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Convergencia económica y desarrollo desigual:el rol de los rendimientos crecientes y los desequilibrios comerciales en el génesis y crisis de la eurozona

Economic convergence and uneven development : the role of increasing returns and trade imbalances in the eurozone genesis and crisis

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CONVERGENCIA ECONÓMICA Y DESARROLLO DESIGUAL:

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INTRODUCTION

Resumen

La Eurozona constituye el intento de integración económica y monetaria entre países más importante de la historia moderna. Culminando el projecto original esbozado en el Tratado de Roma (1957), el Tratado de Maastricht (1992) estableció el origen de una Unión Económica y Monetaria cuyo elemento definitorio será la introducción de una nueva divisa: el Euro.Algunos de sus objetivos más pretenciosos apuntaban a conseguir creciente cohesión y convergencia económica entre sus miembros mientras la Eurozona se transformaba en el área más competitiva a nivel global. Sin embargo, las herramientas consideradas para alcanzar estos objetivos resultaron ingenuas en el mejor de los casos. Confiando fervorosamente en las propiedades de un mercado abierto y la libre movilidad de capitales, el éxito transitorio experimentado por los paises miembros de la Eurozona durante los años noventa y primeros años del nuevo siglo parecieron confirmar estas intuiciones.

A pesar de este éxito inicial, una vez la crisis financiera de 2008 se desató en Europa, las asimetrías características del reciente proceso de construcción Europea no pudieron ocultarse por más tiempo. Un desempeño externo muy asimétrico, gaps de productividad e importantes diferencias sectoriales aparecieron como elementos clave explicando una crisis europea caracterizada por una autoimpuesta ignorancia institucional en materia de política industrial o monetaria más allá de hieráticos objetivos definidos de inflación y laissez-faire industrial. Este sesgo subyacente a la construcción de la Eurozona aún determina a día de hoy el devenir de la crisis Europea y consituye el punto de partida donde se sitúa este estudio. Nuestra pregunta de investigación inicial orbita alrededor del punto muerto constituido por los cerrados lazos identificados entre el paradigma neoclásico en sentido amplio y las instituciones europeas, en un acuerdo tácito coloquialmente denominado neoliberalismo. Así, la hipótesis que inaugura este trabajo sostiene que las instituciones europeas, imbuidas por la perspectiva neoclásica dominante ignoraron problemas estructurales que explican parcialmente la profundidad de la crisis experimentada por los paises miembros de la Eurozona y por la Unión Ecónómica y Monetaria -UEM- en su conjunto. Fundamentalmente, como este trabajo va a desarrollar, tres elementos minusvalorados resultaron especialmente significantes en el contexto europeo: la importancia de las tendecias de productividad

frente al ingeso, el rol central de los rendimientos crecientes de escala y la existencia de una restricción efectiva al crecimiento en el desempeño externo reflejado a través de la balanza de pagos.

Por otro lado, en lo referente al rol periferico otorgado a la convergencia en productividad frente a la convergencia en ingreso por habitante debemos tener en cuenta que la diferencia entre ambos ratios es trivial si asumismos, siguiendo la teoria convencional, la exitencia de pleno empleo. De este modo, si restringimos nuestra mirada al comportamiento mostrado por el ingreso por habitante durante el periodo 1992-2007, la indudable convergencia experimentada entre estados miembros podría ser vista – como las instituciones europeas defendieron-, como un claro indicador del éxito del diseño propuesto en Maastricht. Sin embargo, esta trayectoria demostró no ser más que algo transitorio sostenido por la convergencia forzosa en tipos de interés nominal entre los estados miembros de la Eurozona. Esta convergencia monetaria implicada por la aparición del Euro y del Banco Central Europeo -BCE- como agencia reguladora central alimentaron un proceso de convergencia en ingreso que resulto en última instancia insostenible. Durante algunos años la convergencia entre los miembros de la Eurozona pareció robusta pero la creciente divergencia en productividad, especialmente en el sector manufacturero así como saldos comerciales crecientemente insostenibles acompañaron esta superfice aparentemente exitosia. Por ello, la búsqueda de teorías alternativas para analizar la problemática experimentada por la Eurozona más allá del paradigma dominante se vuelve irrenunciable y constituye la razon de ser de esta tesis doctoral.

Preface

The Eurozone constitutes the most important attempt in modern history of a monetary and economic integration process among countries. Culminating the original project drawn in the Treatise of Rome (1957), the Maastricht Treaty (1992) established the origin of an Economic Union whose cornerstone was the introduction of a common currency: the Euro. Some of its most pretentious goals were to achieve growing cohesion and economic convergence among its members while transforming the Eurozone in the most competitive area worldwide. However, the tools considered in order to achieve these goals were, as it is widely known nowadays, naïve at best. Relying fervorously on the properties of free markets and capital mobility, the transitory success experienced by Eurozone countries during the nineties and early years of the new century seemed to confirm these intuitions.

In spite of this initial success, once the 2008 global crisis was triggered in Europe, the asymmetries which characterised the recent European construction process could not be ignored anymore. Uneven external performance, productivity gaps and sectoral differences appeared as core elements explaining a European crisis characterised by a self-imposed institutional ignorance on industrial or monetary policies beyond inflation targets

and industrial *laissez-faire.* This bias underlying the construction and development of the Eurozone still determines the path of the ongoing European crisis and constitutes the starting point where this dissertation is placed. Our initial research question orbits around the deadlock constituted by the close engagement perceived among neoclassical economics in a broad sense and European Institutions, a tacit agreement informally called neoliberalism. Thus, the hypothesis which inaugurates this works states that European Institutions, imbued by the dominant neoclassical approach ignored structural issues which partially explain the depth of the crisis faced by certain Eurozone countries and by the Economic and Monetary Union –EMU- itself. Fundamentally, as this work is going to develop, three undervalued elements resulted especially significant in the European context: the importance of productivity trends, the role of increasing returns and the effective constraint on economic growth imposed by external performance.

On the one hand, respecting the peripheral role given to productivity convergence in front of income per head we should bear in mind that the difference between both ratios is trivial given the usual assumption of full employment. Thus, if we restrain our focus to income per head behaviour, the prevalence of income per head convergence during the lapse 1992-2007 could be shown – as European Institutions defended- as a proof of Maastricht's design success. Nevertheless, this path demonstrated to be no more than a transitory phenomenon sustained by a forced convergence in nominal interest rates among member States. This monetary convergence implied by the appearance of the Euro and the European Central Bank –ECB- as central regulatory agency boosted a process of income convergence that resulted in the l-ast instance unsustainable. During a few years income convergence among Eurozone members seemed robust but increasing productivity divergence, especially within manufactures as well as growingly unsustainable national trade balances were underlying this seemingly successful surface. Thus, the seek of alternative theories more suitable for analysing the problematic faced by the Eurozone turns mandatory and constitutes the *raison d'être* of this dissertation.

Aim

This study, taking the Eurozone as background, will try to analyse comparatively the neo/new-classical ideas which framed the European economic agenda during the monetary integration process highlighting its inner limitations understanding the Eurozone's deadlock which led in last instance to its recent crisis. In order to do so, this study will deploy and alternative framework inherited to Kaldorian ideas which will light over topics usually faded within the mainstream research agenda as the consideration of demand-driven processes of cumulative causation underlying the prevalence of increasing returns or the importance of demand constraints as a balanced external performance determining long-run economic growth. Given this set of particularities, the object of this work could be considered as threefold or at least divided in three main fields of research.

(i) *On the economic policy level*, and especially through the first chapter of this study, the theoretical bias towards neoclassical economics demonstrated by European institutions will be put under scrutiny. This characterisation will constitute the foundational basis for the remaining sections of this dissertation.

(ii) On a theoretical plane, through the two following chapters, this dissertation will be concerned with the contrast of identified inner limitations in the mainstream view on economic growth against alternative Kaldorian conceptualizations. Chapter two will take into consideration Verdoorn's Law and the debate around the importance of increasing returns while chapter three will be focused on Thirlwall's law and its importance describing scenarios of persistent divergence. A last theoretical effort will be done through the last section of this study working towards a meaningful combination of both critiques of orthodox growth theory.

(iii) in *regard of empirical research*, first, this work will develop an analysis of productivity trends and convergence in the Eurozone within the neoclassical frame proposed by Barro and Sala-i-Martin (1990,1992), afterwards, once demonstrated the generalized absence of convergence, the identified drawbacks of the mainstream approach will be compared against the performance of Verdoorn's and Thirlwall's Law for panel and cross-section samples respectively.

However, the Kaldorian ideas suggested above as an alternative to the neoclassical view are neither free of gaps and shortcomings nor do constitute a fully consistent theoretical framework. Specifically, there exists an important incompatibility in the role assigned to price-competitiveness between growth models considering Verdoorn's and Thirlwall's Law respectively. While price-competitiveness is the usual mechanism of transmission of Verdoorn's Law towards exports performance in cumulative causation models, the unimportance of price-competitiveness is a necessary condition in balance of payments models in order to obtain the result defined as Thirlwall's Law. This study, will attempt through its last section to propose a reconciliatory model which joints both perspectives. Therefore, for the reasons expressed above, the contribution of this work will be fundamentally multidimensional. First, it will analyse main Eurozone trends in productivity and the prevalence of divergence. Afterwards it will propose a comparative analysis between neoclassical and Kaldorian ideas which will be empirically confronted against the Eurozone's reality. Therefore, this dissertation will propose as a final contribution an original growth model trying to overcome the inconsistencies already present in the Kaldorian approach, trying to fill that gap through an original theoretical contribution to the present debate.

Structure

This dissertation will be organised as follows. As it has been advanced, the first chapter of this dissertation will show how the transitory success of the Eurozone in terms of national income per head convergence was complemented by a much more complex picture characterising productivity trends. Applying the traditional

notions of sigma and beta convergence, this introductory chapter will show their limitations when applied exclusively to income per head ignoring productivity behaviour.

Afterwards, through chapter two, an alternative framework considering the presence of increasing returns will be developed. Building on the ideas of Nicholas Kaldor, chapter two analyses the prominence of Verdoorn's Law for a panel of eight Eurozone countries considering the importance of dynamic increasing returns for manufactures and ITC sectors. This Law offers a demand-led alternative to both the original convergence theory rejecting the presence of increasing returns or its closely related neoclassical endogenous growth models where increasing returns are allowed but purely supply-led. However, Verdoorn's Law predates both theories conceiving increasing returns by means of reversing the direction of causation between productivity and income growth rates. In addition, Verdoornś Law highlights the importance of certain economic activities against the traditional neoclassical view which is blind on the importance of manufactures and different sectoral structures while analysing economic growth.

On the other hand, chapter three will analyse another important regularity inherited to Nicholas Kaldor's thought: Thirlwall's Law. In a few words, this so-called law establishes that the growth rate of a country would be determined approximately by the ratio of its growth rate of exports and its income elasticity for imports, a conclusion built on the existence of a balance of payments constraint and the unimportance of price-competitiveness. Again, two axioms which stand against the purely supply view proposed by neo and new classical studies. Considering, as in the first chapter, the original Eurozone members as background, after estimating national exports and imports demand functions, the so-called Thirlwall's Law will be computed in order to analyse the importance of a balance of payments constraint for recent European accumulation trends and its connection with the unsustainability of the income per head convergence experienced before the start of the crisis. Thereby, whereas chapter one will focus on the absence of productivity convergence among the original Eurozone members, chapters two and three will take into consideration the importance of demand-driven dynamic increasing returns and external performance respectively, two traditionally undervalued fields within mainstream growth theory.

Finally, once the key role of increasing returns and external performance for the Eurozone has been covered in depth within a Kaldorian framework, chapter four will conclude this dissertation proposing an original *Augmented Kaldorian Growth Model*. A contribution which will reconcile the features characterising Verdoorn's Law, analysed in depth through chapter two, and Thirlwall's Law, considered in chapter three, beyond their differences considering the role of price competitiveness. Until nowadays, both Kaldorian-inherited traditions present inconsistencies between the mechanisms characterising them, blocking a consistent interbreeding among their canonical formalizations. Overcoming that problematic, this last chapter will offer an original mixed-model

combining cumulative causation and balance of payments features characteristic of Thirlwall's Law. A result whose consistency depends on expanding exports behaviour beyond traditional price competitiveness towards the notion of technological competitiveness. To conclude this dissertation, the performance of the model is analysed estimating it for a sample of eight Eurozone countries. Its relatively robust performance forecasting past output growth rates suggests the suitability of Kaldorian growth models to understand the European problematic. An alternative approach to the determinants of economic growth standing in front of any neoclassical alternative supporting almost automatic economic convergence which by definition underestimates monetary, external and sectoral imbalances.

Methodological cautions

This study, as many other works involving quantitative analysis in social fields, confronts certain characteristic risks and shortcoming, which could be broadly summarised in two main topics. On the one hand, the fragmentation of data sources could constitute an important risk of consistency between series of different variables, which would be later combined or jointly analysed. Hopefully, through this work we will exclusively rely on two data sources EUKLEMS and AMECO, which were not combined among them to an important extent. Chapters two and three will take advantage of EUKLEMS while chapter three will use variables obtained exclusively from AMECO. Chapter four will be the only one taking advantage of both databases, although estimating different set of equations to guarantee consistency. Therefore, all our estimations should be reliable considered from this point of view.

On the other hand, the second source or problems while performing quantitative analysis is the potential incompleteness of series or the existence of heterogeneous time frames for a sample considering multiple countries and different sources. This shortcoming does constitute a relatively important concern for this work. First, because the EUKLEMS growth accounting database covered, during the development of this work, until 2007, if we consider complete series for the twelve original members of the Eurozone; or alternatively, a longer until 2010 for a few of these countries. As a consequence, the first chapter, which considers the whole Eurozone, is forcedly constrained in its productivity analysis until the start of the crisis in 2007. Chapters two and four, which also take into consideration series obtained from EUKLEMS faced a similar problematic. Nevertheless, the fact that both chapters constrained their samples to eight countries which series were complete for a longer time frame allowed to extend the analysed period until 2010. In addition, it has to be highlighted that the decision to constrain our sample to eight countries in chapters two and three was not mainly based in the possibility of obtaining a bit larger time frame at the cost of dropping members of a whole Eurozone sample. On

the contrary, this forced decision was taken considering the fact that for the countries -Greece, Portugal, Luxembourg and Ireland- left from the sample in these sections, the series on sectoral total factor productivity and capital stock were fundamentally absent or incomplete for the period under consideration.

For the reasons expressed above, although the Eurozone will underlie all this study as unit of analysis, the impossibility of constructing a cohesive data framework limits the degree of comparability between the empirical analysis of different chapters to an important extent. However, the objective of this work is not to offer a complete alternative explanation for the Eurozone economic performance and crisis, but rather, to offer a set of inquiries which could be useful in order to highlight the limitations of the dominant narrative until nowadays and the associated neo/new-classical theories which served as basement for it.

Madrid, 9th May 2018

CHAPTER 1

PRODUCTIVITY CONVERGENCE DURING THE EUROZONE GENESIS (1992-2007): EMPIRIC EVIDENCE OF AN EXPECTED PHENOMENA

ABSTRACT

This paper examines the three most common notions of convergence – beta, sigma, and times series approaches – applied to the Eurozone since its Maastricht´s design in 1992 until the start of the crisis in 2008. Due to the limitations of the income per capita approach, this paper focuses in general and sectoral productivity per hour convergence. Evidence of convergence is not found at a general level, while the sectorial picture is mixed. Some branches of services suggests convergence but industrial branches points to strong divergence. Within the neoclassical framework, convergence is an expected phenomena, but empirical evidence shows variability in its on a logical success. In fact, there is not a general process of productivity convergence among original members of the Eurozone. Hence, some key conclusions are presented in order to develop a more accurate theoretical background.

Keywords: Eurozone, convergence, productive asymmetries, growth theory

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1. INTRODUCTION

Is there an inherent tendency that leads less economically developed countries to grow faster than richer ones and finally catch up with them? In fact, this question, which is placed at the core of growth and development theories, should be split into two. On one hand, we have a question about the relation between growth rates and the initial level of a variable, usually, income per person. On the other, we have a question about how absolute differences -in level- between regions or countries narrow becoming eventually zero. The differentiation among alternative varieties of convergence and their mathematical formalization was developed by Robert Barro and Xabier Sala-I-Martin in a series of well-known articles (1991, 1992). Consequently, two new concepts –beta and sigma convergence- were introduced and rapidly occupied a key role within the empirical growth research and deeply influenced the theoretical debates around economic growth.

Succinctly, *beta convergence implies a negative relation between the initial level of income per capita and its growth rate*. On the other hand, *sigma convergence is related to the evolution of the dispersion of income in levels within a group of regions or countries, where a reduction of the dispersion implies sigma convergence*. Theoretically, both beta and sigma convergence are an expected outcome of the neoclassical growth model proposed by Solow (1956) as Barro and Sala-i-Martin (1992) formally proved. In an open economy framework, the neoclassical growth model predicts that technological diffusion –which is a public good- and the diminishing returns of capital strengthen convergence among regions and countries through market forces.

Consequently, economic integration processes among industrialised countries like the European Union are supposed to be accurate areas to look for absolute convergence evidence, especially the core of this process, which has configured a real monetary union: the Eurozone. Within the Euro Area, a reinforced economic convergence was explicitly expected as outcome of the European Union project since its origin in the Maastricht Treaty, as is explicitly demonstrated through the agreement. During the configuration of this monetary area, European institutions trusted in the power of an integrated market and a common currency area as driving forces of convergence. The theoretical basis underlying their policies was, hence, the Neoclassical General Equilibrium approach. Thus, the monetary union designed in Maastricht and the convergence studies which appeared a few years before shared a common theoretical background, a new –hegemonic- "Consensus" broadly known as neoliberalism. Nevertheless, the hegemonic perspective is never the only interesting voice, although sometimes

it is the only one heard. Other traditions, ranging from Keynesian to Marxian authors, but also other neoclassical studies which do not expect convergence as a natural result feed by market forces – grouped under the so-called "New Growth theory", suggested the possibility of asymmetric growth paths. Of course, these divergent scenarios are especially interesting retrospectively, once is almost generally accepted that the Eurozone built in Maastricht was imperfect and its success under question (Priewe, 2012).

Thereby, through the next section we will analyse in depth the theoretical genesis and development of convergence studies. Especial interest is placed on its original neoclassical formulation and the more recent supply side theories known as New –or Endogenous- Growth Theory. Additionally, we will succinctly describe the post-Keynesian tradition based on Kaldor ideas as a potential interesting input in order to develop a better understanding of vicious and virtuous growth circles and their relation to convergence. Section three will focus on demonstrating the inconsistency of Maastricht´s design and its underlying theoretical assumptions. The remaining sections of this work are organised as follows: Section four will define our statistical methodology, including a core reference on how productivity predates income per head as the optimal research variable. Section five will present our main empirical results and findings. Finally, section six concludes and discusses several policy implications.

2. CONVERGENCE: ORIGIN, DEFINITION AND CONTROVERSY

Convergence is a well-known notion in Economics, at least in its broadest sense: a reduction of differences between units –generally countries or regions- for a certain variable –generally income or productivity- along a defined period of time. However, during the period covering from the forties until the mid-eighties, convergence was a topic almost forgotten by mainstream economic research agenda. At least, as a natural result of market forces rather than rational public policies. The modern approach to convergence was empirically inaugurated by Baumol (1986) and only a few years later was formalised by Barro and Sala-i-Martin (1991, 1992). Through this movement, convergence acquired an explicit link to the neoclassical growth model developed, among others, by Robert Solow (1956). Along it, convergence was formally defined as a statistically measurable phenomena. Two core notions emerged from the works of Barro and Sala-i-Martin, *beta* and *sigma* convergence. Both perspectives share three key features: they imply a specific definition of convergence, an associated test methodology and are directly predicted by the neoclassical growth model (Barro, Sala-i-Martin, 1992). Beyond these similarities, Beta and Sigma convergence imply completely different definitions and properties. Beta convergence, relates initial income levels to actual growth rates. Regressing the mean growth rate for a defined

period onto the initial level, a negative relation between this initial level and the growth rate is expected. This phenomenon is called beta convergence, and could be formalised as follows:

$$\Delta ln\bar{y}_i = \alpha + \beta ln y_{i0} + \sum_{P=1}^{P} \delta_p X_i + \varepsilon_i \quad (1)$$

Where:

$$\Delta ln\bar{y}_i = (1/T) ln(\frac{y_{iT}}{y_{i0}}) \quad (2)$$

For a group of *n* countries, the first component represents a logarithmic approximation of the average growth rate of income per capita between $t = 0$and tT for a country$i$. Then, we regress this value on the logarithm of the level of income per capita in the initial period for each$i$ country. If $\beta < 0$ there is statistical convergence. Furthermore, $X_i$represents a vector row of Pvariables controlling structural differences between countries beyond lny_{io} a condition expected for heterogeneous samples. Then, if we define $\sum_{P=1}^{P} X_i \delta_p = 0$ and $\beta < 0$ holds, the convergence can be defined as absolute convergence. On the other hand, If $\beta < 0$ only holds once we have introduced some control variables, we consider this process as conditional convergence. On the other hand, sigma convergence implies the reduction of the dispersion in level of income within a group of countries along time. In other words, the differences in levels are becoming narrower, usually measured through the standard deviation. Following the standard formulation, we can define sigma convergence as follows:

$$\sigma_t = \sqrt{\frac{\sum_n^{i=1} (lny_i - ln\bar{y})^2}{n}} \quad (3)$$

At last, the growth of a time series perspective on convergence is related to a growing emphasis in overcoming the limitations associated to a cross-sectional beta convergence perspective (Quah, 1993). Taking advantage of the properties of unit root analysis, this definition was born in Quah´s (1990) and Bernard & Durlauf´s (1991) pieces of work. Following this new dynamic perspective, there is convergence if the differences between a country and a reference –country or defined mean- are only transitory. Following the easiest way of specification:

$$\Delta z_{it} = \alpha_i + \delta z_{i,t-1} + \varepsilon_i \quad (4)$$

Where:

$$z_{it} = (ln\bar{y}_t - lny_{it}) \quad (5)$$

$$\delta = (\beta - 1) \quad (6)$$

Therefore, if $\beta < 1$, we can reject the null hypothesis of a unitary-root, and support the convergence hypothesis. If we consider the process as stationary with zero mean –i.e $\alpha_i = 0$- the process will be absolute, otherwise, if a drift is included, convergence will be only conditional. This approach seems really attractive but, like the formers, is not free of shortcomings due to its sensibility, Moreover, beyond the differences in definition and application, these three main approaches to convergence share a core element: all of them are implied by the neoclassical Solow´s model. However, other important theoretical traditions do not predict convergence as the natural result of market forces. Within the family of supply side neoclassical models and parallel to the first developments of convergence theory, an important challenge to Solow´s growth model appeared. The so-called New Growth theory, originally proposed by Romer (1986) and Lucas (1988), suggested a family of models characterized by an endogenization of technological change. Its simplest version, the so-called AK model (Romer, 1986) proposed a broader concept of capital including human labour. As a result, constant and not diminishing returns to scale are expected for this new conception of capital. One core implication of this change is that convergence is not necessarily the only possible outcome and differences between countries and regions might be persistent.

However, the dissimilarities between "New" and "Classical" growth theories could be constrained to how they do consider capital and technology (Fine, 2000). Their common structure, that is, a supply side closed-economy perspective grounded in Walrasian micro-foundations is basically preserved. On the contrary, a completely different perspective on convergence was developed by post-Keynesian authors, inheritors of a tradition that considers growth process circular and cumulative. Following Kaldor´s considerations on growth and development (Kaldor, 1970) a family of models were developed considering growth both export-led and determined by Verdoorn´s law (Thirlwall, 2014). The latter constitutes a stylized fact, which establishes a positive causal relation between output growth in manufactures and productivity growth, implying the existence of dynamic increasing returns. Thus, the so-called Kaldorian Endogenous Growth perspective predates its

neoclassical counterpart (Setterfield, 2013). These models present, additionally, two main advantages in front of hegemonic supply side proposals: (1) they take into account differences between sectors, (2) they adopt an explicit open-economy framework. Among these different theories, our analytical position is going to be neutral, neither expecting convergence nor divergence. However, as we will discover through the next section, the same cannot be said about the European institutions, which, although no explicitly, deeply embraced the neoclassical growth model predictions and assumptions.

3. CONVERGENCE AS THE EUROZONE´S TARGET: DESIGN, GOALS AND EVIDENCE

For our purpose, convergence goes far beyond its formal economic definition. In fact, convergence among its members was the explicit goal of the European Union established in late 1992 by the Maastricht Treaty. The agreement established sustainable economic growth and convergence as the final goals of the Union. These goals were considered to be achieved through a process of economic integration, which includes (1) a common market and (2) a monetary union coordinated through (3) a set of common policies. Thus, the 2nd article of the Treaty of Rome was redefined in the following way:

> "The Community shall have as its task, by establishing a common market and an economic and monetary union (…) to promote throughout the Community a harmonious and balanced development (…) sustainable and non-inflationary growth respecting the environment, a high degree of convergence (…) and social cohesion and solidarity among Member States." *(Maastricht Treaty, 1992: 11-12, emphasis added)*

Maastricht was the cornerstone of the European integration process. It both inaugurated the common market and established the basis for a monetary union, which culminated in the adoption of the euro in 2002. Together, they constitute the core of the so-called *Economic Union*. However, what constitutes an economic union and how it could promote growth and convergence is a debated question rooted on the theory that we choose to base our economic assumptions. In this sense, the Maastricht Treaty is certainly problematic, because it does not make any explicit theoretical linkage for its proposals. Nevertheless, theoretical voids do not exist. If we want to identify Maastricht theoretical background we have to highlight how the designed instruments -a common market and a monetary union- relate through certain tools –economic and monetary policies – to the explicit goal of growth and convergence. These links can be clearly identified, for instance, in the 3rd article of the Treaty:

> "1. For the purposes set out in Article 2, the activities of the Member States and the Community shall include (…) the adoption of an economic policy which is based (...) and conducted in accordance with the principle of an open market economy with free competition (…) and the Community shall entail compliance with the following guiding principles: stable prices, sound public finances and monetary conditions and a sustainable balance of payments." *(Maastricht Treaty, 1992: 6-7)*

These guidelines have an obvious pro-market bias that also determined the final configuration of the European Central Bank and the conceptualization of a common monetary policy. On the other hand, the monetarist profile of the Monetary Union built over the institutions designed through Maastricht can be explicitly found in the 5th section of the Treaty:

> "The primary objective of the ESCB shall be to maintain price stability. Without prejudice to the objective of price stability. (…)The ESCB shall act in accordance with the principle of an open market economy with free competition, favouring an efficient allocation of resources, and in compliance with the principles set out in Article 3a." *(Maastricht Treaty, 1992: 29-30)*

The consideration of both economic and monetary policy in "Washington Consensus" fashion implied radical consequences over two other remaining policy dimensions: fiscal integration and industrial policies. The first one because is completely absent; the second, because is explicitly forbidden through a specific article -144- which constrains the role of industrial policies:

> "(…) in accordance with a system of open and competitive markets, their action shall be aimed at: speeding up the adjustment of industry to structural changes; (…) This Title shall not provide a basis for the introduction by the Community of any measure which could lead to a distortion of competition." *(Maastricht Treaty, 1992: 52-53)*

It is straightforward to highlight how Maastricht Treaty considers that an Economic Union, which leads to convergence, is the sum of a common market and a monetary union sustained by generalized pro-market policies along forbidden industrial policies or a non-independent central bank. In sum, the Treaty follows a theory where (1) an open market with (2) free competition along (3) sound finances and (4) stable prices guaranteed by a central bank will lead, if markets are not distorted, to and efficient allocation of resources, where (5) industrial policy is inefficient and fiscal integration is omitted. The resultant (6) structural adjustment and its potential costs will be absorbed by (7) structural and cohesion funds focusing on mean income per head deviations.

The logical chain that relates the seven highlighted elements to boosted growth and convergence as outcome can only be rooted in a neoclassical framework, where convergence is a natural outcome. A non-surprising event during a period characterised by a neoliberal unanimity in almost every country or international institution. However, stable prices and open markets do not directly imply perfect competition and an efficient allocation of resources by markets. Within the real world and outside herculean assumptions the problem is not to avoid market distortion but that markets are already distorted. Transport costs, internal and external economies to scale or monopoly rents can lead to a scenario characterised by increasing returns, imperfect markets and absence of economic convergence. These cautions were predicted by a wide range of perspectives before Maastricht Agreement was signed, but were usually ignored by European institutions. Nonetheless, if we do not suppose the perfect and efficient functioning of markets and free capital flows, then, fiscal integration and industrial intervention are not avoidable –as in Maastricht- but mandatory –as in the US. An Economic Union among asymmetric States that does not consider fiscal integration will be unstable and risky. This point was highlighted even by mainstream non suspicious economists as Milton Freeman (1992). On the other hand, industrial policy is not exactly absent as is explicitly forbidden and its role is replaced by the so-called Structural and Cohesion Funds. These findings were conceived to absorb the costs associated to the weakest areas economic opening process. However, as long as industrial policy is forbidden and they usually do not look beyond income per head as target, their optimality is in question outside an environment characterised by efficient markets and perfect competition.

Focusing on previously reported evidence of economic convergence among the members of the Eurozone, the results are mixed as they deeply vary depending on where we place our analytical focus. Recent Studies considering the whole UE usually include in their samples eastern enlargement countries, which introduces an important bias towards convergence. Consequently, they tend to find evidence of convergence especially using the dominant cross section perspective either focusing on income (Le Gallo and Dall'Erba, 2006; Alexiadis 2013) or productivity per worker (Gugler and Pfaffmayer, 2004; Villaverde and Maza, 2008). On the other hand, the limited evidence following a time series perspective is more contradictory and does not draw a convergent picture (Tsionas, 2000; Sondermann, 2012). Finally, those analyses looking for productivity per hour convergence in the Eurozone –our own perspective- are really scarce. For a similar period of analysis and variable no study has explicitly focused on a sigma-beta perspective whereas, as previewed above, time series evidence consistently suggests a divergent scenario (Sondermann, 2012). As far as we know, the work of

Sondermann (2012) and a special issue developed by the European Commission (Balta, 2013) are the only analyses focusing on productivity per hour convergence among the members of the Eurozone.

There are two main factors which explain this contradictory evidence. First, completely different methodologies are applied to analyse the presence of economic convergence. As we have seen in the previous section, traditional and time series approaches could lead to almost opposite results, where the former tends to exaggerate a convergent picture. However, the second and most important factor explaining this heterogeneity is the selected variable of analysis. A majority of the literature focuses on income per head while the other main choice has been productivity per worker/hour. Within the neoclassical framework this selection is superfluous as a direct and constant relation between employment and population is expected (Barro, Sala-i-Martin, 1991). However, this assumption is especially problematic and unrealistic for the Eurozone. The next section will cover this topic in deep while afterwards our own proposed methodology will be presented.

4. METHODOLOGY: VARIABLE, SAMPLE AND TEST

4.1 The variable

The question about which analytical variable do we choose is not a minor one as the neoclassical theory seems to suggest. On the contrary, if we abandon the clearing-markets assumption,[1] a direct proportionality between productivity and income per head of population -IPH- is no longer expected. Furthermore, the relation among productivity and IPH although straightforward is fundamental to growth theory. Considering output as *Y*, let us define IPH as the ratioY/N, where N denotes total population. Additionally, let define productivity asY/L, where L denotes the number of workers –or worked hours-. Then, we can directly relate both notions as follows:

$$IPH = \frac{Y}{L}.\frac{L}{N} \tag{7}$$

Taking logarithms and differencing with respect to time (7) becomes:

$$\Delta lnIPH = \Delta \ln\left(\frac{Y}{L}\right) + \Delta \ln\left(\frac{L}{N}\right) \tag{8}$$

1 Namely, allow for unemployment or capacity underutilisation.

Hence, there is a direct and positive relation between IPH changes and productivity improvements. But also, there is a positive relation between IPH and the percentage of active population- L/N. The only –realistic- assumption is to consider the economy outside full employment equilibrium. Then, extensive growth of output per capita based on increasing employment on low productivity sectors is compatible with stagnant or decreasing productivity. The only requisite is that $\left|\Delta ln\left(\frac{Y}{L}\right)\right| < \Delta ln\left(\frac{L}{N}\right)$ if productivity growth is negative. In fact, this relation, as we will demonstrate, can explain the late evolution of IPH described in TABLE 0 and fits perfectly with the situation observed in European southern countries. Briefly, the countries which had relative lower levels of productivity and income in 1992 experienced in impressive improvement in terms of income per inhabitant until 2007, however this surface was not in hand of an equivalent path in productivity, especially in core sectors as manufacturing.

TABLE 0: AVERAGE GROWTH RATES AND RELATIVE LEVELS OF INCOME AND PRODUCTIVITY

	Relative levels 1992 (EA=100)			Relative levels 2007 (EA=100)			Accum. Growth (1992-2007)			
	TOTAL	MANUF.	INCOME	TOTAL	MANUF.	INCOME	TOTAL	MANUF.	INCOME	
EA12	100	100	100	100	100	100	1992	2007	2007	2007
Austria	100.87	100.16	20.00	102.58	107.63	118.64	100	108.00	122.50	136.52
Belgium	111.61	111.81	105.74	110.20	112.13	113.90	100	105.44	114.33	137.42
Finland	97.47	105.50	87.22	103.06	118.08	121.71	100	112.91	127.04	178.19
France	106.31	104.13	102.65	107.21	107.42	106.02	100	107.89	117.60	131.89
Germany	106.57	105.67	105.93	108.09	106.88	107.07	100	108.32	114.23	127.95
Greece	72.49	59.98	61.65	75.72	62.66	73.53	100	111.55	119.09	152.29
Ireland	91.78	101.48	85.90	101.33	121.45	124.31	100	117.90	136.44	240.88
Italy	95.39	94.45	100.07	93.02	88.76	94.98	100	104.81	107.13	121.20
Luxembourg	116.75	110.27	209.73	114.67	104.21	195.10	100	104.88	107.74	118.78
Netherlands	104.61	104.95	104.82	104.57	107.32	129.90	100	106.76	116.59	158.12
Portugal	67.71	63.09	51.61	70.10	66.02	54.82	100	110.55	119.30	135.62
Spain	90.27	93.14	70.17	88.60	97.64	79.33	100	104.81	107.27	144.34

Source: AMECO, EUKLEMS and own elaboration. Magnitudes in index numbers and real terms.
EA12: Original 12 countries of the Euro Area INCOME: Income per head of population
MANUF: Real productivity per hour worked in manufactures TOTAL: Real productivity per hour worked. Total economy

This reasoning must be also applied to the analysis which focus on productivity per worker instead of productivity per hour as optimal choice. Productivity per worker can be explained either by real productivity improvements or increasing the intensity of work. As the second is not a real improvement, then the election must be productivity per hour. Furthermore, as Alexiadis (2013) shows, there is a strong negative relation between the mean number of worked hours by employee, and the country productivity level.

4.2 The test

In order to explore evidence on convergence we are going use three different types of test –beta, sigma and time series, applied over a sample, the original 12-Eurozone, which is expected to be a convergent area. As we know, absolute convergence tests are suggested for more homogenous samples like the OECD; that is, a framework where the Eurozone fits perfectly. Our first approach will be sigma convergence, defined as the evolution of the standard deviation of productivity for the members of the Eurozone:

$$\sigma_{j,t} = \sqrt{\frac{\sum_{12}^{i=1}(lny_i - ln\bar{y})^2}{n}} \tag{9}$$

From t=1992 until 2007, for each *j* sector. Thus, if $\sigma_{j,t}$ decreases, it implies sigma convergence for this sector. In other words, if $\sigma_{j,1992} > \sigma_{j,2007}$, the process can be characterized as sectoral or general sigma convergent. Hence, the differences in productivity levels are decreasing along time. Our second test will follow beta convergence definition. Simplifying (1) for an absolute convergence test we have:

$$\Delta ln\bar{y}_{j,i} = \alpha + \beta_j lny_{j,i,0} + \varepsilon_i \tag{10}$$

For each j sector. Consequently, $\beta_j < 0$ implies absolute convergence for sector *j*. This coefficient describes a negative relation between initial levels and growth rates. Relatively poorer countries will grow faster than richer ones. Finally, we compute a final test derived from a time series approach. There are not clear precedents of our test. Our proposal is to integrate the notion of sigma convergence in a time series framework. Therefore, integrating (2) into (5) the resultant equation is:

$$\Delta\sigma_{jt} = \alpha_j + \delta_j \sigma_{j,t-1} + \varepsilon_i \tag{11}$$

From t=1992 until 2007, for each j sector. If $\delta_j < 0$, then, we can reject the null hypothesis of a unit root in sector j and hence, describe the process as convergent from a time series viewpoint. Allowing for $\alpha_j \neq 0$, if we reject the existence of a unit root, makes the process compatible with conditional convergence. This approach has three main advantages. First, it allows us to combine the gains of a joint analysis without the problems associated to panelling individual time series. Second, derived from the neoclassical assumptions, a null value of σ is expected if we make the period arbitrarily long, suiting perfectly to time series properties. Lastly, the economic

implications of this specification are much clearer than using other Dickey-Fuller expansions, where the link to a theoretical definition of economic convergence is not clear.

4.3 Sample and data origin

Finally, our sample is constituted by the twelve original members of the Eurozone – Austria, France, Germany, Luxembourg, Netherlands, Belgium, Italy, Spain, Portugal, Ireland, Finland and Greece- who adopted the euro on 1st January 2002. The period to analyse covers from 1992 to 2007, both inclusive. Then, since the start of the monetary integration process until the start of the 2008 recession. Our analysis will cover the whole economy plus its nine most important economic branches using data obtained exclusively from the EUKLEMS Project database. As stated at the beginning of this section, real productivity per hour will be our main analytical variable and is defined as the ratio between net output and total worked hours deflated by a price index.

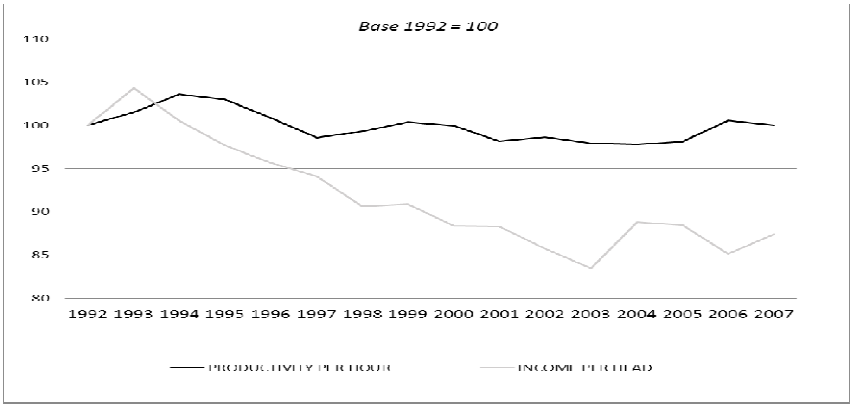
5. EVIDENCE

5.1 Sigma

The sigma convergence definition is the most descriptive and direct approach to convergence. Starting from an aggregated picture, if we expect a reinforced convergent process derived from the monetary integration, the results are quite disappointing and in line with descriptive statistics presented in TABLE 0. GRAPH 1 shows this situation comparing income and productivity paths valuated in index numbers base 1992. A first look shows that productivity differences have not narrowed during the analysed period. On the contrary, the value in 2007 is slightly higher than in 1992, almost flat. Correspondingly, the picture shows how income convergence was not based on productivity improvements, rather on the contrary –as this work has previously suggested- income and productivity have evolved independently, pointing to a structural deadlock based on growing deficits which resulted unsustainable in the long-run. However, this general view is, for sure, superficial. In order to overcome that problem, we are going to decompose total economy in its nine main branches: two from primary sector, three from the industrial sector and the six main branches of services[2].

2 These branches are primary activities, manufactures, energy, construction, wholesale and retail trade, financial activities, transport, real estate, telecommunications and social services and other non-market activities. All of them adopted from an ISIC4 two-digit classification.

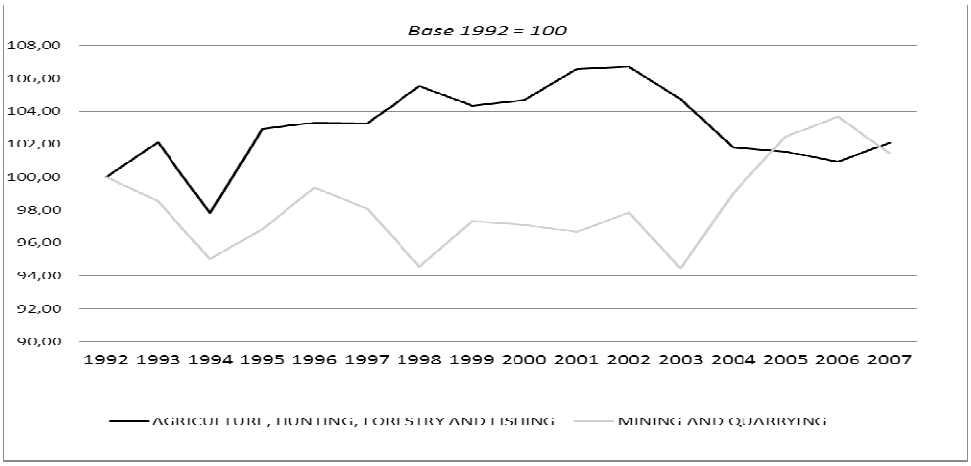
GRAPH 1 PRODUCTIVITY VS INCOME SIGMA CONVERGENCE -INDEX NUMBERS-



SOURCE: EUKLEMS

GRAPH 2 displays the behaviour of primary activities which importance is relatively minor for Western European countries nowadays. In general, although suggesting certain differences during their evolution, both branches support a divergent path. Agriculture's standard deviation showed an increase during the first years followed by a reduction after 2004. Nevertheless, the resultant sigma value is bigger than the original, and thus, leads this sector to divergence. Mining activities, on the contrary, narrowed their productivity differences during the first years, but before 2003, the differences grew leading another time, to a divergent result for the whole period. However, as it has been noted, the importance of primary activities within the Eurozone is, at least, limited.

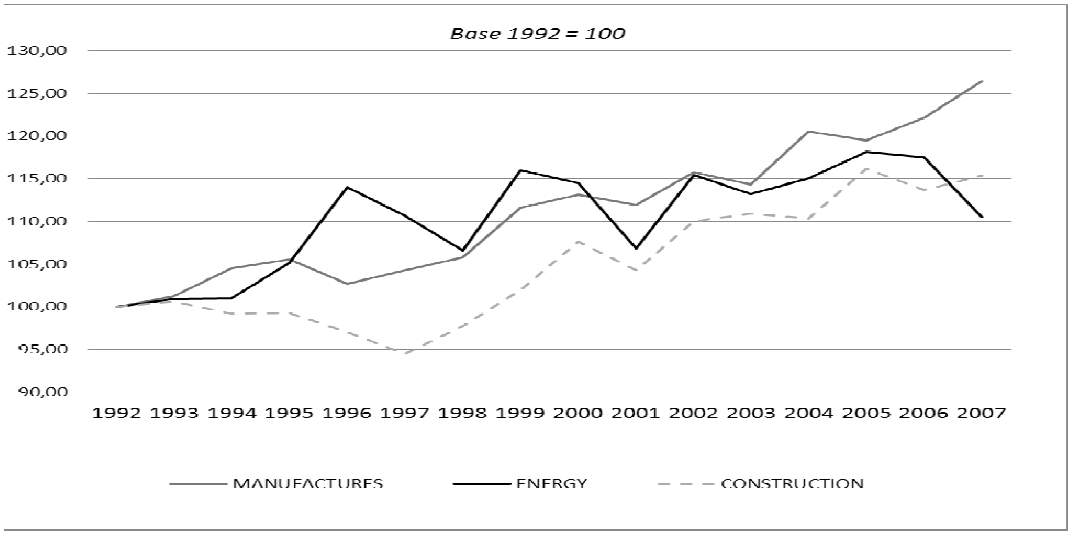
GRAPH 2: PRIMARY ACTIVITIES SIGMA CONVERGENCE -INDEX NUMBERS-



SOURCE: EUKLEMS

In contrast, the importance of industrial branches is central although their relative weight has diminished during the last thirty years. Not only due to their relative size, but also because industrial activities, especially manufactures, are the core of productivity improvements. Once we have decomposed the industrial sector into its branches, the general picture of manufactures is displayed in GRAPH 3, which is incredibly consistent with a divergent scenario. Differences grew in a sustained way during the whole period. This behaviour is compatible to theories focusing on increasing returns and path dependant development, or also, to New Economic Geography analysis. Focusing on the other two main industrial branches, the performance is similar, but less exaggerated. Both energy and construction manifested a sustained divergent path while in energy sector, a minor decrease happened during the last three years; however, without compensating the tendency of the whole period.

GRAPH 3: INDUSTRIAL BRANCHES SIGMA CONVERGENCE -INDEX NUMBERS-

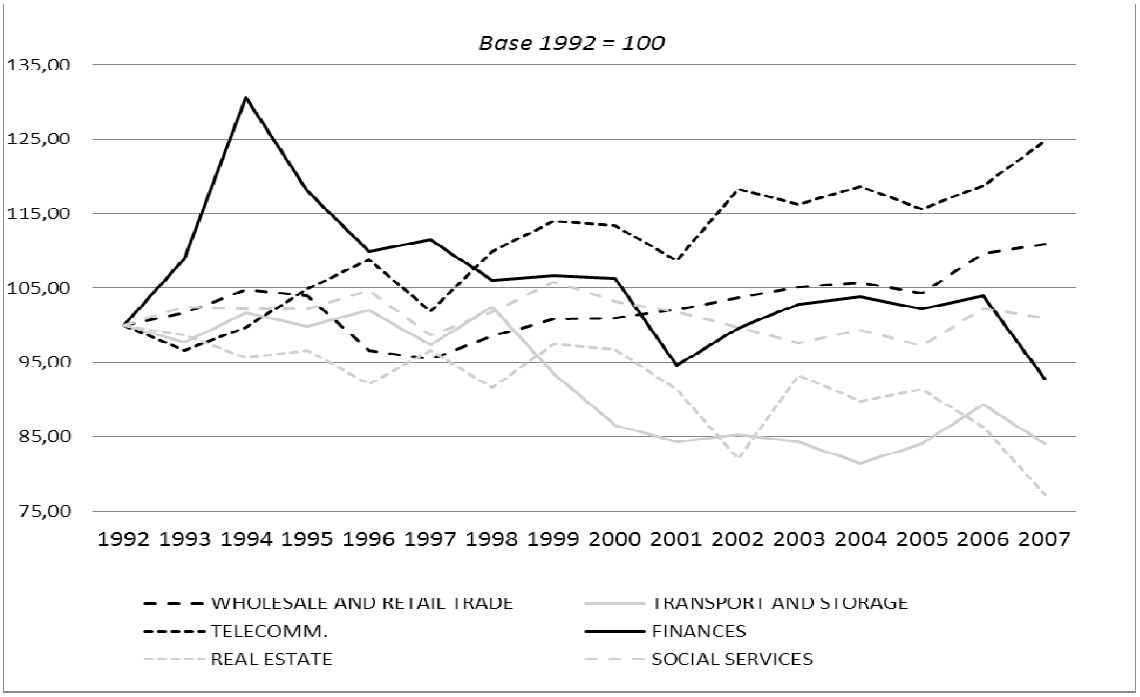


SOURCE: EUKLEMS

In order to complete sigma convergence analysis, we are going to focus on the main branches of services covered by GRAPH 4. Due to the general divergence perceived in primary and secondary sectors, some evidence of convergence is expected in order to justify the almost flat behaviour of sigma reported at a general level. However, the picture among the different branches of services is only mixed. Some a aggregates like transport, financial activities and real estate exhibit a strong convergent path. This result is not surprising. As a consequence of the free movement of factors and abolished trade barriers, a reduction in transport costs is expected. Additionally, the monetary integration process could be easily identified as the driving force, which strengthened financial convergence among Eurozone members. The explanation for the convergent path described by real estate activities is much more complex. Actually, this process seems to be related to the

incredible housing assets bubbles observed in some southern countries, like Spain and Greece during the first 2000s. Nevertheless, an in depth explanation of this phenomena would require a much more detailed analysis focusing on capital misallocation (Balta, 2013) and how German trade revenues boosted southern deficits in a perverted scheme.

GRAPH 4: SERVICES BRANCHES SIGMA CONVERGENCE -INDEX NUMBERS-



SOURCE: EUKLEMS

The remaining 3 sectors show less clear evidence of convergence. Non-market services show weak convergence within an almost plain behaviour. Wholesale and retail trade points to weak divergence. Finally, telecommunications suggest a strong evidence of sigma divergence. Due to the centrality of this sector in the so-called "new economy", these results, in addition to the observed industrial behaviour, are quite disappointing. The most productive sectors as telecommunications and manufactures display a strong divergent path. The observed process is highly compatible to Bernard and Jones´ (1996), Le Gallo and Dall'erba´ (2005) and Sondermann´s (2012) previous findings: while some branches within services show evidence of convergence; the general picture for the industry is divergent. From a theoretical perspective, this kind of evolution looks quite harmonious to the Kaldorian approximation, which focuses on the centrality of manufactures through Verdoorn´s law. Nevertheless, in order to have a complete analysis, we need to focus on the two remaining perspectives.

5.2 Beta

First of all, before running the so-called Barro regressions for a cross-section of Eurozone countries we have to bear in mind certain particularities of the beta convergence approach. Due to the less restrictive conditions of the beta convergence definition,[3] we can expect stronger evidence of this kind of convergence compared to sigma evidence. However, this approach has a clear advantage. Because of the properties of cross-sectional linear regression, we are able to graph the individual situation of each country within a scatter-plot. If we also transform the data to index numbers,[4] we can divide the graph in 4 quadrants,[5] defining each individual situation. We consider this extension more intuitive than only offering the results of the regression and has been reported for some core branches. Also, TABLE 1 shows the main parameters and statistics resulted from our estimations for each considered economic sector.

TABLE 1: BETA CONVERGENCE ANALYSIS RESULTS

Sector/Period	Estimated equation	T-stat	Prob	R-squared
Total Economy	y= -0.567x+166.05	-0.437	0.671	0.01
Primary activities	y= -0.00002x+0,039	-0.777	0.454	0.05
Manufactures	y= 1.108x+12.957	0.974	0.352	0.09
Energy	y= -0.157x+115.43	-0.134	0.895	0.00
Construction	y= 0.0002x+0.0152	0.848	0.416	0.06
Telecommunications	y= 0.034x+103.641	0.039	0.969	0.00
Wholesale and Retail Traide	y= 0.631x+60.289	0.444	0.666	0.02
Transport	y= -1.766+275.810	-2.062**	0.060	0.30
Real Estate	y= -0.001x+0.111	-2.705**	0.022	0.42
Financies	y= 3.669x+490.013	1.714	0.117	0.23
Social Services	y= -0.00+0.002	-0.039	0.969	0.00

Notes:
*, **, ***, Imply a rejecting the null hypothesis at the 10%, 5% and 1% levels of statistical signification
Source:EUKLEMS

Starting from descriptive scatter-plots, we can observe weak – statistically non-significant- absolute beta convergence evidence for total economy, a phenomena also shown in GRAPH 5.[6] The two main advantages of graphing the data clearly appear. First, we can identify groups of countries, for example, the circled group of southern countries: Greece, Portugal, Spain and Italy. Second, showing that this result, although compatible to

3 Sigma convergence implies beta convergence but not on the contrary as the former looks for convergence in levels and the latter in growth rates.

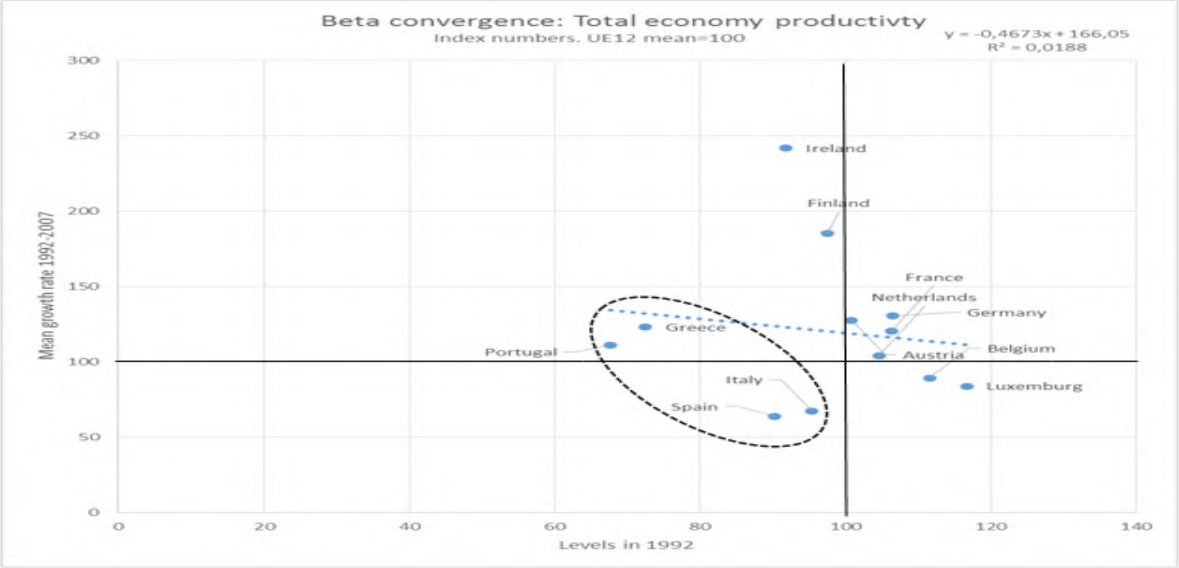
4 When is possible. We cannot develop index numbers from series containing both positive and negative numbers.

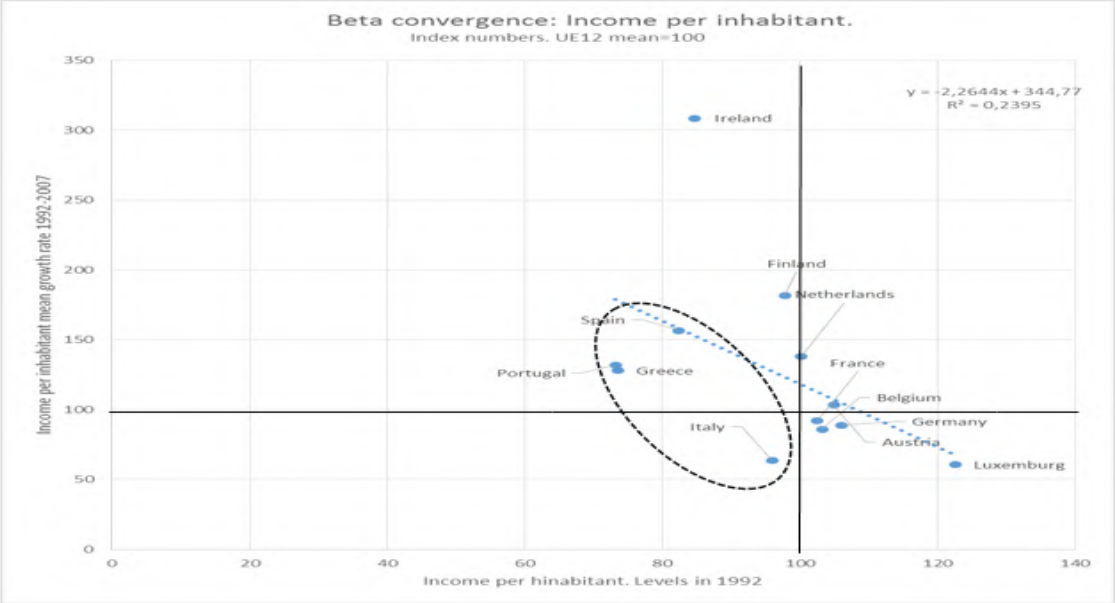
5 Each quadrant implies one of four possible situations: q1 and q3 supports convergence. Poor countries grow faster and rich slower, respectively. On the contrary, q2 and q4 reflects richer countries growing faster, and poorer growing slower. Therefore, q2, and q4 points to divergence.

6 Reported equations above selected GRAPHS are calculated using index numbers and differ for those reported on TABLE 1.

sigma evidence of weak divergence, advises us about the risk of regression fallacy mentioned above and the risk of over-predicting convergence associated to the beta convergence approach. The extreme improvement experimented by relatively low-productivity countries like Ireland could lead to a negative beta coefficient biasing resultant estimations. Also, if we compare these results to data plotted in GRAPH 6 focusing on income, beta convergence is, as expected, comparatively stronger than evidence reported by the sigma convergence approach. This last graph reflects the impressive improvement of all southern countries but Italy in terms of income per head previewed in TABLE 0. More formally, looking to reported equations in TABLE 1, the picture is strongly heterogeneous among sectors. Starting from total economy, we find almost null values in the equation associated to the scatter plot in index numbers reported by GRAPH 5 along a non-significant parameter which p-value is above 0,6, rejecting the presence of statistically significant aggregate convergence.

GRAPH 5, 6: PRODUCTIVITY AND INCOME BETA CONVERGENCE

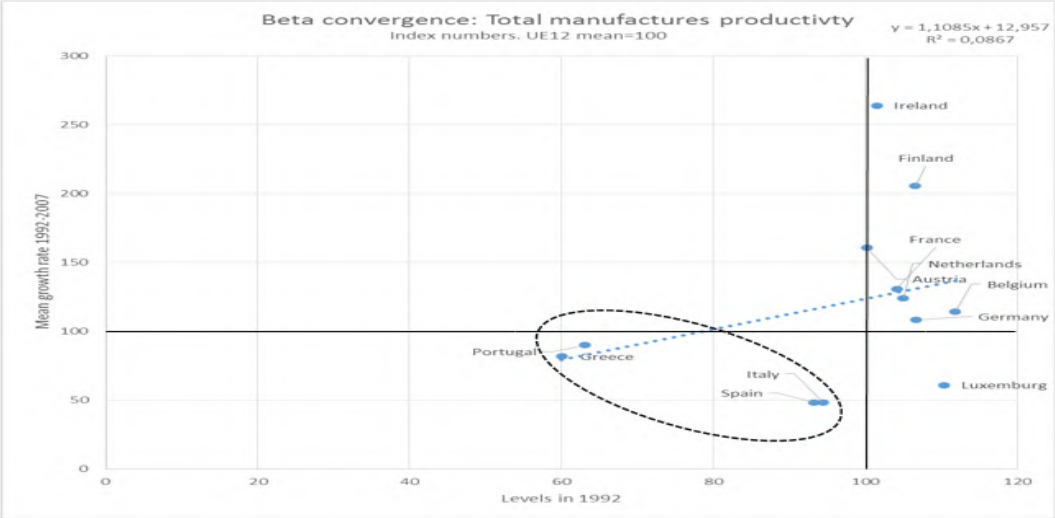




SOURCE: EUKLEMS, AMECO AND OWN ELABORATION

Turning to disaggregate sectoral analysis, the situation, as in the results reported by sigma convergence evidence, the picture drawn by TABLE 1 presents numerous sharps. Within industry, there is weak beta convergence in the energy sector. On the contrary, construction and manufactures point to divergence. The manufacturer sector shows really strong evidence of absolute beta divergence as its associated scatter-plot draws in GRAPH 8 more clearly suggests. In addition, if we focus on the individual situation of each country within manufactures, paradoxically, all southern countries will be placed in the worst quadrant (q4), which implies that starting from a worse position implies lower future productivity improvements. Again, this evidence is highly compatible with theoretical inquiries against the notion of unconditional convergence as cumulative causation schemes, the presence of increasing returns and the possibility of path dependant development. On the other hand, primary activities show a picture characterised by weak statistically non-significant convergence.

GRAPH 7: MANUFACTURES BETA CONVERGENCE



SOURCE: EUKLEMS AND OWN ELABORATION

Focusing on services, all sectors except telecommunications and wholesale & retail trade exhibit absolute beta convergence. The process is weaker in non-market services where the regression line is almost plain. Once again, transport, real estate and finances show strong evidence of convergence with high R-squared values and significant coefficients for transport and real estate. Focusing on the financial sector, we have the expected outcome for a neoclassical perspective: strong financial convergence as the expected result of a monetary integration process based on free capital mobility. The same argument can be extended to the transport sector based on productive factors mobility. However, in hand to the divergent evidence suggested by other sectors, it could be responsible of important imbalances, namely: capital misallocation to highly profitable sectors but characterised by low productivity improvements. Generally, non-tradable sectors like real estate are highly sensitive to financial bubbles. In sum, reported results are consistent and complementary to previous sigma convergence evidence, finding significant convergence only in transport, finances and real estate.

5.3 *Time series*

Finally, we are going to focus on the data from a dynamic perspective. Recalling our proposed definition and methodology for a time series analysis, TABLE 2 shows the resulting estimations after applying a augmented Dickey-Fuller scheme where one lag was included in each specification following the Akaike Information Criteria -AIC. We have chosen 2 different periods, one of them starting in 1970 in order to improve the power of

the test, originally conceived for long series. The other one covers our standard period 1992 -2007 presented for comparative purposes as the original time frame proposed by this work could offer biased results for a unit root analysis applied over series composed of 16 annual observations. Furthermore, we have included a conditional convergence test due to the really restrictive implications of absolute convergence through this perspective. Beginning with a long-term perspective 1970-2007, we found some evidence of absolute convergence on non-market services and finances, more significant in the former. If we allow for conditional convergence, we found also evidence on transport and real estate sectors. These results are consistent to both previous literature (Sondermann, 2012) and our findings through beta and sigma convergence approaches. No evidence is found at a general level or in primary or secondary sectors. Hence, convergence seems to be concentrated in some branches of services.

TABLE 2: TIME SERIES ANALYSIS RESULTS

Sector/Period	*1971-2007*				*1992-2007*			
	Absolute		*Conditional*		*Absolute*		*Conditional*	
	t stat	prob	t stat	prob	t-stat	prob	t-stat	prob
Total Economy	-1.95	0.305	-0.227	0.597	-0.145	0.617	-1668	0.427
Agriculture	-2.27	0.185	-0.16	0.621	0.544	0.822	-2.894*	0.068
Minery and quarrying	-1.61	0.46	0.11	0.714	-0.143	0.618	-2206	0.211
Manufactures	0.992	0.995	2.14	0.991	2844	0.997	-0.5481	0.856
Energy	-1.9	0.325	-0.75	0.381	0.134	0.771	-1915	0.317
Construction	-1.4	0.568	-0.007	0.673	0.7655	0.889	-0.329	0.901
Telecommunications	-2.15	0.224	-0.602	0.449	1205	0.933	-0.686	0.823
Wholesale and retail traide	-1.75	0.398	0.83	0.888	11126	0.924	-0.727	0.812
Transport	-1.53	0.507	-2.000**	0.044	-1167	0.211	-1.45	0.682
Real estate	0.205	0.96	-1.64*	0.094	-1109	0.23	-1187	0.652
Financies	-3.11**	0.033	-2.103**	0.035	-9262	0.575	-1909	0.32
Social services	-5.699***	0.001	-1.901*	0.055	-0.062	0.646	-2.846*	0.07

Notes

Dickey-Fuller test

Null hypothesis: The serie has a unit root.

*, **, ***, Imply rejecting the null hypothesis at the 10%, 5% and 1% of significance respectively.

Source:EUKLEMS

Focusing in our core period 1992-2007, obtained evidence is less clear. Only primary activities point to weak evidence of conditional convergence. The remaining sectors cannot reject the null hypothesis of a unit root both from a conditional or an absolute perspective. These results do not deny our findings looking at beta or sigma analysis. On the contrary, they are related to the strong definition of convergence derived from a time series perspective. Moreover, due to the limitations of small samples in time series analysis, these results may be biased. Then, a longer perspective is preferable. Using longer series, as we have seen, the evidence is strongly consistent to the observed sigma and beta results. Briefly, some branches of services suggest evidence of convergence while industrial branches and telecommunications point to strong divergence. As a consequence,

Eurozone´s general picture aims to soft general divergence, an unexpected result of the integration process following the conventional neoclassical approach.

6. CONCLUSIONS AND POLICY IMPLICATIONS

A common conclusion can be traced from the three approaches implemented in this work. There is not a general process of productivity convergence among Eurozone original members during the period 1992-2007. Only following a beta convergence definition, the weakest, we found some evidence of general convergence but statistically non-significant. Time-series and sigma perspectives point undoubtedly to absence of convergence at a general level. Decomposing into branches, another clear fact appears. While some branches of services aim to convergence, industry suggests strong divergence following any perspective. Transport, financial activities and real estate point to the strongest evidence of convergence. On the contrary, manufactures within industrial branches, and telecommunications in services, lead the strongest divergence. These findings are in line to previous studies and highlight an important issue: convergence occurs within branches involved in low productivity improvements. On the other hand, divergence imposes its path on highly productive sectors where increasing returns tend to appear, namely, manufactures and "New Economy" sectors like telecommunications. Consequently, this work does not provide support for the neoclassical growth model from an empirical perspective.

The Eurozone was supposed to be more homogeneous than OECD samples, but paradoxically, we do not find general evidence of economic convergence. These results, although contradictory, are still compatible to different alternative theoretical frameworks, especially if considered in relation to trade imbalances and specialization patterns. However, further research is necessary in order to explicitly link our results to any theory, analysing sectoral shares evolution and output structure, income elasticities of demand or the presence of increasing returns. Furthermore, once we have discovered the deadlocks characterising the scheme built in Maastricht and that more openness per se does not lead to economic convergence, other kind of proposals should be considered by European policy-makers. New policies, which take into account that convergence is the product of policies rather than automatic forces. Hence, different instruments as a coordinated industrial policy, a deeper integration in terms of labour market or fiscal and wage policies should be consider in order to strengthen productive cohesion. Otherwise, monetary integration would lead to asymmetric outcomes; boosting unsustainable processes of income convergence without underlying productivity convergence as the one

experienced by Eurozone´s members. These situations, unstable in nature, cannot perpetuate ad infinitum as the crisis exploded in 2008 demonstrated. Thus, considering the centrality of the topic, this study only opens a window for further research on Eurozone´s productive dynamic and its relation to the recent crisis.

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CHAPTER 2

DO INCREASING RETURNS CALL THE TUNE? EVIDENCE FROM A PANEL OF 8 EUROZONE COUNTRIES ON VERDOORN'S LAW

ABSTRACT

This work analyses evidence on increasing returns to scale for a panel of 8 original members of the Eurozone covering 4 main sectoral aggregates: Total Economy, Manufactures, ITC Services and Market Services. The analysis is built on the estimation of Verdoorn's Law, which implies that a faster growth of manufacturing output boosts labour productivity growth. However, considering the debate surrounding the causal direction of the Law, the alternative specification proposed by Rowthorn, which assumes output as dependant variable, is also reported. Evidence shows that, after panel effects and IV techniques have been properly applied, the results of both specifications consistently converged, suggesting the presence of dynamic increasing returns for Manufactures and ITC-Services, while Total Economy and Market Services point to constant and diminishing returns to scale respectively.

Keywords: Verdoorn's Law, Growth theory, Returns to Scale, Manufactures, Europe

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1. INTRODUCTION

Since the seminal articles of Romer (1986, 1990) and Lucas (1988), inaugurating the neoclassical view on endogenous growth -the so-called *New Growth Theory*, a reinforced interest on increasing returns and their effect on persistent cross-country differences in real output growth rates has taken place. These authors, closely inherited to Young´s (1929) view on increasing returns and Solow´s supply model (1956), relax its characteristic assumption of constant aggregate returns to scale either establishing unitary returns for capital –AK style models- or considering explicitly the role of innovation. Regardless of these differences, the main consequence of endogenous growth models is that Solow´s Residual becomes endogenously explained. As a consequence, increasing returns are allowed and thereby the clearing and convergent properties associated to perfect capital mobility are not necessarily meet anymore. Formally, the steady-state value becomes endogenous allowing for persistent differences and economic divergence. In addition to these theoretical developments, the uneven growth paths experienced by European countries after the beginning of the crisis in 2007 strongly dismissed a convergent picture in terms of economic performance for the members of the Union, a scenario explicitly forecasted in the Maastricht Treaty. As a result, recent economic trends in Europe seem to suggest that increasing returns and endogenous growth considerations are clearly beyond a purely theoretical exercise.

However, endogenous growth is far from something new withdrawing the use of the term itself. If we focus in the notion of *circular and cumulative causation* originated in Myrdal (1957) and developed by Kaldor afterwards (1966, 1975), we found a framework considering increasing returns and endogenous growth which clearly predates its neoclassical counterpart (Roberts and Setterfield, 2006). In its basics the cumulative causation view is closely related to a pair of stylized facts widely known as the first and second Kaldor´s Growth Laws. The former implies that a higher growth rate of manufactures output will lead to a higher growth rate of output for the total economy. The latter states that a higher growth rate of manufactures will lead to a higher growth rate of manufactures productivity. In sum, both relations draw the intuition that a higher growth rate of manufactures –or alternatively, an increase of its share,- will imply, ceteris paribus, a permanent raise on the growth rate of total output, in a process that is circular –either virtuous or vicious, and path dependant.

Kaldor´s first Law has been coherently baptised *manufactures as engine of growth*. On the other hand, as explained above, Kaldor´s second Law implies a positive causal relation between the growth rate of output in manufactures and productivity growth. This regularity points towards the existence of static and dynamic increasing returns to scale and it is widely known as *Verdoorn´s Law*. In fact, as Kaldor pointed out, the first

formulation of the Law appears in a Verdoorn´s original article from the late forties (Verdoorn, 1949). Although the article got a relatively low profile during the fifties, it was fortunately written during a period when Myrdal, Kaldor and Verdoorn were working together in the United Nations Economic Commission for Europe –UNECE-. This fact allowed Kaldor to recover the notion a few years later in a well-known article testing the Law for a selection of developed countries (Kaldor, 1966). Kaldor originally computed the equation defining Verdoorn´s Law in the following way:

$$p_m = b_0 + b_1 q_m \quad (1)$$

Where p_m denotes the annualized growth rate of productivity in manufactures, q_m stands for the real growth of output in manufactures, b_0 is an intercept and b_1 represents the so called Verdoorn coefficient. If this coefficient b_1 is significantly different to zero, it is interpreted as evidence of strong dynamic increasing returns to scale. Kaldor´s original paper found a value close to 0.5, a measure which has been usually confirmed by more recent studies (McCausland and Theodossiou, 2012; Millemaci and Ofria, 2014; Magacho, 2016) However, R. Rowthorn criticised Kaldor´s argument stating that the causal sense should be reversed (Rowthorn, 1975), thereby defining employment as the exogenous regressor and causing increased growth of output, that is:

$$q_m = b_2 + b_3 l_m \quad (2)$$

The debate is still pertaining although Rowthorn original argument was plainly wrong,[1] fundamentally, because of two main factors. First, because alternative specifications tend to support almost opposed results, Kaldor´s version usually oversize the degree of returns to scale while Rowthorn´s version tends to underestimate the actual degree of returns to scale. Second, because Verdoorn´s Law can be easily derived from a Cobb-Douglas function –among other functional forms- implying a specific kind of endogenous growth production function. For that reason, Rowthorn´s style impulse-response structure for employment and output will be reported, as a proxy for a neoclassical supply side production function allowing for increasing returns, or in neoclassical vocabulary endogenous growth.

The next section describes our proposed specification for Kaldor´s and Rowthorn´s versions of Verdoorn´s Law. In order to choose the most appropriated form, first, we derive the Law from a growth accounting perspective, which allows a Cobb-Douglas specification in levels. Afterwards, certain shortcomings associated to the original equation proposed by Kaldor are described, that is: on the one hand, the omission of the capital stock; on the

1 Rowthorn´s original argument (Rowthorn, 1975) was in relation to a kind of labour shortage in manufactures due to employment absorption by services. Nevertheless, as we know, the problem is fundamentally the opposite: growing structural unemployment since the 1980s.

other, problems of measurement error and/or simultaneity. While the former is straightforward to overcome if, as in our case, data on capital stock is available, the second issue requires the implementation of instrumental variables -IV, which independency, robustness and consistency are difficult to achieve. For that reason, section three, which describes our applied methodology for a panel of 8 Euro Area countries, proposes to adopt a sequential procedure. Consequently, section four, which describes our empirical findings, in a first step, reports pooled OLS estimations. Then, after the usual parametric tests, individual and time effects are included in former specifications if they are required. Finally, over these second estimations, a two-stage OLS -2SLS- approach is applied taking advantage of IV. As expected, discrepancies between Kaldor´s and Rowthorn´s measurements of the degree of returns to scale appeared, nevertheless sequential improvement of original specifications showed an important degree of convergence between Rowthorn´s and Kaldor´s parameters. The results also point to the clear existence of increasing returns in Manufactures and to an uncertain degree, on ITC Services in line to Kaldor´s original intuitions. On light of this evidence, section five finally offers the main conclusions of this research.

2. VERDOORN´S LAW: COBB DOUGLAS DERIVATION AND SPECIFICATION DILEMMA

The relation proposed by Verdoorn´s Law could be obtained from a variety of functional forms. Nonetheless, as Angeriz et al. showed (2006, 2008 and 2009) it could be easily derived from a modified version of the original Cobb-Douglas function proposed by Solow (1956). Although this choice is not neutral,[2] it allows to show straightforwardly the relation between Verdoorn´s Law and the presence of aggregate dynamic returns to scale. In addition, a Cobb-Douglas specification permits to probe that Verdoorn´s Law could be considered a special case of an endogenous growth model. In order to do so, let us assume the standard Solow´s production function:

$$Q_t = A\, e^{\lambda} K_t^{\alpha} L_t^{(1-\alpha)} \qquad (3)$$

Where Q_t represents real output, A is an exogenous constant, K_t is a measure of the capital stock and L_t stands for the total number of hours worked. $(1-\alpha)$ measures the wage share defined as $\frac{w.L}{Y}$ where w is the average wage per hour and, thus α is considered the capital share. Finally, λ is a technological parameter defined as Total Factor Productivity –TFP- or alternatively, as Solow´s Residual. This factor is assumed as exogenous in the original model, however following again Angeriz et al.

2 For a detailed review on Solow´s production function and its shortcomings see Felipe and McCombie (2006).

(2009), this constant, in order to allow Verdoorn´s Law mechanism, is considered endogenous under the following functional form:

$$\lambda=\lambda_0+\pi\left[\alpha\, k_t+(1-\alpha)l_t\right] \tag{4}$$

Then, the exogenous technological factor is reduced to λ_0 , while the weighted growth of factors –considered lower case letters- are multiplied by a parameter representing the degree of returns to scale associated with the endogenous growth of Total Factor Inputs, then, technology is endogenous and induced by growth itself in line to Verdoorn´s Law intuition. Afterwards, taking logarithms of (3) and differencing with respect to time we get:

$$q_t=\lambda+\alpha\, k_t+(1-\alpha)l_t \tag{5}$$

Equation (5) is no more than the usual growth accounting identity. However, considering our proposed equation (4) for endogenous technology, after substituting and rearranging it becomes:

$$q_t=\lambda_0+v\left[\alpha\, k_t+(1-\alpha)l_t\right] \tag{6}$$

Where $(1+\pi)=v$ offers a direct measure of the endogenous degree of returns to scale. In order to obtain a formulation in direct relation to Verdoorn´s original form, one assumption needs to be included:[3] That is, the capital output ratio is assumed constant. Thereafter, defining this ratio as $R=\frac{K}{Y}$ which evaluation in growth rates is $r=k-y$ and recalling our axiom we have $y=k$. Substituting this last form in (6) and rearranging we obtain a Cobb-Douglas derived equation for the original Verdoorn´s Law:

$$p_t=\frac{\lambda_0}{v(1-\alpha)}+\left[\frac{v-1}{v(1-\alpha)}\right]q_t \tag{7}$$

Assuming $\frac{\lambda_0}{v(1-\alpha)}=b_0$ and $\left[\frac{v-1}{v(1-\alpha)}\right]=b_1$ equations (1) and (7) become identical. As it is straightforward to see, a positive result significantly different from zero suggests evidence of increasing returns of scale while $v=1$ would imply $b_1=0$ and thus evidence in favour of constant returns to scale. On the other hand, assuming a Rowthorn´s style functional form, equation (7) can be re-specified as:

$$q_t=\frac{\frac{\lambda_0}{v(1-\alpha)}}{1-\Omega}+\frac{1}{1-\Omega}l_t\;\forall\,\Omega=\left[\frac{v-1}{v(1-\alpha)}\right] \tag{8}$$

3 As we are going to develop later, this assumption has strong implications but can be easily relaxed.

By definition, this specification implies the presence of constant returns to scale if $\frac{1}{1-\Omega}=b_3$ reports an estimation close to zero being statistically significant. In addition a statistically significant value below zero for b_3 would imply the presence of increasing returns to scale while a value above zero would support the existence of diminishing returns. However, there is an important shortcoming associated to the original formulation of Verdoorn´s Law present in both the Kaldorian version and in its Rowthorn´s counterpart. Basically, the robustness of estimations obtained from both versions rely on the assumption of a constant capital output ratio, otherwise, the constant terms b_0 and b_2 would include an endogenous element, leading to spurious regressions. The absence of capital stock measures was originally justified due to lack of data availability, a problem that nowadays, at least respecting the sample proposed in this work, can be consistently overcome. In order to consider a specification including a measure of capital stock growth rate, first, we define total factor inputs growth rate as:

$$tfi_t=\alpha k_t+(1-\alpha)l_t \quad (9)$$

Which, recalling the definition of our variables, implies a weighted measure of the combined growth of capital and labour. Thereafter, substituting (9) in equation (6) we get:

$$q_t=\lambda_{\square}+(1+v_r)tfi_t \quad (10)$$

This last equation is no more than a modified version of Rowthorn´s specification of Verdoorn´s Law, but including two important improvements: capital stock growth is included while at the same time offers a direct measure of the degree of returns to scale. On the other hand, the original Kaldorian specification of Verdoorn´s Law can be straightforwardly obtained after rearranging equation (10), thus:

$$tfi_t=\lambda_{ok}+\frac{1}{(1+v_k)}q_t \quad (11)$$

Although intuitively we would expect that estimations of equations (10) and (11) will offer close estimations, in general, previous works have found that each equation usually reports contradictory results. While Kaldor-Verdoorn specifications tend to suggest the presence of increasing returns of scale, Rowthorn´s style equations usually report estimated parameters suggesting constant or even decreasing returns to scale. This issue is derived from two different but related problematics: the presence of simultaneity and measurement errors. In a nutshell, as McCombie and de Ridder pointed out, the estimations of v_r and v_k, constitute in fact the lower and upper bounds of the real value of Verdoorn´s parameter (McCombie and de Ridder, 1985). The discrepancy between both estimations has been usually confirmed by empirical works (e.g. Angeriz et al., 2009), although

unfortunately, a great majority of works only report results for the original form of Verdoorn´s Law proposed by Kaldor. Constraining our focus to European samples, different perspectives and econometric techniques have been previously applied. As pointed above, Angeriz et al. (2008, 2009) find evidence of increasing returns estimating Verdoorn´s Law for EU NUTS2 regions, results which have been recently confirmed (Fazio et al., 2014). Sharing a spatial approach on EU regions, previous studies by Fingleton and McCombie (1998) and Pons-Novell and Viladecans-Marsal (1999) reported as well similar findings. On the other hand, aggregate cross-country analysis also suggests the presence of increasing returns for European samples (Knell, 2004). More recently, applying an alternative cross-industry perspective, Romero and McCombie (2016) confirms this evidence of increasing returns for a panel of 11 European countries focusing on main manufactures branches grouped by technological intensity. In addition, León-Ledesma (1999, 2000) analyses the individual case of Spanish regions considering, as this work also proposes, to estimate Verdoorn´s Law for sectors different than manufactures, especially the case of ITC services.

Back to the issue of simultaneity, its centrality depends on the importance assigned to this problematic from a theoretical perspective. On one extreme, the neoclassical framework assumes a direction of causation from inputs growth to output growth, a pure supply side view for which Say´s Law usually holds. On the opposite edge, the Kaldorian view, from which Verdoorn´s Law is derived, assumes a reversed direction of causation, tracing its roots to Adam Smith´s view on the positive feedback between a raising extent of the market and a subsequent reinforced labour division –i.e., boosted labour productivity-. If that is the case, a Cobb-Douglas formulation is by no means a candidate for being the function underling Verdoorn´s Law, at least in the original Kaldor-Verdoorn fashion. To see this, we first assume, in line with Kaldor, that causation goes from output growth to productivity growth. That is, output growth would work as exogenous variable. Then, a second equation could describe the behaviour of output growth, but it would be derived from another well-known Kaldorian regularity, the so-called Thirlwall´s Law, which describes economic growth as a demand driven phenomena where the equilibrium rate of growth is defined for a given country by the ratio between the growth of its exports and its income elasticity of imports (Thirlwall, 1979), thereby, without demanding any reference to a underlying neoclassical production function. In sum, instead of a Cobb-Douglas function, Kaldor´s view on Verdoorn could be described by a system of two equations, which can easily be transformed to describe the relation implied by Verdoorn´s Law:

$$TFI = H_0 e^{\lambda_{0k}} Q^{(1+v)^{-1}} \quad (12)$$

$$Q = Q_o X^{\varphi^{-1}} \quad (13)$$

Where H_0 and Q_o are exogenous constants and capital letters denote former variables evaluated in levels. It is straightforward to see that equations (10) and (11) can be easily obtained from equation (12) taking logarithms differencing and rearranging afterwards. Complementarily, a completely different relation to the one expressed by the neoclassical production function is assumed by equation (13), which derivative with respect to time leads to Thirlwall´s Law assuming that X stands for a given level of exports and φ represents a parameter for income elasticity of imports. As a corollary, there are good reasons to consider that a Rowthorn´s style regression could be inspired by a Cobb-Douglas function but not in the case of the original version, which is derived from a completely different demand-driven theoretical framework (Dixon and Thirlwall, 1979). For that reason, we are going to consider Kaldor´s and Rowthorn´s specifications assuming the existence of a certain degree of simultaneity in both of them. Thereby, our proposal will be to estimate equations (10) and (11), which will allow to overcome the two most common issues while estimating Verdoorn´s Law: the omission of capital growth and the existence of simultaneity.

3. METHODOLOGY, SAMPLE AND ESTIMATION TECHNIQUES

As it was previewed in the introduction, this work adopts a sequential procedure. First we estimate simple OLS pooled regressions in order to detect the presence of deterministic effects. Then, revised specifications including, if necessary, individual, time or two-way effects are presented for both Kaldor´s and Rowthorn´s proposed equations. In a third and last step, a 2SLS perspective is applied over these panel effects specifications. Thus, through this sequential procedure, the main advantage will be the possibility of analysing the existence of convergence between Rowthorn´s and Kaldor´s estimated Verdoorn´s parameters comparing their results before and after the application of appropriate econometric techniques. Our study will rely on a panel approach slightly different to the one recently proposed by Romero and McCombie (2016) and Romero and Britto (2017) which apply the system generalized method of moments (SYS-GMM) controlling for fixed effects via first differences in a regression where variables in levels are also included. However the application if this method faces the alternative problematique of requiring overidentification to be computed. Instead, this work, which shares the 2-SLS procedure to treat endogeneity, implements a traditional 2-ways effects -time and fixed- to treat the possibility of heterocedasticity among panel units. Respecting these estimations, all of them have been performed using the statistical language and software R taking advantage of its package PLM[4], which offers an

4 For more information on PLM features and implementation in R see Croissant and Millo (2008).

environment especially designed for performing panel procedures. Focusing on considered variables, all the individual datasets used in this paper have been taken from EUKLEMS Project Database in its 2011 revision.[5] The countries included in this sample where those original members of the Eurozone for which sectoral growth accounting has been reported in ISIC4 standards for at least two-digit disaggregation of industries, during a period covering the 30 years lapse 1980-2010. The units satisfying these criteria were Austria, Belgium, Germany, Finland, France, Italy, Spain and Netherlands. Thus, only Ireland, Luxembourg and Portugal have been excluded from the 11 original members of the Euro Area. Given the relatively small size of these countries and the well-known weak reliability of Luxembourg and Ireland´ statistics as result of their fiscal schemes; the 8 countries considered are assumed to be a representative sample for analysing common underlying trends in the Eurozone.

Four main economic aggregates have been considered for every country based on ISIC4 grouping of industries, which is directly reported in EUKLEMS. These sectors are Total Manufactures (1), ITC-Services (2), Market Services excluding ITC sectors (3) and Total Economy (4).[6] For each sector real series in volume indexes (2010=100) have been obtained considering total output, total worked hours, capital stock and TFP, including annual observations since 1980 to 2010 both inclusive. Thereafter a logarithmic transformation has been applied to all the series and 5-years non-overlapping average growth rates have been calculated, reducing observations to 48 per sector. Although the lower number of observations presents certain shortcomings, in the context of this work the advantages are threefold. Bearing in mind that Verdoorn´s Law stands for a long-run structural relation, first, its specification using either levels or growth rates in an annual base turns difficult to difference the effect of Verdoorn´s Law in front of another Keynesian regularity linking growth and unemployment in the short run known as Okun´s Law. Second, once the growth rate of capital stock has been considered as in this work, its short-run dynamics are partly determined by changes in the degree of capacity utilisation, discouraging the use of annual data. Third, the use of 5-years average growth rates guarantees $I(0)$ variables, which are suitable for linear estimation. In sum, two equations will be reported for each sector building on the original specification of (10) and (11) but modified for a panel data framework, that is:

$$q_{it} = \hat{\lambda}_{1i} + \hat{\theta}_1 t + \left(1 + \widehat{v_1}\right) tfi_{it} + \hat{u}_{it} \quad (14)$$

$$tfi_{it} = \hat{\lambda}_{2i} + \hat{\theta}_2 t + \frac{1}{\left(1 + \widehat{v_2}\right)} q_{it} + \hat{s}_{it} \quad (15)$$

5 Through this study, values for TFP growth have also been directly taken from EUKLEMS rather than calculated.

6 ITC sectors are 58-63 ISIC4 two-digit branches while MARKET SERVICES include ISIC4 categories G-K, see O´Mahony and Timmer (2009) for a detailed description.

Where (14) and (15) are Rowthorn´s and Kaldor´s panel-adapted specifications of Verdoorn´s Law respectively. q_{it} and tfi_{it} represent 5-years averages of total output and total factor inputs growth rates, both directly taken from EUKLEMS. The latter measured as the real weighted growth of labour and the capital stock. $\hat{\lambda}_{1i}$ and $\hat{\lambda}_{2i}$, represent estimations for Kaldor´s and Rowthorn´s exogenous technological growth which will be both set fixed across countries –pooled estimations- or alternatively allowed to vary as either fixed or random effects if the usual diagnosis tests recommends their inclusion. The remaining deterministic parameters, $\hat{\theta}_1 t$ and $\hat{\theta}_2 t$ stand for a time trend which inclusion depends on Lagrange-Multiplier –LM- tests of adequacy. $\hat{u}_{it}$ and $\hat{s}_{it}$ are the usual residuals. Finally, $\widehat{v_1}$ offers a direct measure of the estimated degree of returns to scale in its Kaldorian form while $\widehat{v_2}$ offers an alternative measure based on Rowthorn´s specification. Respecting the issue of simultaneity, after the proper panel specification has been chosen and reported for each sector, a modified version applying instrumental variable –IV- techniques will be estimated. That is, a 2SLS panel estimation seeking to achieve a certain convergence between the contradictory evidence reported by estimations of (14) and (15).

4. EMPIRICAL EVIDENCE FOR 8 EUROZONE MEMBERS (1980-2010)

Our first step will be to compute the results of estimating the Original form of the Kaldor-Verdoorn Law for the 4 aggregates considered applying OLS to their pooled samples. TABLE 1 reports resultant parameters along its associated critical values and R-squared both in their standard and adjusted versions. In addition, panel oriented LM tests are reported in order to check the possibility of improving this preview specification. Beginning with the analysis of Total Economy, computed estimations points to presence of moderate increasing returns to scale. $\widehat{v_1}$ reports a value of 0.709 –implied degree of returns to scale 1.4- which is statistically significant assuming any standard interval of confidence, its associated R-squared stands above 0.60 while its adjusted version is almost identical, as expected in an equation which only includes one exogenous regressor. Focusing on a sectoral picture, the estimations are highly heterogeneous among the 3 sectors considered in this work. On the one hand, Manufactures reports an incredibly low parameter of 0.43 -degree of returns to scale above 2-, which seems overestimated for any reasonable standard. On the other hand, in respect to services, both branches report a relatively high value for estimated parameters around 0.8 implying a degree of returns to scale near 1.25; below Total Economy, the aggregate average. Thereby, as a preview, we could state that the New-Growth and

Schumpeterian intuition that ITC sectors would be subject, as Manufactures, to important dynamic increasing returns to scale does not seem to be confirmed. Nonetheless these estimations could be suffering from important miss-specification problems, which will be approached through different panel techniques.

TABLE 1: POOLED ESTIMATIONS OF VERDOORN´S LAW FOR A PANEL OF 8 EUROPEAN COUNTRIES (1980-2010)

POOLED ESTIMATIONS OF OF ORIGINAL VERDOORN´S LAW								
Sector	*Total Economy*		*Manufactures*		*ITC-Servicies*		*Non-ITC Services*	
Method	POOLED OLS		POOLED OLS		POOLED OLS		POOLED OLS	
Intercept	0.002		-0.005		-0.004		0.005	
t-stat	1.063	(0.293)	-2.423	(0.019)	-0.713	(0.479)	1.719	(0.093)
Coefficient (q)	0.7087		0.4347		0.8169		0.7980	
t-stat	8.611	(0.000)	5.502	(0.000)	8.097	(0.000)	7.2753	(0.000)
R^2	0.617		0.397		0.615		0.564	
Adjusted R^2	0.609		0.384		0.606		0.553	
Diagnosis tests								
Honda LM time effects	nor. =-1.197 (0.028)		nor. =4.962 (0.000)		nor. =-1.699 (0.955)		nor. =-1.012 (0.844)	
Honda LM ind. effects	nor. =1.661 (0.048)		nor. =0.424 (0.664)		nor. =3.280 (0.123)		nor. =1.161 (0.001)	
GHM-LM two-ways effects	N.A.		N.A.		barX^2 =1.347 (0.25)		N.A.	
Hausman test fixed/random	N.A.		X^2 =0.409 (0.522)		X^2 =0.471 (0.492)		N.A.	

Notes:—Values in parenthesis are associated p-values
The presence of time or individual effects was analysed through the Lagrange-Multiplier -LM- procedure following Honda (1985).
The Gourieroux, Holly and Monfort test evaluates the adequacy of a a two-way specification within the LM frame.
Hausman test compares fixed and random effects specifications under the null that both are equally consistent.
N.A. Non assignable

For that purpose, TABLE 1 additionally computes the usual LM-based tests[7] suitable for our perspective. Focusing again on the Total Economy, the reported statistics surprisingly suggest that a pooled estimation is more consistent and efficient than the inclusion of either cross-section or time effects, given a standard 5% level of statistical significance. Back to sectoral analysis, the picture drawn by LM statistics -referred as nor. In Table 1- is not as straightforward as in the aggregate level. Respecting Manufactures, while the presence of time effects are not statistically significant for any level of statistical confidence, individual effects, on the contrary, appear as statistically significant. Conversely, Market Services only points to the presence of statistically significant time effects. In reference to ITC-Services, the null of not significant effects is rejected for individual and time effects versions assuming the narrowest interval of confidence, suggesting the inclusion of both deterministic components through two-way effects. Finally, constraining our focus to the cases were individual effects have reported statistically significant estimations, a Hausmann test was performed suggesting the inclusion of fixed-effects for these two sectors. A result derived from considering random effects inconsistency if, as in our cases,

7 Given the slightly different versions of LM tests available, this work computes the ones proposed by Honda (1985) for the presence of individual or time effects and the one proposed by Gourieroux et al. (1982) for two-way effects.

the null of Hausmann Test is rejected for standard levels of significance. In sum, taking into account the information offered by LM tests, the original specifications of Manufactures, ITC and non ITC-Services branches were estimated again including individual, time and two-way effects respectively.

TABLE 2 reports these new estimations as well as their Rowthorn´s style counterpart. Focusing first on the original Kaldor-Verdoorn specification, there is an explicit increase in the value reported by estimated Verdoorn ´s parameters which is shared by all sectors but ITC which is slightly lower. This fact directly implies a reduction for the degree of returns to scale implied by TABLE1 for Total Economy, Services and Manufactures. However, for the latter these results seem still higher than estimations reported by previous studies. Turning onto Rowthorn ´s estimations in order to complete the picture, in line with former studies the reported estimations appear in direct contradiction to Kaldor-Verdoorn´s evidence. Recalling that the estimated parameters offer a direct measure of degree of returns to scale, obtained estimations implied values of v_2 suggesting decreasing returns for Total Economy and the 3 sectoral aggregates considered. Respecting their specific values, in line with the results obtained from the original specification, Manufactures presents the highest value while Market Services reports the lowest. Respecting ITC Services, although above Market Services, still reports a value, which is below the average reported by Total Economy, the remaining aggregate. Focusing on reported R-squared measures, by definition both specifications share the same value. Comparing obtained unadjusted R-squared values to their pooled equivalents, the value of Manufactures raises above 0.4, while ITC and Market Services reported similar but slightly lower values, implying decreased goodness of fit which should be related to the inclusion of determinist time-effects. As expected, adjusted R-squared reported values decrease dramatically, as a consequence of the reduction in the number of degrees of freedom caused by the inclusion of deterministic effects. The results were found above 0.3 associated to Manufactures and Market Services while for ITC, the adjusted R-squared reported a value just above 0.15, implying a deeper decline. However, this result is still statistically meaningful given the fact that a two-way effects specification implies a greater number of restrictions and the equivalent reduction in the number of degrees of freedom computed for calculating the statistic.

TABLE 2: PANEL EFFECTS ESTIMATIONS OF VERDOORN´S LAW (1980-2010)

KALDOR ESPECIFICATION, PANEL ESTIMATIONS				
Sector	*Total Economy*	*Manufactures*	*ITC-Servicies*	*Non-ITC Services*
Method	POOLED OLS	FIXED EFFECTS	TWO-WAYS	TIME EFFECTS
Intercept	0.002	N.A.	N.A.	N.A.
t-stat	1.063 (0.293)			
Coefficient (q)	0.7087	0.4526	0.7172	0.8311
t-stat	8.611 (0.000)	5.364 (0.000)	4.552 (0.000)	4.971 (0.000)
R^2	0.617	0.425	0.417	0.407
Adjusted R^2	0.609	0.307	0.155	0.308
ROWTHORN ESPECIFICATION, PANEL ESTIMATIONS				
Sector	*Total Economy*	*Manufactures*	*ITC-Servicies*	*Non-ITC Services*
Method	POOLED OLS	FIXED EFFECTS	TWO-WAYS	TIME EFFECTS
intercept	0.0055	N.A.	N.A.	N.A.
t-stat	2.763 (0.008)			
Coefficient (tfi)	0.8708	0.9382	0.5811	0.4897
t-stat	8.611 (0.000)	5.364 (0.000)	4.552 (0.000)	4.971 (0.000)
R^2	0.617	0.425	0.417	0.407
Adjusted R^2	0.609	0.307	0.155	0.308

Notes:—Values in parenthesis are associated p-values
By definition, t-stats and R^2 are shared by both equations
Two-ways estimation reports the within model
N.A. Non assignable

Recapitulating, reported estimations including deterministic effects, partially corrected the exaggeratedly high degree of returns to scale suggested by previous pooled regressions. Nonetheless, the inclusion of Rowthorn´s alternative specification of Verdoorn´s Law implied, as in the majority of previous studies, an inverse interpretation, suggesting decreasing returns for the 4 aggregates considered. In order to approach this paradox and following McCombie and de Ridder (1984), one appealing alternative is to consider instrumental variables –IV- techniques, as it would be suggested for regressions suffering endogeneity. Bearing in mind that Kaldor´s and Rowthorn´s reported estimations constitute the upper and lower bound for the interval where the real degree of returns to scale is comprehended (McCombie and de Ridder, 1984), certain convergence in their values is expected as a result of IV estimations. In a contradictory manner, when IV procedures have been implemented, the results did not converge as expected. This issue is closely related to difficulties finding reliable and meaningful instruments for the variables suffering endogeneity. Usually, the rank method has been applied in order to instrument the variables. This work, alternatively, taking advantage of the explicit inclusion of capital stock growth computes a more suitable candidate instead of own ranks: the growth of employment measured in total hours worked. That is, the original regressor proposed by Rowthorn´s will be used as instrument in our modified specification. Respecting the Kaldorian specification, on the contrary, this instrument does not constitute an effective alternative, as it would cause perfect multicollinearity. For that reason, we still apply the

rank method on total output growth rates in order to get robust instruments for original Verdoorn´s equations. Finally, regarding the econometric procedure, the selected IV-technique for all the panels was 2SLS, which implies a two-step sequence. First, endogenous variables are regressed on their instruments by OLS and obtained estimated parameters are preserved. Afterwards, the endogenous variables are substituted in our previous panel estimations by their equivalent estimated values forecasted from their first-stage associated regression. TABLE 3 reports the results of applying this procedure to previous panel-effects estimations.

TABLE 3: IV PANEL EFFECTS ESTIMATIONS OF VERDOORN´S LAW (1980-2010)

KALDOR ESPECIFICATION, IV APPROACH				
Sector	*Total Economy*	*Manufactures*	*ITC-Servicies*	*Non-ITC Services*
Method	2SLS-POOLED OLS	2SLS-FIXED EFFECTS	2SLS-TWO-WAYS	2SLS-TIME EFFECTS
Intercept	0.0012	N.A.	N.A	N.A
t-stat	0.596 (0.554)			
Coefficient (q)	0.7512	0.6762	1.1037	0.9344
t-stat	8.205 (0.000)	5.328 (0.000)	2.868 (0.008)	4.538 (0.000)
Instruments diagnostics				
Weak-instruments test	F = 199.727 (0,000)	F = 45.87(0.000)	F =155.986(0.000)	F = 59.647(0.000)
Wu-Hausman test	X^2 =1.161 (0.287)	X^2 = 9.15 (0.004)	X^2 =0.119 (0.732)	X^2 =3.615 (0.064)
ROWTHORN ESPECIFICATION, IV APPROACH				
Sector	*Total Economy*	*Manufactures*	*ITC-Servicies*	*Non-ITC Services*
Method	2SLS-POOLED OLS	2SLS-FIXED EFFECTS	2SLS-TWO-WAYS	2SLS-TIME EFFECTS
Intercept	0.0063	N.A.	N.A.	N.A
t-stat	2.957 (0.004)			
Coefficient (tfi)	0.8200	0.9853	1.2566	0.6233
t-stat	7.329 (0.000)	4.967 (0.000)	2.403 (0.023)	4.336 (0.000)
Instruments diagnostics				
Weak-instruments test	F = 211.899 (0.000)	F = 36.565 (0.000)	F = 50.844 (0.000)	F = 50.844 (0.000)
Wu-Hausman test	X^2 =1.169 (0.285)	X^2 =2.393 (0.129)	X^2 =1.632 (0.209)	X^2 =0.988 (0.326)

Notes: —Estimation method: 2SLS with panel effects.
Values in parenthesis are associated p-values.
Instruments: Rank of total output growth for every original specification and growth of employment for Rowthorn´s version.
Weak-instruments test: Computes a F test under the null of instruments robustness.
Wu-Hausman=a X^2 test comparing two specifications under the null of equal consistency of OLS and 2SLS
R^2 is not computable as usual for IV procedures.
N.A. Non assignable

Focusing first in the statistical benchmarks of our proposed instruments, employment growth rate and the rank of output growth rate cannot be rejected as robust instruments assuming any standard level of statistical significance, as the high value reported by all the weak-instruments F statistics confirm. In addition, a Wu-Hausmann test was performed in order to evaluate instruments consistency. The test is computed under the null of equal consistency between instrumental and non-instrumental variables. Thereby, if the null cannot be rejected assuming standard levels of statistical significance implies evidence against our instruments, given that for equal consistency OLS will be preferred as it is by definition more efficient. Keeping in mind this property, and lighting on reported statistics, instruments robustness will be confirmed, assuming again any standard interval of statistical confidence, for 7 out of 8 computed models. The only exception is constituted by the Rowthorn´s Style

specification of Manufactures, although evidence against its robustness is only weak, as the null could not be rejected assuming a stricter 5% level of statistical significance. Thus, we can assert that both employment and output rank are consistent and unbiased instruments. Turning to reported estimations, in respect to the original Kaldorian specification, estimated coefficients converged as expected reporting higher values for Total Economy -0.751- and our 3 sectoral aggregates –Manufactures: 0.676, ITC: 1.105, Services: 0.934-. The differences respect previous estimated parameters are wider for Manufactures and, to a certain extent, ITC Services, while for Market Services and especially Total Economy Verdoorn´s coefficients are only slightly different than their former values.

If we translate Kaldor-Verdoorn´s parameter estimations to implied degrees of returns to scale, the new associated values for ν_1 suggest major changes. In the case of Manufactures, a degree of returns to scale just above 1.4 implies a strong reduction, which now seems compatible to estimations reported by previous studies. Referring to Total Economy and Market Services, both sectors offer less remarkable reductions, although given their lower previous values, their IV reported estimation lay just above the frontier of constant returns to scale. At last, ITC Services associated estimation for ν_2 , unexpectedly turn from increasing returns to decreasing returns, although quite close to unitary constant returns, reporting a value of 0.93, which would be considered in depth below. On the other hand, Rowthorn´s inspired regressions reported generalized convergence towards their Kaldorian counterparts although heterogeneous among different aggregates. Recalling that Rowthorn´s coefficients offer a direct measure of degree of returns to scale, this convergence translates in higher estimated parameters. Focusing on Manufactures, the reported value 0.985 suggests an important increase pointing to constant returns to scale as the lower limit for Manufactures. Total Economy is the only sector which does not report a convergent value, reporting a slightly lower parameter. Market Services, on the other hand, reports an important increase from 0.43 to 0.69 although always within the frame of decreasing returns to scale. Concluding Rowthorn´s style estimations, ITC reports the higher increase of its parameter, even moving consistently beyond the frontier of increasing returns to scale. This last result, recalling its Kaldor´s style counterpart, seems to suggest that in certain cases, the use of instrumental variables can not only reduce the discrepancy between the two parameters but in addition to reverse parameters position as upper or lower limits of the real degree of returns to scale.

TABLE 4: DEGREE OF RETURNS TO SCALE UPPER AND LOWER BOUNDS FOR ALTERNATIVE SPECIFICATIONS AND PROCEDURES

	KALDOR-ROWTHORN DEGREE OF RETURNS TO SCALE INTERVAL							
	TOTAL		MANUFACTURES		ITC SERVICES		NON-ITC SERVICES	
	ROWTH.	KALDOR	ROWTH.	KALDOR	ROWTH.	KALDOR	ROWTH.	KALDOR
Non-IV degree of returns to scale (1)	0.871	1.411	0.938	2.210	0.581	1.394	0.490	1.203
IV degree of returns to scale (2)	0.820	1.331	0.985	1.479	1.257	0.906	0.623	1.070
Spread of non-IV interval (1)	0.540		1.271		0.813		0.714	
Spread of IV interval (2)	0.511		0.493		0.351		0.447	

Note:—The degree of returns to scale is directly meassured by Rowthorn´s estimated coefficients while for the Kaldorian version the degree of returns to scale is obtained as the inverse of its estimated coefficient.

As a useful corollary, TABLE 4 summarises estimated returns to scale for both Kaldor´s and Rowthorn´s panel-effects estimations before and after applying IV procedures. A shared feature could be highlighted in relation to all considered sectors: comparing panel-effects and 2SLS panel-effects estimations an important degree of convergence between Rowthorn´s and Kaldor´s values is observed in the latter respect to the former. This fact translates in narrower intervals for the real degree of returns to scale. The strongest evidence of convergence is reported by Manufactures where discrepancies reduce to less than a half of non-IV estimations. Services, both in its ITC and non-ITC branches offers also an important degree of convergence, where the amplitude of the interval reduces from 0.81 to 0.35 and from 0.71 to 0.45 respectively. Finally, Total Economy reports the weakest convergence between parameters from 0.54 to 0.51, an issue rooted in the limitations of our proposed instrument for total output growth which was, in line to previous studies, its own rank. Nonetheless, and especially in comparison to previous works, the obtained degree of convergence is more than satisfactory. In sum, Verdoorn´s Law seems to be confirmed at least in the case of Manufactures, reporting an interval between 0,985 and 1.479 and thus almost constant returns to scale as lower bound. Total Economy reports an interval between 0.82 and 1.33 suggesting constant returns to scale. Respecting Market Services, its non-ITC aggregate suggests the likely presence of decreasing returns to scale, reporting 1.07 and 0.62 as upper and lower bounds. Finally, respecting ITC Services, where increasing returns are expected to appear for certain theoretical perspectives, obtained results seems to support these views, although evidence is less clear than in Manufactures, a expectable result given the nature of ITC Services as aggregate, including highly dynamic branches involved in the ongoing digital revolution as well as more traditional branches subjects to the same kind of productivity drawbacks as the majority of services.

5. CONCLUSIONS

Drawing on the main stylized facts derived from this empirical research, three core conclusions have to be highlighted in our results. First and foremost, the central axiom of Verdoorn´s Law, which states the existence of dynamic increasing returns in Manufactures seems to be empirically confirmed for a panel of 8 members of the Euro Area. Second, turning to ITC Services they also suggest the presence of slightly weaker increasing returns to scale, thereby reinforcing the intuition that in post-Fordism, the digital economy occupies a fundamental place explaining economic growth. Third, respecting Total Economy and non-ITC Services, as expected, they suggest constant and decreasing returns to scale respectively.

Finally, regarding the robustness of these results, the sequential procedure applied through this study has allowed increasingly accurate estimations of the degree of returns to scale for each sector. This accurateness has been translated in an important convergence between Kaldor´s and Rowthorn´s parameters after IV techniques were applied. This success is also connected to our proposed specification of the Law explicitly considering capital stock growth and thereafter allowing the use of employment as a more efficient instrument than traditional ranks. After treatment, evidence of increasing returns seems to be strong in highly productive sectors, that is manufactures and the “new economy” represented in an important share by ITC activities. To sum up, the evidence presented in this work i the validity of Verdoorn´s Law for a panel of 8 Eurozone countries during the period 1980-2010, even considering the deadlock between Rowthorn´s and Kaldor´s specifications. Surprisingly, our sectoral analysis has shown that nowadays, increasing returns to scale are not confined exclusively in Manufactures but play in addition an important role in ITC Services.

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CHAPTER THREE

BALANCE OF PAYMENTS CONSTRAINT AND NON PRICE COMPETITIVENESS: EVIDENCE FROM THE ORIGINAL EURO AREA (1992-2016)

ABSTRACT

This paper focuses on the importance of external imbalances on growth performance and its close relation with the appearance of the Economic and Monetary Union –EMU. For that purpose, the original Eurozone members are considered in the context of a Balance of Payments Constrained Growth Model –BPCGM. Against the idealized convergent picture forecasted by mainstream neoclassical growth theory, BPCGMs and by extension this work, focus on demand as an effective upper boundary on productive supply growth and the importance of non-price-competitiveness in a long-run open-economy context. Thus, an adapted form of the original BPCGM model is estimated over a relatively long time-lapse of 25 years (1992-2016) for each original constitutive member of the Eurozone but Luxembourg. Our results show that long-run BPCGM forecasts accurately predicted annual average income growth rates in the majority of countries, suggesting the prevalence of Thirlwall's Law in the Eurozone context and the suitability of BPC models to understand the mechanisms leading to the recent European crisis.

Keywords: Eurozone; Convergence; Growth Theory; Thirlwall´s Law

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JEL classification: E12; O41

1. INTRODUCTION

As it has been explained in depth through the previous chapters, the original neoclassical Growth model proposed by Solow (1956) among others is characterised, in its canonical version, by a closed-economy framework and the undervaluation of demand factors in the explanation of output growth performance. Assuming Say´s law, economic growth is explained by supply factors, which generate, under competitive conditions, their own market-clearing properties. Built on these axioms, a more recent and radicalised approach, the so-called "Real Business Cycle Theory" (Lucas, 1980; Kydland and Prescott 1982), proposes to completely ignore external imbalances and to neglect the real effect of any kind of monetary policy. More formally, in a perfectly competitive world sustained by consistent agent-maximizing micro-foundations, cyclical fluctuations are thereby, assumed to be caused by exogenous stochastic shocks (Kydland and Prescott, 1982). In close relation, regarding economic policy, this perspective implies promoting market liberalization and openness in order to achieve boosted growth and convergence as a natural result of, first, the neutral character of technology and second, the diminishing marginal returns to scale allegedly characterising productive factors. The previous chapter focused on the limitations of neglecting increasing returns or its reduction to a purely supply-led phenomenon. In close relation, this chapter will try to discuss the limitations of the dominant framework, which neglects the importance of balance-of-payments -BPC- considerations to understand the determinants of long-run economic growth.

Against the usual closed-economy perspective characterising new and neo-classical views, this chapter takes advantage of the Kaldorian-inherited BPC approach which proposes an open-economy framework characterised by the existence of an external demand constraint imposing balanced trade. Since the first publication of Thirlwall´s original BPCGM model (1979), a wide range of empirical analysis has been applied within the BPC framework. The main corollary of the model, the so-called Thirlwall´s Law, states that the income growth rate of a country is given by the ratio between its growth rate of exports and its income elasticity for imports. Therefore, in its basics, Thirlwall´s Law constitutes a dynamic version of the well-known Hicks super-multiplier (Setterfield, 2011). The corollary of Thirlwall's law relies on two basic assumptions. The first one, which seems quite realistic, assumes that in the long-run no country can sustain ever-growing external deficits. Consequently, trade should be, in average, balanced (Thirlwall, 1979). The second one implies a much stronger axiom imposing the unimportance of price competitiveness determining economic growth in the long-run, or what is to say, the

asymptotic stability of relative prices. In spite of such a strong axiom and its inner simplicity, in most of the cases Thirlwall´s Law has found generalized support as a robust predictor of output growth[1] suggesting scenarios of persistent divergence which put under scrutiny core intuitions underlying the standard neoclassical growth theory and its self-balancing mechanisms beyond the increasing returns critique developed in the former chapter.

Furthermore, the main features characterising BPCGMs could be easily traced back to the centre-periphery scheme originally proposed by Prebisch (1956), visible head of The Economic Conference for Latin America – CEPAL- founded by United Nations in the aftermath of World War II. Within Prebisch´s scheme, the mechanism leading to divergence is virtually the same drawn by Thirlwall although developed in reference to trade specialization patterns instead of income elasticities of demand (Thirlwall, 2011). In short, it assumes the existence of a long-run trend worsening the terms of trade for the periphery due to the existence of uneven specialization patterns. On the one hand, an industrialized core producing complex goods –that is, characterised by a high elasticity of demand for exports. On the other, a periphery specialized in primary activities, which are associated, in average, to a lower income elasticity of exports. The result is a scenario where the ricardian principle of comparative advantage is absent and the gap between core and periphery countries could never narrow. Then, while for neoclassical inherited perspectives convergence between countries and regions would characterize the growth process; for BPCGMs, as in the Singer-Prebisch hypothesis, divergence is likely to be a dominant scenario. Thus, BPCGMs offer an interesting alternative to the usual neoclassical-inherited framework and its underlying assumptions while offering a more suitable background for econometric analysis than the original centre-periphery approach. Turning to Europe, if we focus in the recent European Crisis and its roots, the BPC approach appears as a strongly suitable candidate to analyse the divergent trajectories experienced by, broadly speaking, a resilient European core, and a dependant Mediterranean periphery. A picture where external imbalances played a key role as nowadays is widely accepted.

Up to the date, several individual countries of the Eurozone have been analysed estimating empirical BPCGMs, usually peripheral countries which are more likely to suffer a balance of payments problematic. Spain (Alonso, 1999; León Ledesma, 1999; Garciamartin et al. 2014), Portugal (Antunes and Soukiazis, 2011; Soukizis et al., 2013; Garciamartin et al., 2014) and Italy (Bagnai, 2016) have been individually considered respecting southern countries; while in reference to the European core at least Germany has received a detailed BPC analysis (Atesoglu, 1994). Respecting joint analysis covering groups of EU members, only Eastern European countries have been explicitly considered together as a specific unit (Bajo-Rubio, 2009) while in a handle of works a few

1 See Thirlwall (2011) for an extensive overview on BPC empirical studies.

EU countries have been included in wider samples (Alonso and Garcimartin, 1998; Lanzafame, 2014). If we include analysis constructed over a sectoral perspective, Romero and McCombie (2016) estimates BPCGMs for fourteen European economies, including many of our sample countries. Regarding the differences in respect to this last work, it restrains its focus to five main technological sectors and applies a different econometric perspective –panel and VECM- plus a different period of analysis which does not include the years after the crisis.

Thus, to our knowledge, the BPC framework has not been yet applied for the Eurozone neither as a whole unit for a period including the recent crisis nor applying a 3 Stages-Least-Squares approach allowing structural breaks as this work proposes. Thus, this study will analyse eleven original members of the Eurozone for a period which virtually covers since its design in Maastricht until nowadays (1992-2016). Estimating behavioural equations for imports and exports we will obtain the estimations of demand elasticities needed to calculate a slightly modified version of Thirlwall´s original BPC equilibrium growth rate. In order to present our findings, the remaining sections of this work are organised as follows: the next section will explain the formal mathematical development of the BPCGM. Section three will develop our applied methodology for testing the model while section four will present obtained empirical evidence. Finally, section five concludes and offers a few considerations on the importance of an external constraint over the growth process experienced by the members of the Eurozone.

2. THE BALANCE OF PAYMENTS CONSTRAINT GROWTH MODEL

More formally, beyond the similarities to the Singer-Prebisch hypothesis highlighted above, The BPC approach is derived from the ideas of Nicholas Kaldor on the importance of balanced trade along imports and exports behaviour as key elements explaining economic growth in the long-run (Kaldor, 1966). These intuitions were developed to overcome certain inner limits of his well-known interest on increasing returns and manufactures as core factors underlying regional growth performance (Kaldor, 1957). Following Kador's late works, (i.e. Kaldor, 1970), if we assume an open-economy framework the external sector becomes the key element restraining any virtuous growth circle as described in the previous chapter because the possibility of cumulative causation and increasing returns rest on exports performance and its compatibility within a balanced current account position. Soon after Kaldor's mainly verbal inquires on open-economy considerations, one of his most renowned followers, Anthony Thirlwall developed a straightforward mathematical model based on the importance of exports, imports and its interaction through the balance of payments current account (Thirlwall, 1979). Since

then, it has become the canonical starting point for more complex and developed models. Following Thirlwall, the simplest BPCGM only requires a set of three equations to be formalized. Two behavioural equations -exports and imports demand functions- plus an exogenous constraint: the balance of payments identity reflecting a current account equilibria. Mathematically, let us consider that both exports and imports are determined through their usual Cobb-Douglas formulation. Then, for a given country i , external demand functions can be written in the following manner:

$$X_t = e^{x_o} . \left(\frac{E_t . P_{ft}}{P_t} \right)^{\gamma_1} . Z_t^{\varphi_1} \qquad (1)$$

$$M_t = e^{m_o} . \left(\frac{P_t}{E_t . P_{ft}} \right)^{\gamma_2} . Y_t^{\varphi_2} \qquad (2)$$

Where X_t and M_t represent a given level of exports and imports at a certain t moment in time. x_0 and m_0 stand for an explicit inclusion of the autonomous increase of exports and imports respectively, as originally proposed by Blecker (1992). P_t represents the level of national prices while P_{ft} is a measure of an average price level for its foreign commercial partners. E_t stands for the nominal terms of trade where an increase of its value implies a national depreciation for a country i . Thus, the exchange rate is defined as units of external currency with respect to one unit of national currency. Consequently, γ_1 and γ_2 represent price elasticities of exports and imports respectively. Z_t stands for GDP growth for a given country foreign commercial partners and then φ_1 represents its elasticity. Finally, φ_2 represents the elasticity of imports respect to national income growth Y_t . In order to complete the model, a balance of payments constraint must be added to these behavioural equations, thereby, assuming the same notation:

$$P_t . X_t = \left(P_{ft} . M_t \right) . E_t \qquad (3)$$

Equation (3) is a standard current account identity where trade is balanced. Therefore, it imposes an equilibrium condition over equations (1) and (2) where the level of exports multiplied by the level of national prices has to be equal to the level of foreign prices multiplied by the level of imports and the exchange rate. That is, the external

sector must be balanced.[2] This strong axiom has to be considered in its specific context. We must bear in mind that the model was originally thought to evaluate long-run growth rates rather than absolute levels or short-run disequilibrium. Then, equation (3) should be read as reflecting long-run average/expected values. To obtain and analytical solution and following Thirlwall´s (1979) original proposal, equations (1), (2) and (3) should be rewritten evaluated on growth rates. Then, considering lower cases as logarithmic rates of growth, the model becomes approximately:

$$x_t = x_0 + \gamma_1 (p_{ft} + e_t - p_t) + \varphi_1 z_t \qquad (4)$$

$$m_t = m_0 + \gamma_2 (p_t - e_t - p_{ft}) + \varphi_2 y_t \qquad (5)$$

$$x_t + p_t = m_t + p_{ft} + e_t \qquad (6)$$

Equations (4), (5) and (6) replace previous equations (1), (2) and (3) by their logarithmic transformation differenced respect time. Afterwards, once we have obtained a system of linear equations, in order to solve the model and assuming income is the only dependent variable we have to substitute equations 4 and 5 into 6 and rearrange for y as the only component on the left hand side of the formula. Applying this procedure we get:

$$y_{tBPC} = \frac{(\gamma_1 + \gamma_2 - 1)(p_{ft} + e_t - p_t) + \varphi_1 z_t + (x_0 - m_0)}{\varphi_2} \qquad (7)$$

To describe the dynamics of the BPC equilibrium growth rate described by equation (7) we shall consider that price elasticities of demand γ_{i1}, γ_{i2} and income elasticises of demand φ_1, φ_2 are all expected to be, by definition, greater than zero. First, the growth rate of income positively depends on higher values of φ_1 and lower values of φ_2 on the side of non-price competitiveness. On the other hand, focusing on price-effects, we should assume that the Marshall-Lerner condition[3] holds, that is $(\gamma_1 + \gamma_2 - 1) > 0$. Then, a moderation of national prices respect to foreign ones along exchange rate falls would lead to higher equilibrium income growth rates. However, if we follow Thirlwall's original model price competitiveness is unimportant because relative prices are stable in the long-run, that is $p_{ft} + e_t - p_t = 0$. Alternatively, the same result could be obtained if

2 Although certain developments of the original model allow financial flows -see for instance Hussain and Thirlwall 1982, in our respect, from a theoretical point of view, what is interesting is that asymptotically E[P_it.X_it-(P_fit.M_it).E_it]=0 which is the mathematical counterpart of Thirlwall´s law axiom: "in general no country can sustain perpetual commercial deficits" (Thrlwall, 1979).

3 In its basics the Marshall-Lerner condition states that an exchange rate depreciation will only have a positive effect over the balance of payments if the sum of exports and imports price elasticities of demand exceeds unity.

we assume that price elasticities are inelastic and in the long run the Marshall Lerner condition is assumed to just meet[4] implying $(\gamma_1+\gamma_2-1)\approx 0$. As a consequence the price components of equation (7) disappears. Mathematically, including or ignoring the intercepts, the new solution becomes:

$$y_{itBPC}=\frac{\varphi_{i1}\, z_{it}+(x_{i0}-m_{i0})}{\varphi_{i2}}=\frac{\varphi_{i1}\, z_{it}}{\varphi_{i2}} \qquad (8)$$

And under the same assumption of price competitiveness unimportance, considering exports exogenously given, equation (8) can be approximately reduced to:

$$y_{itBPC}\approx\frac{x_{it}}{\varphi_{i2}} \qquad (9)$$

Equations (8) and (9) have become to be widely known respectively as the weak and strong versions of the so-called Thirlwall´s law. The Law is a main conclusion of the 1979 model and states that the equilibrium growth rate of a certain country is given by the ratio between the growth of its exports and its income elasticity of imports. Thirlwall (1979) estimated the associated BPC growth rate for a group of OECD countries during the post-war period showing that the law in general consistently predicted actual growth rates.

However, some authors criticised the fact that imposing a pure BP equilibrium, even in the long run, is a excessively strong assumption rarely met in reality. Soon afterwards, aware of this limitation, Thirlwall and Hussain (1982) developed an augmented BPC model where financial flows and current account imbalances are allowed in the long run. In this slightly different model, equations (3) and (6) are modified to allow financial flows:

$$(P_t . X_t)+F=(P_{ft} . M_t . E_t) \qquad (10)$$

$$(1-\theta)(p_t+x_t)+\theta . f=p_{ft}+m_t+e_t \qquad (11)$$

$$\text{where} \qquad \theta=(M P_f E-XP)/Y$$

Where F represents the total amount of financial flows balancing the current account, f stands for its annual growth rate and θ is the share of financial flows to GDP. Then, if we assume again that the Marshall-Lerner condition just meets, the stability of relative prices in the long run could be alternatively expressed as

4 Alternatively, it could be assumed that relative prices are stable in the long-run leading to the same conclusions.

$p_t = p_{ft} + e_t$. Finally, substituting equation (6) by (10) and recalling this last identity and after applying a few algebraic transformations the new solution for the BPCGM with Financial Flows is[5]:

$$y_{tBPCFF} = \frac{(1-\theta)(\varphi_1 . z_t) + \theta(f - p_t)}{\varphi_2} \qquad (12)$$

The value of θ is defined exogenously and could vary dramatically between countries or even for the same country through different historical periods. Nonetheless, we should still bear in mind the fact that although for short/medium run scenarios θ and *f* could offer values significantly different from zero, for larger periods of times their importance should be residual and therefore supporting the intuition of an Expected log-run equilibria in BP for a representative unit. Leaving aside these developments, it is important to highlight that a majority of studies focusing on the original and simplest BPC model have found econometric support for the Law in samples including both developed (Romero and McCombie, 2016) and developing countries (Hussain, 1999; Perraton, 2003). Other critiques to the approach have pointed to the lack of long-run information if estimations are based on specifications in growth rates rather than absolute levels. Nonetheless, as Alonso (1999) originally showed, if cointegration techniques are applied and implemented within an error correction model which considers both variables in levels and growth rates, obtained results only slightly differ from linear regression demonstrating Thirlwall´s Law strong resilience beyond the applied econometric procedure.

3. THE EUROZONE AS UNIT OF ANALYSIS: Overview and critique of a structurally rotten EMU.

The original Euro members are strongly suitable candidates to join a sample testing the performance of a BPCGM placed in front of the usual neoclassical paradigm. The Eurozone does constitute the most important modern attempt of building a Common Currency Area -CCA- between countries transgressing the traditional union among regions within a shared state-nation. However, such a pretentious plan also implied an important structural weakness: the Euro Area was the first Monetary Union which design ignored fiscal integration between its constitutive units. Thus, the so-called Economic and Monetary Union -EMU- has always been structurally incomplete. The suitability of that scheme was and still is a matter of spirited debate. For a majority of perspectives which are highly heterogeneous among them (i.e. Friedman, 1995; Krugman 2008) fiscal integration is a mandatory element for any Monetary Union trying to be sustainable in the long run. A kind of necessary condition in order to establish a relatively efficient and resilient CCA in what has become widely

5 We have ignored for simplicity the autonomous demands of exports and imports x_0 and m_0 respectively as the core dynamics of the BPCGM are preserved unaltered.

known nowadays as an Optimal Currency Area -OCA. In order to grasp the importance of fiscal integration we have to bear in mind that two of the most important instruments for any national economic policy were transfer under the control of new central authorities. That is, the determination of central interest rates through a national monetary policy and in close relation, the manipulation of the exchange rate in order to maintain or increase relative competitiveness at a national level.

In this scenario, assuming the absence of deep fiscal solidarity between members any shock associated to the adoption of a new currency will be assimilated in its totality by each individual country either via prices or via income. This latter form of adjustment would imply a narrowing national real income balancing monetary disturbances. Thereby, shock absorption through income is no more than the traditional mechanism underlying economic crisis and recessions, which is per se an undesirable effect. Considering these constrains characteristic of the Eurozone, the only remaining tool in order to manage asymmetric shocks would be constituted by prices and their adaptability. Precisely for that reason, European Institutions conceived an EMU rooted in two core axioms: the promotion of stable and flexible prices along the existence of sound public finances. Both principles were articulated in the Maastricht Treaty (1992) through the so-called Nominal Convergence Criteria -NCC. Grouped into five main branches, two of the criteria focused on achieving healthy public finances -establishing target ratios for public debt and deficit as share of GDP- while the three remaining criteria focused on the different dimensions of prices – that is, fixing targets for inflation, interest and exchange rates-. Although these criteria were only loosely met by the majority of EZ-12 countries shortly before the adoption of the Euro, the ulterior good performance in terms of income growth experienced during the lapse 2001-2008 by the EZ-12 and especially by some lagging countries as Spain and Ireland was understood by European Institutions and the majority on national governments as a reflection of the clear success of the CCA scheme designed a decade before.

TABLE 1: AVERAGE GROWTH RATES FOR SELECTED PERIODS

	Average income real growth rate				*Average External deficit/surplus as GDP %*				*Maastricht long run interest rates*			
	1992-2015	**1992-2000**	**2000-2008**	**2008-2015**	**1992-2015**	**1992-2000**	**2000-2008**	**2008-2015**	**1992**	**2000**	**2007**	**2012**
Austria	1.75%	2.37%	2.31%	0.58%	1.82%	-0.59%	3.45%	3.45%	7.37	5.56	4.3	2.37
Belgium	1.69%	2.06%	2.26%	0.75%	2.77%	3.06%	1.41%	1.41%	8.65	5.59	4.33	3
Finland	1.82%	2.81%	3.35%	-0.68%	4.38%	6.58%	0.79%	0.79%	11.98	5.48	4.29	1.89
France	1.50%	1.96%	2.06%	0.47%	0.12%	1.76%	-1.83%	-1.83%	8.59	5.39	4.3	2.54
Germany	1.28%	1.44%	1.55%	0.85%	3.51%	0.50%	6.07%	6.07%	7.84	5.26	4.22	1.5
Greece	0.67%	2.11%	3.87%	-3.98%	-7.87%	-7.78%	-6.65%	-6.65%	24.13	6.1	4.5	22.5
Ireland	5.07%	6.97%	5.57%	2.67%	13.84%	10.92%	16.95%	16.95%	9.07	5.51	4.31	6.17
Italy	0.59%	1.38%	1.45%	-1.06%	1.25%	2.69%	0.41%	0.41%	13.28	5.58	4.49	5.49
Netherlands	1.92%	3.19%	2.20%	0.35%	7.67%	6.13%	9.26%	9.26%	8.1	5.4	4.29	1.93
Portugal	1.17%	2.75%	1.48%	-0.72%	-6.68%	-8.26%	-3.87%	-3.87%	13.83	5.59	4.42	10.55
Spain	1.86%	2.43%	3.63%	-0.49%	-1.54%	-1.24%	-0.49%	-0.49%	11.72	5.53	4.31	5.85

Source: AMECO, EUROSTAT and own elaboration.

As it is shown in TABLE 1, which computes average growth rates of income for selected periods, for the European Institutions the years following the Euro adoption clearly drawn an orthodox process of income convergence between countries derived from deeper integration and increased competitiveness associated to growing integration in new markets free of tariffs and exchange risk. A narrative seemingly aligned with the orthodox ideas proposed by new-Classical economics: openness, flexibility and price stability as the basic recipe for growth and convergence. This explanation appears as reliable unless we choose to turn our focus over the foreign sector whose average growth rates are also shown in TABLE 1. This apparently successful CCA was in hand to massive external imbalances within a deeply polarized Union. Massive current account deficits appeared in southern countries while other group of countries, especially Germany, experienced important external surpluses. Thus, beyond simplifications, the newborn Eurozone was characterized by a highly contradictory dual scheme. On the surface, nominal interest rates -computed in the last array of TABLE 1- income convergence and sound finances called the tune. Underlying this picture, a highly heterogeneous EMU in terms of external performance and competitiveness. Briefly:

During the lapse 2000-2007 the economic performance of EMU members was determined by the shocks unleashed by the Euro adoption. On the policy level, as it has been highlighted above, the ECB centralized beyond national scope monetary policy while strictly constrained fiscal policy through NCC and by means of its direct inheritor, the Stability and Growth Pact, afterwards. On the monetary side, the convergence towards a common central interest rate fixed by the ECB implied, caeteris paribus, a deep fall of real interest rates for peripheral countries. Real interest rates dropped close to zero for these countries or even reached negative values in the case of Spain. In historical terms, it represented a massive cheapening of credit for their economies which was associated with two undesirable effects which resulted in huge external imbalances. On the one hand, low interest rates present a well-known positive feedback with inflationary pressures and raising wages. These

automatisms cannot be counteracted through exchange rate adjustments within a CCA and therefore weakened cost-competitiveness. In addition, focusing on productivity and investment trends, the effects of this exceptionally low real interest rates led to booming rates of return on internal sectors drawing a situation conceptualized as *capital miss-location* (European Commission, 2010). A concept which describes how naturally barred activities as real-estate offered artificially high returns attracting massive amounts of founding while more productive although competitively exposed sectors weakened suffering from lower founding and shrinking rates of profit. As a result, productivity and thereafter competitiveness became even more faint. However, as rates of return were attractive enough and financing relatively cheap credit kept flowing unaltered, increasingly deteriorating the current accounts of peripheral countries. As a counterpart, core countries and prominently Germany, experienced and almost opposite situation. The well-known contention of wages since 2000 along the presence of stable real interest rates sustained a path of increasing competitiveness, which was reflected in the form of growing current account surpluses. Savings, which were paradoxically used to finance peripheral banks need in an important share. Considered as a whole, these factors depict a Eurozone, which was developing over a threefold miss-conception embraced by European institutions:

1. Tight targets of public debt or deficit should not be a goal per se. Rather, sound public finances have to be understood as flexible tools promoting sustainable long-run growth. If we consider the fast deterioration of these ratios when the recent European crisis exploded -even if the previous decade was characterized by subsequent fiscal surpluses rather than expending frugality- we should notice that the stability of public earnings and its relation to the tax system or automatic stabilizers is at least as important as a short-run obsession against public debt and deficit.

*2. Prices are not even close to be perfectly flexibl*e. First, because lagging economies shocked by the monetary unification -that is, small economies – are surrounded by an important share of products whose prices are exogenously determined. Second, because one of the most important component of prices, wages, are in general sticky and resilient to fall.

3. Monetary policy does matter in the long-run. The determination of central interest rates is not a purely nominal phenomenon as it has consistent real effects in determining private investment and altering leverage, consumption and growth conditions both in the short and long run.

As a corollary, having selected the Eurozone as unit of analysis presents two important advantages both for the understanding of the recent crisis and to empirically test a BPCGM as the one proposed in this work. First, it

allows analyzing the demand imbalances ignored by European institutions and an important share of the academia within an alternative framework explicitly considering their importance. Second, taking advantage of covering a long time frame including almost a decade after the start of the crisis we are able to test the hypothesis that Thirlwall's Law, although temporally displaced by the doomed scheme of seemingly ever-growing peripheral deficits, still holds in the long-run as the massive income adjustments recently experienced by peripheral countries demonstrated. For these reasons we consider the BPC fram3work an strong analytical cornerstone in order to identify future imbalances before they could trigger any undesirable distorting effect.

4. METHODOLOGY

Our object of study will be constituted by, broadly speaking, the 11 original members of the Eurozone.[6] The analysed time lapse considers annual data of variables in level from 1992 to 2015 both inclusive, which reduces to 24 observations evaluated in growth rates. Respecting the primary sources of data, all the variables used throughout this work have been obtained from AMECO for the units and period defined a few sentences above.

Especial attention should be placed around how foreign variables -i.e. *z* and *rp*- have been computed, given the especial nature of our sample, covering a process of monetary integration monitoring all its main constitutive units. On the one hand, for the seek of simplicity the real evolution of relative prices are jointly considered directly obtaining from our primary data source historical series of Real Effective Exchange Rates taking again in consideration a set of 17 main partners. On the other hand our computation of z tries to reflect the fact that a great majority of trade is deployed inside an "inner-monetary trade". To grasp the importance of this phenomenon requires taking into account the importance of Eurozone-intratrade compared to total international trade for each given country. In practical terms, although the share of this ratio slightly differs between countries is almost always above 50%, more than half total transactions of international trade valuated in monetary terms. Taking into account this particularity, instead of computing a standard weighted index of main commercial partners our variable measuring the rate of growth of foreign income will be computed weighting the rates of income growth of the 10 remaining original Eurozone members. As a result, in addition of representing more than a 50% of its total foreign trade, the properties of this modified computation of *z* offer a higher suitability for being used as robust instruments for 2SLS estimations of imports equations .

Once we have defined our variables and their origin, a brief comment about its transformation is needed. As we have stated above, in order to estimate the model we first take natural logarithms of every variable and then they

6 That is: Belgium, Germany, Spain, France, Ireland, Italy, Belgium, Netherlands, Portugal, Austria and Finland and Greece.

are differenced respect the previous observation. Finally, considering that foreign and national prices along the exchange rate are exogenously given $\left(p_{ft}+e_t-p_t\right)$ is measured together as the exogenous evolution of relative prices pr_{it} . Consequently, equations 5 and 6 become directly estimable through OLS in the following form for each country:

$$x_t=\widehat{x_0}+\widehat{\gamma_1}\,pr_t+\widehat{\varphi_1}\,z_t+u_t \qquad (13)$$

$$m_t=\widehat{m_0}+\widehat{\gamma_2'}\,pr_t+\widehat{\varphi_2}\,y_t+v_t \qquad (14)$$

Where:

$$\gamma_2'=-\gamma_2$$

In order to estimate these equations, all the variables are required to be stationary in mean to avoid spurious regression. Consequently, the first step applied in this work will be an analysis of stationarity computing the Augmented Dickey-Fuller –ADF- procedure. In the cases where stationarity was absent, the presence of multiple structural breaks is tested taking advantage of the algorithm proposed by Bai and Perron (2003). In relation, If a break is identified, it would be treated through the inclusion of a time dummy. However, beyond this well-known problematic, this work grasps two usually ignored shortcomings when dealing with the estimation of exports and imports demand functions. First, both equations should have correlated disturbances due to the effect of economic cycles. This fact leads to inefficient OLS individual estimations, suggesting that both equations shall be estimated together taking into consideration the covariance matrix between the disturbances of exports and imports equations. Second, including income growth in the imports equation generates a problem of endogeneity, which needs the inclusion of instrumental variables in order to achieve consistent estimations. In this second case a 2-Stage Least Squares -2SLS- estimation is suggested while in the first, a Seemingly Unrelated Regressions –SUR- perspective, which is based on Feasible Generalized Least Squares –FGLS- estimations (Zellner, 1962), would be appropriated to manage correlation between exports and imports disturbances.

Both SUR and 2SLS approaches have been independently applied before in the context of BPC models (i.e. León-Ledesma, 1999; Antunes and Soukiazis, 2014). However, these perspectives have not been jointly considered yet. Fortunately, a 3SLS procedure which combines both 2SLS and SUR features can be easily implemented instead of OLS, 2SLS and SUR alternatives. This technique, originally proposed by Theil and Zellner (1962) applies an iterated version of feasible generalized least squares as in the SUR procedure but

computing as first step regressions 2SLS estimations of both exports and imports equations instead the usual OLS. As a consequence, parameters obtained by 3SLS are as consistent as 2SLS results and as observations increase, asymptotically more efficient than OLS (Zellner and Theil, 1962). On the theoretical side, a 3SLS procedure assumes the existence of a system a simultaneous equations rather than independent ones, for this work, the interrelation of exports and imports shown by their correlated disturbances. Thus, exports and imports are considered together as system for each individual country. Summarising, the results computed in the next section were obtained estimating 22 functions constituting 11 country-individual systems of structural equations. The basic specification of each model is shared by all units. The regressions were estimated using the statistical software R through its packages URCA and SYSTEMFIT.[7]

3. EVIDENCE

Turning to empiric analysis, our first step consists on benchmarking the suitability of the included variables for linear regression. Recalling that our model is computed in logarithmic first-differences, all our variables are required to be $I(0)$, that is, directly stationary in mean. To test the order of integration of our variables, the widely used ADF scheme testing the presence of a unitary root as null hypothesis has been applied. In respect to its possible specification, an equation allowing a drift with no time trend is proposed for all the variables. In addition, one lagged value was included in each estimation following Akaike´s Information Criteria -AIC. TABLE 2 computes a matrix of the resultant ADF statistics for each variable and country. Leaving aside Ireland particularities, where all the series consistently pointed to absence of stationarity, a general panoramic shows that, assuming the standard 5% of statistical significance, 47 out of 66 individual time series will reject the null hypothesis of unit root presence, more than a 70% of all series. If we relax the level of statistical significance to 10%, the number of series rejecting the presence of a unit root would increase over 50. A result consistently pointing to a majority of stationary series in an important majority of the cases. A remarkable output considering that our sample is strongly affected by the shocks unleashed after the start of the crisis in 2008.

7 R is a collaborative software which packages SYSTEMFIT (Henningsen and Hamann, 2007) and URCA (Pfaff, 2008) work under Open Source licenses, easing the replication of our estimations. Visit the project's webpage for more information: www.r-project.org.

TABLE 2: ADF UNIT ROOT TEST FOR 1992-2016 ANNUAL TIME SERIES

ADF Unit root test

		exports	*imports*	*rprices*	*income*	*fincome*	*consump.*
Belgium		-4.392	-4.729	-3.079	-3.700	-3.362	-4.668
Germany		-4.471	-4.658	-3.026	-5.244	-2.673	-4.967
Ireland		-1.404	-1.877	-2.295	-1.512	-3.392	-1.697
Greece		-3.170	-2.047	-3.154	-1.634	-3.560	-2.560
Spain		-2.783	-2.676	-4.078	-2.104	-3.680	-1.739
France		-3.018	-3.824	-5.121	-3.180	-3.410	-2.654
Italy		-3.781	-4.297	-3.212	-3.074	-3.441	-2.822
Netherlands		-3.351	-3.020	-4.209	-2.596	-3.439	-1.286
Austria		-3.822	-4.754	-3.463	-3.466	-3.371	-3.351
Finland		-2.519	-3.159	-8.636	-3.075	-3.378	-3.519
Portugal		-3.899	-2.276	-3.128	-1.988	-3.423	-2.269
critical values	*5%*	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00
	10%	-2.64	-2.64	-2.64	-2.64	-2.64	-2.64

Notes:—ADF Augmented Dickey-Fuller
Reported values are t-statistics. Null-hypothesis: the serie has a unit root
ADF Specification with intercept and no time trend for all the variables
One lag was included in every ADF specification following Akaike´s Information Criteria

However, this seemingly well-performing picture also presents important particularities. First, evidence of non-stationarity is concentrated in certain variables. Relative prices, foreign income and exports report the strongest evidence of stationarity where only Ireland consistently suggests the presence of a unit root. On the other, income, consumption and imports present a more mixed picture where 4 or more series resulted non-stationary in 4 or more cases. This fact is closely related to an even more remarkable characteristic: the concentration of non-stationary variables in peripheral countries. Headed by Ireland, where all the variables suggested the presence of a unit root, Greece, Portugal and Spain also offered evidence of I(1) processes for imports, income and consumption. In relative terms, it implies that only 4 series resulted non-stationary outside peripheral countries, an intuitive result given the depth and duration of the recent crisis for these members. Given this evidence, we can conclude that stationarity was absent fundamentally in peripheral countries for those variables implied in the estimation of exports equations. In this scenario linear regression is spurious unless the presence of structural breaks is taken into account. For that purpose we have followed an strategy consistent in a two step procedure. Firs, identifying the presence of multiple structural breaks in peripheral imports equations following the approach of Bai and Perron (2003) and second, including those breaks as time dummy regressors correcting the associated breaks.

Afterwards, once we have analysed the dynamic properties of the series, the next logical step in our scheme is to estimate through 3SLS 11 systems of 2 simultaneous equations respectively considering exports and imports. For each expression the value of its intercept and its estimated regressors are reported along their associated p-values. Taking into account that standard R-squared coefficients do not have their usual interpretation in a 3SLS

context, a McElroy R-squared[8] has been computed instead. These results are summarised in TABLE 3, which presents three blocks. A first one corresponding to estimated exports equations, a second one considering imports while the last block computes the most common diagnosis test for the adequacy of selected instruments and chosen estimation method are reported for each model. Starting from the joint goodness of fit of exports and imports equations measured by McElroy R-squared statistic, each country but Ireland -0.431- resulted in values above 0.5; 7 of them even above 0.65. The two top statistics were reported, after controlling structural breaks, in Spain and Portugal, where the degree of goodness of fit was fairly above 0.8. In sum, McElroy's R-squared suggested a high degree of linear bondness of fit for a great majority of cases.

Focusing on the first block of equations regarding the behaviour of exports, with the exception of Ireland[9] all the estimated income elasticities of exports were found statistically significant assuming any standard interval of confidence. The estimations of φ oscillate between a lower bound of 1.58 corresponding to Ireland and a maximum of 3.4 associated to Finland if we omit the Greek case where numerous structural break where present. Conversely, considering the effect of relative prices even assuming a narrower interval -0.90- only 3 out of 10 countries, obtained statistically significant parameters for price elasticities of exports. The most statistically significant results among price elasticities were obtained for Italy -any level of significance- followed by Spain -5%- and Germany -10%-. Two cautions have to be mentioned. First, although only 3 out of 10 countries reported statistically meaningful price effects for 2 out of 3 the Marshall-Lerner condition were close to just meet -cases of Spain and Germany- and therefore suggest that although price elasticities could be statistically meaningful in a few cases, they are often still ineffective altering in the long-run the BPC equilibrium growth rate. At last, the intercepts have to be understood as a structural trend -or autonomous component- boosting –if positive- or hardening –if negative- exports growth. Regarding our results, only Italy reported a negative autonomous effect, consistent to its known weak growth during the last decades. Among the positive intercepts, only Ireland suggests a clearly high value, although it shall be considered carefully due to poor statistical quality of regression, as has been highlighted above.

8 McElroy´s R-squared (McElroy, 1977) offers a measure of joint goodness of fit for a system of SUR or 3SLS equations.

9 Although Ireland´s well-known competitiveness of exports would suggest a greater foreign income elasticity of exports, its successful exports behaviour even during generalized crisis –implying negative foreign income growth rates- underlies the low estimation reported for Ireland´s income elasticity of exports.

TABLE 3: 3SLS ESTIMATIONS FOR IMPORTS AND EXPORTS EQUATIONS (1992.2016)

	Exports Equation			*Imports Equation*						*Diagnosis tests*			
	Int.	*z*	*rp*	*Int.*	*y*	*rp*	*dum(1)*	*dum(2)*	*dum(3)*	*McElroy R2*	*Weak Inst.*	*Sargan*	*Wu-Haus.*	*Hausman*
Belgium	0.01	2,028	0,414	0.00	2,521	0,243				0,611	50,142	0,057	2,810	0,015
		(0,000)	*(0,106)*		*(0,000)*	*(0,384)*					*(0,000)*	*(0,811)*	*(0,109)*	*(0,999)*
Germany	0.01	2,964	0,602	0.01	2,876	0,390				0,781	13,350	0,300	8,098	0,024
		(0,000)	*(0,060)*		*(0,000)*	*(0,181)*					*(0,000)*	*(0,583)*	*(0,009)*	*(0,999)*
Finland	0.00	3,423	0,426	0.02	1,672	0,066				0.659	73,752	4,272	0,761	0,061
		(0,000)	*(0,128)*		*(0,000)*	*(0,706)*					*(0,000)*	*(0,039)*	*(0,393)*	*(0,999)*
Nether.	0.02	1,876	0,154	0.01	1,789	0,140				0,589	103,477	7,298	0,203	1,6356
		(0,000)	*(0,457)*		*(0,000)*	*(0,465)*					*(0,000)*	*(0,007)*	*(0,656)*	*(0,950)*
Austria	0.00	3,009	0,294	-0.01	3,063	0,723				0,736	65,789	2,241	6,013	0,014
		(0,000)	*(0,260)*		*(0,000)*	*(0,026)*					*(0,000)*	*(0,134)*	*(0,023)*	*(0,999)*
France	0.01	2,217	0,0833	0.00	3,080	0,202				0,740	76,980	3,761	0,109	0,031
		(0,000)	*(0,722)*		*(0,000)*	*(0,254)*					*(0,000)*	*(0,0523)*	*(0,744)*	*(0,999)*
Italy	-0.02	2,993	0,691	0.01	3,132	-0,246				0,748	137,852	2,070	2,758	0,003
		(0,000)	*(0,002)*		*(0,000)*	*(0,155)*					*(0,000)*	*(0,150)*	*(0,112)*	*(0,999)*
Ireland	0.07	1.58	-0.36	0.05	0.97	-0.54				0.590	3.085	0.024	0.449	4.447
		(0.049)	(0.334)		*(0.008)*	*(0.048)*					*(0.069)*	*(0.878)*	*(0.511)*	*(0.727)*
Greece	-0.01	4.061	-0.028	-0.02	3.849	-0.128	-0.142	0.133	0.164	0.458	4.493	0.006	10.780	0.067
		(0.000)	*(0.897)*		*(0.002)*	*(0.299)*	*(0.416)*	*(0.099)*	*(0.038)*		*(0.027)*	*(0.937)*	*(0.004)*	*(0.999)*
Spain	0.01	2.301	-0.723	-0.01	3.400	-0.272		-0.051	0.087	0.840	98.305	2.281	5.965	12.869
		(0.000)	*(0.002)*		*(0.000)*	*(0.431)*		*(0.007)*	*(0.000)*		*(0.000)*	*(0.131)*	*(0.025)*	*(0.116)*
Portugal	0.02	2.14	-0.10	-0.01	3.080	-0.57	0.04	0.05	0.03	0.816	97.447	0.003	0.014	6.451
		(0,000)	*(0.756)*		*(0,000)*	*(0,069)*	*(0.029)*	*(0.001)*	*(0.019)*		*(0.000)*	*(0956)*	*(0.908)*	*(0.693)*

Estimation Method: 3 stage least squares (3SLS) in log-dif transformation for each variable
Signif. codes: 0 '***' 0.01 '**' 0.05 '*' 0.1 ' ' 1
Values in brackets are associated p-vales
McElroy R2 is a measurment of goodness of fit for a whole system of simultaneous equations
Nul hypothesis weak instruments test: Instruments are weak
Nul hypoothesis Sargan Test: The model is just identified (instruments are valid)
Nul hypothesis Wu-Hausman Test: OLS estimations are as consistent as 2SLS (non-endogeneity)
Nul hypotesis Hausman Test of adequacy: 3SLS estimations are as consistent as 2SLS (3SLS estimation is preferable)

Moving our focus onto the estimations obtained of imports equations we must recall that the presence of dummies accounting for structural breaks have been allowed a in the peripheral countries which reported absence of stationarity. Thus, starting by the values reported by the autonomous growth of imports, all the intercepts were found slightly positive with the exception of Spain and Austria, which reported values were minimally below zero, potentially implying a positive effect, which could modify equilibrium income growth rates. However the particularities of the intercept and its mandatory inclusion in any well-performing least-squared-based procedure, implies that any association of reported estimations of parameters x_0 and m_0 to economic regularities cannot be more than temptative. Regarding proper estimated regressors. Looking on income elasticities of imports, all the computed parameters were statistically meaningful assuming any standard level of significance and taking values between a minimum of 1.3 for Ireland and top values above 3 for Spain, Italy and France, pointing to structural dependency of southern countries while the remaining cases report values comprehended within these limits. Respecting estimations of price elasticities of imports, only the parameter associated to Austria -which p-value is below 0.03, reports a statistically significant result. However, this last issue is unsurprising considering the ambiguous effect of relative prices on imports compared to exports performance.

Focusing at last on reported diagnosis tests,[10] weak instruments F statistics suggest that, for every country, we cannot reject the null hypothesis of robust instruments assuming any standard level of statistical significance. In addition, Sargan test evaluates the validity of our instruments under a null hypothesis, which states that our model is over-identified. Reported results suggest that our selected instruments[11] are valid assuming any usual level of statistical significance. Going into detail the null-hypothesis of over-identification was rejected at a 1% for 6 out of 10 countries, while we could only assume a 5% of statistical significance for Finland and just a 10% for France. Instruments consistently pointed to miss-specification only in the cases of Spain and Netherlands.[12] Considering reported values for Wu-Hausman test, this statistic compares OLS and 2SLS specifications consistency under the null hypothesis that OLS is as consistent as 2SLS, implying evidence of non-endogeneity. For our sample, Germany and Austria point to strong evidence of endogeneity, assuming levels of 1% and 5% of statistical significance respectively. Lighting on remaining countries, Spain, France and Netherlands report p-values below 0.15, suggesting that endogeneity may by an issue while remaining cases are less clear. At last, Hausman test compares 2SLS and 3SLS under the null-hypothesis that both estimations are consistent, but if we bear in mind that 3SLS is asymptotically more efficient (Zellner and Theil, 1962), it would be preferable. The quite high p-values reported for all the cases indicates that our decision of taking into account cross correlation between the disturbances was consistent. In sum, our reported 3SLS systems of equations are in general characterised by strong goodness of fit, robust instruments and a consistent technique of estimation considering both endogeneity and cross-correlation between disturbances.

Moving to Thirlwall´s Law and its estimation, TABLE 4 computes our main findings. First, it reports national average actual growth rates for the period 1992-2016 in the first column. The second row offers its associated BPC equilibrium growth rates derived from the equations presented in TABLE 3 which value is given by the expression $\hat{y}_{BPC} = \left[\left(\hat{x}_o - \hat{m}_o \right) + \hat{\varphi}_1 z \right] / \hat{\varphi}_2$, which is no more than our proposed version of Thirlwall´s Law.[13]

10 Weak instruments, Wu-Hausman and Sargan test have been applied over intermediate 2SLS estimations of imports equations, as it is the relation assumed to present endogeneity within our framework.

11 Consumption and foreign income growth have been chosen as instruments of national income, while remaining exogenous regressors of imports and exports are considered self-instruments for themselves.

12 Although Sargan´s Test strongly suggests over-identification in both Austria and Spain, given that consumption and foreign income still are strong instruments of income in imports equations they are preserved for comparability purposes.

13 Although Thirlwall´s Law is usually computed as the original x/φ placing growth of exports rather than an estimated parameter on the upper side of the formula, this procedure is not costless as price-competitiveness could be influencing its behaviour (Setterfield, 2011). Thus, the version of Thirlwall´s Law included in this work represents its “strong” form.

And in case financial flows are allowed it becomes $\hat{y}_{tBPCFF}=\frac{(1-\theta)(\widehat{\varphi_1}.z_t+\hat{x}_o)+\theta(f-p_t)-\hat{m}_o}{\widehat{\varphi_2}}$ In order to test its adequacy, the parametric test proposed by McCombie is reported in the 3rd array. As stated above, McCombie´s Test is constructed over a t-test working under the null hypothesis of equality between the empirical elasticity $\varphi_{i2}=y_i/x_i$ and its associated estimated parameter which has been obtained from forecasts of the original TL.

TABLE 4: ACTUAL VS PREDICTED AVERAGE GROWTH RATES (1992-2016)

	Actual y	*TL*	TL+FF	$\widehat{\varphi_{i2}}$	φ_{i2}	*t-stat*	*p-value*
Austria	1.90%	1.90%	1.89%	3.009	2.549	-1.093	0.285
Belgium	1.78%	1.78%	1.84%	2.028	2.185	0.199	0.843
Finland	2.18%	2.14%	2.46%	3.423	1.103	-2.144	0.042
France	1.35%	1.35%	1.35%	2.218	3.138	1.6201	0.119
Germany	1.55%	1.55%	1.42%	2.964	3.647	1.234	0.23
Greece	1.27%	1.56%	1.12%	2.706	2.637	-0.1261	0.9007
Ireland	5.27%	5.14%	5.00%	2.109	2.183	0.064	0.95
Italy	0.45%	0.46%	0.43%	2.993	2.884	-0.068	0.946
Netherlan	1.87%	1.87%	1.87%	1.876	1.923	0.068	0.946
Portugal	1.74%	1.68%	1.56%	1.187	1.122	0.2663	0.7924
Spain	1.85%	1.84%	1.84%	1.919	1.842	-1.485	0.1509

Source: AMECO and own estimations

$\widehat{\varphi_{i2}}$ φ_{i2} are estimated and actual import elasticities of income

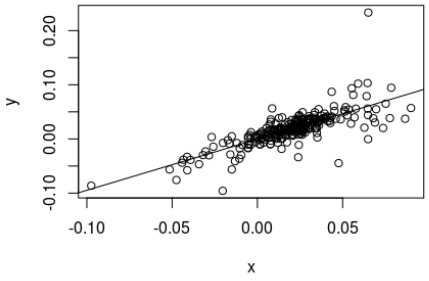
Finally, the last column plots each corresponding t-statistic and its associated p-value. Preliminarily, a common feature must be highlighted for 10 out of 11 countries constituting our sample for the original TL: the equality of empirical income elasticities of imports and their equivalent estimations implied by the BPCGM cannot be rejected assuming any standard level of statistical significance. The only exception is constituted by Finland, Greece and France, although if we relax the confidence interval it would imply that the null is not rejected assuming a 1% level of statistical significance.

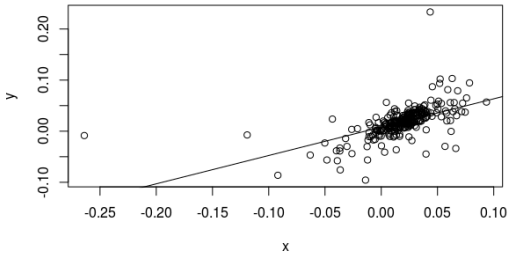
Concerning the goodness of fit reported values by estimated TL growth rates respect to actual values, 8 countries reported an estimated rate which deviation from the real value was below 0.2 points, measured in absolute terms. The widest deviation was computed for Portugal, which reported a deviation above 0,5 while the narrowest deviation of less than 0.02 percent points pertains to Spain. Respecting a possible sample bias towards deficit or surplus units, 5 individual estimations were slightly above actual rates while the remaining 5 forecasts were below actual rates. In addition, the estimations of TL allowing the presence of financial flows reported next to the original TL reported in general only slightly different forecasts, which were worse than the ones offered by the original in more than half of the cases. A scenario which reinforces the intuition that TL prevails in the long

run. Thereby, our estimations seem generally robust and absent of sample bias, making suitable for a purely parametric joint test as the one proposed originally by McGregor and Swales.

TABLE 5: MCGREGOR AND SWALES CROSS-SECTION POOLED REGRESSION

Thirlwall's Law (left plot) and Thirlwall's Law including financial flows (right plot)





	Thirlwall's Law		**Thirlwall's Law +FF**	
	intercept	*coefficient*	*intercept*	*coefficient*
n of obs 264				
value	-0.00050	0.94212	0.00796	0.55479
tstat	-0.322	19.205	4.411	11.161
R Squared	0.5847		0.3223	
Residuals	*statistic*	*p-value*	*statistic*	*p-value*
Residual sum of sq.	0.102371		0.167051	
Residual mean	1.08E-19		2.24E-19	
Jarque Bera Statistic	6316.9	0.000	3838.7	0.000

McGregor And Swales (1985) proposed test of pooled linear regression goodness of fit

At last, these intuitions, which are individual in nature, need to be complemented through a joint perspective, which may be approached implementing the parametric test proposed by McGregor and Swales (1985). As it was explained in the former section, this test proposes to regress annual growth rates on their equivalent annualized BPC estimations. Therefore, this procedure practically computes a pooled cross-country regression which interpretation is straightforward: if the computed intercept is not significantly different from zero and, on the other hand, its estimated predictor coefficient does not differ significantly from unity, we could not reject the hypothesis that BPC estimated values are robust predictors of actual growth rates. In the case of our dataset, considering that our sample is constituted by a cross-section of 11 countries and 24 observations per unit, the test will be performed considering 251 observations, assuring certain statistical power. Thus, after pooling our sample and applying this methodology we obtained the estimated regression reported in TABLE 6. Considering first the original TL and its general goodness of fit, the reported regression is characterised by a high R-squared

around 0.6, which implies a relatively good adjustment considering the importance of annual fluctuations. Beyond this surface, a more detailed analysis requires to focus on reported regression parameters.

First, placing our view on the estimated intercept, it resulted neither statistically significant nor different from zero, reporting a value below 0.000. On the other hand, the estimated regression coefficient for BPC predictors was significant for any standard level of significance –the computed t-stat is higher than 19– and its estimated value was slightly minor than unity, reporting a value of 0.942. This proximity to a perfectly unitary coefficient in hand to an R-squared around 0.6 suggest, given the unbiased nature of the sample and the relatively high number of observations, evidence in favour of BPC forecasts reliability for the Eurozone. Conversely, if we turn our attention of the results reported by TL when financial flows are allowed, the performance is quite disappointing reporting a R-squared just above 0,30 and the coefficient of regression of 0,55 associated to a lower t-statistic of 11.16. This evidence points to an excessive sensibility of TL in the short-run if financial flows are included worsening its predictive capacity. Considering these results, the prevalence of TL and the minor role of financial flows modifying long-run equilibrium growth rates is again suggested.

Analysing these results in relation to previously reported country-individual forecasts, the obtained equation of regression seems to reinforce that results considering a stricter joint perspective. Thereby, this last test offers additional evidence in line to the axioms characteristic of the BPC framework: the centrality of non-price competitiveness and a balanced external current account in the long-run. A corollary, which seems to outperform conventional analysis in their understanding of the uneven growth performance exhibited by Eurozone´s members in recent times.

4. CONCLUSIONS

The first contribution of this work is related to its estimation procedure. The joint estimation of imports and exports behaviour as a system of simultaneous equations for the 11 original Eurozone countries through 3SLS has allowed estimations which are more consistent and asymptotically more efficient than OLS, SUR or 2SLS alternatives, the usual estimation techniques applied for previous BPC studies. In addition, regarding obtained econometric results, the contribution of this work is twofold. On the one hand, estimated elasticities highlighted the importance of non-price competitiveness computing statistically significant results for income elasticities of demand of exports and imports while price-competitiveness estimated coefficients resulted in general statistically not significant. Thus, the strongest axiom of Thirlwall´s Law which states the unimportance of price-competitiveness in the long-run seems to be confirmed for the Eurozone. On the other hand, regarding the

forecasting robustness of Thirlwall´s Law, estimated BPC equilibrium growth rates correctly predicted actual GDP growth rates of Eurozone´s members. Even more, the allowance of financial flows did not seem to play in the long run altering TL equilibrium growth rates. This conclusion has been reached following two different methodologies. At a country-individual level and following McCombie´s procedure, forecasts were statistically significant in all cases, assuming the strictest level of statistical confidence in nine of them. Respecting a joint cross-country analysis of the Eurozone, McGregor and Swales pooled test reported an intercept, which was not significantly different from zero and a regression coefficient close to unity, which was meaningful for any level of statistical significance, suggesting the suitability of BPC equilibrium estimations as robust predictors of income growth rates within our sample. Summarising, this research presents evidence in favour of the two fundamental axioms underlying Thirlwall´s Law: the unimportance of price-competitiveness in the long-run and the existence of a balance of payments restriction working as constraint. As a consequence, convergence among European countries is no more a naturally expected outcome but a possible scenario among others where growth paths depend on internal and external non-price competitiveness or what is to say: the cross-relation between income elasticities of imports and exports as a core element explaining growth performance.

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1. Technical Annex I: Allowing the presence of multiple structural breaks in behavioural equations at undefined dates.

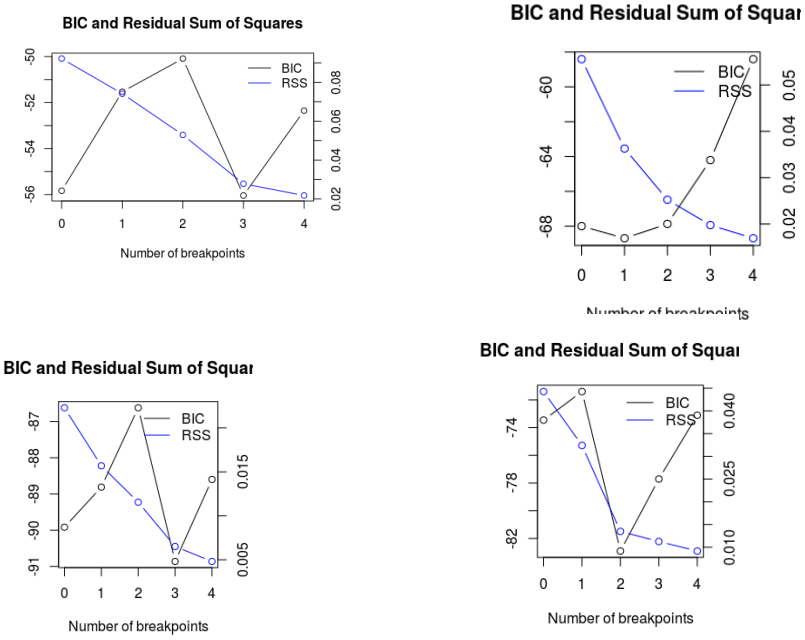
There are a few alternative approaches to estimate structural breaks, although some of them imply important advantages. For instance, as this work does, following the approach of Bai and Perron (2003) allows the simultaneous estimation of multiple breakpoints. To understand its logic let us assume a standard linear model expressed in matrix form:

$$Y_i = x_i^T \beta_j + u_i \qquad \text{for} \qquad (i_{j-1}+1 \ldots i_j)(j = 1 \ldots h+1)$$

Given a segment size h establishing the maximum number of breaks the algorithm for computing the optimal number of breakpoints given the number of potential breaks is based on a dynamic programming approach rooted on Bellman's principle. Assuming that the RSS diminishes as the number of computed breaks grows, the procedure of Bai and Perron determines the optimal number of breaks as the one which minimises the Bayes Information Criteria -BIC-. Given this rule of thumb, Graphs A1 to A4 reports the optimal number of breaks associated to each country.

GRAPHS A1-4: IDENTIFYING THE OPTIMAL NUMBER OF BREAKS

Order: Greece, Ireland, Portugal and Spain



The procedure proposed by Bai and Perron (2003) also allows to date the identified optimal number of breaks suggested by the BIC. Therefore, considering the information contained in the preceding graphs TABLE A1 computes the associated optimal breakdates and their corresponding year of apperance.

TABLE A1 : DATING BREAKS

	break at observation number			corresponding to years		
break nº	1	2	3	1	2	3
Greece	3	9	18	1994	2000	2009
Ireland	10				2001	
Portugal	4	11	20	1995	2002	2011
Spain	8	18		1999	2009	

As expected, the Euro adoption and the start of the recent crisis were in general the events unleashing instability in the peripheral countries considered. Finally, once both the optimal number of breaks and their associated dating have been computed, the associated treatment to identified breaks would be the inclusion of time dummies in the affected equations. The only necessary caution is to keep in mind that the breaks are identified at the start of the observation and it should be included in the corresponding time dummy.

CHAPTER FOUR

BALANCE OF PAYMENTS CONSTRAINT MODEL WITH TECHNOLOGICAL COMPETITIVENESS AND CUMULATIVE CAUSATION: CONSTRUCTION, DYNAMICS AND EVIDENCE FROM SEVEN EUROZONE COUNTRIES

ABSTRACT

This article proposes a new open-economy growth model in Kaldorian lines. The aim of the model is to offer a consistent solution to the deadlock characterising the relation between two well-known Kaldorian growth models: the balance of payments –BPC- and cumulative causation –CC- approaches. While certain reconciliations have been proposed, up to the date, there is no agreement around how to solve the issue surrounding the role of relative prices. Our proposal, inscribed in this debate, lights an unexplored alternative: introducing technological-competitiveness while dropping price-competitiveness from the set of behavioural equations describing the short-run dynamics of the model. As a result, beyond the proposed formalization itself, this work implies two other important contributions. First, long-run transitional dynamics and the existence of a stable steady-state solution will be formally analysed. Second, the model will be estimated for a sample of seven Eurozone countries over the period 1980-2010 as a benchmark of its empirical performance.

Keywords: Growth Theory, Endogenous Growth, Kaldor, Schumpeter

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1. INTRODUCTION

Since the mid-eighties, the interest on increasing returns within economic theory has been steadily growing. This turn took place after a long period characterised by the monolithic prominence of Solow's growth model (Solow, 1956) which states, in its canonical form, the existence of diminishing returns to productive factors and constant aggregate returns to scale respectively. Against this view, building on the original intuitions of Young (1928), Romer (1986, 1990) and Lucas (1988) proposed a new family of models characterised by a redefined notion of capital allowing the presence of aggregate increasing returns. To achieve this result, they explored alternative possibilities to incorporate mechanisms leading to increasing returns within Solow's original frame. These models, widely known as Endogenous Growth Models –EGM-, were built under the shared intuition that technological change, which is explicitly exogenous in Solow´s growth model, should be considered, instead, endogenous. Afterwards, this view was theoretically refined in accordance with traditional Schumpeterian intuitions on technological change and the notion of creative destruction (e.g. Aghion and Howitt, 1992). Complementing this view, on the other hand, a second important challenge to Solow's model appeared beyond the traditional boundaries of pure growth theory. Certain researchers on international trade theory came to the conclusion while analysing specialization patterns, that without taking in consideration the role of increasing returns it would be almost impossible to understand the generally accepted presence of spatial clustering or agglomeration economies (Krugman, 1989, 1991). Branded as New Economic Geography -NEG, this rising perspective constituted a kind of cornerstone for modern trade theory. However, these pair of perspectives although sharing their microeconomic foundations are far from being two related faces of a common framework. First, endogenous growth models are usually conceived within a closed-economy one-sector world while New Economic Geography stylizations relies just on the opposite. In addition, their focus strongly diverge from technological spill-overs in EGM to trade and localisation in NEG. As a result, although individually promising, there exists a relative isolation between these critiques from a theoretical point of view.

Fortunately, besides this relatively new interest on increasing returns demonstrated by neoclassical economists, there is an alternative long tradition analysing the importance of returns to scale in capital accumulation dynamics. In its basics, the importance of increasing returns can be traced back, at least, to Adam Smith or even the physiocrats. Through his Magnus Opus, *The Wealth of Nations* (Smith, 2003), Smith remarkably refers to the importance of the extent of the market as a fundamental engine to achieve a vigorous capital accumulation. The idea is straightforward: an increased aggregate demand –i.e. market extent- is the key which allows increased labour-division, growing specialization and thus, boosted labour productivity. More recently, although clearly still predating neoclassical EGM, Kaldor (1966, 1970) and some of his most renowned followers (Dixon and Thirlwall, 1975) proposed -either verbally or mathematically- growth schemes built on the presence of

increasing returns to scale. Taking advantage of Verdoorn's Law (Verdoorn, 1949), which states a positive causal relation between income growth and productivity growth, the so-called Kaldorian Growth Models –KGMs- usually proposes cumulative causation –CC- circuits as an alternative demand-led view on endogenous growth. The idea of CC originated in Myrdal (1957) one of Kaldor´s closest fellows. Broadly speaking, Myrdal traced a picture where economic growth and development are historical results where previous success feedbacks present economic growth. Accumulation becomes self-reinforcing and path and therefore, virtually leading to divergence among countries and regions.

For the purpose of this paper, this alternative approach presents two important advantages in front of its neoclassical counterparts. First, in opposition to EGMs, KGMs explicitly adopt an open economy framework characterised by an export-led accumulation process. Second, KGMs take into consideration the importance of sectoral structure, especially focusing on manufactures, while EGMs, as highlighted above, root their conclusions in one-sector/commodity stylizations. Unfortunately, the Kaldorian perspective still presents an important shortcoming, which gives meaning to this research. It is widely accepted that there are at least two related but independent families of KGMs. The first one, inherited to the original Dixon and Thirlwall (1975) formalization quoted above constitutes the canonical CC growth model. The second perspective in consideration appeared rapidly after the publication of the CC and was developed by Thirlwall (1979) and his BPC model; the same author involved in the aforementioned model. This new proposal explicitly solves a well-known shortcoming of his 1975 model: the erogeneity of imports behaviour and the absence of any reference to balance of payments problematics. Nonetheless, the solution offered by Thirlwall in his 1979 model openly refutes its elder relative. In a few words, whereas the original CC model relies on price competitiveness to set up a cumulative causation scheme, BPC models base their main conclusion just on the opposite: the unimportance of price competitiveness in the long-run. This problematic, although previously considered by certain studies (e.g. Blecker, 2009), is far from getting a consensual solution and constitutes the starting point of this work.

Therefore, our proposal implies a twofold contribution to previously existing literature on KGMs and endogenous growth. First, after explaining in their basics both CC and BPC growth models in the next section, this paper will propose a new model combining characteristic features of both CC and BPC that is: a feedback between Verdoorn´s and Thirlwall's laws. For that purpose, section 3 develops a model where the original price-competitiveness mechanism is replaced in exports equation by the Schumpeterian notion of technological competitiveness (Farenberger, 1988). Afterwards, following the proposal of Blecker (2009), CC features are considered expanding the original BPC model through the inclusion of an innovation-expanded version of Verdoorn's law. At last, concluding section 3, the dynamic and steady state properties of this new model are derived, showing its conditional convergence properties and the possibility of path dependant development. As a

second main contribution, section 4 will propose an estimation framework to test the performance of the model based on the ARDL approach to cointegration proposed originally by Pesaran and Shin (2001). Subsequently, section 5 will compute the results of estimating these three structural equations for a sample of seven European countries and thirty over a period of 30 annual observations (1980-2010) obtaining their associated augmented Thirlwall's Law equilibrium growth rates characteristic of the model. Finally, after analysing the country-individual performance of the model and the robustness of forecasted growth rates, section 6 concludes and draws certain lines for a future research agenda.

2. KALDORIAN GROWTH MODELS: AN OVERVIEW

The canonical version of a CC growth model was first verbally exposed by Kaldor in its annual inaugural lecture at Cambridge (Kaldor, 1966), building on Myrdal (1957) original ideas. Soon afterwards, the scheme proposed by Kaldor was developed into a proper mathematical model by Dixon and Thirlwall (1975), two of his closest fellows. In its simplest version, the model relies in three basic stylized facts, which summarise the kernel of late Kaldor´s though on growth and development. First, economic growth is considered as a fundamentally export-led process. Given the assumption that exports are the only truly autonomous component of aggregate demand, income will growth proportionally to exports behaviour. Second, exports are afterwards conceptualised as determined by two complementary factors: price competitiveness and non-price competitiveness. Regarding the latter, it could be measured as the income elasticity of demand of external income growth. Additionally, respecting price competitiveness, it might be measured through the evolution of the Real Effective Exchange Rate –REER. Thereafter, assuming inflation evolves at a growth rate measured by the difference between the growth rates of wages and labour productivity, the introduction of a cumulative causation mechanism would be straightforward. To illustrate this, let us define a third regularity: There exists a positive causal relation between income and labour productivity rates of growth, the so-called Verdoorn's Law. Together, these three axioms imply that a reinforced growth of output[1] could lead, through the effect of Verdoorn's Law, to boosted productivity growth which, ceteris paribus, would increase price-competitiveness and thus exports growth rate. As a result, income growth rate would be boosted, reinforcing again Verdoorn's Law in a causative loop drawing a path dependant scheme of development. Mathematically, Dixon and Thirlwall (1975) showed that Kaldor´s view could be easily synthesised in a system of three structural equations, which could be written as follows:

$$y = \alpha x \qquad (1)$$

$$x = \varepsilon z + \tau (q - w + p(f) - e) \qquad (2)$$

$$q = \lambda_0 + \lambda_1 y \qquad (3)$$

1 Although Verdoorn's Law was originally confined to manufactures, the CC growth model usually relies on total output growth. See for instance Thirlwall (2014).

Where lower case letters represent logarithmic growth rates and Greek letters are parameters. y represents income growth rate and $x$stands for exports growth rate. In the second equation z is foreign income growth rate while $q, w, p(f)$, and e are productivity, wages, foreign prices and nominal exchange rate growth rates respectively. Consequently,$\varepsilon$and τ are non-price and price elasticities $\lambda_0$is a constant and $\lambda_1$stands for Verdoorn's Law coefficient. Recalling these definitions, in order to obtain a solution for the model we have to substitute equations (2) and (3) into (1) and rearrange for output growth rate, thus:

$$y^E = \frac{\alpha\left[\varepsilon z + \tau(\lambda_0 - w + p(f) - e)\right]}{1 - (\alpha\tau\,\lambda_1)} \qquad (4)$$

Equation (4) constitutes the standard solution for the CC model. Assuming that exogenous variables grow at a stable rate and ignoring $\lambda_0$the solution depends exclusively on the values of elasticity parameters. In a few words it implies that a national or regional growth rate will depend positively in the values of any of these parameters if the stability condition $(\alpha\tau\,\lambda_1)<1$ is met. However, only a few years after the development of this model, an important critique was placed against it by one of its original authors (Thirlwall, 1979). Briefly, the original CC model over-predicted actual growth rates when applied empirically to samples of countries. According to Kaldor's early self-critique, this fact was related to the absence of an imports equation or a balance of payments constraint in the original model. In order to solve this shortcoming, two new relations have to be included in the original CC model:

$$m = \psi y + \theta(q - w - p(f) - e) \qquad (5)$$

$$x + p = m + p(f) - e \qquad (6)$$

Equation (5) describes import behaviour and replaces (1) in the original model while (6) is added as a fourth equation working as a constraint imposing a balanced foreign sector. Until this point, both BPC and CC models seem compatible, but Thirlwall proposed an additional axiom for the BPC model: the unimportance of price competitiveness in the long-run. Adducing good reasons for this assumption,[2] the consequences of its adoption are disastrous for the Verdoorn mechanism allowing a CC process as it becomes purely superfluous. To grasp this outcome let us assume that the original CC model is working under this axiom. Algebraically, replacing equation (1) by (5) and (6) the solution defined by equations (1-2-3-5-6) collapses to a new equilibria described by:

$$y = \frac{\varepsilon z}{\psi} \approx \frac{x}{\psi} \qquad (7)$$

2 The unimportance of price competitiveness could be derived from either its long-run stability or under the assumption that the Marshall-Lerner condition just meet.

Equation (7) is the main corollary of Thirlwallś 1979 model and has become to be widely known as Thirlwall's Law. This regularity which states that a national/regional equilibrium growth rate is shaped by the ratio between its exports growth rate and its income elasticity of imports. Although this Law is based on a strong assumption it has usually found an important degree of empirical support (e.g. Thirlwall, 2011). However, as highlighted before, this good performance also constitutes an important problematic for the working of the original CC model, as its cumulative features chaining exports behaviour and Verdoorn's Law were built over the importance of price competitiveness as transmission mechanism. A few previous researchers have analysed or proposed solutions to this well-known problematic (Setterfield, 2011; Romero and McCombie 2016). Nonetheless, in our view, previous attempts to solve this dilemma have been only partially successful. First, they have not embraced a general model combining BPC and CC features as Blecker (2009) suggested. Second, in previous reconciliatory attempts, cumulative causation is allowed to keep holding by means of redefining exports rather than reconsidering Verdoorn's Law itself. Third, these proposals have been generally constrained to the theoretical field without empirically testing their performance. Given that deadlock, this article's main objective will be to fill this triple gap. First, proposing a mixed BPC-CC formal sche where Verdoorn's and Thirlwall's law are successfully combined. Second, incorporating the notion of technological competitiveness to export and explicitly considering the role of innovation on Verdoorn's Law. Finally, a last and third step will estimate the model for a sample of seven developed European countries through a 30 years lapse (1980-2010). As starting point, In order to deploy these novelties, the next section will formally develop our proposed BPC-CC mixed model.

3. RECONCILING THIRLWALL'S LAW AND CUMULATIVE CAUSATION: A KALDORIAN-SCHUMPETERIAN VIEW

Our model is constituted by three behavioural equations; exports and imports equations describing what could be named National Demand Regimes –NDR- and the latter, Verdoorn's Law, trying to grasp the importance of what could be defined as a National Productivity Regime -NPR. Beyond these three equations the model is closed imposing one restriction: the balance of payments equilibrium identity. All of them are conceived to be formed by variables in annual levels. Beginning by its standard features taken from previous Kaldorian models, imports behaviour and the balance of payments identity are directly inherited from the canonical BPC model, thereby:

$$M_t = \Gamma_0 Y_t^{\psi} R^{\theta} \qquad (8)$$

$$X_t = \frac{M_t}{R_t} \qquad (9)$$

Where capital letters are former variables evaluated on levels and Γ_0 is an exogenous constant which could be

alternatively included as an exp() function allowing the presence of an intercept in the regression in log-differences. Parameters have been assigned following the same notation present in previous specifications. In addition, as price-competitiveness will not be the mechanism allowing cumulative causation in this model, prices are measured together as one variable: the exogenous evolution of the real effective exchange rate R_t. The two remaining equations present important differences respect their standard Kaldorian counterparts. Respecting exports, following the approach proposed in a recent work by Romero and McCombie (2016) this work adopts a functional form including Schumpeterian features under the notion of technological competitiveness. However, our proposed equation differs from Romero and McCombie´ one in two important respects. First, it drops price competitiveness from exports specification in line with Thirlwall's Law intuition. Second, it includes TFP rather than labour productivity as a proxy for both quality and technological competitiveness. Bearing in mind these remarks, our exports function could be expressed as:

$$X_t = \Omega_0 Z_t^{\varepsilon} TFP_{|M|t}^{\delta} \qquad (10)$$

Where $\Omega_0$is an exogenous constant and the usual notation for non-price competitiveness is preserved. Regarding the second component, which stands for technological and quality competitiveness, $TFP_{|M|t}$ computes TFP levels in manufactures and δ is its associated elasticity. As it is easily perceived, this specification, seeking simplicity, does not consider innovation openly. On the contrary, this feature will be characteristic of our proposed cumulative causation engine in Verdoorn's Law. Regarding this last equation, in the spirit of Leon-Ledesma (2002) CC model, this work proposes to expand the traditional specification of Verdoorn's Law through the inclusion of a mechanism of innovation. However, differing from Leon-Ledesma previous work and following Angeriz et al. (2009) rather than including a new equation for innovation, research and development is incorporated itself in an augmented version of Verdoorn's Law. A mechanism fulfilling the requirements may be formalized in the following manner:

$$TFP_t = \Phi_0 RD_t^{\pi} Y_t^{\lambda} \qquad (11)$$

In this last equation RD_t stands for euros per capita in real terms expended in research and development, consequently the parameter represented by λ measures the importance of relative innovation in our augmented version of Verdoorn's Law. Respecting the traditional Verdoorn´s coefficient, in order to allow cumulative causation and to avoid the well-known problematic concerning simultaneity, aggregate output growth is included as regressor instead of its relative constrained to manufactures. At this point, once we have defined each behavioural equation individually, to get a form suitable to obtain an analytical solution, let us take logarithms and first difference equations (8) to (11), which become:

$$m_t = \psi y_t + \theta r_t \qquad (12)$$

$$x_t = \varepsilon\, z_t + \delta\, tfp_{|M|t} \qquad (13)$$

$$tfp_{|M|t} = \lambda\, y_t + \pi rd \qquad (14)$$

$$x_t = m_t - r_t \qquad (15)$$

Bearing in mind that lowercase letters stands for log-dif transformed variables and all previous notation still holds, it is straightforward to derive an equilibrium growth rate for this model. Let us substitute equations (13) to (15) into (12); afterwards, rearranging for income growth as the only element in the left hand side we get:

$$y_t^E = \frac{\left[(1-\theta)\, r_t + \varepsilon\, z_t + \delta\pi\, rd_t\right]}{\psi - \lambda\delta} \qquad (16)$$

Equation (16) describes a BPC-CC static equilibrium growth rate which value depends positively on the values of $\varepsilon, \delta, \pi, \lambda$and negatively on $\theta$and ψ. That is, there is a positive feedback among innovation, Verdoorn's law and boosted exports feeding a process allowed to be self-reinforcing. On the other hand, respecting relative prices, it effect in this model is clearly negative although softer as consequence of dropping its presence from exports, while income elasticity of imports is, as expected in Thirlwall's Law, the main constraint on economic growth. However, in order to build a complete picture of the model we have to understand its transitional properties and thereby we have to make it dynamic. For that purpose we assume that total output reacts lagged one year in Verdorn´s law. This axiom is not a mere tool in order to make the model dynamic but it also has solid theoretical foundations. Considering that capitalists behave following adaptive expectations, they do not raise salaries immediately as in a perfectly competitive environment, but rather, supply adjustments follow lagged to demand, as in the original Cobweb model (Kaldor, 1934). This argument could be linked to the fact that the growth of wages –which underlies by identity TFP growth- occurs as consequence of past increases of demand rather than simultaneously. Considering this modification, the solution of the BPC-CC model becomes:

$$y_t = \frac{\left[(1-\theta)\, r_t + \varepsilon\, z_t + \delta\pi\,(rd_t)\right]}{\psi} + \frac{\lambda\delta}{\psi}\, y_{t-1} \qquad (17)$$

Equation (17) transforms the former equilibrium into a difference equation. In order to describe its dynamics, first we have to rewrite it as a expression where *y* is independent from its own past values. This characteristic can be achieved obtaining a cumulative function by infinite recursion, that is:

$$y_t = \left(\frac{\lambda\delta}{\psi}\right)^t y_0 + \left[\frac{(1-\theta)\, r_t + \varepsilon\, z_t + \delta\left[\pi\, rd_t\right]}{\psi}\right] \cdot \sum_{i=0}^{t-1} \left(\frac{\lambda\delta}{\psi}\right)^i \qquad (18)$$

Finally, in order to obtain a proper solution of equation (18), we have to assume that $0 < \left(\frac{\lambda\delta}{\psi}\right) < 1$to guarantee the existence of a solution in the real plane. As a result, applying the properties of infinite series to equation (18)

it becomes:

$$y_t^E = \left(\frac{\lambda\delta}{\psi}\right)^t y_0 + \frac{(1-\theta)r_t + \varepsilon z_t + \delta[\pi rd_t]}{\psi - \lambda\delta} \qquad \text{for } t \to \infty \qquad (19)$$

Equation (19) transition dynamics towards a stationary state depend in the long-run evolution of $\left(\frac{\lambda\delta}{\psi}\right)^t$ and its speed converging to zero. However, for this model, the likely prevalence of non-explosive growth dynamics -which also are the norm empirically -does not imply the prevalence of economic convergence. Unlike Solow's model and in line to Kaldor´s thought, the stability of the model would not necessarily imply narrowing differences in the growth rate of income among countries or regions. To illustrate this let assume that $\frac{\psi}{(\lambda\delta)} > 0$, in that case as t approaches infinity we have:

$$\lim_{t \to \infty} \left(\frac{\lambda\delta}{\psi}\right)^t = 0 \leftrightarrow \frac{\psi}{(\lambda\delta)} > 0 \qquad (20)$$

Under this condition, equation (19) collapses to a stationary state solution described by equation (16). Therefore, this model, as it is generalized within the Kaldorian tradition, can easily derived conditional convergence properties. Nonetheless, a divergent picture can be also conceived, following Setterfield (2011), assuming a unit root in the growth process, that is $\left(\frac{\lambda_1 \delta}{\psi}\right) = 1$, implies that initial conditions will be always present, suggesting a clear example of path dependant economic growth. Thus, values of $\left(\frac{\lambda\delta}{\psi}\right)$ close to one will imply a slow speed of convergence while values close to zero will suggest faster convergence rates.[3] Finally, although the possibility of explosive growth could exist if $\left[\frac{\lambda\delta}{\psi}\right] > 1$, it would imply explosive growth and ever-growing differences in income growth rates, which is a phenomena empirically unobserved. Nevertheless, the best benchmark in order to describe the actual dynamics of our proposed model will be to estimate it for a representative sample as the next section proposes.

3 We are always referring to convergence in growth rates, which is a weaker notion than the traditional convergence in levels implied by Neoclassical Theory.

4. ESTIMATION METHODOLOGY: ARDL APPROACH TO COINTEGRATION

A sample of eight[4] developed European countries has been chosen to test the performance of our mixed BPC-CC model. Equations will be estimated over a period of 30 annual observations since 1980 until 2010. All the variables used has been directly obtained from AMECO and EUKLEMS Project Database with the exception of research and development –RD- measures. The latter have been obtained from EUROSTATS and then constructed as the ratio between national per capita expenditure on RD and a foreign proxy computed as a weighted average of the remaining six sample countries per capita expenditure on RD. Respecting the estimation of exports and imports equations, in line with a great majority of recent literature (Araujo and Lima, 2007; Romero and McCombie 2016), we decided to rely on the properties of cointegration[5], useful for preserving long-run information contained in variables in levels which is lost in a standard regression in differences.

Traditionally, the equations derived from Kaldorian growth models as the ones described in section 3 have been usually estimated through standard linear regression of first-differenced variables. However, although this procedure is correct if included first-differenced variables are I (0), it implies losing all the long-run information potentially contained by variables in levels leading to an important risk of miss-specification.

There are a few different approaches to cointegration developed during recent years, (i.e. Engle and Granger, 1987; Johansen 1988). However, the approach proposed by Pesaran and Shin (2001) presents certain important advantages in front of other alternatives (Nkoro and Uko, 2016):

- *More robust than alternative approaches for small samples.*
- *Allows to combine I(0) and I(1) processes or even fractional orders of integration contained within both extremes.*
- *Relatively robust against endogeneity given the inclusion of the lagged dependant variable as regressor.*
- *Whenever we face a single cointegrating vector, this procedure solves the problem of identifications associated to VARs and by extension to the Johansen cointegration procedure.*

Thus, considering its flexibility and adaptation to small samples, the Pesaran-Shin procedure will be applied to the three behavioural equations describing our model. The approach is based on the properties of a single dynamic equation model: the autoregressive distributed lag -ARDL- and its re-parametrization in the form of ECM. In a few words, an ARDL model is simply a linear equation where both lags from the exogenous and dependant variables are included as regressors. The simplest case, an ARDL (1,1) with only one lag and one

4 Austria, Belgium, Finland, France, Germany, Italy, Netherlands and Spain.

5 In a few words, two variables are cointegrated if a linear combination of them is stationary see Engle and Granger (1987) for a detailed explanation.

exogenous regressor may be expressed as follows:

$$y_t = \Phi\, y_{t-1} + \Theta_0 x_{t-1} + \Theta_1 \Delta x_t + u_t \qquad (21)$$

where x is a exogenous I(1) variable describing a random walk:

$x_t = x_{t-1} + v_{(t)}$

Therefore, x first difference $\Delta x_t = v_{(t)}$is a straightforward I(0) white noise variable. The ARDL cointegration approach is based in two re-parametrizations of equation 14 known as the Unrestricted and Restricted Error Correction Model -UECM and RECM in following references. Obtaining an UECM the preceding ARDL (1,1) is a straightforward transformation. Recalling that the difference operator satisfies by definition $\Delta y_t = y_{(t)} - y_{t-1}$ after a bit of algebra over equation 12:

$$\Delta y_t = -(1-\Phi)\, y_{t-1} + (\Theta_0 + \Theta_1)\, x_{t-1} + \Theta_1 \Delta x_t + u_t \qquad (22)$$

which could be simplified if it is rewritten as:

$$\Delta y_t = \alpha\, y_{t-1} + \Theta\, x_{t-1} + \Gamma \Delta x_t + u_t \qquad (23)$$

Thus, equation 14 is a reduced form of 13 assuming that $\alpha = -(1-\Phi), \Theta = (\Theta_0 + \Theta_1)$and $\Theta_1 = \Gamma$. In addition, A cointegrating relationship between both variables could be expressed in a simple manner as: $y_t = \beta\, x_t$or what is to say:

$$y_t - \beta\, x_t = 0 \qquad (24)$$

Equation 24 is the long-run cointegrating equation between two (I) variables in levels. This information can be estimated easily incorporated to equation 22 rearranging its terms in the following form:

$$\Delta y_t = \alpha(y_{t-1} - \beta\, x_{t-1}) + \Gamma \Delta x_t + u_t \qquad (25)$$

Where $\beta = -\left(\frac{\Theta}{\alpha}\right)$. Equation 16 is the usual ECM representation as described by Engle and Granger (1987). In our context constitutes the restricted form -RECM- of equation 10 as it presumes the existence of a cointegrating relationship described by the Error Correction Term -ECT α. The procedure described by Pesaran et al. (2001) taken advantage of the equations above requires a few basic steps. First we must choose the ARDL (p,q) structure which will be used to describe our model. In our case, where observations are >30, no additional lags where conceivable as we would reduce even more the small number of degrees of freedom of the F statistic characteristic of the bound test. Then, if the results suggest so, it will be estimated in a UECM form as the one described in equation 23. Once we have chosen the appropriate lag structure for the ARDL, the bound test approach to cointegration is straightforwardly described as a combination of three consecutive steps.

(i) First, we have to Estimate an Unrestricted ECM (ARDL) in the form of equation 23 according to our

proposed lag structure.

(ii) Afterwards, a F test has to be applied restricting lagged variables to 0 as null hypothesis. The obtained F statistic should be contrasted against the tables of critical values provided by Pesaran and Shin (2001) or Narayan (2005) in the case of small samples

(iii) Finally, if the applied bound test suggests the presence of a cointegrating vector, an usual RECM as the one depicted by equation 25 is estimated. In order to do so, α would have to be obtained incorporating the residuals of $y_{t-1} - \beta^{x}_{t-1}$ obtained from the UECM of the first step regression onto the standard regression in first differences. On the contrary, if the bound test is unable to identify any cointegrating relationship, a usual regression should be performed once we have assured that no long-run information is lost.

Once these last step is performed, we would have obtained the short and long-run parameters characterising the three behavioural equations of our model. In order to empirically estimate our model, described by equations 12-15, only the short-run parameters will be needed. At last, to commute forecasts of the income growth rate our model, we do not need to assume Thirlwall's strong axiom that long run $ree\, r_{it} = 0$. Instead, although price competitiveness is still unimportant for exports behaviour, our estimated output growth rate for the model will be defined as:

$$\hat{y}^{e}_{it} = \frac{\left(\hat{\varepsilon}_i z_i + \left(1 - \hat{\theta}\right) r_t + \hat{\delta}_i \hat{\pi}\, rd_i\right)}{\hat{\psi}_i - \hat{\lambda}\, \hat{\delta}_i} \qquad (26)$$

Equation 26, which constitutes an augmented form of the original Thirlwall's Law, describes what could be concisely named an Augmented Thirlwall's Law –henceforth, ATL. Finally, in regard of the statistical framework used to perform estimations, all reported values have been obtained using R and its package URCA designed for cointegration and unit root analysis.[6]

5. EVIDENCE: EIGHT EUROZONE COUNTRIES AS EMPIRICAL BENCHMARK (1980-2010)

Although the approach proposed by Pesaran and Shin does not require pre testing the stationarity of included variables, it is still a recommendable step in order to discard the presence of I(2) trend variables. This procedure is required for variables considered in exports and imports as well as for Verdoorn's Law equation. In addition, it is well known that $I(0)$ stationary variables are expected to avoid spurious linear regressions. Given the nature of our included variables, taken in natural levels, both characteristics could be meet at the same time if suggest the existence of stationarity after applying a logarithmic first different transformation on them. TABLE 1 performs this transformation and analyses the presence of a unit root for each country variables evaluated in

6 Further information in packages used on R framework could be found in Pfaff (2008) and Croissant and Milos (2008) for URCA and PLM features respectively.

growth rates. The applied procedure to test the presence of a unit root has been the usual Augmented Dickey Fuller -ADF- and in all the cases, following Akaike's Information Criteria, only one lag was included in each specification.

TABLE 1: TIME SERIES UNIT ROOT TESTS

ADF STATIONARITY ANALYSIS

period: 1980-2010	*lags: 1*						
variable	*Exports*	*Imports*	*REER*	*RD*	*TFP*	*Income*	*Foreign I.*
Determ. C.	*NONE*	*DRIFT*	*NONE*	*NONE*	*NONE*	*DRIFT*	*DRIFT*
Austria	-1.762	-3.565	-2.954	-1.670	-2.114	-2.479	-2.739
Belgium	-1.387	-2.517	-5.239	-2.449	-2.252	-2.640	-2.726
Finland	-1.758	-2.587	-4.859	1.408	-1.955	-2.666	-2.757
France	-1.342	-2.043	-3.225	-2.574	-2.365	-1.701	-3.081
Germany	-2.126	-3.245	-3.805	-3.467	-2.326	-3.143	-1.672
Italy	-1.748	-2.656	-2.995	-2.326	-2.957	-1.289	-2.854
Netherlands	-1.426	-2.737	-4.337	-4.013	-2.668	-3.120	-2.742
Spain	-1.356	-1.384	-2.657	-2.614	-2.765	-1.804	-2.310
10% critical value	-1.61	-2.6	-1.61	-1.61	-1.61	-2.600	-2.6
5% critical vaule	-1.95	-2.93	-1.95	-1.95	-1.95	-2.93	-2.93

Notes:—ADF: Augmented Dickey-Fuller Test
Null Hypothesis: The serie has a unit root

Focusing first on exports behaviour, the null hypothesis of a unitary root could only be rejected assuming a 5% of statistical significance for Germany while assuming a 10% of statistical significance Belgium, France Netherlands and Spain do not consistently point to stationarity. Regarding imports, the picture is similar in general. Germany and Austria reject the null assuming a 5% of statistical significance while remaining countries but France report values close to the 10% boundary of statistical significance. On the other hand REER, relative RD and TFP suggest the strongest evidence of stationarity. For REER and TFP, the null of non-stationarity is rejected in all the cases assuming a 5% of statistical significance while for relative RD only Finland does not suggest stationarity. Respecting income, national measures suggest stationarity at a 10% level of statistical significance in four cases and assuming a 5% for Germany. The remaining units, France and Italy, point to the existence of a unit root. At last, turning onto foreign income, only Germany does not seem to report a stationary behaviour. In sum, and considering the limitations of a sample including seven individual countries, we can assume that the majority of the series evaluated in growth rates were $I(0)$ allowing to perform the ARDL cointegration procedure.

The first cross-country group of behavioural equations analysed was the one constituted by imports which results have been summarised in TABLE 2. The first array of this table reports the ARDL regressions associated to the

first step of Pesaran and Shin (2001) procedure to analyse cointegration. Although the estimated parameters will not be used for forecasting purposes, it is still interesting to report a general overview. Focusing first on lagged variables in levels and assuming the common 5% level of statistical significance x out of x , b out of b and c out of c estimated parameters reported statistically significant estimations. In addition, the majority of significant estimations were condensed in a few countries while other units reported These results suggest a mixed picture were, as we are going to demonstrate, such intuition was confirmed after the application of cointegration bound tests.

TABLE 2: IMPORTS ARDL COINTEGRATION ANALYSIS

	ARDL (UNRESTRICTED ECM)			PESARAN ND SHIN BOUND TEST				REST. ECM / REGRESSION IN DIF.		
	Regressors	**Estimate**	**t.value**	**Res. RSS**	**Unres.RSS**	**F**	**Chisq**	**Regressors**	**Estimate**	**t.value**
AUS	c	2.7763	2.8006	0.0298	0.0165	**6.1422**	**18.4266**	c	0.0154	0.2064
	M(-1)	0.8595	4.1949					y	2.0526	4.6514
	Y(-1)	-1.6618	-4.1992					e	-0.5652	-1.6955
	E(-1)	0.5245	3.2590					ECT	-0.0026	-0.2889
	y	1.7173	4.8977							
	e	-0.4053	-1.4948							
BEL	c	4.5707	3.1004	0.0114	0.0075	**3.9474**	**11.8421**	c	0.0226	0.4408
	M(-1)	0.6088	3.3237					y	2.4382	9.2901
	Y(-1)	-1.2826	-3.3687					e	0.0184	0.1368
	E(-1)	-0.0952	-0.9030					ECT	-0.0039	-0.6174
	y	2.1681	8.6499							
	e	0.1083	0.8955							
FIN	c	1.3164	1.4544	0.0255	0.0200	**2.0842**	**6.2526**	c	-0.0030	-0.4149
	M(-1)	0.3888	1.9039					y	1.9474	10.8035
	Y(-1)	-0.6819	-1.7886					e	-0.2239	-2.4666
	E(-1)	0.1370	1.5016					ECT	-	-
	y	2.0314	11.1615							
	e	-0.3450	-3.0982							
FRA	c	-1.6570	-0.5706	0.0143	0.0124	**1.1694**	**3.5081**	c	-0.0135	-1.7851
	M(-1)	-0.0554	-0.3525					y	2.9485	8.3768
	Y(-1)	0.2071	0.4938					e	0.2176	0.8702
	E(-1)	0.0970	0.4978					ECT	-	-
	y	3.0267	8.2763							
	e	0.0593	0.2115							
GER	c	-0.5572	-1.0966	0.0436	0.0245	**5.9973**	**17.9919**	c	0.0336	0.2867
	M(-1)	0.3414	3.5195					y	1.6146	2.2059
	Y(-1)	-0.5890	-3.2554					e	-0.6059	-2.9133
	E(-1)	0.6430	4.1084					ECT	-0.0003	-0.0229
	y	1.1939	5.0141							
	e	-0.2986	-1.7098							
ITA	c	4.6471	2.0561	0.0323	0.0221	**3.5541**	**10.6623**	c	-0.1680	-1.6204
	M(-1)	0.4172	2.5086					y	3.0827	7.8817
	Y(-1)	-1.0039	-2.3058					e	0.0246	0.1999
	E(-1)	0.0588	0.7952					ECT	0.0203	1.5829
	y	3.2696	9.3840							
	e	-0.0423	-0.3637							
NED	c	2.6953	1.1435	0.0094	0.0083	**0.9990**	**2.9969**	c	0.0001	0.0116
	M(-1)	0.3094	1.3945					y	1.9854	9.9345
	Y(-1)	-0.6264	-1.3643					e	0.0181	0.1367
	E(-1)	-0.1086	-0.5870					ECT	-	-
	y	1.9662	7.4553							
	e	0.1163	0.6625							
SPA	c	0.7826	0.5230	0.0463	0.0273	**5.3247**	**15.9741**	c	0.0905	1.9352
	M(-1)	0.0817	1.0060					y	3.7775	9.5134
	Y(-1)	-0.3576	-1.7172					e	-0.0523	-0.2433
	E(-1)	0.2455	1.4188					ECT	-0.0243	-2.8190
	y	3.9589	5.9297							
	e	-0.1432	-0.5001							

Pesaran and Shin (2001) Cointegration analysis procedure

Critical values for bound test taken from Narayan (2005)
case iint. no trend k=8 n=80

	10.00%		5.00%	
	Lower B	Upper B	Lower B	Upper B
F →	2.676	3.59	3.272	4.31

ECT: Error Correction term
For the t-test the usual critical values applies → 1.72(5%)
1.32 (10%)

The second array of rows report the F statistics needed to perform the bound test. Additionally, the associated X^2statistic has been reported as well for comparative purposes, even if for small samples we assume it is biased towards over-acceptance of the null-hypothesis of the existence of cointegration. Assuming a broad 10 % of statistical significance 5 out of 8 countries reported and F statistic above the value of lower bound limit. If we

narrow significance to a 5% the same 5 cases persist, even 3 of them above 4,31, the upper bound at a 5% of signification. As a consequence, 5 second step estimations were performed under the form of a RECM assuming the existence of a long-run cointegrating relationship while the remaining 3 cases -Finland, France and Netherlands- were estimated applying the usual linear regression in first differences as the existence of a long-run relationship could not be inferred.

These second step estimation results are reported in the third array of rows of TABLE 2. The obtained short-run parameters will be the ones used later to perform forecasts while an additional error correction term coefficient is reported for the cases where cointegration was identified. Starting by these cases, only 1 ECT reported a meaningful coefficient assuming a 5% confidence or 2 increasing it to 10%. Regarding the signs, 4 out of 5 cases reported values between 0 and -1 as expected for a long-run stable relation while the case of Italy was the only exception reporting a positive value and a relatively high t-stat. Turning properly to short-run coefficients, reported income elasticities of imports were in general, as expected, highly meaningful for all the individual cases assuming the strictest level of statistical significance. Regarding the range of their values, income elasticities of imports moved within a reasonable interval where the case of Netherlands -1.98- constituted the lower limit and Spain -3.7 reported the upper value. On the other hand, the picture offered by the elasticities estimated for the real effective exchange rate was clearly more heterogeneous. Only 1 -at a 5%- or 2 cases -at a 10%- reported statistically meaningful values with associated t-statistics above 1,32. Regarding the sign of estimated coefficients, the picture is even more contradictory with half of total cases regarding positive and negative values respectively. However, this last result is unsurprising and in line with previous studies as the relation between imports and the real exchange rate is highly dependant on the economic cycle.

Turning our attention to the estimation of exports equation, we have to keep in mind that the applied methodology will be the same used on imports. Therefore, TABLE 3, which reports our estimations for exports equations, has been organised in an analogous way as its preceding sibling focusing on imports. Again, the first array of rows offers the results for the UECM specification. Regarding obtained coefficients for included lagged variables in levels, assuming a 5% level of statistical significance, 3 cases were found significant for exports and foreign income and 4 cases for TFP. If we relax the level of significance to 10%, the number of significant coefficients will increase to 4 in the case of exports and 6 for foreign income growth and TFP. As it was observed in the case of imports, the majority of meaningful coefficients concentrated in a few countries where cointegration could exist. More properly, analysing the values of the F-statistic offered in the second section of TABLE 3. First, it has to be noted that the critical values associated to the test are slightly different to the ones reported for imports as no drift was included in the ARDL specification. Respecting the computed results of the bound test, 3 countries -Finland. Netherlands and Spain- reported F statistics at least above the lower bound limit

at a 5 percent significance while Belgium while also lie just over the lower bound limit assuming a 10% of significance. However, considering that preview RECM estimations for Belgium did not offered improved estimations or a meaningful ECT, only 3 RECM were estimated for exports equations. The remaining 5 cases report traditional regression in first-differences.

TABLE 3: EXPORTS ARDL COINTEGRATION ANALYSIS

	ARDL (UNRESTRICTED ECM)			PESARAN ND SHIN BOUND TEST				REST. ECM / REGRESSION IN DIF.		
	Regressors	**Estimate**	**t.value**	**RSS1**	**RSS2**	**F**	**Chisq**	**Regressors**	**Estimate**	**t.value**
	X(-1)	0.145	1.844					c	0.004	0.450
	Z(-1)	0.160	1.554	0.030	**0.025**	**1.368**	**4.103**	z	1.345	2.702
	TFP(-1)	-0.406	-1.646					tfp	0.630	2.595
AUS	z	1.379	2.759					ECT	-	-
	tfp	0.734	2.924							
	X(-1)	0.021	1.080					c	0.010	1.697
	Z(-1)	0.020	0.302	0.014	**0.011**	**2.374**	**7.121**	z	1.282	5.310
BEL	TFP(-1)	-0.057	-0.533					tfp	0.472	3.358
	z	1.387	5.370					ECT	-	-
	tfp	0.574	3.954							
	X(-1)	0.173	1.618					c	-0.007	-0.131
FIN	Z(-1)	0.123	1.452	0.049	**0.033**	**3.801**	**11.402**	z	-0.410	-0.862
	TFP(-1)	-0.329	-1.493					tfp	1.081	8.176
	z	-0.261	-0.556					ECT	0.008	0.689
	tfp	1.168	8.034							
	X(-1)	0.033	1.600					c	0.001	0.143
	Z(-1)	0.129	1.824	0.018	**0.016**	**1.321**	**3.964**	z	1.387	5.308
FRA	TFP(-1)	-0.267	-1.920					tfp	0.899	3.759
	z	1.353	5.231					ECT	-	-
	tfp	1.016	4.267							
	X(-1)	0.038	0.547					c	0.001	0.088
	Z(-1)	-0.090	-0.619	0.055	**0.048**	**1.236**	**3.708**	z	1.827	2.138
GER	TFP(-1)	0.108	0.325					tfp	0.506	1.796
	z	2.182	2.492					ECT	-	-
	tfp	0.398	1.106							
	X(-1)	0.043	1.110					c	0.003	0.238
	Z(-1)	-0.157	-1.451	0.050	**0.046**	**0.750**	**2.249**	z	1.089	2.349
ITA	TFP(-1)	0.233	1.361					tfp	1.193	3.583
	z	0.873	1.785					ECT	-	-
	tfp	1.058	2.839							
	X(-1)	0.039	2.117					c	-0.037	-0.809
	Z(-1)	0.082	1.567	0.013	**0.009**	**3.547**	**10.642**	z	1.258	5.019
NED	TFP(-1)	-0.188	-1.707					tfp	0.677	4.452
	z	1.208	5.025					ECT	0.009	1.100
	tfp	0.742	4.874							
	X(-1)	-0.102	-2.433					c	0.117	1.423
	Z(-1)	0.390	2.498	0.070	**0.045**	**4.505**	**13.514**	z	1.157	2.238
SPA	TFP(-1)	-0.602	-2.440					tfp	0.163	0.433
	z	1.830	3.328					ECT	-0.019	-1.053
	tfp	0.475	1.335							

Pesaran and Shin (2001) Cointegration analysis procedure

Critical values for bound test taken from Pesaran and Shin (2001)
case no int. no trend k=3

	10.00%		5.00%	
	Lower B	Upper B	Lower B	Upper B
F →	2.37	3.20	2.79	3.67

ECT: Error Correction term
For the t-test the usual critical values applies → 1.72(5%)
1.32 (10%)

The third array of TABLE 3 reports the final estimations for the parameters of interest of exports equations. Starting by the three cases were a RECM specification was applied, each one reported not significant ECT associated to low t-statistics and only in the case of Spain reported the expected negative sign. Therefore, there is only weak evidence in favour of a meaningful long-run relationship for the variables involved in the behaviour of exports growth. Turning onto estimated elasticities for external income growth and TFP growth in manufactures; 6 out of 7 cases were found positive and statistically meaningful at a 5 % of significance in both

cases. The exceptions were Finland[7] in the case of external income growth, reporting a negative non significant coefficient, and Spain in the case of TFP, although in this case the coefficient reported the expected positive sign. At last, focusing on the spread of values obtained for the meaningful elasticities, the estimations ranged between 1 and 2 approximately in the case of elasticities of external income and between a wider interval between 0,4 -Belgium- and 1,9 -Italy. Thus, compared to traditional exports equations including the REER instead of TFP as regressor, estimations for TFP elasticities were in general consistently more significant implying slightly lower associated elasticities of external income compared to the usual ones.

Finally, we must turn on the estimation of Verdoorn's Law reported in TABLE 4. As in the two preceding cases, the first group of rows reports ARDL estimations of UECM estimations of Verdoorn's Law trying the identify the presence of any meaningful long-run relationship between variables. For that purpose, we first analyse the coefficients reported by the lagged values of the variables included as regressors. In this last set of equations, assuming again a 5% of statistical significance, only 2 cases for TFP, 1 for total income and 4 cases for RD were identified associated to t-values above this boundary. Relaxing significance to 10%, 2 cases in TFP, still 1 for total income, and 5 cases for RD reported t-statistics above the critical value of 1,32. This first overview points to the same heterogeneous picture found for exports and imports, were cointegration evidence does not seem to be generalized. Applying one more time the Pesaran and Shin (2001) bound test, the results reported by the F-statistic in the second group of rows indicate that assuming a 5% statistical significance only 3 countries will report values above the lower bound limit critical value of 2.37. However, assuming a 10% level of statistical significance the number of countries which would be above the lower benchmark value of 2.37 will increase to 6. In this occasion, as preliminary RECM regression suggested a significant ECT and evidence of cointegration in the limit cases, RECM estimations were finally performed for 6 countries while the two remaining cases were instead specified as a regression in first-differences as in the preceding tables focusing on imports and exports.

The last group of rows in TABLE 4 reports the coefficients found for the estimated parameters of interest of our RD augmented version of Verdoorn's law. Placing our attention over the long-run information present in the 6 RECM estimations, assuming a 5% level of statistical significance Belgium, Finland and Spain reported associated t-statistics far above the critical value of 1.72. If we assume a less strict 10% level of significance, only France will offer a t-stat value close to meet but below its critical value. Additionally, all the 6 countries were a RECM estimation was performed reported negative coefficients between 0 and -1 as it would be expected if a long-run cointegration relationship exists. Again, this performance seems more consistent than the one offered by imports and exports ECM. Regarding the coefficients estimated as partial elasticities of total income and RD. As expected, all the coefficients of total income were found significance reporting t-values above 2 in

7 Alternative specifications for the RECM or even a straightforward regression in first differences where performed obtaining always the same contradictory results.

all the cases implying statistical significance at a 5% for all the individual cases. Although endogeneity is a minor concern given that TFP from manufactures is regressed on total income rather than It is interesting to note that a RECM specification partially addresses the problematic of endogeneity in Verdoorn's Law through the inclusion of a lagged dependant variable in levels.

TABLE 4: VERDORN LAW ARDL COINTEGRATION ANALYSIS

	ARDL (UNRESTRICTED ECM)			PESARAN ND SHIN BOUND TEST				REST. ECM / REGRESSION IN DIF.		
	Regressors	**Estimate**	**t.value**	**RSS1**	**RSS2**	**F**	**Chisq**	**Regressors**	**Estimate**	**t.value**
	TFP(-1)	0.355	2.283					c	0.011	0.105
AUS	Y(-1)	-0.299	-2.308	0.016	0.011	**3.315**	**9.944**	y	1.845	5.398
	RD(-1)	-0.030	-1.704					rd	0.073	0.410
	y	1.612	4.828					ECT	-0.005	-0.325
	rd	0.089	0.540							
	TFP(-1)	-0.068	-0.439					c	0.901	3.702
BEL	Y(-1)	0.128	0.655	0.022	0.016	**2.706**	**8.117**	y	1.081	3.655
	RD(-1)	-0.069	-1.106					rd	0.021	0.141
	y	1.017	2.578					ECT	-0.201	-3.791
	rd	0.110	0.601							
	TFP(-1)	0.158	1.083					c	0.548	3.544
FIN	Y(-1)	-0.051	-0.400	0.055	0.042	**2.304**	**6.912**	y	2.180	7.013
	RD(-1)	-0.082	-2.299					rd	-0.893	-3.928
	y	1.847	4.452					ECT	-0.084	-3.424
	rd	-0.698	-2.459							
	TFP(-1)	0.118	1.327					c	0.185	1.186
FRA	Y(-1)	-0.001	-0.016	0.009	0.007	**2.358**	**7.073**	y	0.822	3.292
	RD(-1)	-0.090	-2.357					rd	-0.156	-1.381
	y	0.743	3.216					ECT	-0.033	-1.190
	rd	-0.372	-2.386							
	TFP(-1)	0.360	2.614					c	0.034	0.129
GER	Y(-1)	-0.042	-0.577	0.049	0.031	**4.727**	**14.180**	y	0.955	3.186
	RD(-1)	-0.227	-3.058					rd	0.414	1.810
	y	0.710	2.838					ECT	-0.009	-0.217
	rd	0.242	1.155							
	TFP(-1)	0.047	0.431					c	-0.005	-0.781
ITA	Y(-1)	-0.013	-0.171	0.012	0.010	**1.505**	**4.515**	y	0.898	3.671
	RD(-1)	-0.024	-1.495					rd	-0.006	-0.088
	y	0.780	2.715					ECT	-	-
	rd	-0.112	-1.095							
	TFP(-1)	0.177	1.432					c	-0.005	-0.553
NET	Y(-1)	-0.163	-1.195	0.016	0.014	**0.851**	**2.553**	y	0.942	3.520
	RD(-1)	0.022	0.376					rd	-0.028	-0.182
	y	0.902	3.361					ECT	-	-
	rd	-0.054	-0.349							
	TFP(-1)	-0.067	-0.976					c	1.353	4.881
SPA	Y(-1)	0.075	1.235	0.018	0.012	**4.400**	**13.200**	y	0.846	3.776
	RD(-1)	-0.039	-2.237					rd	-0.099	-1.552
	y	0.704	2.576					ECT	-0.305	-4.933
	rd	-0.120	-1.408							

Pesaran and Shin (2001) Cointegration analysis procedure

Critical values for bound test taken from Pesaran and Shin (2001)
case no int. no trend k=3

	10.00%		5.00%	
	Lower B	Upper B	Lower B	Upper B
F →	2.37	3.20	2.79	3.67

ECT: Error Correction term
For the t-test the usual critical values applies → 1.72(5%) 1.32 (10%) 1.32 (10%)

On the other hand, reported findings on RD elasticities draw a more mixed picture. Only Germany, Finland and Spain reported t-statistics above the 5% critical value of significance while only Germany reported a meaningful positive result. Assuming a 10% of statistical significance, France will also be included, although as in the cases of Finland in Spain, it reported again a contradictory negative effect of RD. Considering the range of estimated coefficients, in the case of total income, the value of its partial elasticity ranged between an upper limit of 2.2 -Finland- and a lower boundary of 0.8 -France. In the case of RD, the only significant and meaningful estimation was the one Reported by Germany and its reported value was 0.4. Although the contradictory effect reported by RD intensity growth in a majority of cases requires further research, a first inquiry will suggest the importance of

being a relatively big, open, export-led country as minimal requirements to meet in order to get meaningful results or alternatively, as suggested in Romero and Britto (2017) as a catch-up variable allowing conditional convergence. In this last context, a negative coefficient for RD may be economically meaningful.

At this point, once we have computed estimated parameters for the 3 behavioural equations defining our model, the last remaining step is to calculate their associated ATL equilibrium growth rates and confront them against their actual counterparts. TABLE 5 summarises associated ATL estimations as well as their actual growth rates averages for the same period. In addition, values for $\left(\frac{\psi}{\lambda\delta}\right)$ are reported in the first row under the name of stability condition. As explained through the third section, values above 1 for this expression are required in order to assure the existence of an stable growth rate of income which could be forecast by our model. Thus, starting by this necessary condition to meet in regard of the structural stability of reported models, evidence is unambiguous: all the units but Finland reported values above 1 assuring long-run stability and the possibility of computing ATL growth rates. However, the parameters reported by Finland makes impossible to get meaningful forecast as the numerator of the ATL growth rate negative. For all the remaining countries constituting our sample conditional convergence in output growth rates could be properly calculated.

TABLE 5: FORECASTED VALUES AND ROBUSTNESS BENCHMARK

	stability	*observed*	*predicted*	*t test*	*pvalue*	*5% interval of confidence*	
Austria	1.765	2.19%	2.10%	1.776	0.085	-0.002	0.034
Belgium	4.775	1.98%	1.85%	-0.280	0.781	-0.011	0.008
Finland	**0.827**	-	-	-	-	-	-
France	3.989	1.94%	1.41%	-1.389	0.171	-0.013	0.002
Germany	4.561	2.07%	1.75%	-0.348	0.730	-0.044	0.031
Italy	7.360	1.45%	0.44%	-2.710	0.010	-0.018	-0.003
Netherlands	3.115	2.39%	1.71%	-1.333	0.189	-0.019	0.004
Spain	27.444	2.80%	1.50%	-3.010	0.004	-0.022	-0.004

Observed annual income growth rates versus forecasts derived from parameters estimated in TABLES 2,3 and 4

quick look on predicted values suggest that the forecasts of our model performed relatively well in general, although a slight bias towards under-prediction has to be highlighted as a trend underlying estimations for all the individual countries. Beyond that fact, the performance was remarkably accurate in the cases of Austria, Germany and Belgium where reported deviations from actual values where below 0.3 percentage points. The model also reported relatively accurate forecasts in the cases of Netherlands, and France while Italy and Spain were the only units where forecasts differed by more than 1.0 percentage points respect its actual value.

Beyond that general overview and in order to analyse the performance of ATL forecasts, the test proposed by McCombie (1997), which has already been put in use in the preceding chapter will be applied as benchmark again, although directly over income growth rates actual and forecasted values. For that purpose, 30 annual ATL forecasts have been computed for the period 1980-2010. Afterwards, this forecasts have been tested against real observations through a Welch t-test where the null hypothesis stands for the equality between ATL forecasts and their equivalent observed growth rate. Thus, if the p-values of reported t-statistics are above the critical values associated to a certain level of significance, we could not reject the null hypothesis implying evidence in favour of ATL robust performance as predictor of income growth rate. Focusing on the t-statistics reported in the fourth row of table 5 and assuming the narrowest usual interval of confidence at a 90%, Belgium, France, Germany and Netherlands could not reject the null of equality between ATL forecasts and observed values. Widening the interval to a 95% will imply not rejecting the null in the case of Austria, and for a 99% in the case of Italy as well. On the other extreme forecasts for Spain will reject the null for any standard interval of confidence while, as noted above, the test could not been performed for Finland. In sum, the performance was better for core European countries than Mediterranean was, preliminary this feature could be associated to the degree of openness and export-led profile of their economies. Unluckily, the only Northern European country included in this sample, Finland, did not meet the prerequisite of stability necessary to perform forecast by the model that has been introduced and estimated in the above sections.

6. CONCLUSIONS

First and foremost, this article has developed a working alternative for the deadlock characterising the two most important traditions of Kaldorian growth models: Cumulative Causation and Balance of Payments Constraint approaches. Through the incorporation of innovation and technological competitiveness, the end-road constituted by price competitiveness has been consistently overcame proposing a model where price elasticities are dropped from exports equations and substituted by TFP growth in manufactures as a proxy measuring technological competitiveness As a consequence, the effect of Verdoorn's Law is transmitted onto exports even if price competitiveness is considered unimportant resulting in a model where both cumulative causation and a BP constraint are operating at the same time while the role of innovation and research and development are as well incorporated in line with Kaldorian-Schumpeterian ideas. In addition, this model could constitute an interesting alternative to neoclassical EGMs which although considering innovation still pertain to a frame characterised, against this proposal, by closed-economy/one-sector models which ignore the importance of manufactures or external performance. Combining Thirlwall´s and Verdoorn´s laws, the BPC-CC model built through this study has proposed a straightforward development of exports equation including technological competitiveness while the engine of cumulative causation has been augmented to consider innovation.

A second remarkable contribution of this work is derived from the estimation of this new model for a sample of eight European countries during a lapse of 30 years (1980-2010). Three important features must be highlighted regarding obtained estimations. First, regarding the applied methodology, reported estimations of parameters of interest were obtained applying the ARDL cointegration approach, a procedure which allows the incorporation of long-run information contained in variables in levels absent from the traditional regression in first-differences. Second, although the forecasts of the model were relatively accurate in a majority of cases, a slight bias towards underprediction of actual income growth rates was observed for all the individual countries. This fact could be closely related to the contradictory results reported by RD effort in the augmented version of Verdoorn's Law. Anyway, the parametric t-test applied over predicted values to benchmark their performance was strongly satisfactory in at least half of the cases. However, it also has to be mentioned that forecasts could not be performed for Finland, as it did not meet the necessary condition in order to obtain an stable growth rate of income, a kind of scenario which possibility was explicitly noted during the formal exposition of the model. Finally, regarding a future research agenda derived from this study, the need of additional empirical works focusing on different samples and alternative time-periods seem obvious while further developments of the model including multi-sectoral features could be easily implemented.

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GENERAL CONCLUSION

The first main conclusion of this work can be traced back to its first chapter: there is not a consistent process of economic convergence among the original Eurozone members. Productive imbalances and divergent forces imposed their path in core sectors as manufactures and ICT since the beginning of the Euro integration process in Maastricht 1992. In addition, as the research of chapter three demonstrated, trade imbalances boosted by the Euro introduction helped to hide this problematique, for a while through the accumulation of growing external deficits in peripheral countries. The result was a spurious image of income per head convergence among Eurozone countries which was quickly evaporated after the start of the financial crisis in 2007. This outcome, as has been shown in depth through this study, was product of both the misguided policies applied by European Institutions and the theories that suggested their suitability. For that reason, once the weaknesses of the neoclassical framework became explicit, this dissertation has proposed alternative approximations to these theoretical shortcomings building over two well-known Kaldorian notions, Thirlwall and Verdoorn Laws. Thus, the second field of conclusive remarks of this dissertation is concerned with the estimation of these laws in relation to the mainstream view taking as background the Eurozone members.

On the one hand, chapter two has shown the importance of dynamic increasing returns through the estimation of Verdoorn's Law for a panel of 8 Eurozone countries during the period 1980-2010. As it was noted in the introduction of this dissertation, the absence of series on capital stock and sectoral TFP for a few of the original Eurozone members turned non-viable the consideration of a whole sample suggesting a global analysis taking in consideration the advantages of panel data analysis. Fundamentally, chapter two has shown the interesting possibility of understanding the presence of dynamic increasing returns from a demand-led perspective while the possibility of supply-led spill-overs was not discarded ex-ante but taken into consideration. As a result, and after treating endogeneity in our specification of Verdoorn's Law, the presence of increasing returns was strongly suggested but concentrated in certain sectors. In sum, evidence suggested the importance of taking into

consideration sectoral differences especially in regard to manufactures, which still constitutes the engine of growth and ITC branches, where dynamic increasing returns were also identified.

On the other hand, chapter three has focused in trade imbalances through the estimation of a balance of payments constrained growth model and its derived equilibrium output growth rate known as Thirlwall's Law. Taking advantage of the completeness of AMECO database for the countries and variables under consideration, the analysis could be extended again to all the original members of the Eurozone but Luxembourg for a period which covered since the Maastricht Agreement until nowadays (1992-2016). Thereby, considering that the effect of the crisis could distort our estimations, the presence of structural breaks was analysed and subsequently introduced in the form of dummies for affected equations in the case of breaks identification. Reported estimations of exports and imports equations for 11 original Eurozone countries during the period in consideration clearly showed the accurateness of Thirlwall's Law forecasting actual income growth rates while demonstrating the non-sustainability of structural deficits characterising peripheral countries growth trajectories before the explosion of the crisis. Obtained evidence also suggested that allowing the presence of financial flows in Thirlwall's Law, although important and distorting in the short-run were relatively unimportant in the long run, offering similar or slightly worse forecasts than the original version of Thirlwall's Law.

Finally, chapter four has proposed an original model combining Kaldorian features highlighted in chapters two and three. This means the possibility of interbreeding cumulative causation and increasing returns implicit in Verdoorn's Law and the existence of a balance of payments constraint in an open-economy export-led environment as described by Thirlwall's Law. This conclusive chapter has proposed an original working solution to the paradox on price-competitiveness characterising a direct interbreeding of cumulative causation and balance of payments growth models by means of introducing the notion of technological competitiveness redefining the usual estimation of exports equation. Therefore, this conclusive model offers a solution to the limitations inherent to a canonical combination of Thirlwall's and Verdoorn's Laws. However, as this last chapter also relied in sectoral TFP series from EUKLEMS we have had to drop some original members of the original Eurozone from the sample which tested the model performance. Under this scenario, an considering the provisional character of the original model proposed, increasing the accuracy of estimations was favored as in chapter two in front of constraining the time-lapse to the Eurozone construction era. Then, the time period was longer than in previous chapters in order to get a minimal number of observations suitable for working with the proposed ARDL cointegration approach. Thus, the chosen time span 1980-2010 was the longer at disposition from EUKLEMS for our selection of eight Eurozone countries. Relying when possible in ECM estimations for exports and imports functions and a panel approach for a technologically-expanded Verdoorn's Law, estimations

for the resultant augmented version of Thirlwall's Law seemed robust and suggesting evidence of cointegration for the 8 Eurozone countries constituting our sample. As a corollary, summarising evidence obtained from each chapter, this research has shown the possibility of building an alternative Kaldorian approximation to understand the inner logic of the crisis faced by Eurozone.

In a nutshell: given the fact that the European problematic is far from solved, the contribution of this research is twofold. On the one hand it has shown how embracing alternative explanations to economic growth and development could offer interesting insights to the European deadlock. On the other, once confirmed the robustness of predictions derived from Kaldorian-inherited models, a deep debate around the causes underlying economic divergence and the associated policies to struggle against it appears urgent. If, as this dissertation has shown, economic convergence is not the automatic result of market forces but a historically overdetermined result, a completely new frame appears. A new perspective which working under realistic assumptions about returns to scale or external performance suggests the consideration of public policies managing existing productive and external heterogeneity among Eurozone members rather than simply promoting free market among heterogeneous countries and regions.