize how, in addition to the price gap, the ECI gap may have favoured German exports over those of Mediterranean countries. On similar lines, a positive association between the ECI and trade performance is also evident in Kohler and Stockammer (2022). While confirming the statistical usefulness of the ECI in this regard, Keil (2024) emphasises the conceptual difficulties of this indicator as well as the challenges of representing NPC through a single synthetic indicator.

4.2 The role of demand factors in triggering productivity

The second cornerstone of our inquiry is the literature on the effects of aggregate demand on productivity. This line of research draws inspiration from Kaldorian ideas, according to which productivity can be affected by the evolution of output (which is demand-determined). This concept echoes the principles of the Verdoorn law (Verdoorn, 1949; Kaldor, 1966), which posits the existence of a positive, long-run relationship between output and labour productivity growth rates. This

[10] A similar position emerges also in Simonazzi et al. (2013), who underline the non-price dominance of German export.

effect is grasped by the Kaldor-Verdoorn (henceforth, KV) coefficient. Recently, this approach has been reappraised by post-Keynesian scholars who align with Kaldor's concept of economic growth driven by demand (Kaldor, 1975), an element which unambiguously "makes technical progress an endogenous variable" (Lavoie, 2014, p. 428).[11] In this framework, output growth, which serves as a suitable proxy for a larger extension of the market, can boost labour productivity beyond economic cycles through two distinct channels. First, it does so through various factors (among which, labour division, positive externalities, specialisation processes and learning-by-doing) capable of generating economies of scale (Young, 1928; Kaldor, 1966, 1972; McCombie, 2002; McCombie and Roberts, 2007). Second, output growth fuels investment through the accelerator principle, facilitating the introduction of more advanced technologies (Kaldor, 1957; Kaldor and Mirrlees, 1962; Cesaratto et al., 2003).

Concerning the size of the KV coefficient, it has been originally estimated at about 0.45/0.50 (Verdoorn, 1949; Kaldor, 1966). All-embracing reviews on early attempts to estimate the KV law can be found in McCombie (1983), Thirlwall (1983), and McCombie et al. (2002). Yet, the empirical literature has recently reached a positive momentum. Millemaci and Ofria (2014) estimated a long-run KV coefficient for several advanced economies, with values settling in the interval from 0.3 to 0.6. The same method is used by Deleidi et al. (2020), who validate the KV law for six (out of nine) European countries (the estimated coefficients range from 0.4 to 0.6). Additional evidence on the validity of the KV law stems from Magacho and McCombie (2017), Antenucci et al. (2020), Gabrisch (2021), Deleidi et al. (2023) and Paternesi Meloni (2024). Although the extant literature presents variability in the estimated long-run elasticity of productivity to output dynamics, a take-away message arises: indeed, the evolution of demand (and hence output) has the potential to accelerate the trend growth rate of aggregate productivity in advanced economies.

However, the research focus of our study necessitates a more nuanced assessment of the demand factors driving total output and the separation of their impact on productivity growth. First, assessing the significance of the PEP mechanism requires estimating the EV coefficient, thereby determining the direct export effect on productivity. The focus on the aggregate demand component of exports is consequential in this context and is grounded in the seminal work by Kaldor (1970). Second, the complex role of nominal wages in the comprehensive assessment of the PEP mechanism underscores the importance of considering not only competitiveness effects through export sales but also domestic demand effects on productivity.

Adhering to the assumption of balance-of-payments-constraint growth, exports assume a pivotal role in propelling total output growth and, consequently, productivity growth.[12] This perspective is reinforced by research findings from scholars such as Bagnai and Mongeau Ospina (2017), who have confirmed the influence of export competitiveness on productivity. Similarly, Deleidi et al. (2020) and Paternesi Meloni (2024) explicitly identified exports as the primary explanatory variable

---

[11] This marks a notable departure from neoclassical theory, where the primary catalyst for economic growth is considered to be the growth in labour productivity. Although endogenous technical progress is acknowledged in certain 'new growth' models (e.g., Romer, 1994; Aghion et al., 2001), the influence of output growth on labour productivity is not extrapolated into the long term. For an in-depth discussion, refer to Antenucci et al. (2020).

[12] But even outside the Kaldorian tradition, a positive role for export in fostering productivity comes from the so-called 'learning-by-exporting' literature. According to the underlining hypothesis, firms increase their productivity as a consequence of exporting. This approach can be traced back to endogenous growth models (Grossman and Helpman, 1993), in which participation in international markets induces the diffusion of technology, thereby potentially enhancing within-firm productivity. For a detailed discussion and supporting evidence, refer to Wagner (2007) and De Loecker (2013).

for productivity in their empirical assessments, while also exploring the effects of government spending as an alternative proxy of autonomous demand in a separate setting. Interestingly, the effects of domestic components of aggregate demand, such as public spending, on productivity are lower and less statistically significant compared to EV effects. Furthermore, Girardi et al. (2020) found a positive effect of demand shocks, including export and public spending, on productivity for a panel of mature economies. At this point, it has to be acknowledged that causality between exports and productivity potentially appears to be bidirectional (see Forges Davanzati et al., 2019, for the specific case of Italy; and Paternesi Meloni, 2024, for a set of mature economies).

Yet, the separate Verdoorn effects stemming from different demand channels have not been collectively estimated within the same setting. The same applies to nominal wages, whose role as driver of domestic demand has not been explicitly addressed in the context of estimating Verdoorn effects. However, as we assume wage growth to be exogenous in the medium run, they become a central driving force of domestic sources of aggregate demand, such as private consumption and government spending.[13]

4.3 Combining the two strands of literature: export-driven models of cumulative causation

If, on one hand, the two research lines can be considered autonomous and analytically independent, on the other hand, one could argue that some approaches have already attempted to overlap them, incorporating them into a common export-centred approach. In particular, the father of this modelling is the above cited contribution by Kaldor's (1970), whose fundamental concept was that growth is propelled by demand, particularly through export. This 'virtuous circle' of faster technical progress, improving competitiveness, increasing exports, and rapid output growth has been formalized in Dixon and Thirlwall (1975) and reappraised in subsequent works on both analytical (e.g., Setterfield and Cornwall, 2002; Blecker, 2012) and empirical grounds. The remaining of this sub-section refers explicitly to export-driven models of cumulative causation (CC henceforth).

Ultimately, joint estimations of the price elasticity and the Verdoorn coefficient are rare. A model of CC has been presented and tested by Boyer and Petit (1981). The authors state that, alongside investment, demand factors are capable of affecting productivity growth. In turn, productivity growth contributes to an increase (or prevents a decrease) in competitiveness, influencing export. The model is estimated for a panel of six European industries, revealing evidence of an EV effect of 0.32. As expected, productivity growth is also found to have a positive effect on exports (+0.32), while the price elasticity of exports is negative (-0.37), indicating the presence of a CC process. Leon-Ledesma (2002) presented and estimated a CC model where also innovation and catching-up is taken into consideration. The modified model of export-led growth is capable explaining convergent processes in terms of productivity levels. The effect magnitudes of price elasticity is -0.2 and that of the Verdoorn effect is 0.6. In particular, the author introduced non-price competitiveness into the picture, arguing that also factors other than costs may have an influence in triggering export and therefore productivity *via* the KV law. At the same time, higher non-price competitiveness may be reflected in higher value added

[13] While the relationship between wages and productivity has not been directly explored within the framework of the KV law, it has been the subject of numerous theoretical inquiries and empirical investigations. Many of these focus on the cost effect of labour and the incentive to substitute labour with other factors of production, thereby potentially increasing labour productivity. See Fontanari and Palumbo (2023) for a recent contribution and an overview of various theoretical perspectives.

per unit of labour, as competition in terms of quality appears to be most prevalent in the high-value-added branches of production.

As mentioned in section 2.1, the role and significance of international prices was questioned and this affected the further developments and extensions of the CC model. Instead of considering relative prices and ULC as the triggering and transmitting force of CC, several scholars focussed on factors as structural change or non-price competitiveness. One recent example is the work by Romero (2019), who presents a Kaldorian-Schumpeterian model of cumulative growth. The author assumes that the price channel of CC is blocked due to the mentioned limitations of elasticity pessimism and PPP. Accordingly, the circuit of CC runs through the channel of non-price competitiveness. Furthermore, Magacho and McCombie (2020) elucidated how also structural change, intended as a shift of the economy towards high-tech industries characterised by high income elasticities and high Verdoorn effects, may trigger a process of CC. Recently, Dávila-Fernández and Oreiro (2023) have constructed an export-led growth model where the nominal exchange rate variations affect price as wells as non-price competitiveness triggering cumulative processes.

This section reviewed the ongoing discussion concerning the two crucial elements enabling export-driven circles of CC as well as their wide-ranging assessment. In sum, the debate regarding the significance of costs and prices has yet to yield a conclusive outcome. Many contributions highlight the influence of ULC and ULC-based RER on exports and suggest controlling for non-price elements as well. Moreover, there is a vast body of literature indicating that output, and particularly export as one of its main determinants, has the capability of influencing the evolution of labour productivity. A clear message stems from the reported research: productivity should not be seen as truly exogenous variable, as (among other factors) it can be stimulated by demand factors. Finally, some compelling works are located at the crossroads of the literature on the role of cost and price competitiveness in determining exports and the Kaldorian approach to (demand-led) endogenous productivity: the assessment of models of cumulative causation. It is at this intersection that we aim to position our research. Borrowing from the analytical apparatus described in Section 2 and from this literature review, the paper now proceeds with an empirical investigation for selected European countries.

5. Empirical design

The paper now proceeds to the empirical analysis. In this section, we commence by presenting our variables of interest (Section 5.1). Following this, we introduce our estimation strategy along with the methodology employed for the estimations (Section 5.2). Concluding this sequence, we present our model specification (Section 5.3).

5.1 Data and variables

Our empirical exploration spans from 1995 to 2020, utilizing on quarterly data (1995q1-2020q4).[14] We focus on the 10 major European countries introduced in Section 3. In our procedures, certain variables are utilized in their raw form, while

[14] We deliberately leave aside the post-2020 ages, since the Covid-restrictions and geopolitically motivated sanctions following the Ukraine conflict became the major determinants of trade flows, rendering the standard export equation based on the impact of foreign demand and relative prices insufficient.

others involve specific procedural arrangements, as elucidated below (further technical details can be found in Table A1 in Appendix A, alongside the sources of data). All variables undergo logarithmic transformation before estimation. This allows the estimated coefficients to be interpreted as elasticities.

Specifically, we leverage the following variables:

- export (X), defined as total export of goods in real terms (expressed in constant euros);[15]
- domestic productivity ($PROD$), defined as valued added per person employed in real terms;
- domestic price/cost competitiveness (ULC^{RER}), measured by the real effective exchange rate deflated using the ULC (index, 2015=100);
- foreign price/cost competitiveness (ULC^{f}), calculated as double export weighted competitor countries' ULC converted to euros, implicitly incorporating the nominal exchange rates (index, 2015=100);
- domestic nominal wages (NW), defined as wage per person employed in current euros; procedurally, NW series are calculated on the basis of ULC and $PROD$;
- investment (INV), defined as gross fixed capital formation per person employed in real terms;
- foreign demand (FD), proxied by real foreign income (gross domestic product) in real terms, converted in euros.

5.2 Estimation strategy

Our approach combines two methods, namely the three-stage least squares (3SLS) estimation and the autoregressive distributed lags (ARDL) model. Given the interrelated nature of the equations in our system, we employ 3SLS (for recent methodological formulation, see Greene, 2018) to estimate them jointly. This approach helps mitigate endogeneity issues, where independent variables are correlated with error terms, by providing more efficient and consistent parameter estimates. This is particularly relevant in our context, as our model implies concurrent effects of variables on each other. Labour productivity ($PROD$), as the central endogenous variable of our model, does exemplify this fact: on the one hand it can be influenced by the Verdoorn scale effect. On the other hand, $PROD$ is reflected in ULC^{RER}, which in turn affects X creating a complex interplay of variables without a clear direction of causality. In parallel, the 3SLS method allows for the treatment of certain variables as purely exogenous: in our setting, they are represented by NW, ULC^{f}, INV, and FD. Procedurally, the three steps nested in the 3SLS method can be described as follows. In the initial step, we regress each endogenous variable on all exogenous variables in the system of equations. By doing so, we calculate predicted (fitted) values for the endogenous variables. In the second step, we estimate the covariances between the error terms of the different equations in the system. Finally, in the third step, we utilize the estimated covariances obtained in the second stage. These covariances are incorporated into the weighting scheme of the generalized least squares (GLS) estimation framework. By applying GLS, we estimate the structural parameters of interest, taking into account both the predicted (fitted) values from the first stage and the estimated error covariances from the second stage.

We complement the 3SLS approach with an ARDL formulation to derive robust long-run coefficients. Pioneered by Pesaran et al. (2001), ARDL employs bounds testing techniques to analyse time series relationships. The general

---

[15] We deliberately exclude export of services since the CC model is oriented towards the manufacturing sector; therefore, confining the analysis to exported goods appears an appropriate focus.

superiority of ARDL-based models in estimating long-run trade elasticities was recently demonstrated in Keil (2023): comparing results from various methods, it was argued that this model produces the most reliable outcomes. The 3SLS-ARDL approach helps identify long-term relationships between variables expressed in levels as well as it controls for endogeneity and serial correlation.[16]

5.3 Model specification

Taking stock of the discussion in Section 3 and the methodological premise in Section 5.2, the empirical model we introduce (and estimate for 10 major European countries) is composed by three equations, which can be formalized as follows:

$$\Delta X_t = c + \alpha_1 X_{t-1} + \eta_1 FD_{t-1} + \eta_2 ULC_{t-1}^{RER} + \beta_1 \Delta X_{t-1} + \beta_2 \Delta FD_t + \beta_3 \Delta ULC_t^{RER} + \epsilon_t \quad (1)$$

$$\Delta ULC_t^{RER} = \Delta NW_t - \Delta PROD_t - \Delta ULC^f{}_t \quad (2)$$

$$\Delta PROD_t = c + \alpha_2 \Delta PROD_{t-1} + \beta_8 \Delta INV_t + \beta_9 \Delta X_t + \beta_{10} \Delta NW_t + \varepsilon \quad (3)$$

Equation 1 is the standard export equation, where export (X) is determined by foreign demand (FD), expected to exert a positive effect, and the price competitiveness variable (ULC^{RER}), expected to exert a negative effect. The relevant ARDL long-run coefficients out of this equation are calculated by $\gamma_1 = -(\eta_1/\alpha_1)$ for the income elasticity (referred as IE in the results), and by $\gamma_2 = -(\eta_2/\alpha_1)$ for the price elasticity (referred as PE).[17] In addition to that, we estimate an extended model which encompasses the effects of non-price competitiveness factors, with the latter expected to boost export (see Section 6.2.1). Formally, the export equation is articulated as an ARDL model, since a formulation in first differences would result in a loss of information generating unreliable price elasticities (cf. Keil, 2023).[18]

Equation 2 describes the evolution of domestic price/cost competitiveness and is specified as identity equation in first differences. The reason for this specification is to explicitly reveal the endogenous components of ULC^{RER}, which is domestic labour productivity ($PROD$). This formulation allows to depurate the price elasticity of export (stemming from Equation 1) from the cost advantage in terms of productivity that stems from the EV effect (captured by β_9). Put differently, this equation is intended to endogenize this effect, and to estimate an adjusted price elasticity of export, which allows for causal interpretation. In contrast, standard export equations which do not incorporate this effect are conjectured to capture a biased price elasticity of export (which is *also* influenced by endogenous productivity).

Equation 3 can be seen as a Kaldor productivity equation (in first differences) augmented by a Verdoon-type scale effect (in the spirit of Michl, 1985; and recently reappraised by Antenucci et al., 2020). Indeed, productivity is affected by the process of capital intensification (INV), which is capable of boosting productivity by expanding and modernizing the stock

16 In order to meet the assumptions of the regression models, we test the order of integration of all variables in levels and in first differences. Results are reported in Table B1 (in Appendix B).

17 Standard errors are computed by applying the 'delta method'.

18 Minimising the Akaike criterion is the chosen strategy to detect the most appropriate lag structure, starting from 4 lags.

of capital per worker (β_8). Next to the investment variable, we consider separately two major demand determinants of the production scale affecting labour productivity, namely export (X), capturing demand from abroad, and nominal wages (NW), capturing wage-induced domestic demand. As introduced in Section 2.2, wages have a twofold nature: on the one side, they are cost factors that undermine competitiveness and negatively affect export (as in Equations 1 and 2); on the other side, they can drive domestic demand which, in turn, may foster productivity through a Verdoorn-type mechanism (as in Equation 3). The consideration of two different effects of nominal wage growth permits us to assess the comprehensive effect of cost-centred export-led strategies: indeed, wage compression may promote export and productivity thought the cost channel (β_9), but at the same time it slows down productivity growth by confining the expansion of domestic demand (β_{10}). As a further robustness check, we also estimate a model which encompasses government spending instead of nominal wages as a source of domestic demand (see Section 6.4).

6. Findings and discussion

6.1 Main findings

For clarity, we present the coefficients of the most representative variables from our cumulative causation (CC) model, specifically those from the export equation (Equation 1) and the productivity equation (Equation 3). For the export equation, formulated as an ARDL model, we report the long-run coefficients, key statistics (alpha and F-test) to assess the presence of a long-term relationship and the model's lag order. Table 2 shows the central results of the baseline model covering the entire time span from 1995q1 to 2020q4. The presence of effects originating from the PEP mechanism is confirmed when both a negative long-run price elasticity (γ_2) and a positive export-Verdoorn effect (β_9) are detected concurrently. As potential endogeneity is controlled for, the estimates can be interpreted as causal effects.

	Export equation (DV: X)					Productivity equation (DV: PROD)		
COUNTRY	IE (γ_1)	PE (γ_2)	ALPHA	F-TEST	ARDL	INV (β_8)	X (β_9)	NW (β_{10})
AUT	1.953***	-1.133***	-0.226***	8.69***	(2 2 2)	-0.011	0.439***	0.012***
	(0.036)	(0.207)	(0.056)			(0.011)	(0.083)	(0.018)
BEL	1.457***	-0.221	-0.156***	9.05***	(2 2 2)	0.058**	0.393***	0.404***
	(0.066)	(0.342)	(0.038)			(0.028)	(0.037)	(0.011)
FIN	1.67***	-7.19*	-0.071	3.72	(2 2 2)	1.205***	-0.316***	0.176
	(0.523)	(4.029)	(0.046)			(0.122)	(0.092)	(0.216)
FRA	1.406***	-1.352***	-0.104**	5.93**	(3 3 3)	0.455***	0.021	0.622***
	(0.113)	(0.46)	(0.047)			(0.149)	(0.074)	(0.052)
GER	2.033***	-1.134***	-0.242***	5.56**	(3 3 3)	0.098*	0.331***	0.129***
	(0.054)	(0.17)	(0.06)			(0.056)	(0.058)	(0.011)
GRC	1.788***	-0.198	-0.187***	3.93	(2 2 2)	0.089*	0.392**	0.251***
	(0.189)	(0.327)	(0.066)			(0.051)	(0.167)	(0.035)
ITA	1.182***	-0.201	-0.134***	5.48*	(2 2 2)	0.178**	0.246***	0.153***
	(0.121)	(0.277)	(0.04)			(0.068)	(0.053)	(0.009)
NDL	1.929***	-1.094*	-0.179***	9.60***	(3 3 3)	0.017	-0.579*	0.130***
	(0.108)	(0.622)	(0.059)			(0.021)	(0.329)	(0.022)
SPA	1.804***	-0.013	-0.147***	4.66*	(2 2 2)	0.124**	0.219***	0.604***
	(0.091)	(0.236)	(0.039)			(0.62)	(0.044)	(0.037)
PRT	1.866***	0.007	-0.261***	11.40***	(2 2 2)	0.038	0.314***	0.067***
	(0.045)	(0.163)	(0.05)			(0.037)	(0.027)	(0.008)

Table 2. *3SLS coefficients. Entire timespan (1995q1-2020q4), baseline model (standard errors in parentheses). Lag length choice according to AKAIKE criterion minimisation.*

For this sample, the effects are statistically significant and pronounced for Germany (PE: -1.1; EV: 0.33) and Austria (PE: -1.1; EV: 0.44). A combination of effects showing the correct sign can be detected in the cases of Belgium, France, Greece, Italy and Spain with, however, mostly very modest price elasticities. In 7 out of 10 cases, a statistically significant EV effect, with an average magnitude of 0.3, is found. The Verdoorn coefficients of wage-induced domestic demand range from 0.1 to 0.6 and are significant in 9 cases. Additionally, the growth rate of investment per worker has the potential to stimulate productivity growth: in Spain, Finland, France, Greece, and Italy, increased investment is associated with significantly higher productivity growth. However, this effect appears less systematic, and the coefficient sizes show high variability.

By considering the entire time span, which includes the economic crisis starting in late 2008, we recognize that this period encompasses a structural break that may affect the reliability of our estimation results. Therefore, we continue our interpretation based on country-specific estimates from all subperiods, which are depicted in Table 3. Analysing results from the entire timespan, pre-crisis, and post-crisis periods helps to identify generalizable patterns and avoid reliance on isolated findings. The general empirical evidence supports the presence of an endogenous feedback mechanism linking prices, exports, and productivity. Both the price elasticity of exports and the export-Verdoorn (EV) mechanism show effects significantly different from zero and of the expected sign in many cases. Specifically, the price elasticity (PE) approaches -1, and the EV ranges from 0.1 to 0.4, if significant. Consistent PEP effects are detected in Austria (1995-2008, 1995-2020), Belgium (1995-2008), Germany (1995-2008, 2009-2020, 1995-2020), Spain (2009-2020), and Portugal (2009-2020). Although not statistically significant, PEP effect estimates showing the expected sign and a reasonable magnitude are also found for France and Italy. However, no PEP effects have been indicated in the cases of Finland, Greece, and the Netherlands due to the persistent non-significance and low effect size of the central coefficients or even entirely unreliable estimates.

	1995q1-2008q4			2009q1-2020q4			1995q1-2020q4		
COUNTRY	PE (γ_2)	X (β_9)	NW (β_{10})	PE (γ_2)	X (β_9)	NW (β_{10})	PE (γ_2)	X (β_9)	NW (β_{10})
AUT	**-1.06**	0.10	**0.15**	-0.71	**0.44**	**0.09**	**-1.13**	**0.44**	**0.01**
BEL	**-0.27**	**0.19**	**0.39**	-0.05	**0.39**	**0.44**	-0.22	**0.39**	**0.40**
FIN	**-1.21**	**-0.24**	0.19	**-1.53**	**-0.25**	0.38	**-7.19**	**-0.32**	0.18
FRA	**-1.14**	-0.03	**0.60**	0.06	**0.06**	**0.66**	**-1.35**	0.02	**0.62**
GER	**-0.40**	**0.19**	**0.16**	**-0.92**	**0.40**	**0.07**	**-1.13**	**0.33**	**0.13**
GRC	-0.38	0.11	**0.26**	0.03	0.15	**0.25**	-0.20	**0.39**	**0.25**
ITA	-1.43	0.13	**0.14**	-0.66	**0.24**	**0.12**	-0.20	**0.25**	**0.15**
NDL	-1.42	-0.33	**0.14**	**-0.96**	**-0.48**	**0.09**	**-1.09**	-0.58	**0.13**
SPA	**-1.12**	-0.09	**0.84**	**-0.89**	**0.34**	**0.56**	-0.01	**0.22**	**0.60**
PRT	0.06	0.04	**0.07**	**-0.58**	**0.36**	**0.08**	0.01	**0.31**	**0.07**

Table 3. *3SLS coefficients of central variables for different periods. Coefficients that are significant at the 90% level are reported in bold. Detailed estimation results reported in Table 2 as well as in Tables C1 and C2 (in Appendix C).*

Let us start a more nuanced assessment of the results by interpreting the estimates of the price elasticity, which represents a central premise of the PEP mechanism. We consider it imperative to emphasise that the validity of the price elasticity estimates is bounded. Our analysis indicates a general price effect in the vicinity of -1, when significant, but specific single point estimates of the price elasticity coefficients exhibit variability in terms of the effect magnitude across subperiods and should be interpreted with caution. In recent literature, the unreliability of the price coefficient is a well-documented phenomenon, which is related to methodological issues such as structural breaks and the difficulty of proxying the true relative level of price competitiveness (Keil, 2023). In this regard, the non-significant coefficient in the case of Italy is quite emblematic: the negative point estimates and their confidence intervals lay in the expected range, but vary a lot; a different situation occurs for Greece, as the price effect tends to be of negligible magnitude.

The EV effect as the second coefficient being crucial to the PEP mechanism, is significant in almost all cases – except the Netherlands and Finland[19] – with an average magnitude of 0.3 over the entire period, displaying minor variability across specifications.[20] Our results confirm the suspicions of several scholars regarding the export-led growth model, according to which the parameter values of PE and EV are too low for a self-sustained and self-reinforcing process. However, in cases of persistently triggering effects from outside the PEP circle, the endogenous chain of causation produces considerable macroeconomic effects. For instance, an annual 1% advantage in terms of ULC growth rates generates an additional 3% productivity boost over the course of 10 years. Moreover, the EV estimates for subperiods show that coefficients were significantly higher during 2009-2020 (0.3/0.4) compared to 1995-2008 (0.1/0.3). This confirms that the demand channel of exports became increasingly important as other sources of aggregate demand dried up after the start of the euro crisis. Accordingly, the importance of the PEP effects increased as well.

So far, our findings suggest that competitiveness-oriented wage policies potentially foster export sales and subsequently speed up productivity growth through the PEP feedback mechanism. Clear and unambiguous estimates for Austria, Germany, and Spain (2009–2020) illustrate the significant role of the PEP feedback mechanism, evidenced by above-average export price elasticities and substantial EV effects. Nonetheless, our model acknowledges the presence of the central counteracting force of (wage-induced) domestic demand potentially retarding the PEP circle of causation. Indeed, wage moderation may dampen domestic demand dynamics, subsequently limiting the overall scale of production and lowering productivity growth through the Verdoorn effect. Across different specifications, the estimated domestic demand Verdoorn effects average between 0.3 and 0.4. Adding up the Verdoorn effects of exports and nominal wages, the cumulative Verdoorn effect approaches 0.6 and therefore is in line with recent empirical applications surveyed in Section 4.2. However, using nominal wages as a proxy for domestic demand may encounter limitations in case the relationship is endogenous.[21] Therefore, to verify the robustness of our findings, we will test the coefficient representing the domestic demand scale effect on productivity using an alternative proxy in Section 6.2.2.

Yet, comparing the Verdoorn coefficients of export and domestic demand can give an indication of whether there is an incentive for export-led strategies based on wage containment. In Austria, Germany, Italy, and Portugal, the EV effect is stronger than the nominal wage effect on productivity, reflecting a high reliance on export sales and a lower importance of domestic demand. Through the PEP mechanism, wage containment policies in these cases result in competitiveness effects on productivity that are stronger than the counteracting domestic demand effects on productivity, given that the respective exports are averagely price-sensitive (i.e., approximately -1). For all other countries, the negative domestic

[19] In detail, no EV effect is detected for the Netherlands, and Finland lacks meaningful or reliable estimates.

[20] The general effect size of 0.3 is further confirmed by the robustness check employing 4 lags (to account for seasonality) for every right-hand side variable in the productivity equation. See Tables C6 and C7 (in Appendix C) for further details.

[21] However, as highlighted in Section 3, national nominal wage growth did not reflect national productivity growth in the medium run, potentially excluding endogeneity issues.

demand effects appear stronger, and thus, competitiveness-oriented wage policies cannot lead to net gains in terms of labour productivity.

To underscore the detected relevance of the PEP mechanism, let us consider the case of Italy and Germany after the introduction of the common currency. Both share the characteristic, that the dynamics of domestic demand (as evidenced by the growth of government spending in Table 1) have been modest compared to other countries. Consequently, productivity dynamics, which heavily rely on the expansion of production scale, depended significantly on export demand. Assuming that the exports are price sensitive (namely, PE is -1) and the EV coefficient takes the magnitude of 0.3, the gap in competitiveness (the average annual ULC-RER growth rate in the period 1995–2008 is +1% for Italy and -1% for Germany) induced by different growth rates of nominal wages (ITA: 2.3%; GER: 0.5%) led to an additional >3% gain in terms of German labour productivity through the PEP mechanism. Therefore, the PEP mechanism accounts for approximately half of the observed 8% productivity gap between Italy and Germany over this 12-year period.[22]

6.2 Extensions of the model

6.2.1 Model with non-price competitiveness. As discussed in Section 2, our model accommodates the inclusion of non-price competitiveness as an additional driver of exports. Consistent with the literature, higher export quality increases the likelihood of exporting. To measure quality and technological sophistication, we use the Economic Complexity Index (ECI), following the approach of studies reviewed in Section 4.1. Notably, ECI data are only available annually; thus, standard interpolation techniques have been applied to generate quarterly series. Including NPC in our model alters our export equation (Equation 1) as follows:

$$\Delta X_t = c + \alpha_1 X_{t-1} + \eta_1 FD_{t-1} + \eta_2 ULC_{t-1} + \eta_3 NPC_{t-1}^{RER} + \beta_1 \Delta X_t + \beta_2 \Delta FD_t + \beta_3 \Delta ULC_t^{RER} + \beta_Q \Delta NPC_t + \epsilon_t \quad (1.1)$$

The results of this extended model are reported in Table 4 (left panel) and generally confirm the baseline estimations. Interestingly, however, two aspects emerge. Firstly, the inclusion of non-price factors does not compromise the significance of the income and price elasticities or the Verdoorn coefficients, underscoring the robustness of the baseline results. Secondly, the long-run coefficient $\gamma_3 = -(\eta_3/\alpha_1)$ associated with NPC does not significantly contribute to explaining exports; this coefficient is predominantly negative and rarely significant.[23] Since we do not believe that exports are only driven by prices (in line with recent evidence by Pariboni and Paternesi Meloni, 2022, and Herrero et al., 2023), this finding highlights the difficulty of controlling appropriately for non-price factors in the empirical export equation not having a single overarching indicator (as already emerged in Keil, 2024).

[22] The importance of the PEP mechanism is sensitive to the assumed or estimated effect strengths and, thus, the mentioned variability of the price elasticity magnitude affects heavily the outcome. Taking the estimates from the sample spanning the entire time span, the PEP mechanism could explain an additional 4.5% productivity gain for Germany over the same period.

[23] Given that the NPC variable did not add explanatory power to our empirical model, we prefer not considering the variable in all other specifications and, thus, take advantage of more degrees of freedom and a higher precision of the resulting estimates.

	Export equation (DV: X)						Productivity equation (DV: PROD)		
COUNTRY	IE (γ_1)	PE (γ_2)	NPC (γ_3)	ALPHA	F TEST	ARDL	INV (β_8)	X (β_9)	NW (β_{10})
AUT	1.851***	-1.149***	-0.32**	-0.259***	6.69***	(3 3 3 3)	-0.009	0.408***	0.112***
	(0.09)	(0.254)	(0,139)	(0,139)			(0.127)	(0.085)	(0.023)
BEL	1.392***	-0.327	-0,128	-0.232***	10.29***	(3 3 3 3)	0.039	0.366***	0.423***
	(0.071)	(0.274)	(0,089)	(0.05)			(0.03)	(0.036)	(0.012)
FIN	3.002***	-4.217	1,536	-0.094*	5.38**	(3 3 3 3)	1.268***	-0.37***	0.208
	(1.17)	(2.742)	(1,995)	(0.056)			(0.123)	(0.012)	(0.226)
FRAU	0.995***	-1.202***	-0,571	-0.108**	0.98	(2 2 2 2)	0.401***	0.023	0.66***
	(0.344)	(0.459)	(0,508)	(0.042)			(0.138)	(0.067)	(0.05)
GER	2.001***	-0.955***	-0,155***	-0.363***	5.86***	(2 2 2 2)	0.086	0.338***	0.125***
	(0.04)	(0.102)	(0,045)	(0.061)			(0.059)	(0.036)	(0.012)
GRC	1.441***	0.225	-0,64	-0.185*	2.99	(3 3 3 3)	0.055	0.218	0.256***
	(0.397)	(0.743)	(1,125)	(0.091)			(0.051)	(0.142)	(0.035)
ITA	1.052***	-0.198	-0,517	-0.113***	4.29**	(3 3 3 3)	0.338***	0.238***	0.128***
	(0.155)	(0.333)	(0,418)	(0.042)			(0.069)	(0.047)	(0.01)
NDL	1.908***	0.948	0,709	-0.085	3.67*	(3 3 3 3)	0.018	-0.255	0.126***
	(0.313)	(1.76)	(0,737)	(0.054)			(0.02)	(0.239)	(0.022)
SPA	2.028***	-0.175	0.345	-0.195***	5.45**	(3 3 3 3)	0.111*	0.205***	0.633***
	(0.224)	(0.198)	(0,293)	(0.057)			(0.067)	(0.047)	(0.05)
PRT	1.771***	-0.174	0.169	-0.274***	4.7*	(2 2 2 2)	0.033	0.314***	0.068***
	(0.112)	(0.217)	(0.22)	(0.067)			(0.04)	(0.028)	(0.008)

Table 4. *3SLS coefficients. Entire timespan (1996q2-2020q2), model accounting for non-price competitiveness (standard errors in parentheses). Lag length choice according to AKAIKE criterion minimisation.*

6.2.2 Alternative definition of domestic demand

As stated in Section 6.3, the use of nominal wages as a proxy for domestic demand presents some limitations. As an alternative, we test another proxy, namely government spending, which predominantly consists of expenditures for public sector wages and government consumption. Consequently, we revise the productivity equation (Equation 3) as follows:

$$\Delta PROD_t = c + \alpha_2 \Delta PROD_{t-1} + \beta_8 \Delta INV_t + \beta_9 \Delta X_t + \beta_{11} \Delta GOV_t + \varepsilon \qquad (3.1)$$

Here, GOV represents current government expenditure, excluding public investment to avoid overlap with the aggregate investment variable. Results of this modification are reported in Table 5.

	1995q1-2008q4			2009q1-2020q4			1995q1-2020q4		
	PE (γ_2)	X (β_9)	GOV (β_{11})	PE (γ_2)	X (β_9)	GOV (β_{11})	PE (γ_2)	X (β_9)	GOV (β_{11})
AUT	**-1.05**	**0.17**	0.52	0.01	**0.21**	**0.69**	**-1.30**	**0.28**	**0.55**
BEL	**-0.27**	**0.31**	**0.47**	-0.61	**0.42**	**0.75**	**-0.57**	**0.41**	**0.56**
FIN	**-1.18**	0.12	**0.43**	**-1.15**	0.08	**0.66**	**-6.21**	-0.18	**0.41**
FRA	**-1.14**	0.14	**1.48**	-0.02	-0.22	**1.13**	**-1.93**	-0.06	**0.92**
GER	**-0.38**	**0.25**	0.44	**-0.86**	**0.38**	**0.49**	**-0.98**	**0.37**	0.45
GRC	-0.39	0.09	0.43	0.07	0.18	**0.30**	-0.23	**0.30**	0.35
ITA	-1.55	0.04	**0.31**	-0.76	0.24	**0.32**	0.13	**0.24**	**0.32**
NDL	-2.53	0.23	0.39	-0.45	0.61	**0.50**	-1.45	**-0.51**	0.40
ESP	**-1.09**	-0.07	**0.46**	**-0.87**	**0.33**	**0.36**	-0.01	**0.25**	**0.43**
PRT	0.13	0.04	**0.06**	**-0.57**	**0.36**	**0.11**	-0.01	**0.32**	0.07

Table 5. *3SLS coefficients of central variables for different periods. Coefficients that are significant at the 90% level are reported in bold. Detailed estimation results reported in Tables C3, C4 and C5 (in Appendix C).*

In this scenario, government spending proves to be significant in shaping productivity, with the domestic demand-Verdoorn coefficient being higher than that for nominal wages, averaging approximately 0.4 when significant. This alteration of the domestic demand proxy confirms the robustness of all other coefficients, which only show minor changes in magnitude compared to the baseline specification. Notably, the EV effect is confirmed, demonstrating an impact of about 0.3, on average.

Comparing the estimation outcome with that of the baseline specification, more cases with significant PEP effect emerge. The effects are statistically significant for the following countries: Austria (1995-2008, 1995-2020), Belgium (1995-2008, 1995-2020), Germany (1995-2008, 2009-2020, 1995-2020), Spain (2009-2020), and Portugal (2009-2020). The highest combined PEP effects are confirmed for Austria and Germany. Although not consistently statistically significant, expected signs of PE and EV are detected for Finland, France, Italy and the Netherlands. When considering the effects of higher government spending on productivity, instead of those from nominal wages, the competitiveness incentive vanishes in all cases. This is because the government spending (GOV) coefficient is consistently higher than the EV coefficient. This outcome reflects the fact that government spending encompasses not only wage-induced domestic demand but also fiscal outlays for government consumption. Thus, a combination of wage and fiscal policies can play a dominant role and may fully counterbalance the potential negative productivity effects through the PEP mechanism. However, it should be born in mind that this scenario could lead to a more negative current account, as the competitiveness disadvantage results in export share losses, and imports are stimulated by higher domestic demand.

7. Concluding remarks and implications

In this paper, we empirically scrutinized the existence and potential macroeconomic impact of a Kaldorian mechanism of cumulative causation among prices, exports, and productivity within the Euro area context. The price-export-productivity (PEP) mechanism posits a loop where a price competitiveness advantage stimulates price-sensitive exports, which subsequently enhances productivity through the Verdoorn effect. Despite the theoretical significance of this core mechanism underlying the Kaldorian export-led growth model, it has been somewhat overlooked due to shifting perspectives on prices and doubts regarding their relevance for export competitiveness. However, the unique setting of the Euro area, a common currency area characterized by different national paths of nominal wage growth reflected in divergent export competitiveness and a lack of equilibrating mechanisms, creates favourable conditions for significant effects through the PEP mechanism. This paper offers a nuanced assessment of these macroeconomic effects, particularly by considering the double character – the competitiveness and the demand effects – of nominal wages as potential triggering factor of the PEP mechanism. The effects are quantified for 10 major Euro area countries from 1995 to 2020, employing a system of equations to address endogeneity concerns.

The results of our empirical analysis indicate the presence of the PEP mechanism in the majority of countries, with exports showing an average price elasticity of -1 and export demand exhibiting Verdoorn effects of 0.3. The PEP effects are particularly pronounced in Austria and Germany, reflecting a high relevance of export competitiveness. Our findings suggest that wage containment strategies result in higher export competitiveness and trigger PEP effects, meaning that productivity will be affected positively. In countries heavily dependent on exports, the PEP mechanism can even become the primary determinant of productivity growth, underscoring the significance of this core concept underlying the export-led theories of cumulative causation. However, the detected relevance of the PEP mechanism should not be interpreted as a generalized incentive to pursue export-led strategies and policies based on cost compression, such as wage moderation.

Indeed, further insights from our analysis reveals a dual nature of nominal wages: on the one hand, the nominal wage containment propels productivity growth through the PEP mechanism; on the other hand, it reduces domestic demand and compromises productivity growth. By comparing the separated Verdoorn effects of exports and wage-induced domestic demand, we assess the net impact of competitiveness-oriented wage moderation policies on labour productivity. In Austria and Germany, the potential net effect of wage moderation indeed appears to be positive, suggesting an incentive towards beggar-thy-neighbour policies. However, in most other countries, our estimates indicate that wage moderation has a detrimental net effect on productivity, particularly in France and Spain, where the impact of the PEP mechanism is overshadowed by the much higher Verdoorn effect of wage-induced domestic demand.

In summary, it can be said that the PEP mechanism, triggered by different paths in nominal wage growth, can exacerbate macroeconomic disparities, particularly in productivity dynamics. In the case of more export-reliant economies, the importance of the PEP mechanism appears to be particularly strong. However, the overall Verdoorn effect is found to be dominated by the channels of domestic demand. In particular, the strong and significant impact of beyond-wage-induced demand further underscores the importance of autonomous fiscal spending and investment for productivity growth.

References

Adamczyk, P., Westmore, B. (2020). Unpicking Portugal's export performance: A microdata analysis. OECD Economics Department Working Papers, No. 1618, OECD Publishing, Paris.

Aghion, P., Harris, C., Howitt, P., Vickers, J. (2001). Competition, imitation and growth with step-by-step innovation. *The Review of Economic Studies*, 68(3), 467-492.

Antenucci, F., Deleidi, M., Paternesi Meloni, W. (2020). Kaldor 3.0: An empirical investigation of the Verdoorn-augmented technical progress function. *Review of Political Economy*, 32(1), 49-76.

Athanasoglou, P. P., Bardaka, I. C. (2010). New trade theory, non-price competitiveness and export performance. *Economic Modelling*, 27(1), 217-228.

Baccaro, L., Benassi, C. (2017). Throwing out the Ballast: Growth Models and the Liberalization of German Industrial Relations. *Socio-Economic Review*, 15(1), 85-115.

Baccaro, L., Bulfone, F. (2022). Growth and Stagnation in Southern Europe: The Italian and Spanish Growth Models Compared. In: *Diminishing Returns: The New Politics of Growth and Stagnation*. Oxford: Oxford University Press.

Baccaro, L., Pontusson, H. J. (2016). Rethinking comparative political economy: the growth model perspective. *Politics & Society*, 44(2), 175–207.

Baccaro, L., Tober, T. (2017). *The role of cost and price competitiveness*. Working paper, University of Geneva 39528.

Baccaro, L., Tober, T. (2022). The role of wages in the Eurozone. *Review of International Political Economy*, *29*(4), 1263-1286.

Bagnai, A., Mongeau Ospina, C. A. (2017). Neoclassical versus Kaldorian explanations of Southern Europe's productivity slowdown. *Acta Oeconomica, 67*(1), 113-135.

Bibow, J. (2018). How Germany's anti-Keynesianism has brought Europe to its knees. *International Review of Applied Economics, 32*(5), 569-588.

Blecker, R. A. (2012). Open economy models of distribution and growth. In: *A Modern Guide to Keynesian Macroeconomics and Economic Policies*, Cheltenham: Edward Elgar.

Blecker, R. A. (2013). Long-run growth in open economies. In: *The Oxford Handbook of Post-Keynesian Economics, Volume 1: Critiques and Methodology (edited by Harcourt, G. C.; Kriesler, P.)*. Oxford: Oxford University Press

Blecker, R. A. (2023). How important is the real exchange rate for exports and growth? *European Journal of Economics and Economic Policies, 20*(2), 250-265.

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

Boyer, R., Petit, P. (1981). Progrès technique croissance et emploi: un modèle d'inspiration kaldorienne pour six industries européennes. *Revue économique*, 1113-1153.

Breuer, S., Klose, J. (2015). Who gains from nominal devaluation? An empirical assessment of euro-area exports and imports. *The World Economy*, 38(12), 1966–1989.

Caglayan, M., Demir, F. (2019). Exchange rate movements, export sophistication and direction of trade: the development channel and North–South trade flows. *Cambridge Journal of Economics, 43*(6), 1623-1652.

Cesaratto, S., Serrano, F., Stirati, A. (2003). Technical change, effective demand and employment. *Review of Political Economy*, 15(1), 33-52.

Cesaratto, S. (2018). The nature of the eurocrisis: a reply to Febrero, Uxó and Bermejo. *Review of Keynesian Economics, 6*(2), 240-251.

Dávila-Fernández, M. J., Oreiro, J. L. (2023). Competitiveness and dynamic cumulative causation in an export-led growing economy. *Industrial and Corporate Change, 32*(2), 522-550.

Loecker, J. D. (2013). Detecting learning by exporting. *American Economic Journal: Microeconomics, 5*(3), 1-21.

Deleidi, M., Paternesi Meloni, W., Stirati, A. (2020). Tertiarization, productivity and aggregate demand: evidence-based policies for European countries. *Journal of Evolutionary Economics*, 30(5), 1429-1465.

Deleidi, M., Fontanari, C., Gahn, S. (2023). Autonomous Demand and Technical Change: Exploring the Kaldor-Verdoorn Law on a Global Level. *Economia Politica*, 40(1), 57-80.

Dixon, R., Thirwall, A. P. (1975). A Model of Regional Growth-rate Differences on Kaldorian Lines. *Oxford Economic Papers*, 27(2), 201-214.

European Commission (2010). Quarterly report on the Euro area – Special issue: The impact of the global crisis on competitiveness and current account divergences in the euro area (vol. 9, n. 1).

Fontanari, C., Palumbo, A. (2023). Permanent scars: The effects of wages on productivity. *Metroeconomica, 74*(2), 351-389.

Forges Davanzati, G., Patalano, R., Traficante, G. (2019). The Italian economic stagnation in a Kaldorian theoretical perspective. *Economia Politica*, 36(3), 841-861.

Gabrisch, H. (2021). The long-run properties of the Kaldor–Verdoorn law: a bounds test approach to a panel of Central and East European (CEE) countries. *Empirica, 48*(1), 101-121.

Girardi, D., Paternesi Meloni, W., Stirati, A. (2020). Reverse hysteresis? Persistent effects of autonomous demand expansions. *Cambridge Journal of Economics, 44*(4), 835-869.

Gräbner, C., Heimberger, P., Kapeller, J., Schütz, B. (2020). Is the Eurozone disintegrating? Macroeconomic divergence, structural polarisation, trade and fragility. *Cambridge Journal of Economics, 44*(3), 647-669.

Greene, W. H. 2018. *Econometric Analysis*. 8th ed. New York: Pearson.

Grossman, G. M., Helpman, E. (1993). *Innovation and growth in the global economy*. Cambridge: MIT press.

Hidalgo, C. A., Hausmann, R. (2009). The building blocks of economic complexity. *Proceedings of the national academy of sciences, 106*(26), 10570-10575.

Herrero, D., Rial, A. (2023). Labor costs, KIBS, and export performance: A comparative analysis of Germany and Mediterranean economies. *Structural Change and Economic Dynamics*, *65*, 184-198.

Herrero, D., Paternesi Meloni, W., Rial, A. (2023). How did Mediterranean economies transit to export-led growth? An analysis of the determinants of international competitiveness. Paper presented at the 27th FMM conference, Berlin, October.

Höpner, M., Lutter, M. (2018). The diversity of wage regimes: why the Eurozone is too heterogeneous for the Euro. *European Political Science Review*, 10(1), 71-96.

Höpner, M., Seeliger, M. (2021). Neither existing nor emerging: euro stabilization by means of European wage coordination. *Journal of Economic Policy Reform, 24*(4), 439-455.

Kaldor, N. (1957). A model of economic growth. *The Economic Journal*, *67*(268), 591-624.

Kaldor, N. (1966). *Causes of the slow rate of economic growth of the United Kingdom*. Cambridge University Press. In: Kaldor N (1978) *Further Essays on Economic Theory*, published by Holmes & Meier Publishers, Inc., New York.

Kaldor, N. (1970). The Case for Regional Policies. *Scottish Journal of Political Economy*, 17, 337-348.

Kaldor, N. (1972). The irrelevance of equilibrium economics. *The Economic Journal*, *82*(328), 1237-1255.

Kaldor, N. (1975). Economic Growth and the Verdoorn Law – A Comment on Mr Rowthorn's Article. *The Economic Journal*, *85*(340), 891-896.

Kaldor, N., Mirrlees. J. A. (1962). A new model of economic growth. *The Review of Economic Studies*, *29*(3), 174-192.

Kaldor, N. (1978). The effect of devaluation on trade in manufacturers. *Future Essays in Applied Economics*, 99-116. New York: Holmes & Meier Publishers.

Keil, S. (2023). The challenging estimation of trade elasticities: Tackling the inconclusive Eurozone evidence. *The World Economy, 46*(5), 1235-1263.

Keil, S. (2024). Assessing the role of non-price factors: Shedding new light on the European competitiveness puzzle. *International Economics*, 178, August 2024.

Kohler, K., Stockhammer, E. (2022). Growing differently? Financial cycles, austerity, and competitiveness in growth models since the Global Financial Crisis. *Review of International Political Economy*, 29(4), 1314-1341.

Lavoie, M. (2014). *Post-Keynesian economics: new foundations*. Edward Elgar Publishing.

León-Ledesma, M. A. (2002). Accumulation, innovation and catching-up: an extended cumulative growth model. *Cambridge Journal of Economics, 26*(2), 201-216.

Magacho, G. R., McCombie, J. S. (2017). Verdoorn's law and productivity dynamics: An empirical investigation into the demand and supply approaches. *Journal of Post Keynesian Economics*, *40*(4), 600-621.

Magacho, G. R., McCombie, J. S. (2020). Structural change and cumulative causation: A Kaldorian approach. *Metroeconomica, 71*(3), 633-660.

McCombie, J. S. (1983). Kaldor's Laws in Retrospect. *Journal of Post Keynesian Economics*, Spring *5*(3), 414-429.

McCombie, J. S. (2002). Increasing Returns and the Verdoorn Law from a Kaldorian Perspective. In: *Productivity Growth and Economic Performance: Essays on Verdoorn's Law*, edited by J. S. McCombie, M. Pugno, and B. Soro. Basingstoke: Palgrave Macmillan.

McCombie, J. S., Roberts, M. (2007). Returns to scale and regional growth: the static-dynamic Verdoorn Law paradox revisited. *Journal of Regional Science*, *47*(2), 179-208.

McCombie, J. S., Thirlwall, A.P. (1994). Non-Price Competition, Trade and the Balance of Payments. In: *Economic Growth and the Balance-of-Payments Constraint*. Heidelberg: Springer.

McCombie, J. S., Pugno, M., Soro, B. (Eds.). (2002). *Productivity growth and economic performance: Essays on Verdoorn's law*. Heidelberg: Springer.

Michl, T. R. (1985). International comparisons of productivity growth: Verdoorn's law revisited. *Journal of Post Keynesian Economics, 7*(4), 474-492.

Millemaci, E., Ofria, F. (2014). Kaldor-Verdoorn's law and increasing returns to scale: a comparison across developed countries. *Journal of Economic Studies*, *41*(1), 140-162.

Missio, F. J., Jayme Jr, F. G. (2012). Structural heterogeneity and endogeneity of elasticities on the balance of payments constrained growth model. In: *Models of Balance of Payments Constrained Growth: History, Theory and Empirical Evidence*. London: Palgrave Macmillan.

Morgan, A. D. (1970). Income and price elasticities in world trade: A comment. *The Manchester School, 38*(4), 303-314.

Newey, W. K., West, K. D. (1994). Automatic lag selection in covariance matrix estimation. *The Review of Economic Studies, 61*(4), 631-653.

Pariboni, R., Paternesi Meloni, W. (2022). *Exporting differently? The political economy of alternative export-led strategies*. FMM working paper series, No. 80-2022.

Paternesi Meloni, W. (2018). Italy's price competitiveness: An empirical assessment through export elasticities. *Italian Economic Journal*, 4(3), 421–462.

Paternesi Meloni, W. (2024). Okun vs. Verdoorn: distinguishing between cyclical and structural effects of output on productivity. *Economia Politica – Journal of Analytical and Institutional Economics*. Online article, DOI: 10.1007/s40888-024-00334-1.

Peeters, M., den Reijer, A. (2014). Coordination versus flexibility in wage formation: a focus on the nominal wage impact of productivity in Germany, Greece, Ireland, Portugal, Spain and the United States. *Applied Economics, 46*(7), 698-714.

Pesaran, M. H., Shin, Y., Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics, 16*(3), 289-326.

Rebooting Consensus Authors (2015) *Rebooting the Eurozone: Step 1 – agreeing a crisis narrative*. Available at: http://www.voxeu.org/article/ez-crisis-consensus-narrative.

Romer, P. M. (1994). The origins of endogenous growth. *Journal of Economic Perspectives, 8*(1), 3-22.

Romero, J. P. (2019). A Kaldor–Schumpeter model of cumulative growth. *Cambridge Journal of Economics, 43*(6), 1597-1621.

Setterfield, M. (2002). A model of Kaldorian traverse: cumulative causation, structural change and evolutionary hysteresis. In: *The economics of demand-led growth*. Cambridge: Edward Elgar Publishing.

Setterfield, M.; Cornwall, J. (2002). A Neo-Kaldorian Perspective on the Rise and Decline of the Golden Age: Challenging the Supply-side Vision of the Long Run. In: *The economics of demand-led growth*. Cambridge: Edward Elgar Publishing.

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

Storm, S., Naastepad, C. W. (2015a). Europe's Hunger Games: income distribution, cost competitiveness and crisis. *Cambridge Journal of Economics*, *39*(3), 959–986.

Storm, S., Naastepad, C. W. M. (2015b). Crisis and recovery in the German economy: The real lessons. *Structural Change and Economic Dynamics, 32*, 11–24.

Thirlwall, A. P. (1979). The balance of payments constraint as an explanation of international growth rate differences. *BNL Quarterly Review, 32*(128), 45-53.

Thirlwall, A. P. (1983). Foreign trade elasticities in centre-periphery models of growth and development. *BNL Quarterly Review, 36*(146), 249-261.

Thorbecke, W., Kato, A. (2012). The effect of exchange rate changes on Germany's exports. Research Institute of Economy, Trade and Industry RIETI Discussion Paper Series.

Tober, T. (2023). The launch of EMU and German export interests. *Socio-Economic Review*, 21(3), 1657-1678.

Verdoorn, P. J. (1949). On the Factors Determining the Growth of Labour Productivity. *L'Industria*. In: McCombie, J. S. (2002). *Productivity Growth and Economic Performance: Essays on Verdoorn's Law*. London: Palgrave Macmillan.

Wagner, J. (2007). Exports and productivity: A survey of the evidence from firm-level data. The *World economy, 30*(1), 60-82.

Wyplosz, C. (2013). The Eurozone crisis and the competitiveness legend. *Asian Economic Papers, 12*(3), 63-81.

Xifré, R. (2021). Non-Price Competitiveness Factors-A simple measure and implications for the five largest euro area countries. *The World Economy*, *44*(11), 3019-3110.

Young, A. A. (1928). Increasing returns and economic progress. *The Economic Journal*, *38*(152), 527-542.

Appendix A. Variables and sources

Variable	Description	Calculation and notes	Source
Export (X)	Total export of goods at constant euros (base year 2015). quarterly.	-	Eurostat.
Domestic productivity ($PROD$)	Valued added per person employed in constant euros (base year 2015). quarterly.	-	Eurostat.
Unit labour cost (ULC)	Nominal unit labour cost (index. 2015=100). quarterly.	On person base.	Eurostat.
Domestic price/cost competitiveness (ULC_{RER})	ULC37-based real effective exchange rate (index. 2015=100). quarterly.	Double export weights. against a basket of 37 industrialized countries.	Ameco.
Foreign price/cost competitiveness (ULC^f)	ULC-based real effective exchange rate. weighted average (index. 2015=100). quarterly.	Calculated as (ULC/ULC_{RER}). multiplied by 100.	Our calculation starting from Eurostat and Ameco data.
Domestic nominal wages (NW)	Wage per person employed in current euros. quarterly.	Calculated as ($ULC*PROD$)/100.	Our calculation starting from Eurostat data.
Non-price competitiveness (NPC)	Index of Economic Complexity. annual.	Converted to quarterly basis by using the cubic interpolation.	Harward Growth Lab.
Investment (INV)	Gross fixed capital formation per person employed in constant euros (base year 2015). quarterly.	-	Eurostat.
Foreign demand (FD)	Gross domestic product of selected foreign countries in constant euros. PPP (base year 2015). quarterly.	Based on a set of 43 foreign countries. Data converted from dollars to euros using the nominal exchange rate.	Our calculation starting from OECD data.
Government spending (GOV)	Current government expenditure in constant euros (base year 2015). quarterly.	-	Eurostat.
Employment	Number of persons employed.	Employed for the calculation of INV.	Eurostat.
Nominal exchange rate	Defined as the exchange rate between EUR and USD.	Employed for converting FD.	OECD.

Table A1. *Variables, definitions and sources.*

Appendix B. Statistical annex

Country	X	FD	ULC-R	NPC	NW	GOV	INV	ΔX	ΔFD	ΔULC-RER	ΔNPC	ΔNW	ΔGOV	ΔINV
AUT	1.43***	3.79***	0.82***	1.94***	3.78***	3.74***	2.07***	0.22	0.12	0.55**	0.09	0.41*	0.16	0.07
BEL	1.42***	3.79***	0.96***	2.34***	3.76***	3.66***	3.46***	0.06	0.12	0.19	0.20	0.27	0.02	0.03
FIN	0.97***	3.81***	0.69**	3.39***	3.81***	3.62***	2.08***	0.32	0.12	0.13	0.13	0.34	0.09	0.30
FRA	1.35***	3.81***	0.92***	3.13***	3.83***	3.85***	3.01***	0.23	0.12	0.09	0.12	0.01	0.02	0.09
GER	1.44***	3.79***	0.90***	2.01***	3.73***	3.77***	2.02***	0.31	0.13	0.39*	0.08	0.03	0.09	0.04
GRC	1.37***	3.81***	0.84***	1.51***	1.77***	1.06***	2.30***	0.05	0.12	0.43*	0.10	0.33	0.23	0.23
ITA	1.38***	3.82***	2.05***	2.02***	3.32***	1.29***	1.40***	0.03	0.13	0.24	0.19	0.11	0.07	0.17
NDL	1.45***	3.81***	1.46***	2.55***	3.71***	3.63***	1.20***	0.27	0.12	0.09	0.11	0.04	0.18	0.04
SPA	1.46***	3.81***	0.79***	3.21***	3.67***	3.49***	0.76***	0.32	0.12	0.18	0.04	0.13	0.30	0.23
PRT	1.49***	3.82***	0.53*	2.15***	3.41***	1.94***	1.11***	0.16	0.12	0.24	0.16	0.11	0.07	0.13

Table B1. *Kwiatkowski-Phillips-Schmidt-Shin-Unit Root Test. H0: level stationarity (no trend). Lag structure according to automatic bandwidth selection procedure (Newey and West, 1994).*

Appendix C. Alternative model specifications

	Export equation (DV: X)					Productivity equation (DV: PROD)		
COUNTRY	IE (γ_1)	PE (γ_2)	ALPHA	F TEST	ARDL	INV (β_8)	X (β_9)	NW (β_{10})
AUT	2.242***	-1.061***	-0.376***	16.54***	(2 2 2)	-0.206	0.095	0.151***
	(0.073)	(0.213)	(0.111)			(0.14)	(0.117)	(0.031)
BEL	1.829***	-0.268***	-0.698***	8.08***	(2 2 2)	0.071*	0.191***	0.387***
	(0.024)	(0.067)	(0.118)			(0.041)	(0.033)	(0.013)
FIN	2.620***	-1.205***	-1.183***	14.4***	(2 2 2)	1.164***	-0.238**	0.187
	(0.040)	(0.104)	(0.194)			(0.152)	(0.099)	(0.242)
FRA	1.773***	-1.143***	-0.584***	7.1***	(2 2 2)	0.846**	-0.029	0.603***
	(0.03)	(0.083)	(0.129)			(0.346)	(0.159)	(0.105)
GER	2.389***	-0.398**	-0.425***	4.53**	(2 2 2)	0.089	0.19***	0.16***
	(0.091)	(0.165)	(0.132)			(0.061)	(0.068)	(0.013)
GRC	2.321***	-0.384	-0.281*	2.38	(2 2 2)	0.069	0.113	0.258***
	(0.417)	(0.572)	(0.166)			(0.091)	(0.163)	(0.039)
ITA	2.407*	-1.43	-0.075	4.63*	(2 2 2)	0.353***	0.125	0.136***
	(1.436)	(1.725)	(0.089)			(0.076)	(0.076)	(0.013)
NDL	2.894***	-1.423	0.096	0.73	(2 2 2)	0.171**	-0.33	0.139***
	(0.936)	(1.741)	(0.107)			(0.08)	(0.322)	(0.032)
SPA	2.399***	-1.116***	-0.228***	6.33**	(2 2 2)	0.064	-0.086	0.844***
	(0.193)	(0.295)	(0.081)			(0.082)	(0.053)	(0.046)
PRT	1.764***	0.056	-0.339***	2.75	(2 2 2)	0.078**	0.039	0.066***
	(0.305)	(0.662)	(0.116)			(0.034)	(0.043)	(0.009)

Table C1. *3SLS coefficients of central variables, subperiod 1995q1-2008q4, baseline model specification with 2 lags.*

	Export equation (DV: X)					Productivity equation (DV: PROD)		
COUNTRY	IE (γ_1)	PE (γ_2)	ALPHA	F TEST	ARDL	INV (β_8)	X (β_9)	NW (β_{10})
AUT	1.491***	-0.706	-0.289***	4.82**	(2 2 2)	0.219	0.436***	0.090***
	(0.353)	(1.027)	(0.101)			(0.235)	(0.118)	(0.033)
BEL	1.356***	-0.046	-0.263***	4.67*	(2 2 2)	0.05	0.387***	0.444***
	(0.131)	(0.623)	(0.074)			(0.043)	(0.055)	(0.019)
FIN	0.175	-1.529***	-0.972***	1.78	(2 2 2)	1.267***	-0.253**	0.376
	(0.112)	(0.403)	(0.172)			(0.165)	(0.098)	(0.447)
FRA	1.097***	0.063	-0.145	1.05	(2 2 2)	0.311***	0.056*	0.655***
	(0.272)	(0.856)	(0.099)			(0.063)	(0.03)	(0.026)
GER	1.790***	-0.917***	-0.360***	2.66	(2 2 2)	0.036	0.401***	0.073***
	(0.197)	(0.316)	(0.095)			(0.092)	(0.044)	(0.017)
GRC	2.343***	0.025	-0.656***	15.7***	(2 2 2)	0.043	0.146	0.252***
	(0.584)	(0.559)	(0.122)			(0.066)	(0.167)	(0.065)
ITA	1.016***	-0.657	-0.256***	4.69*	(2 2 2)	0.304***	0.241***	0.124***
	(0.144)	(0.548)	(0.071)			(0.107)	(0.061)	(0.014)
NDL	1.401***	-0.962**	-0.401***	4.49*	(2 2 2)	0.001	-0.484*	0.094***
	(0.125)	(0.486)	(0.147)			(0.014)	(0.249)	(0.030)
SPA	1.162***	-0.892***	-0.564***	3.89	(2 2 2)	-0.008	0.34***	0.557***
	(0.117)	(0.132)	(0.093)			(0.079)	(0.044)	(0.068)
PRT	2.027***	-0.580***	-0.904***	4.84**	(2 2 2)	-0.059	0.356***	0.076***
	(0.046)	(0.081)	(0.164)			(0.062)	(0.038)	(0.015)

Table C2. *3SLS coefficients of central variables, subperiod 2009q1-2020q4, baseline model specification.*

COUNTRY	Export equation (DV: X)					Productivity equation (DV: PROD)		
	IE (γ_1)	PE (γ_2)	ALPHA	F TEST	ARDL	INV (β_8)	X (β_9)	GOV (β_{11})
AUT	1.971***	-1.302***	-0.237***	8.97***	(3 3 3)	0.201***	0.283***	0.549***
	(0.053)	(0.197)	(0.055)			(0.061)	(0.054)	(0.037)
BEL	1.499***	-0.565*	-0.188***	8.99***	(2 2 2)	0.211***	0.413***	0.555***
	(0.065)	(0.234)	(0.045)			(0.048)	(0.06)	(0.03)
FIN	1.556***	-6.211*	-0.076	3.45	(3 3 3)	0.898***	-0.175**	0.405***
	(0.466)	(3.256)	(0.046)			(0.118)	(0.079)	(0.073)
FRA	1.475***	-1.927***	-0.079*	1.68	(3 3 3)	0.484***	-0.062	0.921***
	(0.133)	(0.732)	(0.043)			(0.167)	(0.086)	(0.095)
GER	2.057***	-0.976***	-0.246***	3.49	(2 2 2)	0.048	0.368***	0.448***
	(0.05)	(0.138)	(0.055)			(0.049)	(0.032)	(0.034)
GRC	1.696***	-0.231	-0.206***	3.93	(3 3 3)	0.066	0.301*	0.352***
	(0.185)	(0.311)	(0.071)			(0.055)	(0.176)	(0.066)
ITA	1.129***	0.127	-0.199***	5.27**	(4 4 4)	0.401***	0.238***	0.32***
	(0.136)	(0.346)	(0.041)			(0.064)	(0.045)	(0.023)
NDL	1.878***	-1.447	-0.111**	1.91	(3 3 3)	0.016	-0.505**	0.403***
	(0.17)	(1.071)	(0.052)			(0.016)	(0.235)	(0.039)
SPA	1.766***	-0.010	-0.145***	4.42*	(2 2 2)	0.224***	0.253***	0.431***
	(0.103)	(0.243)	(0.041)			(0.08)	(0.058)	(0.05)
PRT	1.871***	-0.014	-0.263***	11.42***	(3 3 3)	0.049	0.316***	0.074***
	(0.049)	(0.171)	(0.055)			(0.039)	(0.036)	(0.01)

Table C3. *3SLS coefficients of central variables, timespan 1995q1-2020q4, model specification with government spending and 3 lags. Lag length choice according to AKAIKE criterion minimisation.*

COUNTRY	Export equation (DV: X)					Productivity equation (DV: PROD)		
	IE (γ_1)	PE (γ_2)	ALPHA	F TEST	ARDL	INV (β_8)	X (β_9)	GOV (β_{11})
AUT	2.229***	-1.047***	-0.532***	4.51*	(2 2 2)	0.055	0.173***	0.517***
	(0.080)	(0.204)	(0.041)			(0.056)	(0.064)	(0.035)
BEL	1.834***	-0.271***	-0.723***	11.87***	(2 2 2)	0.268***	0.31***	0.466***
	(0.023)	(0.063)	(0.023)			(0.066)	(0.058)	(0.031)
FIN	2.615***	-1.175***	-0.645***	14.55***	(2 2 2)	1.021***	0.123	0.434***
	(0.038)	(0.094)	(0.111)			(0.136)	(0.093)	(0.113)
FRA	1.772***	-1.141***	-0.356***	16.02***	(2 2 2)	0.497**	0.139	1.481***
	(0.029)	(0.08)	(0.054)			(0.206)	(0.094)	(0.107)
GER	2.397***	-0.380**	-0.361***	8.63***	(2 2 2)	0.020	0.247***	0.441***
	(0.086)	(0.153)	(0.069)			(0.065)	(0.075)	(0.042)
GRC	2.325***	-0.392	-0.083	2.09	(2 2 2)	0.033	0.093	0.425***
	(0.415)	(0.567)	(0.126)			(0.108)	(0.195)	(0.111)
ITA	2.504	-1.548	-0.462***	2.28	(2 2 2)	0.461***	0.041	0.307***
	(1.627)	(1.952)	(0.046)			(0.081)	(0.078)	(0.036)
NDL	3.338**	-2.525	-0.076	1.56	(2 2 2)	0.097	0.232	0.391***
	(1.684)	(3.116)	(0.099)			(0.064)	(0.253)	(0.05)
SPA	2.345***	-1.088***	-0.409***	2.74	(2 2 2)	0.385**	-0.066	0.463***
	(0.207)	(0.305)	(0.083)			(0.163)	(0.111)	(0.07)
PRT	1.715***	0.126	-0.363***	2.43	(2 2 2)	0.079**	0.042	0.059***
	(0.314)	(0.676)	(0.077)			(0.034)	(0.043)	(0.008)

Table C4. *3SLS coefficients of central variables, subperiod 1995q1-2008q4, model specification with government spending.*

	Export equation (DV: X)					Productivity equation (DV: PROD)		
COUNTRY	IE (γ_1)	PE (γ_2)	ALPHA	F TEST	ARDL	INV (β_8)	X (β_9)	GOV (β_{11})
AUT	1.259***	0.008	-0.762***	3.13	(2 2 2)	0.537***	0.210***	0.687***
	(0.427)	(1.236)	(0.062)			(0.106)	(0.068)	(0.069)
BEL	1.304***	-0.613	-0.355***	5.56**	(2 2 2)	0.104**	0.417***	0.754***
	(0.146)	(0.690)	(0.034)			(0.047)	(0.059)	(0.037)
FIN	0.223**	-1.147***	-0.042	7.72***	(2 2 2)	0.271*	0.080	0.659***
	(0.112)	(0.389)	(0.106)			(0.144)	(0.055)	(0.074)
FRA	0.923*	-0.017	0.261**	0.56	(2 2 2)	0.463***	-0.218**	1.127***
	(0.539)	(1.257)	(0.105)			(0.137)	(0.082)	(0.125)
GER	1.754***	-0.855***	-0.411***	5.46**	(2 2 2)	0.092	0.384***	0.488***
	(0.211)	(0.333)	(0.097)			(0.071)	(0.033)	(0.061)
GRC	2.388***	0.071	-0.095	15.16***	(2 2 2)	0.042	0.181	0.298***
	(0.579)	(0.552)	(0.130)			(0.068)	(0.169)	(0.048)
ITA	0.971***	-0.762	-0.462***	3.01	(2 2 2)	0.373***	0.242***	0.318***
	(0.153)	(0.549)	(0.056)			(0.090)	(0.052)	(0.029)
NDL	1.443***	-0.449	0.182	2.46	(2 2 2)	0.010	0.606***	0.504***
	(0.215)	(0.904)	(0.211)			(0.012)	(0.166)	(0.101)
SPA	1.173***	-0.868***	-0.594***	12.58***	(2 2 2)	0.231***	0.334***	0.355***
	(0.118)	(0.135)	(0.087)			(0.087)	(0.057)	(0.072)
PRT	2.026***	-0.574***	-0.112	22.3***	(2 2 2)	-0.046	0.357***	0.114***
	(0.047)	(0.082)	(0.122)			(0.061)	(0.038)	(0.023)

Table C5. *3SLS coefficients of central variables, subperiod 2009q1-2020q4, model specification with government spending.*

	Export equation (DV: X)					Productivity equation (DV: PROD)		
COUNTRY	IE (γ_1)	PE (γ_2)	ALPHA	F TEST	ARDL	INV (β_8)	X (β_9)	NW (β_{10})
AUT	2.107***	-0.970***	-0.526***	6.21**	(4 4 4)	0.161	0.330***	0.594
	(0.041)	(0.126)	(0.083)			(0.104)	(0.049)	(0.446)
BEL	1.424***	-0.053	-0.116	6.6***	(4 4 4)	0.165**	0.240***	0.673***
	(0.079)	(0.425)	(0.086)			(0.075)	(0.059)	(0.183)
FIN	1.279***	-6.288**	-0.812***	7.05***	(4 4 4)	0.219	0.334**	0.034
	(0.377)	(2.78)	(0.054)			(0.261)	(0.149)	(0.562)
FRA	1.220***	-0.497	-0.444***	7.44***	(4 4 4)	0.18	0.168*	1.297***
	(0.249)	(0.819)	(0.081)			(0.183)	(0.097)	(0.295)
GER	2.107***	-0.971***	-0.526***	19.4***	(4 4 4)	0.158	0.325***	0.491
	(0.041)	(0.126)	(0.083)			(0.112)	(0.06)	(0.306)
GRC	1.661***	0.140	-0.144	3.76	(4 4 4)	0.112	0.720**	0.237
	(0.259)	(0.455)	(0.107)			(0.125)	(0.292)	(0.296)
ITA	1.141***	-0.067	-0.646***	6.61***	(4 4 4)	0.198	0.249***	0.624***
	(0.089)	(0.204)	(0.075)			(0.123)	(0.069)	(0.215)
NDL	1.846***	-0.302	-0.152	1.63	(4 4 4)	0.031	0.213	0.265
	(0.115)	(0.581)	(0.107)			(0.530)	(0.133)	(0.398)
SPA	1.602***	0.093	-0.405***	7.75***	(4 4 4)	0.253**	0.321***	0.324
	(0.144)	(0.280)	(0.088)			(0.119)	(0.085)	(0.240)
PRT	1.830***	-0.053	-0.214**	7.24***	(4 4 4)	0.004	0.433***	0.098
	(0.054)	(0.181)	(0.087)			(0.071)	(0.075)	(0.185)

Table C6. *3SLS coefficients of central variables, subperiod 1995q1-2020q4, baseline model specification with 4 lags of every independent variable. The reported statistics of the central variables of the productivity equation pertain to the examination of linear combinations representing the cumulative effect, incorporating all 4 lags.*

	Export equation (DV: X)					Productivity equation (DV: PROD)		
COUNTRY	IE (γ_1)	PE (γ_2)	ALPHA	F TEST	ARDL	INV (β_8)	X (β_9)	GOV (β_{11})
AUT	1.998***	-1.287***	-0.762***	4.14*	(4 4 4)	0.300*	0.334***	0.403
	(0.044)	(0.169)	(0.062)			(0.165)	(0.076)	(0.336)
BEL	1.481***	-0.588	-0.723***	7.34***	(4 4 4)	0.301**	0.333***	0.446
	(0.079)	(0.427)	(0.071)			(0.154)	(0.110)	(0.428)
FIN	1.261***	-5.782**	-0.685***	7.28***	(4 4 4)	0.143	0.295***	0.868*
	(0.355)	(2.371)	(0.070)			(0.199)	(0.111)	(0.481)
FRA	1.269***	-0.959	-0.638***	7.56***	(4 4 4)	0.107	0.324**	1.087***
	(0.213)	(0.691)	(0.084)			(0.256)	(0.138)	(0.428)
GER	2.110***	-0.960***	-0.416***	14.23***	(4 4 4)	0.164	0.321***	0.092
	(0.041)	(0.125)	(0.089)			(0.108)	(0.067)	(0.27)
GRC	1.589***	-0.292	-0.103	3.61	(4 4 4)	0.315**	0.016	0.499
	(0.235)	(0.405)	(0.112)			(0.130)	(0.268)	(0.388)
ITA	1.120***	-0.017	-0.692***	5.56**	(4 4 4)	0.365***	0.259***	-0.052
	(0.096)	(0.226)	(0.068)			(0.125)	(0.067)	(0.233)
NDL	1.877***	-0.832	-0.004	1.71	(4 4 4)	0.040	0.396**	0.086
	(0.129)	(0.791)	(0.107)			(0.071)	(0.183)	(0.332)
SPA	1.608***	0.054	-0.354***	7.67***	(4 4 4)	-0.206	0.311***	0.032
	(0.139)	(0.267)	(0.092)			(0.149)	(0.104)	(0.196)
PRT	1.869***	-0.091	-0.212***	6.82***	(4 4 4)	0.068	0.442***	0.243
	(0.050)	(0.164)	(0.084)			(0.071)	(0.078)	(0.115)

Table C7. *3SLS coefficients of central variables, timespan 1995q1-2020q4, model specification with government spending and 4 lags of every independent variable. The reported statistics of the central variables of the productivity equation pertain to the examination of linear combinations representing the cumulative effect, incorporating all 4 lags.*