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Balance of Payments Constrained Growth in the Eurozone: Evidence on Multi-Sector Thirlwall's Law for a Sample of 9 Founding Euro Countries, 1992-2019.

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Abstract

This article examines Thirlwall's Law for a sample of 9 eurozone countries from 1992 to 2019. Thirlwall's Law states that a country's long-run growth rate is determined by the ratio of its income elasticities of demand for exports and imports. Using product level data from COMTRADE, this article constructs 5 main sectors based on technological intensity and estimates exports and imports equations for each sector and country in error correction model form. Estimation techniques are seemingly unrelated regressions for exports and three stages least squares for imports. The results reveal significant variations in the income elasticities across sectors and countries, with a strong correlation between higher elasticities for more technological sectors, especially among the so-called central economies. The article concludes that Thirlwall's Law is both a strong predictor of actual growth rates and a useful tool for understanding the role of external imbalances on Eurozone's economic performance during the last decades.

JEL Classification: C30, E12, F45

Keywords: Balance-of-Payments-Constrained Growth, Thirlwall's Law, Multi-Sector Analysis, Current Account Imbalances, Error Correction Models.

1. Introduction

The relationship between external imbalances and economic growth has been a central topic of debate in open-economy macroeconomics, with two primary perspectives taking the forefront. The standard neoclassical view maintains that external imbalances represent an optimal allocation of savings and investments across countries, and as long as they are financed by private capital flows, they do not threaten global stability. In contrast, Keynesian theorists highlight the importance of external imbalances and the challenges faced by countries with large and persistent current account (CA) deficits. A key demand-oriented approach in this context is the balance-of-payments-constrained (BOPC) growth model, which posits that a country's growth rate is limited by its CA position, which must be balanced in the long run. According to this model, a country can only grow as fast as its exports permit, given its income elasticity of demand for imports. In stark contrast to the mainstream view, this approach considers that price competitiveness is ineffective in the long run, or what is to say: a country´s export performance relies fundamentally on its non-price competitiveness.

The BOPC model was originally developed by Thirlwall (1979) , who derived a simple expression in Kaldorian lines for the long-run equilibrium growth rate of a country, known as Thirlwall's Law (TL). TL states that a country's GDP growth rate is equal to the ratio of its export growth rate to its income elasticity of demand for imports. While TL provides valuable insights and its performance in forecasting growth rates has been remarkable, it relies on various simplifying assumptions, such as a single-sector economy and the absence of financial flows. To address these limitations, researchers have proposed numerous extensions and modifications to the original model. The work of Thirlwall & Hussain (1982) is probably the most important early incorporation, relaxing TL to allow a certain degree of deficit and surplus positions in the CA. In recent times, the most significant ampliation of TL´s framework is the so-called multisectoral BOPC model (Araujo & Lima, 2007). This model, built on Pasinetti's notion of vertical integration, incorporates multiple export and import sectors with varying demand elasticities, allowing for a more comprehensive analysis that considers the key importance of sectoral structure and its evolution for economic growth.

The aim of this article is to estimate a multisectoral BOPC growth model for a sample of 9 Eurozone countries during the period 1992-2019. The Eurozone presents an intriguing case study because it comprises countries that share a common currency and monetary policy but have differing economic structures and trade patterns. Such heterogeneity manifested in growing external imbalances after the euro adoption, which were a driving force behind the Eurozone's debt crisis as post-Keynesian authors have explored in length from diverse perspectives elsewhere (Cesaratto, 2015; Stockhammer, 2016). Following Lall´s (2000) technological classification, this article estimates export and import equations for each sector using the autoregressive distributed lag (ARDL) approach, employing the seemingly unrelated regressions (SUR) method for exports and the three-stage least squares (3SLS) method for imports. After examining variations sectors and nations we compute Multi-Sector Thirlwall´s-Law (MSTL) and benchmark its performance as predictor of actual growth rates.

The remainder of this article is structured as follows: Section 2 presents the framework underlying both the original one-sector and the multisectoral BOPC growth models and afterwards summarizes previous literature on TL, especially those works focusing on Eurozone countries and applying a multi-sector approach. Section 3 outlines the econometric methodology applied for estimations, describes the primary data sources, and performs a descriptive analysis on data. Section 4 presents and discusses estimation results for sector imports/exports and computes MSTL for our sample of countries. Finally, Section 5 draws the main conclusions of this study and discusses their implied policy recommendations.

2. THE MULTI-SECTOR BOPC GROWTH MODEL

For the sake of simplicity, we will derive the fundamental principles of the BOPC, in both its standard and multisector versions, from a common set of equations. Let us assume an open economy constituted by *n* distinct sectors where foreign trade is the only truly autonomous component of aggregate demand. As in the original version of the model developed in Thirlwall (1979) assuming standard Cobb-Douglas demand functions, the resulting sector-demand equations of imports and exports for each sector will be defined in the following manner:

$$X_{it} = x_{io}.\left(\frac{P_{it}}{Pf_{it}E_t}\right)^{\gamma_{i1}}.Z_t^{\varphi_i} \quad (1)$$

$$M_{it} = m_{io}.\left(\frac{Pf_{it}E_t}{P_{it}}\right)^{\gamma_{i2}}.Y_t^{\psi_i} \quad (2)$$

Where X_{it} and M_{it} are volume of exports and imports respectively, evaluated in real terms, for a certain moment t and sector i. ($E_t\ Pf_{it}/P_{it}$) stands for the evolution of sector-domestic relative prices (Pf_{it} foreign prices, P_{it} national prices, and exchange rate E_t). Thus γ_{i1} and γ_{i2} are price-elasticities of demand for exports and imports. Respecting income-elasticities of demand Z_t represents foreign income and φ_i is its associated elasticity. Finally, Y_t, stands for national income and ψ_i for its elasticity. On the other hand, consider the usual CA equilibrium identity defined, in nominal terms and for a certain period t as:

$$P_t.X_t = Pf_t.E_t.M_t \quad (3)$$

Equation (3) implicitly assumes TL main lemma: in the long run, growth is BPC and the CA has to be, in average, balanced. Is straightforward to connect sector-demand equations defined in (1) and (2) to the aggregate CA identity exposed in (3) through cumulative sector-sums. Following this strategy, aggregate level of nominal exports will be $P_t\ X_t=\sum^n_{i=1}(P_{it}\ X_{it})$ and just rearranging we will get:

$$X_t = \sum\nolimits_{i=1}^{n}\left(\frac{P_{it}}{P_t}X_{it}\right) = \sum\nolimits_{i=1}^{n}X_{it} \quad (4)$$

In the same manner, aggregate nominal imports are represented by $Pf_t\ M_t=\sum^n_{i=1}(Pf_{it}\ M_{it})$ and after the same transformation applied to exports, we have:

$$M_t = \sum\nolimits_{i=1}^{n}\left(\frac{Pf_{it}}{Pf_t}M_{it}\right) = \sum\nolimits_{i=1}^{n}M_{it} \quad (5)$$

This set of 5 equations is all we need to develop both the original and multi-sector versions of the BOPC growth model. First, as a prerequisite to easily evaluate the dynamics and solution of the model we have to transform it from levels to growth rates. Taking logarithms and first-time differences of equations (1), (2) and (3) we get:

$$x_i = \gamma_{i1}(p_i - e - pf_i) + \varphi_i z_i \quad (6)$$

$$m_i = \gamma_{i2}(pf_i + e - p_i) + \psi_i y_i \quad (7)$$

$$p + x = m + pf + e \quad (8)$$

Where lower case variables stand for growth rates of corresponding variables in levels. Now, assume that for simplicity we only have one economic sector. Assuming ($n=i=1$), we can solve for y the system constituted by (6), (7), and (8). After some algebraic manipulation we get:

$$y_{BPC} = \frac{(\gamma_1 + \gamma_2 - 1)(pf + e - p) + \varphi z}{\psi} \quad (9)$$

Assuming, as evidence suggests, that in the long run price effects are minimal as a result of either Purchasing power parity (PPP) holding $(pf_i+e-p_i)\simeq 0$ or price competitiveness unimportance through the Marshall-Lerner condition being just met[1] $(\gamma_1+\gamma_2-1)\simeq 0$, equation (9) can be reduced to:

$$y_{TL} = \frac{\varphi z}{\psi} \quad (10)$$

This equation is the original form, or "strong" version of TL. Finally, if we substitute the upper part of (10) directly by exports growth rate, the only estimated parameter would be ψ leading to the final form of Thirlwall Law in its so-called "weak" version.[2]

$$y_{WTL} = \frac{x}{\psi} \quad (11)$$

Let's turn over the multisectoral version of the model originally developed by Araujo & Lima (2007). Recall equations (6) and (7) for sectoral demands in log-differences and let assume now $n>1$ and that sectoral relative prices growth follow in average the PPP postulate as exposed above so that price effect becomes irrelevant. As a result, we can easily

1 The Marshall–Lerner condition implies that a currency devaluation only leads to an improvement in the current account if the sum of price elasticities of exports and imports (in absolute values) is greater than one.

2 Weaker understood as depending on less behavioural parameters (only income elasticity of demand for imports).

define aggregate equations derived from combining (4) with (6) and (5) with (7) respectively. Aggregate growth of exports and imports in the BOPC growth model are then defined as:

$$x = \bar{z} \sum_{i=1}^{n} (\mu_i \varphi_i) \tag{12}$$

$$m = \bar{y} \sum_{i=1}^{n} (\lambda_i \psi_i) \tag{13}$$

Where $\bar{z}$ and $\bar{y}$ are average annual growth rates of income and foreign income respectively. At last, μ_i and λ_i represent individual sectoral shares, that is:

$$\sum_{i=1}^{n} \mu_i = 1 \ \forall \ \mu_i = \frac{X_{it}}{X_t} \tag{14}$$

$$\sum_{i=1}^{n} \lambda_i = 1 \ \forall \ \lambda_i = \frac{M_{it}}{M_t} \tag{15}$$

Finally, to obtain multi-sector version of TL (MSTL) we have to substitute equations (12) and (13) in the original one sector TL defined in (10):

$$y_{MSTL} = \bar{z} \frac{\sum_{i=1}^{n} (\mu_i \varphi_i)}{\sum_{i=1}^{n} (\lambda_i \psi_i)} \tag{16}$$

Equation (16) is assumed to be a more robust version of (10) which takes into consideration additional factors as sector structure or technological specialization. Therefore, it generally offers both a more complete picture and closer forecasts of actual growth rates of income than traditional TL.

Empirical studies computing Thirlwall's law encompass a broad array of countries and time periods, including the EU and some of its individual member states. Notably, numerous studies have focused on Mediterranean countries such as Italy (Soukiazis et al., 2014), Greece (Soukiazis et al., 2018), Portugal (Soukiazis & Antunes, 2011), and Spain (Alonso, 1999; León-Ledesma, 2002). Bajo-Rubio et al. (2015) even conducted research on Thirlwall's law in a sub-national context, analysing its application across various Spanish regions. More recently, (Charles et al., 2022) extended the scope of the analysis to France, one of the few individual examples beyond the strictly Mediterranean area.

Although a considerable body of literature examines Thirlwall's law across multiple countries and regions, there is relatively limited evidence regarding its multisectoral counterpart, particularly when focusing exclusively on European countries. Following the original publication of Araujo & Lima's (2007) model, initial studies such Gouvea & Lima (2010) and Romero et al. (2011) concentrated on Latin American countries, with the former analysing a sample of four nations and the latter specifically investigating Brazil. More recent research on European countries includes Soukiazis et al. (2017) examination of 11 Eastern European countries. The study by Romero & Mccombie (2016) is the solely which has previously estimated MSTL for a set of 14 Western European countries and is the closest antecedent of this work. However, their focus was not exclusively on EU members and their coverage ended at the dawn of the 2000s.

Thus, this study makes a novel contribution to the literature by estimating MSTL for the original euro members across three distinct phases that have defined the Eurozone since its inception: 1) a first phase of booming credit marked by escalating CA deficits for Mediterranean countries, 2) the subsequent Eurozone crisis, and 3) the normalization of CA positions for these countries in the aftermath. Prior research has not attempted yet to compute MSTL, nor its one-sector variant, for this particular combination of sample and timeframe. Additionally, from a methodological standpoint, our combination of ARDL bounds testing and an iterative Feasible Generalized Least Squares (FGLS) estimation procedure for deriving export and import equations confers significant advantages, especially in terms of handling cointegration with different order regressors and incorporating panel information into individual estimations. Our study also broadens the scope of comparative analysis by juxtaposing MSTL with two alternative estimations of TL, one inclusive of services and another exclusive of them. Notably, our research is the first to consider the implications of excluding services from the conventional commodity classification utilized in MSTL studies. Lastly, in our effort to establish a rigorous benchmarking MSTL against actual rates, we regress the latter on its MSTL forecasts in a dynamic, year-based panel setting. To enhance the robustness of our findings, we supplement the traditional Wald test with a detailed analysis of residuals.

3. Methodology

Specification and estimation procedure

In order to conduct our analysis, the estimation of sector exports and imports is performed adapting equations to include long-run information. As is standard in the literature, we rely on the properties of cointegration for that purpose following the ARDL bounds testing approach proposed by Pesaran et al (2001). The advantages of this procedure against Engle-Granger (1987) and Johansen (1991) alternative approaches are clear for estimating exports and imports as it allows a mixture of I(1) and I(0) variables in equations, a likely scenario for relative prices if, as proposed by TL, PPP holds. Following previous works (Lanzafame, 2014), we decide to impose a common ARDL structure to all equations for homogeneity reasons. We set a (1,1,1) lag structure for both sectoral imports and exports. As a result, we estimate the following Unrestricted Error Correction models (ECMs):

$$\Delta X_{ikt} = a_0 + a_1.L(X_{ikt}) + a_2.L({Y^f}_{it}) + a_3.L(P_{ikt}) + a_4.\Delta {Y^f}_{ikt} + a_5.\Delta P_{ikt} \quad (17)$$

$$\Delta M_{ikt} = b_0 + b_1.L(M_{ikt}) + b_2.L(Y_{it}) + b_3.L(P_{ikt}) + b_4.\Delta Y_{it} + b_5.\Delta P_{ikt} \quad (18)$$

Where all variables are measured in logarithms, *L()* stands for the lag operator and Δ reflects growth rates and is therefore equal to *(1-L)*. Regarding subindexes, i stands for the ieth country, k fot the kth sector and t for the corresponding year. Superindex f is assocítated to foreign partners.

The estimations are performed by means of iterated FGLS taking into consideration information from the panel of countries for each sector country-individual estimation. For exports, this translates in a SUR approach. For imports, as endogeneity was perceived as still being an issue, a 3SLS technique is applied which adds a first step estimation with instrumental variables before applying FGLS. Consumption and total exports have been selected as instruments of income for that purpose.

Data origin

Variables referring to total values have been obtained from AMECO including, exchange-rate, income, exports, imports, consumption and foreign income. The latter has been measured through the average growth rate of the EU-15 after subtracting the part corresponding to the reporter. All the variables but the exchange rate are expressed in real euros base 2010. On the other hand, sector variables have been constructed obtaining product level data from United Nations database on foreign trade COMTRADE. 3-digits data was collected and afterwards aggregated into the 5 main technological sectors proposed by Lall´s (2000) classification. This is the standard division considered in the majority of previous works estimating MSTL. It classifies activities from SITC categories at 3-digits into different trade sectors depending on their degree of technological complexity. From top to bottom: (1) High-tech, (2) Medium-tech, (3) Low-Tech, (4) Resource-Based production and (5) Primary activities.

We computed sectoral export and import prices in three stages. First, we estimated unit values by dividing the total dollar value by the associated traded volume in physical terms, using aggregates from 3-digit SITC categories sourced from COMTRADE. Second, product prices were calculated as the difference between unit value growth and real volume growth, evaluated in log-diffs. Third, we summed individual product prices, each weighted by its relative size, to derive final aggregates for sectoral prices. Finally, we converted nominal exports and imports per sector into real 2010 euros, by discounting their corresponding sectoral price and applying the exchange rate. Regarding our sample, we focused on 9 of the original 12 Eurozone members, excluding the Benelux countries—due to data unavailability prior to 1995—and Ireland, owing to its exceptional economic behaviour that would distort our FGLS estimation method. This group was selected to enable the longest feasible retrospective analysis of the EMU since the Maastricht Treaty (1992).

Data overview

A first broad look on some descriptive indicators on foreign trade highlight important differences among Eurozone countries. Table 1 provides a detailed snapshot of the CA positions of sample countries as a percentage of GDP from 1992 through 2019. The data clearly illustrates distinctive patterns and trends that underscore important asymmetries. Germany demonstrates a consistent strengthening of its CA position throughout the period, peaking at 7.14% in 2007 and slightly dipping to 5.56% by 2019. This robust performance underlines Germany's success in maintaining a heavily export-oriented economy. In a similar fashion, Central European countries - Austria, Finland, and the Netherlands - display a relatively stable foreign sector, maintaining positive or nearly neutral CA positions throughout the period. The Netherlands stands out with the largest surplus of 9.70% in 2019, while Finland's position shows some volatility, with a dip to a low of 0.37% in 2019. On the other hand, Mediterranean countries, including Greece, Italy, Portugal, and Spain, exhibited a concerning trend of deteriorating CA positions in the years leading up to the euro crisis. The situation was particularly severe for Greece, which had a significant deficit of -10.45% in 2007. These deficits highlight the countries' increased dependency on foreign funding and their inability to strike a balance between imports and exports. During the post-crisis period, these countries have shown signs of recovery with improving CA positions by 2019. France's situation is somewhat unique, neither aligning with the core Eurozone countries nor exactly with the Mediterranean group. Its CA position has remained relatively less positive than other core countries and more akin to the Mediterranean nations. As noted by Charles et al. (2022), France's position has been gradually declining, indicating a possible shift towards certain structural flaws shared with Mediterranean countries.

Therefore, recent evidence on CA positions seems to dismiss the simplistic view which associated central economies with an export-led growth model and a debt-led model to their Mediterranean counterparts. Countries as Spain or Portugal have been consistently running CA surpluses in recent times suggesting that while the split on export-led/debt-led growth was useful for the period preceding Europe´s debt crisis, it doesn´t seem to describe the growth patterns followed by Mediterranean countries during the last decade (Kohler & Stockhammer, 2022). Some traits of those growth-models rather than structural may have been exacerbated by the impact of booming consumption and credit around housing assets as a result of the adoption of a strong common currency coupled to significantly lower central interest rates implied by the euro adoption. Therefore, as some post-Keynesian authors have highlighted, CA deficits would not be the only driving cause for the euro crisis, but also a symptom of imbalanced financial flows, excessive bank credit and a flaw and incomplete design of the Eurozone as a monetary union (Febrero et al., 2019).

TABLE 1: Current account positions (% over GPD) for selected years

	(X-M)/Y (%)				
year	1992	2000	2007	2019	(1992-2019)
Austria	-2.93	0.53	3.83	4.42	1.46
Finland	-1.70	4.27	3.76	0.37	1.68
France	0.57	1.80	0.23	-0.77	0.45
Germany	0.28	1.05	7.14	5.56	3.51
Greece	-4.49	-7.52	-10.45	-0.69	-5.79
Italy	-1.54	0.76	0.08	2.75	0.51
Netherlands	4.81	6.09	6.21	9.70	6.71
Portugal	-3.97	-6.92	-5.24	-0.03	-4.04
Spain	-2.59	-1.55	-7.29	3.23	-2.05
CENTRAL	0.61	1.98	6.53	5.89	3.75
MEDIT.	-2.16	-0.92	-3.43	2.57	-0.99

Net exports as percentage of GDP. Source: AMECO
Central Countries: Austria, Finland, Germany, Netherlands
Mediterranean Countries: Greece, Italy, Portugal, Spain

Table 2 presents a comparative analysis of sectoral shifts in export and import shares for Eurozone countries from 1992 to 2019, segregating sectors based on their technological intensity into high (HIGH), medium (MED), low (LOW), as well as primary (PRIM) and resource-based (RES) sectors. This elucidates not only the unique economic trajectories of each nation but also uncovers overarching regional trends, particularly between Central Eurozone and Mediterranean countries. Generally, both Central Eurozone and Mediterranean countries have witnessed an increase in high-technology exports, hinting at a collective trend towards more technologically advanced industries. However, this transition has manifested at divergent rates among these regions.

Central Eurozone countries, specifically Germany, Austria, and the Netherlands, have consistently demonstrated higher proportions of high-tech exports in both 1992 and 2019 compared to their Mediterranean counterparts. In this regard, France closely aligns with the Central Eurozone countries. Conversely, Mediterranean nations, including Greece, Italy, Portugal, and Spain, despite enhancing their share of high-tech exports, still trail in absolute percentages. The most marked transition in this region is observable in Greece, where high-tech exports escalated from a minimal 2% in 1992 to 9% in 2019. Examining medium-tech exports, their share ranks among the two highest for all countries at both the beginning and the end of the period, yet with slight variations, and no distinct patterns discernible between Central Eurozone and Mediterranean countries. In contrast, low-technology exports have generally diminished across both regions, with Greece exhibiting the most significant reduction from 35% to 11%. In terms of primary sector exports, every country (with the exceptions of Greece and the Netherlands) exhibited an increase in their respective shares of primary activities, most notably Austria and Italy with a growth of 5%. Lastly, resource-based sectors demonstrated two distinct patterns: Central Eurozone countries, including France, invariably experienced a decrease in their shares, while Mediterranean economies (with Italy as the only exception declining by 1%) witnessed a substantial increase in resource-based exports, most notably Greece with an impressive 15% surge.

TABLE 2: Sector shares evolution for exports and imports (1992-2019)

		EXPORTS (%)					IMPORTS (%)				
		HIGH	MED	LOW	PRIM	RES	HIGH	MED	LOW	PRIM	RES
Austria	1992	8	32	20	22	18	11	32	18	24	14
	2019	14	31	15	27	13	14	29	16	28	14
Finland	1992	9	22	11	19	39	13	27	13	29	18
	2019	9	29	8	23	32	14	27	11	29	19
France	1992	14	31	13	24	17	13	28	16	28	16
	2019	20	29	12	26	14	15	28	15	27	14
Germany	1992	12	40	13	22	13	14	26	18	26	16
	2019	17	37	10	25	12	17	27	13	29	14
Greece	1992	2	7	35	33	23	8	36	14	27	15
	2019	9	13	11	28	38	11	18	13	39	18
Italy	1992	8	31	26	22	14	13	29	12	27	19
	2019	9	31	19	27	13	13	26	14	33	14
Netherlands	1992	13	22	12	32	21	13	24	16	30	16
	2019	18	25	11	27	20	19	22	13	29	17
Portugal	1992	4	20	40	15	21	10	34	16	26	14
	2019	7	29	21	18	24	14	28	15	28	15
Spain	1992	8	39	15	19	18	12	30	13	29	16
	2019	10	34	15	21	20	12	28	14	31	15

Source: Own calculations based on COMTRADE data and Lall´s (2000) sector classification.

Turning onto imports, the majority of countries in both regions have seen a surge in high-technology imports. Among these, The Netherlands witnessed the most substantial growth in this sector, with an increase from 13% to 19%. Contrarily, there was a general decline in low-technology imports for all countries but Spain, which experienced a slight increase. When it comes to medium-technology imports, the data revealed a prevalent downward trend. This downward trajectory was particularly pronounced in Mediterranean countries. At one end of the spectrum, Finland, France, and Germany registered almost the same proportion of medium-tech imports at the beginning and end of the observed period. Conversely, Greece experienced a marked decline of over 18 percentage points, a likely repercussion of the numerous economic shocks it encountered post-2008. Finally, when evaluating primary and resource-based activities, most countries recorded a modest increase in their shares by less than 5% for the entire period. France was the sole exception to this pattern, recording the only contractions in both primary (-1%) and resource-based activities (-2%). In stark contrast, Greece demonstrated a substantial combined increase of 15%, predominantly propelled by a 12% surge in primary imports.

In sum, while both Central Eurozone and

Mediterranean countries have shown a shift towards higher tech sectors in both their exports and imports composition, the pace and extent of this transformation have varied. Central Eurozone countries have generally demonstrated a more advanced shift towards high value-added and tech intensive exports, whereas the pace of change has been slower for Mediterranean countries, which may have contributed to their vulnerability during the euro crisis.

4. ESTIMATION RESULTS

Stationarity and unit root analysis

We initiate the empirical section of our research by conducting an analysis of stationarity on the variables used in the estimation of equations for both exports and imports. It is expected for all variables to demonstrate stationarity in differences, alternatively referred to as integration of order one. To validate this, we implement two complementary testing procedures. Initially, we subject all the variables to a Dickey-Fuller Generalized Least Squares (DFGLS) test, which operates under the null hypothesis of a unit root present in the series. Subsequently, we perform the Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test on all variables, where the null hypothesis is that the series is stationary. Due to the extensive number of series involved in this study, it is impractical to present all individual results. Therefore, we have summarized the principal findings from the DFGLS and KPSS tests, aggregated by sectors and variables, in Table 3.

TABLE 3: Stationarity and unit root analysis

	V1		V2											
	Total		Total		High-tech		Med-tech		Low-tech		Res. Based		Primary	
V1,V2	DF gls	KP SS	DFg ls	KP SS	DF gls	KP SS	DF gls	KP SS	DF gls	KP SS	DF gls	KP SS	DF gls	KP SS
y, x	0	1	0	1	2	0	0	0	0	0	0	0	1	0
%	100	98.9	100	98.9	98.9	100	100	100	100	100	100	100	98.9	100
fy, m	0	0	0	0	0	0	0	0	0	0	0	0	0	0
%	100	100	100	100	100	100	100	100	100	100	100	100	100	100
c, px	0	3	0	3	0	0	0	0	0	0	0	0	0	0
%	100	97	100	97	100	100	100	100	100	100	100	100	100	100
I,pm	0	0	0	0	8	9	8	9	6	9	5	8	3	5
%	100	100	100	100	11.1	0	11.1	0	33.3	0	44.4	11	66.7	44
,px*	-	-	1	0	0	0	0	0	0	0	0	0	0	0
%	-	-	98.9	100	100	100	100	100	100	100	100	100	100	100
,pm*	-	-	0	0	8	9	8	9	6	9	7	8	4	5
%	-	-	100	100	11.1	0	11.1	0	33.3	0	22.2	11	55.5	44

Number of series that were unable to pass the test for 5% level of significance (% over total below)
V1: Variables referring to total-economy (obtained from AMECO).
V2: Variable refereeing to technological sectors constructed from COMTRADE.
** Variables analysed in levels (logs).*

All tested series either rejected the presence of a unit root applying DFGLS or could not reject the KPSS null of stationarity assuming standard 5% levels of signification. In general, less than 10% of our series shown any form of non-stationarity. Exports and imports prices constitute a special case among our variables as, if PPP applies in the long run, it will imply that the underlying process would be I(0) or what is to say: directly stationary in level. Such circumstance would constitute an important problem for applying Engle-Granger (1989) or Johansen (1991) perspectives on cointegration as them require all variables to be I(1) in levels to produce consistent estimation results. Hopefully, the Bounds testing approach described by Pesaran et al. (2001) and applied by this paper allows for a mixture of I(0) and I(1) in the equation to be estimated. As shown in table 3, this property is important for this work as, when exports and imports prices were tested in levels, showed that around 20% of the series pointed to be directly stationary increasing the risk of combining I(1) and I(0) variables as regressors.

Unrestricted ECM and Cointegration F Bound test

Once we have checked the suitability of our variables for cointegration analysis, we move to the next step which involves determining the optimal autoregressive structure of the ARDL to estimate. Following common practice in literature we impose a common structure for exports and imports in all countries. After pretesting alternative structures for exports and imports and comparing them through Bayes Information Criteria (BIC) we choose a (1,1,1) structure for all equations to be estimated. After having decided the model structure the next step in the procedure is to estimate the models in their Unrestricted ECM and perform and F test on the obtained regression testing the existence of a long-run relationship among the variables. The F statistic proposed by Pesaran et al. (2001) does not follow a standard distribution and requires alternative critical values to be computed. Remarkably, this approach is so-called the "Bounds approach" as it offers a bound of 2 values and not just one as a consequence of allowing both I(0) and I(1) variables in the cointegrating relation.[3]

TABLE 4: F-Statistics obtained from Unrestricted ECM estimations. Bounds testing.

F BOUNDS TEST: UNRESTRICTED ECMs

	IMPORTS					EXPORTS				
Countries	PRIM	RES	LOW	MED	HIGH	PRIM	RES	LOW	MED	HIGH
Austria	4.5	4.2	11.1	13.1	4.0	4.0	5.3	3.6	2.8	1.4
Finland	6.3	2.9	13.7	7.9	18.1	13.2	7.4	7.2	5.5	16.6
France	1.2	1.5	8.1	14.5	5.4	2.0	6.0	6.0	7.5	7.2
Germany	2.7	27.0	6.0	5.1	3.4	7.7	9.0	5.6	4.5	5.6
Greece	6.1	2.1	3.8	10.8	9.9	5.9	3.0	2.8	6.0	7.0
Italy	2.6	0.6	13.2	36.9	0.9	4.0	6.2	14.2	8.2	2.0
Netherlands	2.4	6.8	6.4	5.8	11.0	4.1	8.7	5.5	1.7	12.6
Portugal	2.6	1.6	8.3	7.0	8.7	1.0	1.9	6.2	3.8	5.4
Spain	4.5	3.0	5.6	19.0	17.7	2.5	4.1	5.4	6.4	15.9

Critical values from Narayan (2004).
Case III (intercept and no time trend). 5%: {(I(0)=4.27, I(1)=5.47} 10%:{I(0)=3.44, I(1)=4.47}

Table 4 summaries obtained F statistics for both sectoral exports and imports equations. We compare them against the critical values proposed by Narayan (2004) which revises the original ones adjusted for small samples.[4] There exist 5 scenarios regarding the inclusion of a deterministic component and/or time trend. For this study, all reported values were estimated applying a case III specification (no time trend, intercept computed as part of the short run relationship). Critical values of the F test for a standard significance of 5% are 4.27 and 5.47 for the lower and upper bounds respectively. That implies that approximately a 62% of exports and a 57% of imports sectors strongly suggest the presence of a long run cointegrating relationship. Including values between the upper and lower bounds -which is reasonable given the presence of I(0) sectoral prices reported above- those percentages will increase to around 65% of the 90 sector equations. Relaxing significance to 10% more than 71% of exports and 78% of imports equations respectively will report and F statistic above the lower bound. In sum, a majority of equations demonstrated evidence of cointegration and the suitability of our estimation procedure.

Restricted ECM: Analysis of sector elasticities of demand

Having determined the presence of cointegration among analysed variables, the next phase is to re-estimate all equations, transforming our Unrestricted ECM into its Restricted representation. In this form, the long-term cointegrating relationship is integrated as an Error Correction Term (ECT). For stable cointegration to exist, it is essential that the regression coefficient of each ECT is significant, and falls within the interval (-1,0). This restricted ECM estimation for both exports and imports will provide the elasticities that will be utilized to calculate TL in the subsequent section. As was previously outlined, an iterated FGLS was employed for both exports and imports.[5] This method strategically leverages the contemporaneous correlations

3 If the variables are a combination of I(0) and I(1) processes, the result supporting the presence of cointegration would be compatible with values between the lower and upper bounds. On the other hand, if all variables are I(1) an F statistic greater than both bounds would be required for cointegration to exist among the variables.

4 Narayan (2004) simulate their critical values for a sample of 30 annual observations suitable to our period (1992-2019) which includes 28 annual observations per unit.

5 All the models were estimated using R package Systemfit (Henningsen and Hamann, 2008) and converged as expected to stable values after a few iterations.

among the error terms of different countries' demand equations to enhance the efficiency of our estimates for each sector. However, despite the adoption of an ARDL approach, endogeneity remained a challenge as demonstrated that around a 25% of imports equation where unable to pass Wu-Hausman test (not reported for conciseness). Therefore, distinct procedures were required for the final estimation of exports and imports. Exports were estimated through a standard iterated FGLS, which in this context is also known as SUR. Conversely, for imports, a two-step procedure was employed. This involved the utilization of Instrumental Variables (IV) regressions before conducting an iterated FGLS in the final step. This process is commonly referred to as 3SLS in the literature. Due to the extensive size of the tables presenting the results, the obtained estimations are included in ANNEX 1.

Table 5 provides a comprehensive analysis of estimated demand elasticities for exports across sectors and countries. All series, except for two related to Greece, indicated significant income elasticities of demand at a 5% significance level, with the expected positive sign. Moreover, Breusch-Godfrey´s test indicates that a significant majority of the evaluated equations do not exhibit problematic autocorrelation. The two exceptions in the Greek data included an insignificant elasticity for high-tech exports (1.49) with a p-value around 0.25, and a negative elasticity for resource-based activities (-0.46) with an even higher p-value. These irregularities could be attributed to Greece's unique economic situation during the 2000s and the absence of any country-specific controls in the estimated equations, a trade-off necessary to maintain a shared specification across the sample countries.

Upon examining significant income elasticities, Portugal emerges with a strikingly high elasticity for high-tech activities (9.96), while Finland displays an exceptionally elevated elasticity in the low-tech sector (6.06). These cases are unique, marking the only instances reporting abnormally high or low values. When categorized by sector, pronounced contrasts between Central and Mediterranean countries become apparent. In the realm of high-tech exports, excluding the notable exception of Portugal, Mediterranean countries (including France) recorded the lowest elasticities for high-tech activities, with Italy posting the highest elasticity at a modest 2.29. In contrast, among Central EU countries, the elasticity spectrum ranged from Austria's low of 3.05 to Finland's high of 4.98, denoting considerably higher elasticities for this group. Medium-tech activities generally exhibited the greatest elasticities for both groups of countries, with the smallest value surpassing 3. However, two distinctive patterns emerge: France, Spain, and Italy were the only countries reporting elasticities below 4, while Greece and Portugal exceeded this mark.

Among Central EU countries, only Austria (at 4.11) reported a value below this threshold, signifying a significant central-peripheral gap similar to that observed in high-tech activities. In contrast, low-tech, primary, and resource-based activities demonstrated a more uniform behaviour across both regional groups and countries. With the exception of the outliers previously mentioned, nearly all demand elasticities for these sectors fell within the 2-4 range, with no distinguishable pattern emerging among countries. In addition, all reported ECT estimations were contained as expected in the interval 0 -1 and resulted statistically significant at a 5% level. Finally, considering price elasticities of demand, only a few (18%) equations reported significant estimations at a 5% signification, around 31% for a 10%. Among those significant, all but the ones included in primary activities, reported the expected negative sign. However, evidence was much more mixed when considering all price elasticities and positive values were not uncommon.

Shifting focus to Table 6, which details estimation results for sector imports, a distinct pattern emerges. All income elasticities were found significant at a 5% level, exhibiting the expected positive signs. The complete set of analysed equations refutes the presence of weak instruments at a 5% significance level. Furthermore, a substantial proportion (60%), appear to fulfil the validity criteria based on the results of the Sargan's over-identification test. The elasticity values ranged between 1.49 and 6.21, with approximately 90% falling within the range of 2 to 5. This pattern largely mirrors the export data. Contrary to the export findings, where higher elasticities of demand for high and medium-tech products were concentrated among Central European countries, the import data revealed a reverse pattern. Here, Mediterranean countries reported higher elasticities for high-tech imports, with somewhat less pronounced differences for medium-tech imports. In this group, Italy stands out with the highest elasticity in medium-tech (6.21) and low-tech (4.60) sectors. Conversely, Greece consistently reports the lowest elasticities across all sectors. Spain and Portugal display similar patterns across sectors, but Portugal has the lowest elasticity in primary activities (2.11) among all Mediterranean countries.

In Central Europe, the Netherlands shows the highest elasticity in high-tech activities (5.67), and France exhibits the highest elasticity in medium-tech activities (5.97). Austria, Finland, and Germany show a more balanced distribution of elasticities across sectors. Regarding ECT, the picture is a bit less conclusive than exports, yet still conclusive for a great majority of equations (36/45) were both contained in the interval (-1,0) and statistically significant at a 5% level. Lastly, moving on price elasticities of demand, around 35% of reported values were significant at a 5% level, rising to slightly above 50% at a 10% level. This overall lack of significance, coupled with a mix of positive and negative values, aligns with previous studies. Evidence drawn from both exports and imports underscores the relative insignificance of price competitiveness in the long run.

Thirlwall's law computation and analysis

Regarding the computation of MSTL values, first, to obtain total elasticities of demand, we summed up sector elasticities weighted by their respective mean shares for the period 1992-2019. The process was applied over exports and imports and the resulting elasticities are presented in the first two columns of Table 7. Then the third column shows the result of dividing those total elasticities of demand for exports by those of imports, obtaining what is known as TL ratio. It is expected that stronger economies with significant shares of high and medium technology exports would have higher TL ratios. Intuitively, a ratio above 1 suggests average growth exceeding that of trade partners, while a ratio below 1 indicates the opposite. The fourth column finally calculates TL multiplying TL ratio by the corresponding average growth rate of foreign income for the whole period.

The first noteworthy finding is the well-fitting of TL to actual growth rates, with a mean deviation of just 0.428%. This accuracy is in line with or even slightly more precise than the best predictions of preceding literature on MSTL, such as those by McCombie and Romero (2016). It also significantly outperforms the deviations obtained by previous works on one-sector TL. Comparing individual countries, none of the reported TL values deviated significantly from the observed income rate. Both Austria and Finland reported the most accurate TL values, with a deviation of only 0.11%. The greatest deviations were observed in Italy (-0.73%) and the Netherlands (0.70%). Moreover, the Netherlands was the only Central European country not reporting a TL ratio above 1, while Portugal was the only Mediterranean country reporting a ratio above 1. In general, the TL ratio supports the intuition of higher values being associated to export-oriented economies specialized in tech-intensive activities. The direction of deviations, a mix of positive and negative, does not show a clear pattern for either Central or Mediterranean countries. Especial attention should be place on Germany's negative deviation, because it could be the result, as certain authors have suggested (Ibarra and Blecker, 2016), of a self-imposed demand constriction to boost competitiveness which typically would result in a TL above their effective growth rate.

TABLE 7: Thirlwall´s Law: Alternative computations (1992-2019)

	Multi-Sector Thirlwall's Law						Thirlwall's Law (Lall´s)				Thirlwall's Law (AMECO)			
	Ed X	Ed M	TL ratio	Δy	Δẏ	Δy-Δẏ	Ed X	Ed M	Δẏ	Δy-Δẏ	Ed X	Ed M	Δẏ	Δy-Δẏ
Austria	3.49	3.34	1.04	1.81	1.70	**0.11***	3.84	4.57	1.37	0.44	2.55	3.30	1.26	0.55
Finland	4.57	3.27	1.40	2.17	2.27	**-0.11***	5.66	3.80	2.42	-0.25	3.32	2.11	2.55	-0.39
France	2.95	3.91	0.76	1.59	1.24	**0.35***	2.93	5.36	0.90	0.69	1.96	3.79	0.85	0.74
Germany	3.74	3.51	1.07	1.33	1.84	-0.50	3.69	3.89	1.63	**-0.30***	2.67	2.09	2.19	-0.86
Greece	1.85	2.60	0.71	0.80	1.17	**-0.37***	1.83	1.97	1.53	-0.73	4.43	1.30	5.61	-4.81
Italy	3.31	4.20	0.79	0.67	1.40	-0.73	3.54	4.35	1.45	-0.78	2.66	3.43	1.38	**-0.71***
Netherlands	3.54	4.24	0.83	2.04	1.34	0.70	3.48	3.02	1.85	**0.19***	2.19	2.36	1.50	0.54
Portugal	3.63	3.37	1.08	1.37	1.76	-0.39	2.95	3.54	1.36	**0.01***	2.27	2.34	1.58	-0.21
Spain	3.25	3.57	0.91	2.04	1.45	**0.59***	2.88	3.70	1.25	0.79	2.34	2.59	1.44	0.60
Average	3.37	3.56	0.95	1.54	1.58	**0.428***	3.42	3.80	1.53	0.464	2.71	2.59	2.04	0.575g

* *Smallest absolute mean deviation.* *g: Greece Excluded*

Total economy Lall's computes total exports/imports as the sum of the previously computed main 5 sectors. AMECO stands for total exports imports in real terms as computed by AMECO references OXGS and OMGS For exports and imports respectively and PXGS and PMGS as their associated prices.

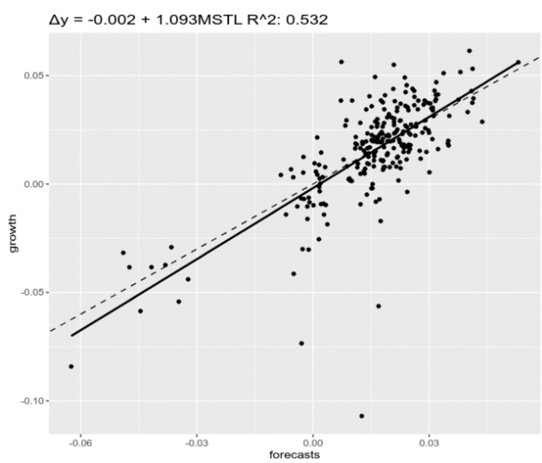
Ed: Income Elasticity of Demand

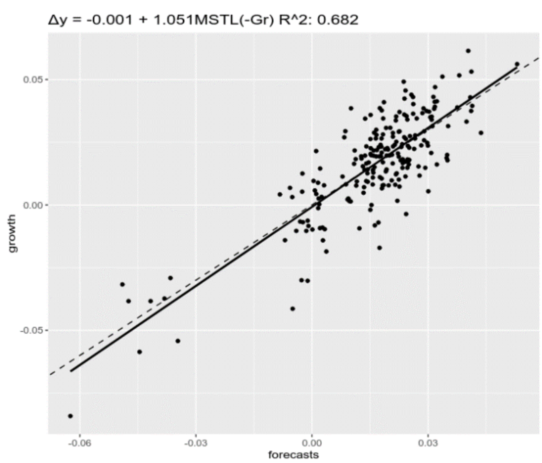
The latter part of the table presents values derived from computing two alternative definitions of TL for a one-sector economy. We applied the same ECM structure and estimation procedure already used to obtain sector equations to compute the one-sector models.[6] On the one hand, the central columns present values for a model estimated after aggregating our 5 sectors into a single one, representing the total economy. Notably, even though the one-sector model was outperformed by its multi-sector counterpart, its mean average error was small, less than 0.5%. The value of TL calculated for the Netherlands was significantly closer to actual rates than MSTL. The income elasticities of demand were within the same range as those offered by the weighted sectors for MSTL, the interval 2-5, for both imports and exports. However, the implied TL ratios differed significantly from those provided by the multi-sector version. Even considering the Netherlands' ratio above 1 in TL, it is the only exception, along with Finland, in a generalized dominance of TL ratios below unity, even for Central economies. On the other hand, the last group of columns presents values corresponding to estimations obtained considering total exports/imports as reported in the AMECO database.[7] This new definition includes a broader group of commodities as it also encompasses trade of services. Yet, this wider coverage did not result in a stronger correlation with actual growth rates.

A considerable part of the unsatisfactory performance can be attributed to the insignificant values reported for both Greek exports and imports. If Greece were to be excluded, the average deviation would decline from more than 1% to a more reasonable 0.575%. Two key aspects of this final TL computation are worth emphasizing. First, the elasticities reported were generally lower than those obtained from COMTRADE for both exports and imports. This could potentially be a consequence of services typically having lower export/import elasticities of demand than goods and their greater volatility in trade volumes. Second, a blend of positive and negative deviations of TL from actual rates is observed, without any discernible pattern.

Perhaps the most interesting observation when comparing this last version of TL to MSTL results is that it performed similarly (Spain, Portugal) or even slightly better (Italy) when considering only Mediterranean countries but Greece. It's conceivable that the inclusion of services in countries where tourism plays a key role in balancing the CA improves the fitting of TL forecasts. Thus, even if reported TL values performed significantly better in our definition of the total-economy excluding services, we should not infer that TL should be built solely on goods. This holds particularly true for the multi-sector version, as it would not imply invalidating our previous findings but rather expanding the model to include one or more service sectors, reweighting each sector accordingly to compute MSTL.

FIGURE 1: GDP growth rates vs MSTL (Greece excluded, right side)





6 For matters of conciseness estimation results for total-economy models are not reported here and are disposable from the author under request.

7 Considered series are Total exports -OXGS- and imports -OMGS- of good and services (national accounts) at constant 2010 prices.

TABLE 8: GDP growth vs MSTL: Pooled regression analysis

McGregor And Swales regression

Coefficients: growth ~ intercept + MSTL

<table>
<tr><th></th><th>Estimate</th><th>St. Error</th><th>t-value</th><th>Pr(>|t|)</th></tr>
<tr><td>Intercept</td><td>-0.0019</td><td>0.0016</td><td>-1.272</td><td>0.204</td></tr>
<tr><td>MSTL
***</td><td>1.0928</td><td>0.0657</td><td>16.633</td><td>0.000</td></tr>
</table>

*Sig. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05*

REE: 0.01617 on 241 DF   MAE: 0.0109

Multiple R-2: 0.5344, Adjusted R-2: 0.5325

F-stat: 276.7 on 1 and 241 DF, p-value: < 0.00

Tests on regression results

Levin-Lin-Chu Panel Unit-Root test

z = -4.5116, p-value = 3.217e-06

studentized Breusch-Pagan test

BP = 0.78442, df = 1, p-value = 0.3758

Wooldridge's test for unobserved effects

z = 1.4329, p-value = 0.1519

Linear hypothesis test (Wald test)

Model : growth ~ a + b*forecasts

H0> a=0&b=1

F-stat= 1.073, df = 241 (2), p-value =0.3436

For a more appropriate statistical analysis of TL, it is customary in related literature to test the validity of computed TL values as predictors of actual growth rates. Originally, this was typically accomplished by testing on the equality between estimated and empirical elasticities of demand for imports. However, McGregor and Swales (1985) showed that this approach presented a number of weaknesses and proposed an alternative more robust test based on directly regressing actual growth rates on their corresponding TL forecasts. This test posits that if TL is a good predictor of actual growth rates, the resulting intercept should not differ significantly from 0 while the regression coefficient is expected to be not significantly different from 1. This second approach has become the standard for analysing TL nowadays.

Graph 1 displays the scatter plots associated with regressing annual growth rates on its MSTL forecasts after pooling our panel of countries. As can be seen, MSTL was quite accurate at predicting actual growth rates, as reflected by an R-squared above 0.53 and coefficients close to 0 for the intercept (-0.002) and 1 for TL (1.093). As expected, the latter also reported a large t-statistic, significant for any standard level of confidence. If we shift our focus to the right side of graph where Greece is excluded from the analysis, the goodness of fit would significantly improve, as reflected by an R-squared of almost 0.70, the absence of outliers, and regression coefficients that are even closer to their respective benchmarks, with an intercept of just 0.001 and a highly significant value for MSTL of 1.051.

Let´s turn again over our full model to test its performance accordingly. Prior to applying the traditional Wald-test on coefficients, we analysed the robustness of our pooled regression of growth rates on MSTL values, focusing on its residuals properties. First, we computed the panel data unit root test proposed by Levin et al. (2002) which tests the null hypothesis of unit root with a common process across units which implies as alternative hypothesis all series being stationary (as would be the case if TL is a good pooled predictor of actual growth rates). The obtained statistic rejects the presence of a unit root at the standard 5% significance level. Second, the Breusch-Pagan test could not reject the null of homoscedasticity for the same signification levels. Third, once stationarity and homoscedasticity have been already analysed, we applied Wooldridge's (2002) test to identify the presence of unobserved individual effects derived from our pooled-panel perspective. For any standard level of significance, the null hypothesis of no omitted effects could not be rejected. Finally, the direct analysis of TL regression coefficients requires performing a Wald test with two restrictions: equality to 1 for MSTL beta coefficient and to 0 for the regression intercept. The resulting F-statistic reported a small value of 1.073 that could not reject the null of the coefficient being equal to 1 and the intercept not significantly different from 0, even at the strictest 1% significance level. This last step provides additional support on the appropriateness of TL for predicting growth rates of Eurozone countries over the past three decades.

5. CONCLUSIONS

This study has calculated MSTL for a sample of 9 Eurozone countries over the period 1992-2019. To do so, we estimated exports and imports equations across five technological sectors, based on Lall's (2000) technological classification. Our findings indicate that, in general, High and Medium-tech sectors exhibited greater demand elasticities than other sectors. While this trend is consistent across all countries for imports, higher elasticities for High and Medium-tech exports are primarily observed in Central European countries. Mediterranean countries, with the exception of Portugal, demonstrate more varied results. The analysis reveals that most Eurozone countries have experienced long-run growth rates that align with MSTL predictions, as evidenced by an average deviation of only 0.43% from actual growth rates. This deviation is significantly lower than forecasts derived from the standard Thirlwall's Law for a single sector. Furthermore, when properly tested by pooling and regressing annual growth rates on their MSTL, the resulting regression yielded a high R-squared value above 0.53 and regression coefficients of 0.002 for the intercept and 1.09 for MSTL. A subsequent Wald test on these coefficients could not reject the null hypothesis of the coefficients being equal to 0 and 1, respectively, as would be expected if Thirlwall's Law is a strong predictor of actual growth rates.

It is crucial to note that although Thirlwall's Law forecasts were accurate in the long run, Mediterranean countries exhibited two distinct periods: a boom in demand during the early 2000s and a lower actual growth rate than their potential growth rate, as implied by Thirlwall's Law, following the crisis. This empirical evidence suggests that Thirlwall's Law holds in the long run, and that demand constraints are essential for understanding the Euro crisis. In a way, Thirlwall's Law predicted the unsustainability of the Eurozone's external imbalances, and this study, covering an extensive time frame, demonstrates how Eurozone economies were constrained by their balance of payments in the long run. However, even if no country can in average grow above its BOPC, there is no reason forbidding from achieving a structurally lower growth rates, as Germany´s growth path seems to suggest.

These findings highlight the need for policies that: a) improve export performance and reduce import dependence for Mediterranean countries through structural change; b) boost internal demand in some Central European economies, especially Germany, to foster European growth without causing CA imbalances. A more cohesive monetary-union would be more resilient to BOP challenges like those faced in the early 2000s and would have reduced the negative shock on income caused by the structural adjustment plans which followed the crisis. Moreover, the Economic Union's incomplete design, which neglected fiscal integration, makes it prone to recurrent CA problems under the financial cycle's boom and bust phases.

For a future research agenda, it would be useful to increase the sample size to include both founding and Eastern European Eurozone countries, as MSTL has not been estimated for both groups together. More specific analyses that account for European heterogeneity and control for events like the Euro debt crisis, which deeply affected growth performance in countries such as Greece, could supplement the findings of this study. A final methodological suggestion would be to adopt a new or updated technological classification that reflects the role of services in foreign trade. Tourism, for instance, plays a key role in balancing the structural trade-deficit of technologically intensive goods in most Mediterranean countries.

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ANNEX A

ANNEX A. TABLE 5A: Restricted ECMs of Exports Sectors from COMTRADE (SUR)

		HIGH		MED		LOW		PRIM		RES	
		Coef.	Prob.	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.	Coef.	Prob
AUS	ect_x	-0.22	0.00	-0.24	0.00	-0.40	0.00	-0.24	0.00	-0.38	0.00
	dif_rprices	0.15	0.00	-0.01	0.78	-0.06	0.28	0.06	0.20	0.04	0.36
	dif_fincome	3.05	0.00	4.11	0.00	3.52	0.00	3.38	0.00	2.69	0.00
	BG	0.07	0.79	3.95	0.06	0.34	0.57	1.99	0.17	0.39	0.54
FIN	ect_x	-0.24	0.00	-0.25	0.00	-0.50	0.00	-0.36	0.00	-0.34	0.00
	dif_rprices	-0.01	0.86	-0.05	0.08	0.00	0.98	0.02	0.02	0.01	0.50
	dif_fincome	4.98	0.00	5.12	0.00	6.06	0.00	3.51	0.00	4.29	0.00
	BG	3.88	0.06	0.00	1.00	2.31	0.14	1.34	0.26	2.98	0.10
FRA	ect_x	-0.31	0.00	-0.27	0.00	-0.49	0.00	-0.20	0.00	-0.32	0.00
	dif_rprices	-0.02	0.05	0.00	0.93	-0.02	0.59	-0.04	0.00	0.01	0.24
	dif_fincome	2.25	0.00	3.61	0.00	3.20	0.00	2.69	0.00	2.75	0.00
	BG	1.26	0.27	7.45	0.01	1.25	0.28	8.12	0.01	2.01	0.17
GER	ect_x	-0.32	0.00	-0.21	0.00	-0.27	0.00	-0.28	0.00	-0.19	0.00
	dif_rprices	0.01	0.69	0.02	0.46	0.02	0.52	0.03	0.09	0.01	0.49
	dif_fincome	3.54	0.00	4.46	0.00	3.22	0.00	3.24	0.00	3.21	0.00
	BG	0.16	0.69	3.76	0.07	0.94	0.34	0.11	0.75	3.21	0.09
GRE	ect_x	-0.28	0.00	-0.37	0.00	-0.09	0.00	-0.45	0.01	-0.16	0.01
	dif_rprices	0.04	0.09	-0.10	0.00	-0.03	0.46	0.00	0.91	-0.06	0.24
	dif_fincome	1.50	0.29	4.38	0.00	3.28	0.00	2.18	0.03	-0.46	0.83
	BG	0.44	0.52	3.64	0.07	0.07	0.80	2.34	0.14	0.01	0.92
ITA	ect_x	-0.19	0.01	-0.14	0.01	-0.41	0.00	-0.20	0.01	-0.38	0.00
	dif_rprices	0.00	0.97	-0.02	0.60	-0.04	0.08	-0.02	0.16	-0.01	0.23
	dif_fincome	2.29	0.00	3.84	0.00	3.60	0.00	2.93	0.00	2.93	0.00
	BG	1.76	0.20	8.98	0.01	8.97	0.01	8.31	0.01	2.52	0.13
NED	ect_x	-0.63	0.00	-0.10	0.00	-0.28	0.00	-0.22	0.00	-0.29	0.00
	dif_rprices	0.00	0.87	0.07	0.17	0.06	0.45	-0.03	0.01	0.04	0.16
	dif_fincome	4.47	0.00	4.54	0.00	2.77	0.03	3.15	0.00	2.58	0.02
	BG	0.26	0.62	1.35	0.26	4.78	0.04	1.45	0.24	3.81	0.06
PRT	ect_x	-0.57	0.00	-0.41	0.00	-0.36	0.00	-0.27	0.03	-0.30	0.00
	dif_rprices	0.09	0.06	-0.03	0.02	0.09	0.15	0.01	0.73	0.03	0.42
	dif_fincome	9.96	0.00	4.47	0.00	2.55	0.00	3.35	0.00	2.46	0.02
	BG	0.61	0.44	5.79	0.03	0.48	0.49	0.03	0.87	0.00	0.97
SPA	ect_x	-0.25	0.00	-0.30	0.00	-0.15	0.00	-0.09	0.00	-0.27	0.00
	dif_rprices	-0.03	0.00	0.01	0.66	-0.01	0.13	-0.01	0.04	-0.01	0.15
	dif_fincome	2.50	0.00	3.49	0.00	3.64	0.00	2.92	0.00	3.19	0.00
	BG	0.53	0.47	1.02	0.32	2.14	0.16	4.44	0.05	1.05	0.32

ANNEX A. TABLE 6A: Restricted ECMs of Imports Sectors from COMTRADE (3SLS)

		HIGH		MED		LOW		PRIM		RES	
		Coef.	Prob.	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.	Coef.	Prob
AUS	ect_m	-0.44	0.00	-0.82	0.00	-0.70	0.00	-0.31	0.00	-0.41	0.00
	dif_rprices	0.01	0.59	-0.06	0.00	0.09	0.02	0.09	0.06	0.09	0.11
	dif_income	2.77	0.00	4.25	0.00	3.04	0.00	3.13	0.00	2.78	0.00
	Weak-IV	52.77	0.00	64.42	0.00	72.29	0.00	57.34	0.00	60.98	0.00
	Sargan	1.19	0.28	1.93	0.16	10.11	0.00	3.76	0.05	0.85	0.36
FIN	ect_m	-0.44	0.00	-0.17	0.04	-0.20	0.04	-0.23	0.00	-0.14	0.03
	dif_rprices	0.00	0.97	-0.06	0.01	0.02	0.02	0.01	0.37	0.03	0.08
	dif_income	2.50	0.00	4.26	0.00	2.71	0.00	2.96	0.00	3.41	0.00
	Weak-IV	171.2	0.00	187.61	0.00	169.76	0.00	121.31	0.00	120.20	0.00
	Sargan	2.15	0.14	4.00	0.05	5.25	0.02	3.61	0.06	2.84	0.09
FRA	ect_m	-0.51	0.00	-0.29	0.00	-0.75	0.00	-0.22	0.00	-0.21	0.00
	dif_rprices	-0.03	0.04	-0.03	0.00	0.08	0.04	-0.04	0.00	0.02	0.13
	dif_income	2.21	0.01	5.97	0.00	3.92	0.00	3.31	0.00	3.16	0.00
	Weak-IV	67.60	0.00	63.43	0.00	63.48	0.00	39.62	0.00	40.58	0.00
	Sargan	0.29	0.59	0.02	0.89	7.71	0.01	5.31	0.02	7.17	0.01
GER	ect_m	-0.23	0.00	-0.59	0.01	-0.43	0.00	-0.35	0.00	-0.41	0.00
	dif_rprices	-0.07	0.00	-0.02	0.68	0.01	0.80	-0.07	0.00	0.02	0.46
	dif_income	2.95	0.00	4.93	0.00	2.46	0.00	3.20	0.00	3.31	0.00
	Weak-IV	57.54	0.00	58.93	0.00	49.46	0.00	52.82	0.00	59.12	0.00
	Sargan	0.72	0.40	0.92	0.34	0.72	0.40	0.36	0.55	0.00	0.99
GRE	ect_m	-0.22	0.02	-0.74	0.00	0.02	0.47	-0.04	0.32	0.00	0.84
	dif_rprices	0.01	0.66	-0.09	0.02	0.16	0.00	-0.02	0.39	-0.05	0.21
	dif_income	1.49	0.01	3.81	0.00	2.77	0.00	2.32	0.00	1.84	0.00
	Weak-IV	159.77	0.00	125.24	0.00	107.34	0.00	120.18	0.00	86.68	0.00
	Sargan	0.20	0.65	1.07	0.30	2.26	0.13	4.52	0.03	2.23	0.14
ITA	ect_m	-0.16	0.00	0.00	0.19	-0.06	0.00	-0.08	0.06	0.01	0.76
	dif_rprices	0.03	0.06	0.05	0.45	0.00	0.90	0.11	0.04	-0.02	0.18
	dif_income	3.75	0.00	6.21	0.00	4.60	0.00	2.95	0.00	3.39	0.00
	Weak-IV	211.01	0.00	166.81	0.00	191.27	0.00	172.71	0.00	195.44	0.00
	Sargan	2.31	0.13	0.00	0.96	2.91	0.09	0.70	0.40	8.96	0.00
NED	ect_m	-0.79	0.00	-0.16	0.00	-0.14	0.00	0.02	0.80	-0.20	0.00
	dif_rprices	0.03	0.09	-0.02	0.49	0.06	0.23	-0.03	0.05	-0.06	0.08
	dif_income	5.67	0.00	4.86	0.00	3.92	0.00	3.72	0.00	3.05	0.00
	Weak-IV	53.32	0.00	24.92	0.00	28.34	0.00	67.34	0.00	53.12	0.00
	Sargan	2.78	0.10	6.98	0.01	3.29	0.07	8.72	0.00	13.95	0.00
PRT	ect_m	-1.06	0.00	-0.59	0.00	-0.55	0.00	-0.28	0.00	-0.21	0.00
	dif_rprices	0.00	0.90	0.01	0.00	0.10	0.06	-0.02	0.61	0.01	0.61
	dif_income	4.78	0.00	4.99	0.00	2.79	0.00	2.11	0.00	2.29	0.00
	Weak-IV	78.31	0.00	77.52	0.00	78.88	0.00	84.20	0.00	86.02	0.00
	Sargan	0.04	0.84	0.11	0.74	9.24	0.00	6.76	0.01	7.78	0.01
SPA	ect_m	-0.55	0.00	-0.56	0.00	-0.02	0.73	-0.20	0.00	-0.17	0.00
	dif_rprices	0.01	0.23	-0.01	0.14	0.04	0.00	0.00	0.75	0.01	0.10
	dif_income	3.43	0.00	5.12	0.00	3.21	0.00	2.45	0.00	3.37	0.00
	Weak-IV	137.49	0.00	108.62	0.00	139.30	0.00	107.98	0.00	180.58	0.00
	Sargan	3.40	0.07	2.04	0.15	11.46	0.00	7.70	0.01	12.62	0.00

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