The response of non-price competitiveness and productivity due to changes in passed income gaps. Evidence from the OECD countries

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The response of non-price competitiveness and productivity due to changes in passed income gaps. Evidence from the OECD countries.

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Abstract

Non-price competitiveness given by the ratio of the income elasticity of the demand for exports relatively to the income elasticity of the demand for imports is the key factor for measuring the competitiveness of an economy associated with the quality of the produced goods. This factor is essential in the export-led growth theory and the balance-of-payments constraint hypothesis advocated by Thirlwall´s Law (1979). Increasing returns to scale in the production process are also important for generating a cumulative causation growth circle and this factor has been earlier identified by Verdoorn (1949) and later by Kaldor (1966). According to Palley (2002) it is the non-price competiveness (through mostly changes in the income elasticity of the demand for imports) that adjusts to close the gap between the actual and the potential income. Setterfield (2012) on the other hand attributes higher importance to increasing returns to scale as the responsible for closing the income gap, implying changes in the Verdoorn coefficient. The aim of this paper is to shed light to this discussion bringing empirical evidence that shows how the non-price competitiveness (through the income elasticity of imports) and productivity (through increasing returns to scale) react with respect to previous income gaps. It is verified that both factors react significantly to changes in passed income gap but the reaction of the non-price competitiveness is more pronounced.

Keywords: non-price competitiveness, increasing returns to scale, potential income, income gap, overlapping and non-overlapping regressions.

JEL code: C23, D24, F10, O47

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1. Introduction

The importance of increasing returns to scale for the growth process was first recognized by Verdoorn (1949), who established a relationship between the growth of labor and the growth of output with the slope coefficient being less than one. Later on, Kaldor (1966) used this relation as part of a cumulative causation growth process, emphasizing that the manufacturing sector is the sector where higher increasing returns to scale properties are more evident. Therefore, if countries allocate productive resources to sectors with higher increasing returns to scale (higher productivity) they will grow faster. Although Kaldor recognized the importance of exports as the engine of growth[1] he ignored the import side of the economy. Later, Thirlwall (1979) showed that growth can be constrained by external imbalances and established the rule that no country can sustain a growth rate higher than the one compatible with its balance-of-payments equilibrium, unless it can continuously finance the external deficit by capital flows, which is not a sustainable solution in the long term[2]. The balance-of-payments equilibrium growth rate is given by the ratio of the income elasticity of the demand for exports to that of imports, multiplied by the growth of foreign income. The ratio of the income elasticities of trade reflects the non-price competitiveness of the economy, capturing the quality characteristics of the produced goods associated with innovation, variety, product differentiation, durability, among other supply characteristics. When this ratio is higher than one, the country will grow faster than its trade partners without creating problems in the balance-of-payments equilibrium (mostly on the current account).

The relation between increasing returns to scale indicated in Verdoorn/Kaldor Law and the non-price competitiveness defined in Thirlwall´s Law has been analyzed in the Kaldor-Dixon-Thirlwall model (see Thirlwall and Dixon, 1979)[3]. Increasing returns to scale are directly linked to factors such as high technology, innovation, new production techniques, more efficient reallocation of resources, *etc*. which all affect the non-price competitiveness of the produced goods. Our argument is that the higher the increasing returns to scale (higher productivity), the higher the non-price competitiveness of the economy and, consequently the faster the economic growth rate. On the other hand, both the increasing returns to scale and the non-price

[1] Kaldor established three Laws of growth: the first law relates the output growth to manufacturing growth assuming that the output in manufacturing drives economic growth in the whole economy. The second law is the Verdoorn´s Law relating the growth rate of labour to the growth rate of output (manufacturing output); this relation captures increasing returns to scale when the slope coefficient is smaller than one. The third law relates the growth rate of sectors (other than manufacturing) to the growth rate of the manufacturing output recognizing the positive externality effects of manufacturing for increasing the productivity in all other sectors.

[2] For an extension of Thirlwall`s model that introduces explicitly the external and internal imbalances, see Soukiazis, Cerqueira and Antunes (2011 and 2013).

[3] See also, among others, León-Ledesma (2002) or Blecker (2013).

competitiveness depend on the market size and on the division of labor, especially in the case of small open economies. Therefore, international markets are essential for seeking gains in productivity and improving non-price competitiveness.

Palley (2002) uses the concept of non-price competitiveness (the ratio of the income elasticity of the demand for exports to that of imports)[4] to explain the adjustment in income gap between the actual (given by the balance-of-payments equilibrium growth rate) and potential income growth rates. When the gap is positive, the income elasticity of the demand for imports will increase to fill the existing income gap, through a reduction in the balance-of-payments equilibrium growth rate to the potential level. Likewise, in case of a negative gap, the income elasticity of the demand for imports will decrease to bring the balance-of-payments equilibrium growth rate at the level of the potential income.

In contrast to this explanation, Setterfield (2012) argues that it is the Verdoorn coefficient, capturing increasing returns to scale, that changes to fill the gap between the income growth rates. Therefore, when the growth rate compatible with the balance-of-payments equilibrium is higher than the potential output growth, firms are induced to increase productivity through innovative methods and technical, to respond to the shortage of supply in the markets for goods and services. What changes in this growth adjustment process is the coefficient of Verdoorn, which links directly the productivity growth to the growth of the components of autonomous demand including exports.

To the best of our knowledge, the adjustment mechanism to close the income gap has not been tested before in the relevant literature, and the aim of this paper is to assess this issue considering a sample of 23 OECD countries over the period 1980-2016. More specifically, we test the reaction of the income elasticity of the demand for imports (Palley's argument) and the reaction of the Verdoorn's coefficient (Setterfield's argument) with respect to previous income gaps between the actual or the balance-of-payments equilibrium growth rates and that of potential growth rate to check out in which case is the reaction more pronounced. In doing so, the paper is organized as follows: Besides the introduction, Part 2 explains the adjustment mechanism in the income gap following the Palley and Setterfield arguments. Section 3 explains the sensitivity of economies to scale and of the income elasticity of the demand for imports with respect to previous changes of

[4] In fact Palley considers $1/\pi$ as the indicator of the non-price competitiveness derived from Thirlwall´s Law given as $y_{BP} = \frac{\dot{x}}{\pi}$ where $\dot{x}$ is the growth of exports and π the income elasticity of the demand for imports.

the income gap, through a regression analysis. The last section concludes, summarizing the main empirical findings.

2. The mechanism explaining the adjustment in income gap

The explanation of the adjustment process in income gap depends on two basic relations established earlier in the demand orientated growth theory: the Verdoorn's Law and the Thirlwall's Law, respectively.

The Verdoorn's Law can be described by the following simple relation

$$q = \alpha_0 + \beta y \qquad (1)$$

where q is the rate of growth of labour productivity, y is the rate of growth of output, α_0 is autonomous productivity and $\beta<1$ is the Verdoorn's coefficient showing the increasing returns to scale effects which, according to Kaldor, are exclusive to manufacturing sector[5]. The Verdoorn's coefficient β captures the static and dynamic increasing returns to scale, which can be internal or external in nature. The dynamic increasing returns to scale are associated with technical progress, learning by doing and innovation activities, while the static ones result from the large-scale of production. The internal gains in productivity are idiosyncratic to each manufacturing sector and the external ones are due to spill over effects and positive externalities coming from other sectors.

The Thirlwall's Law is given by the following relation

$$y_{BP} = \frac{\varepsilon}{\pi} y^* \qquad (2)^6$$

where m and x are the growth rates of imports and exports (goods and services), y_{BP} is the growth rate consistent with balance-of-payments equilibrium (on the current account), y^* is the growth rate of foreign income, and π and ε stand for the domestic and foreign income elasticity of the demand for imports and exports, respectively. The ratio ε/π defines the non-price competitiveness

[5] In this relation, labour productivity is given by the difference between the growth of output y, and growth of labour e, that is, $q=y-e$. Substituting this and solving for y we get, $y= \alpha_0/(1-\beta) + e/(1-\beta)$. Therefore, $1/(1-\beta)$ captures the increasing returns to scale in the aggregate production function when $0<\beta<1$, and constant returns to scale if $\beta=0$.

[6] Thirlwall´s Law is derived by considering the import function $m=\pi y$, the export function $x=\varepsilon y^*$, and the equilibrium condition on current account $x=m$. Thirlwall´s Law can be defined alternatively as $y_{BP}=x/\pi$ (this is the relation that Palley uses), stating that domestic income growth is given by the ratio of export growth to the income elasticity of the demand for imports. $1/\pi$ is known as the dynamic Harrod foreign trade multiplier.

of the economy, thus capturing supply characteristics related to quality, product differentiation, and innovation, among others.

Having into account the above relations, it is important to describe whether adjustments of actual growth to its potential rate are due to shifts in the non-price competiveness (mostly changes in the income elasticity of imports) or to shifts in productivity through the Verdoorn's coefficient. To show this, we first define potential real output, as the maximum output that the economy can attain with the available resources and production technology, that according to Setterfield (2012) is given by

$$y_p = q + n \tag{3}$$

where y_p denotes the growth of potential output, q is the rate of growth of labour productivity and n the population growth (which is assumed to be the same as the rate of growth of the working population). Substituting the Verdoorn's Law given in Equation (1) into Equation (3) and replacing actual income growth y by that as given in Thirlwall's Law (Equation (2)) we get:

$$y_p = a_0 + n + \beta \frac{\varepsilon}{\pi} y^* \tag{4}$$

The adjustment process with cumulative causation characteristics involves the following equations:

$$y_{BP} = \frac{\varepsilon}{\pi} y^* \qquad \text{Thirlwall's Law} \tag{5}$$

$$y_p = a_0 + n + \beta \frac{\varepsilon}{\pi} y^* \qquad \text{Potential income} \tag{6}$$

$$\dot{\lambda} = \lambda(y_{BP} - y_p) \qquad \text{Gap in income growth} \tag{7}$$

$$\pi = \pi(\lambda), \pi' > 0 \qquad \text{Palley's argument} \tag{8}$$

$$\beta = \beta(\lambda), \beta' > 0 \qquad \text{Setterfield's argument} \tag{9}$$

Equation (5) is Thirlwall's Law defining the growth rate consistent with the balance-of-payments equilibrium (on current account) and Equation (6) defines the growth rate of potential income which depends on autonomous productivity, population growth, increasing returns to scale, non-price competitiveness and the growth rate of foreign income. Equation (7) is obtained by defining the ratio of actual income level to the potential one as $\lambda = Y_{BP}/Yp$ and then taking growth rates. Assuming that actual growth is given by Thirlwall's Law, Equations (8) and (9) are the Palley's

and Setterfield's arguments on how the adjustment mechanism (between actual growth and potential growth) takes place. Following Setterfield (2012) we can distinguish two adjustment mechanisms with different implications:

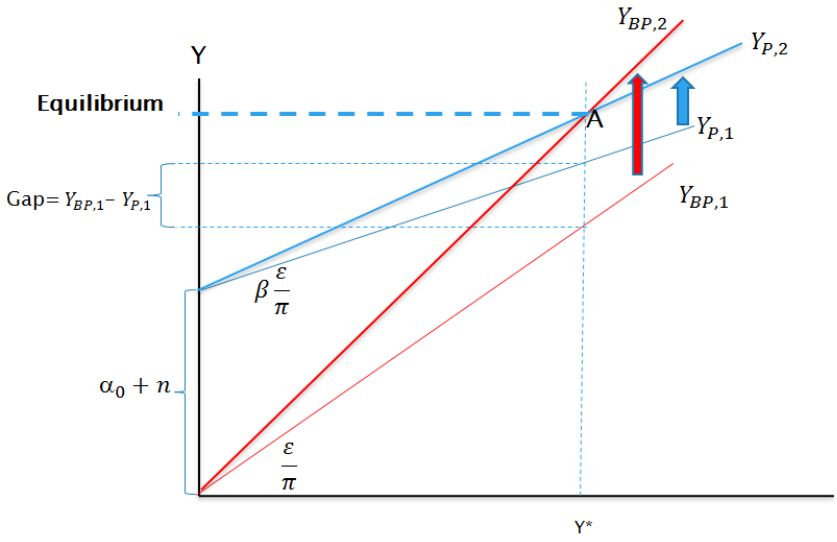
(i) Growth adjustment through changes in non-price competitiveness

Consider the case where actual growth (given by Thirlwall's Law)[7] is smaller than the potential growth rate that is, $y_{BP}<y_p$ in equation (7). Palley (2002) argues that in this case imports will decrease and therefore so will the income elasticity of the demand for imports in Equation (8). Consequently, the fall in π will increase the balance-of-payments equilibrium growth rate y_{BP} (through Equation (5)) to the level of the potential output y_p. Therefore, in the long run, the non-price competitiveness given by the income elasticity ratio ε/π will change (increase, in this case) in order for domestic income growth to adjust to its potential rate, at which point we have sustainable steady-state growth.

The Palley's argument and the adjustment process can be seen in Figure 1. Starting from a negative gap where potential income y_{p1} exceeds the balance-of-payment growth rate y_{BP1}, that is $y_{BP1}-y_{p1}<0$, to restore equilibrium, π must decrease shifting upwards the balance-of-payments curve (red line). But at the same time the potential income curve (blue line) shifts also upwards but to a lesser extent, since its slope is given by $\beta(\varepsilon/\pi)$, with $0<\beta<1$. An equilibrium will be reached at point A where $y_{BP2}=y_{p2}$. The opposite movement of both curves will occur (downwards shift through the increase in π) when the gap is positive, that is, when $y_{BP1}>y_{p1}$. We have to notice that Palley's explanation does not consider that the potential income curve will also shift properly in order to attain the equilibrium position.

[7] We assume here that Thirlwall's Law makes an accurate prediction, so that, y_{BP} is approximately equal to the actual growth rate y.

Figure 1 : Growth adjustment between the balance-of-payments growth rate and potential growth (Palley's argument).



Source: own configuration

(ii) Growth adjustment through changes in productivity

Setterfield (2006) proposed an alternative mechanism to the same problem. When actual growth (proxied by Thirlwall's Law) is higher than the potential output growth ($y_{BP}>y_p$), the tightening of labour and therefore the shortage of supply in the goods market induces firms to increase productivity through innovation and technical progress. What changes in this growth adjustment process is the coefficient of Verdoorn β as given in Equation (1), which links directly the productivity growth to the growth of the components of autonomous demand including exports. This adjustment mechanism with cumulative causation tendencies can be described through Equations (5), (6), (7) and (9).

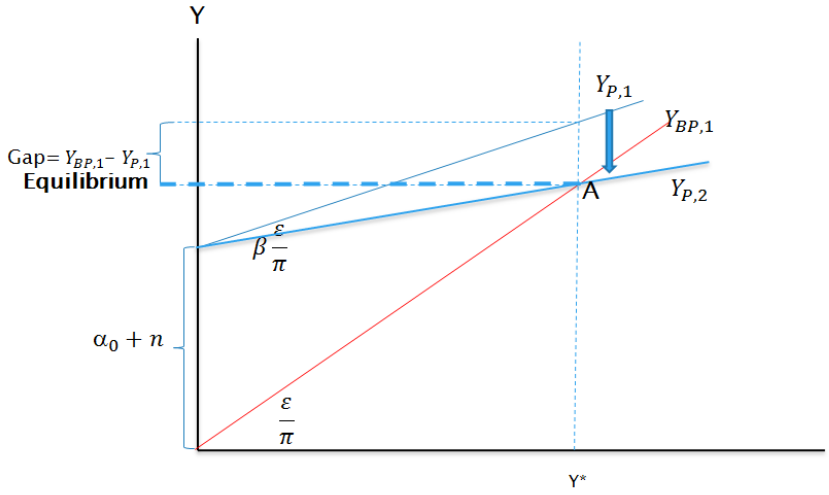
As follows from Equation (7), any initial growth disequilibrium like, $y_{BP}>y_p$, will increase λ and, therefore the Verdoorn's coefficient β in Equation (9) will also increase, as well as the potential growth rate in Equation (6). This process of adjustment will continue until potential growth becomes equal to actual growth (given by the balance-of-payments equilibrium growth rate), at which point we will have again sustainable steady-state growth. The growth adjustment according to Setterfield (2006) is made through changes in productivity captured by the Verdoorn's Law. The rationale is that the increase of λ tightens the labour and goods markets, inducing firms to seek more technological change and productivity augmenting innovation. When λ decreases, the reverse happens, that is, the labour and goods markets become less tight and the incentives to increase productivity farther are reduced. This is consistent with the findings of Cornwall and

Cornwall (2002) and Crespi and Pianta (2008), among others. The first shows that productivity growth increases with the growth of the components of autonomous demand, but varies inversely with unemployment rate, and the latter shows a positive association between productivity growth and household consumption.

The adjustment process according to Setterfield's argument can be described in Figure 2. Given an initial disequilibrium y_{BP1}-y_{p1}<*0*, the Verdoorn's coefficient β will decrease, moving the potential income curve downwards to meet the balance-of-payments curve, till an equilibrium y_{BP2}=y_{p2} is achieved at point A. The opposite movement will occur (upwards shift in potential income curve through an increase in the Verdoorn's coefficient β) when the initial gap is positive, that is, y_{BP1}>y_{p1}.

To the best of our knowledge, the two growth adjustment processes described above have not been tested empirically in the relevant literature. This is the main goal of our study which will be the subject of analysis in the following section.

Figure 2: Growth adjustment between the balance-of-payments growth rate and potential growth (Seterfield's argument).



Source: own configuration

3. **The reaction of non-price competitiveness and productivity to changes in the income gap.**

In this section we clarify the dispute between Palley and Setterfield on the growth adjustment mechanism by bringing evidence for 23 OECD countries. As we explained in Section 2, Palley argues that it is the income elasticity of the demand for imports π, that adjusts to fill the income

gap through Equation (8), $\pi = \pi(\lambda), \pi' > 0$, with λ the ratio of the income level consistent with the balance of payments equilibrium to potential income level. Setterfield claims that it is the Verdoorn's coefficient β that adjusts to fill the income gap through Equation (9), $\beta = \beta(\lambda), \beta' > 0$ and brings the economy into equilibrium. Having this in mind we define two alternative concepts of income gap: (i) the disparity between the balance-of-payments equilibrium growth rate (given by Thirlwall's Law) and that of actual growth (y_{BP}-y); and (ii) the difference between the balance-of-payments equilibrium growth rate (given by Thirlwall's Law) and potential output growth (y_{BP}-y_P). Therefore, it is interesting to test the reaction (change) of π and β in both cases, considering these two definitions of income gap.

(i) How π and β react to changes in income gap, as given by the difference between the Balance-of-Payments equilibrium growth rate and actual growth rate (y_{BP}-y)

In order to establish if it is the non-price competitiveness (through π) or productivity (through β) that adjusts to close the income gap between the balance-of-payments equilibrium growth rate and the actual one, we need to estimate the import and export equations (Equations (2) and (3)) and the Verdoorn Equation (1) over a number of different periods (using overlapping and non-overlapping periods), to check the long-run performance of the import and export income elasticities and of the Verdoorn's coefficient. Our methodology involves three steps:

The first step estimates the following equations to get estimators for the parameters β, ε and π:

$$q_{it} = \alpha_{q,ki} + \beta_{ki} y_{it} + u_{q,it} \quad \text{Verdoorn's equation} \tag{10}$$

$$m_{it} = \alpha_{m,ki} + \pi_{ki} y_{it} + u_{m,it} \quad \text{Import equation} \tag{11}$$

$$x_{it} = \alpha_{x,ki} + \varepsilon_{ki} y^*_{it} + u_{x,it} \quad \text{Export equation} \tag{12}$$

with *i=1,…,23, k=1,…,22 and t=1,….,12* for the overlapping periods[8]

and *i=1,…,23, k=1,…,3 and t=1,….,12* for the non-overlapping periods[9]

As before, q is the growth of labour productivity, m and x the growth rates of imports and exports, and y and y^* the growth rates of domestic and foreign income, respectively. The subscript i refers to the individual country (23 OECD countries), the subscript k is the number of the overlapping (22 periods) and non-overlapping periods (3 sequential sub-periods) and t is the number of years in each overlapping and non-overlapping periods (12 years). Equations (10) to (12) are estimated

[8] The overlapping method applies a rolling-window approach of equal size (12 observations) with the sample moving one observation ahead.

[9] The non-overlapping process considers 3 distinct periods: 1980-1991, 1992-2003 and 2004-2015 (*k=1,2,3,* respectively*)* a span of 12 years in each subsequent sub-period.

by the SUR method for each country to capture the interrelations between them shown in the cross-equation correlation of the error terms[10].

The estimated values for β, ε and π are reported in the Appendix A, in figures B and C and table A. These results show that the majority of the countries suffered a decrease in β during the nineties, except Austria, Belgium, Canada, Luxembourg, the Netherlands and Spain which display a stable tendency, and Australia and Turkey, reporting a substantial increase. After the nineties most countries recovered (except Ireland and the USA that experienced a continued decrease), but while some have reached or, even, surpassed the initial level (like Denmark, Finland, France, Germany, Iceland, Norway, Sweden and the UK), others just recovered partially (Italy, Japan, New Zealand, Portugal and Switzerland). Furthermore, Belgium, Canada, Luxembourg and the Netherlands, who did not experience a decrease in β throughout the nineties, they have shown a substantial increase in this coefficients over the last decade.

As for the estimated demand elasticity of exports (ε) and demand elasticity of import (π), more important than the individual variations of each coefficient, is how their relative strength has evolved over time. Some countries kept over the whole period the relative position of each coefficient: Australia, New Zealand, Norway, Turkey and Belgium, with $\pi>\varepsilon$ and Luxembourg, Switzerland, Ireland and Netherlands with the reverse case $\pi<\varepsilon$. On the contrary, we also observe countries which have inverted the relative strength of the parameters: Finland, Germany, Japan, Italy and Sweden have seen their demand elasticity for exports to overpass that of imports, while Iceland, Portugal and the USA went through the opposite path.

The second step uses the estimated income elasticities of demand for exports and imports to compute the growth rate consistent with balance-of-payments equilibrium for each overlapping period, given as:

$$\hat{y}_{BP,ik} = \frac{\hat{\varepsilon}_{ki}}{\hat{\pi}_{ki}} y^*_{ik} \tag{13}$$

and define the income gap as:

$$\hat{y}_{Agap,ik} = (\hat{y}_{BP,ik} - y_{ik}) \tag{14}$$

where y_{ik} is the observed average growth rate of domestic income of country i in each overlapping period k.

The estimated actual gap is shown in Figure A and Table B of appendix A. Combining the information, we are able to perceive that there is a number of countries who´s their gap turns from negative (or around zero) to positive in a very sharp way, like Finland, Germany, Italy, Japan, and

[10] In the Appendix A, Figure B depicts the estimated values for β and Figure C shows the estimated values for ε and π for the overlapping periods. Table A shows the estimated values for the non-overlapping periods.

Sweden. Others have always shown a positive gap, as Netherlands, Switzerland and Luxembourg. These countries end the period with an actual income lower than the one consistent with the balance of payments equilibrium. On the other hand, New Zealand, Iceland, Ireland, Turkey and the USA ended the studied period with a negative gap, and in most cases this tendency is continuous since the beginning of the period.

Finally, the third step is to analyse the reaction of the income elasticity of imports π and the Verdoorn's coefficient β due to changes in previous income gap. We address this issue by performing the following regressions:

$$\Delta\hat{\beta}_{ik} = \alpha_{\beta,i} + \beta_{\beta}\, \hat{y}_{Agap,ik-1} + u_{\beta,ik} \tag{15}$$

$$\Delta\hat{\pi}_{ik} = \alpha_{\pi,i} + \beta_{\pi}\hat{y}_{Agap,ik-1} + u_{\pi,ik} \tag{16}$$

Equation (15) relates the change (the current overlapping period relatively to the previous one) of the estimated values of the Verdoorn's coefficient with the income gap lagged one period (the previous overlapping period) and Equation (16) relates the change of the estimated income elasticities of imports with the same income gap at the country level. The estimation approach uses pooled data, fixed effects panel data, the SUR method for pooled data and the SUR method with fixed effects. The results are reported in Table 1. The first part of the table displays the regression results from the overlapping procedure and the second part shows the outcomes from the non-overlapping 3 distinct periods.

The results of Table 1 show that the income elasticity of demand for imports π and the Verdoorn's coefficient β respond almost always to the previous income disequilibrium with the expected sign. For instance, if the gap is positive $(\hat{y}_{BP,ik} - y_{ik})>0$, then β will increase to raise actual income to that rate consistent with the balance-of-payments equilibrium (Palley's argument), or/and π will increase to reduce the balance-of-payments equilibrium growth rate (Setterfield's argument) to the level of the actual income growth rate, closing therefore the gap. The opposite movement will occur when the income gap is negative.

Table 1 – Reaction of the income elasticity of demand for imports π and the Verdoorn's coefficient β to past actual income gap $(\hat{y}_{Agap,ik})$

Estimations using 12 years overlapping rolling-windows								
Model	Pooled		FE		SUR		SUR/FE	
Equation	Eq. Δβ	Eq. Δπ	Eq. Δβ	Eq. Δπ	Eq. Δβ	Eq. Δπ	Eq. Δβ	Eq. Δπ
constant	0.002 (0.37)	0.024 (1.29)	**0.002** **(12.99)*****	**0.023** **(13.44)*****	0.002 (0.38)	0.024 (1.29)	-0.001 (-0.03)	**0.211** **(2.31)****

y_{Agap-1}	0.003 (1.50)	0.017 (1.14)	**0.005 (2.08)****	0.036 (1.61)	0.003 (1.59)	**0.017 (2.78)****	**0.005 (1.72)***	**0.036 (4.60)*****
R^2	0.001	0.014	0.004	0.014	0.001	0.010	0.012	0.051
	$F_{1,550}$=2.24 [0.135]	$F_{1,550}$=1.31 [0.253]	$F_{1,22}$=4.33 [0.049]	$F_{1,22}$=2.59 [0.122]	BP-test:0.484 [0.487]		BP-test: 0.807 [0.369]	
					Corr. matrix of residuals		Corr. matrix of residuals	
						Δβ Δπ		Δβ Δπ
					Δβ	1	Δβ	1
					Δπ	-0. 030 1	Δπ	-0.038 1

Estimations using 12 years non-overlapping sub-samples (1980-1991, 1992-2003 and 2004-2015)

Model	Pooled		FE		SUR		SUR/FE	
Equation	Eq. Δβ	Eq. Δπ	Eq. Δβ	Eq. Δπ	Eq. Δβ	Eq. Δπ	Eq. Δβ	Eq. Δπ
constant	0.007 (0.009)	0.195 (0.96)	-0.011 (-0.79)	0.156 (3.22)***	0.008 0.10)	0.195 (1.03)	0.189 (0.56)	-0.256 (-0.29)
y_{Agap-1}	**0.0265 (2.31)****	**0.131 (2.81)*****	**0.048 (3.04)*****	**0.177 (3.17)*****	0.027 (1.50)	**0.132 (2.98)*****	**0.048 (2.25)****	**0.177 (3.69)*****
R^2	0.047	0.161	0.014	0.134	0.047	0.162	0.168	0.400
	$F_{1,44}$=5.34 [.0256]	$F_{1,44}$=7.90 [0.007]	$F_{1,22}$=9.23 [0.006]	$F_{1,22}$=10.08 [0.004]	BP-test: 8.076 [0.005]		BP-test: 16.952 [0.000]	
					Corr. matrix of residuals		Corr. matrix of residuals	
						Δβ Δπ		Δβ Δπ
					Δβ	1	Δβ	1
					Δπ	-0.419 1	Δπ	-0.607 1

Notes:
The Pooled model assumes no heterogeneity between countries (same intercept and slope coefficients)
The Fixed Effects model assumes time invariant heterogeneity between countries captured in the country specific intercepts
The SUR estimation approach controls for the cross-equation error correlation in the pooled model.
The SUR/FE estimation approach controls for the cross-equation error correlation in the Fixed Effects model.
Numbers in parenthesis are t-ratio and numbers in square brackets are p-values.
Robust standard errors to heteroskedasticity are used.
The BP-test is the Breusch-Pagan test of independence of the residuals.
*** , **, * indicate that coefficients are statistically significant at the 1%,5% and 10% level, respectively

Looking at the significance level in the case of the overlapping rolling-windows approach (top panel of Table 1) the most statistically relevant evidence is taken from the Fixed Effects (FE) model and the SUR estimation approach applied to the FE model where the cross-equation error correlation is considered, thus capturing potential correlation[11] between the change in the Verdoorn's coefficient β and the income elasticity of the demand for imports, π. However, the statistical significance and the marginal impact of the passed income gap are higher in the case of the change of π than in the case of the change of β. Considering the non-overlapping approach, the results are more robust in terms of the statistical significance of coefficients and the goodness of fit. The previous gap in income is statistically significant in all cases (except in the SUR method for the change in β) but it is higher significant in the case of the change in π (at 1% level) than in the change of β (at 5% level only). We can also observe that in all cases the marginal impact of the income gap is higher in the former case than in the latter.

Therefore we have sound evidence showing that the Verdoorn's coefficient β capturing gains in productivity, and the non-price competitiveness given by the income elasticity of the demand for imports π are both responding properly to accommodate passed income gaps (between the

[11] This correlation is only confirmed in the non-overlapping procedure through the BP-test where the null hypothesis of no-error correlation is rejected at the conventional significance level.

balance-of-payments equilibrium growth rate and actual growth rate), but the reaction of the latter is stronger than the former. This farther shows that Palley's argument (Equation 8) and Setterfield's claim (Equation 9) are both valid in explaining the adjustment process of income gap, but the former is more apparent than the latter.

(ii) How π and β react to changes in income gap given by the difference between the Balance-of-Payments equilibrium growth rate and potential growth rate (y_{BP}-y_P)

In this subsection, we implement the same approach as in the previous one but measuring the income gap as the difference between the balance-of-payments equilibrium growth rate (as given in Equation 5) and that of potential income (as given in Equation 6), that is:

$$\hat{y}_{Pgap,ik} = (\hat{y}_{BP,ik} - \hat{y}_{P,ik}) \tag{17}$$

Before presenting the estimation results it would be interesting to compare the actual gap with the potential one, and this difference at the country level is illustrated in Table B (for the non-overlapping periods) and Figure A (for the overlapping periods) in the Appendix A. These results show that the actual gap and the potential gap are closely related to each other with an average correlation coefficient across countries of 0.57 in the non-overlapping approach and 0.76 in the overlapping case. However, the actual gap with a cross-country estimated average standard deviations of 2.476 (for the non-overlapping windows) and 2.121 (for the overlapping procedure) is more volatile than the potential gap, where the cross-country average standard deviations are smaller, 1.302 for the non-overlapping approach and 1.364 for the overlapping procedure.

As before, the aim is to check the changes in the income elasticity of the demand for imports π (capturing the non-price competitiveness) and the change in Verdoorn's coefficient β (capturing gains in productivity) given a previous disequilibrium in the potential income gap. Table 2 reports the estimated results from the overlapping rolling windows procedure and the non-overlapping approach considering three distinct sequential periods.

Table 2 – Reaction of the income elasticity of imports π and the Verdoorn's coefficient β to past potential income gap ($\hat{y}_{Pgap,ik}$)

Estimations using 12 years overlapping rolling windows								
Model	Pooled		FE		SUR		SUR/FE	
Equation	Eq. Δβ	Eq. Δπ	Eq. Δβ	Eq. Δπ	Eq. Δβ	Eq. Δπ	Eq. Δβ	Eq. Δπ
Constant	0.003 (0.47)	0.020 (1.05)	0.003 (0.98)	**0.017 (4.89)*****	0.003 (0.45)	0.020 (1.00)	-0.013 (-0.43)	0.129 (1.42)
y_{Pgap-1}	-0.001 (-0.11)	0.018 (1.42)	-0.002 (-0.18)	**0.026 (2.67)****	-0.001 (-0.19)	**0.018 (1.71)***	-0.002 (-0.42)	**0.026 (2.16)****
R^2	0.000	0.005	0.000	0.005	0.000	0.005	0.007	0.022

	$F_{1,550}$=0.01 [0.910]	$F_{1,550}$=2.02 [0.155]	$F_{1,22}$=0.03 [0.86]	$F_{1,22}$=7.14 [0.014]	BP-test:0.241 [0.623]			BP-test: 0.247 [0.619]		
					Corr. matrix of residuals			Corr. matrix of residuals		
						Δβ	Δπ		Δβ	Δπ
					Δβ	1		Δβ	1	
					Δπ	-0. 021	1	Δπ	-0.021	1
Estimations using 12 years non overlapping windows (1980-1991, 1992-2003 and 2004-2015)										
Model	Pooled		FE		SUR			SUR/FE		
Equation	Eq. Δβ	Eq. Δπ	Eq. Δβ	Eq. Δπ	Eq. Δβ	Eq. Δπ		Eq. Δβ	Eq. Δπ	
Constant	0.034 (0.44)	0.179 (0.92)	0.053 (0.87)	0.053 (0.66)	0.033 (0.42)	0.179 (0.87)		0.301 (0.67)	0.406 (0.48)	
y_{Pgap-1}	-0.005 (-0.12)	**0.197 (2.19)****	-0.034 (-0.37)	**0.386 (3.23)*****	-0.005 (-0.12)	**0.197 (2.00)****		-0.034 (-0.61)	**0.386 (3.13)*****	
R^2	0.000	0.080	0.001	0.080	0.001	0.080		0.084	0.358	
	$F_{1,44}$=0.01 [0.905]	$F_{1,44}$=4.81 [0.034]	$F_{1,22}$=0.13 [0.718]	$F_{1,22}$=10.42 [0.004]	BP-test: 3.998 [0.045]			BP-test: 5.675 [0.017]		
					Corr. matrix of residuals			Corr. matrix of residuals		
						Δβ	Δπ		Δβ	Δπ
					Δβ	1		Δβ	1	
					Δπ	-0. 021	1	Δπ	-0.021	1

Notes:
The Pooled model assumes no heterogeneity between countries (same intercept and slope coefficients).
The Fixed Effects model assumes time invariant heterogeneity between countries captured in the country specific intercepts.
The SUR estimation approach controls for the cross-equation error correlation in the pooled model.
The SUR/FE estimation approach controls for the cross-equation error correlation in the Fixed Effects model.
Numbers in parenthesis are t-ratio and numbers in square brackets are p-values.
Robust standard errors to heteroskedasticity are used.
The BP-test is the Breusch-Pagan test of independence of the residuals..
*** , **, * indicate that coefficients are statistically significant at the 1%,5% and 10% level, respectively

The results are quite different in comparison to the previous case where the actual income gap was considered. From the overlapping rolling-windows approach it is shown that only the import elasticity reacts significantly to the passed potential income gap (at the 5% and 10% significance level). The results are more robust in the non-overlapping distinct periods approach reinforcing the conclusion that passed potential income gap affects significantly the change in the income elasticity of the demand for imports but not the change in the Verdoorn's coefficient and this is valid for all methods of estimation. Therefore, when the potential income gap is considered, our evidence supports Palley's argument that, it is the non-price competitiveness (through the income elasticity of demand for imports) that adjusts to fill the gap in income and not productivity (through the Verdoorn's coefficient) associated with Setterfield's statement.

4. Conclusions

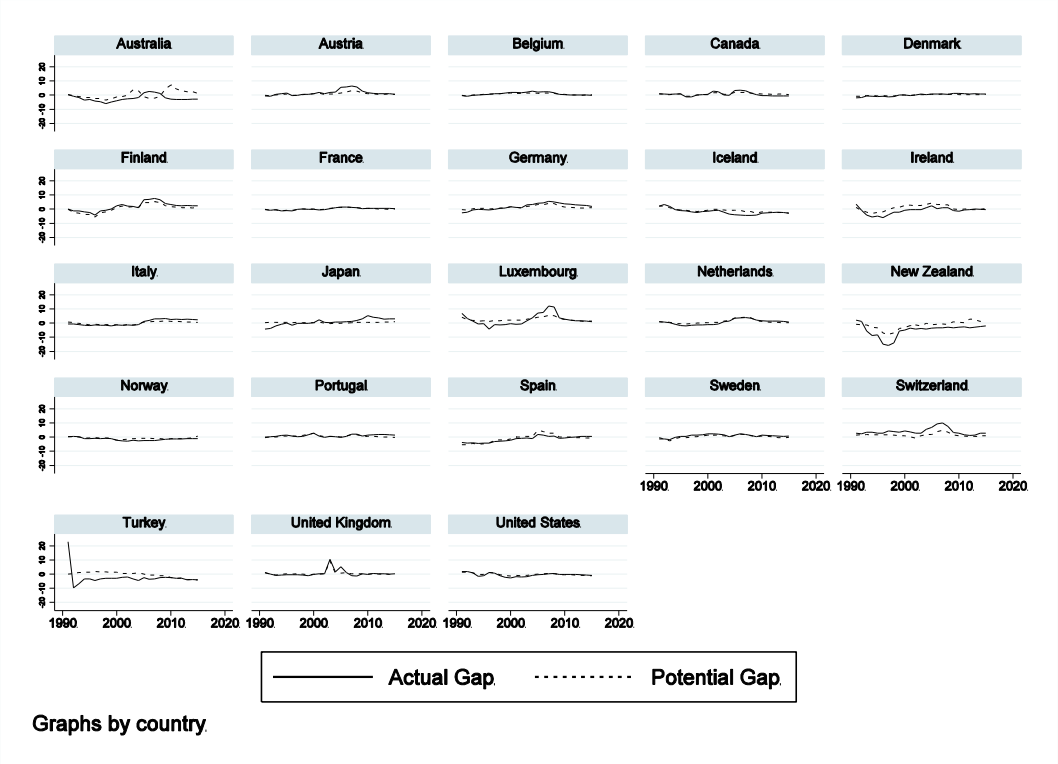
In this study we suggest an empirical methodology to test if the channels proposed by Palley (2002) and Setterfield (2006 and 2012) close the observed gap between the growth rate consistent with the balance of payments equilibrium, as stated by Thirlwall's Law, and the potential output driven by a cumulative causation growth process, earlier identified by Verdoorn (1949) and later by Kaldor (1966).

The proposed methodology consists of three steps: first we estimate the income elasticity of imports and exports as the Thirlwall's model requires, and the Verdoorn coefficient which captures increasing returns to scale properties; second, we computed the growth rate consistent with the balance of payments equilibrium and defined the income gap in two manners: the difference between the balance of payments equilibrium growth rate and actual growth rate, and the difference between the former and potential income; third, by implementing non-overlapping and overlapping procedures on a sample of 23 OECD countries, we estimated the reaction of the income elasticity of imports (π) and the Verdoorn´s coefficient (β) assuming changes in past values of the income gap.

The obtained evidence suggests that both channels are important in order to close the actual income gap, but only the income elasticity of imports reacts significantly to close the potential income gap. These results, seem to indicate that any discrepancy between the actual/potential income and the one consistent with the balance of payments equilibrium cause changes in the non-price competitiveness given by the income elasticity of the demand for imports, and changes in productivity given by the Verdoorn coefficient, but the former reacts more effectively in the adjustment process to fill the income gaps. Although both channels are important to adjust the existing gap in income, our results favour the Palley's argument that changes in non-price competitiveness are dominant to bring the economies into equilibrium.

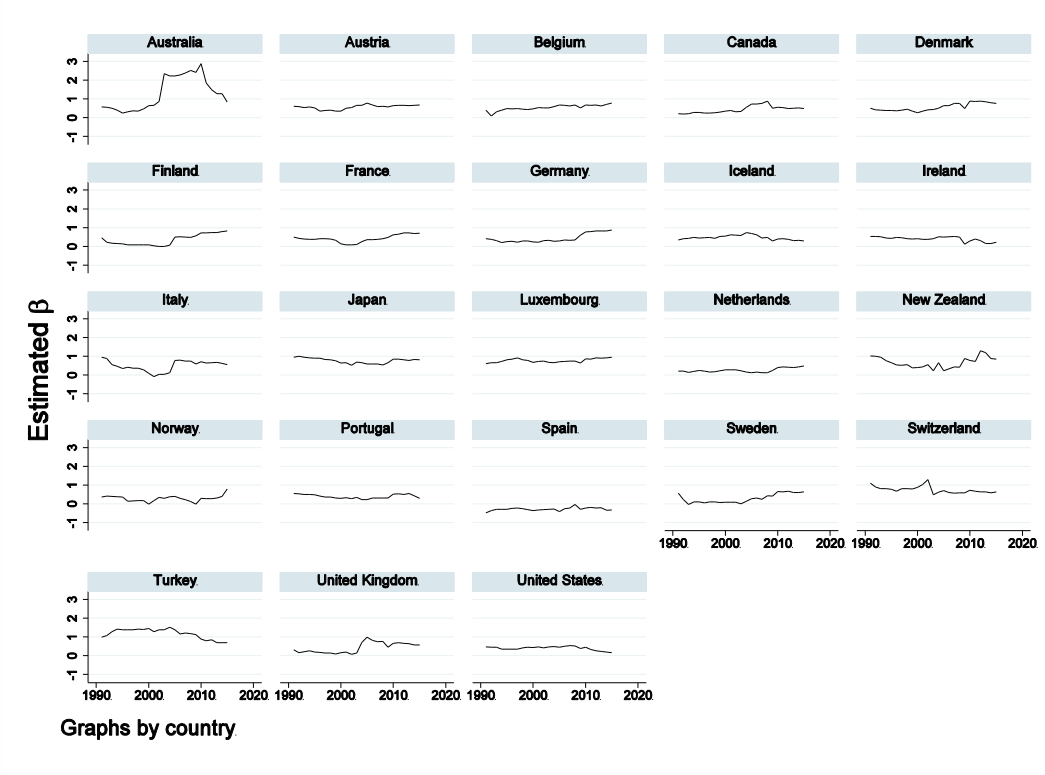
APPENDIX A

Figure A: Actual and Potential income GAP for 23 OECD countries for the overlapping periods



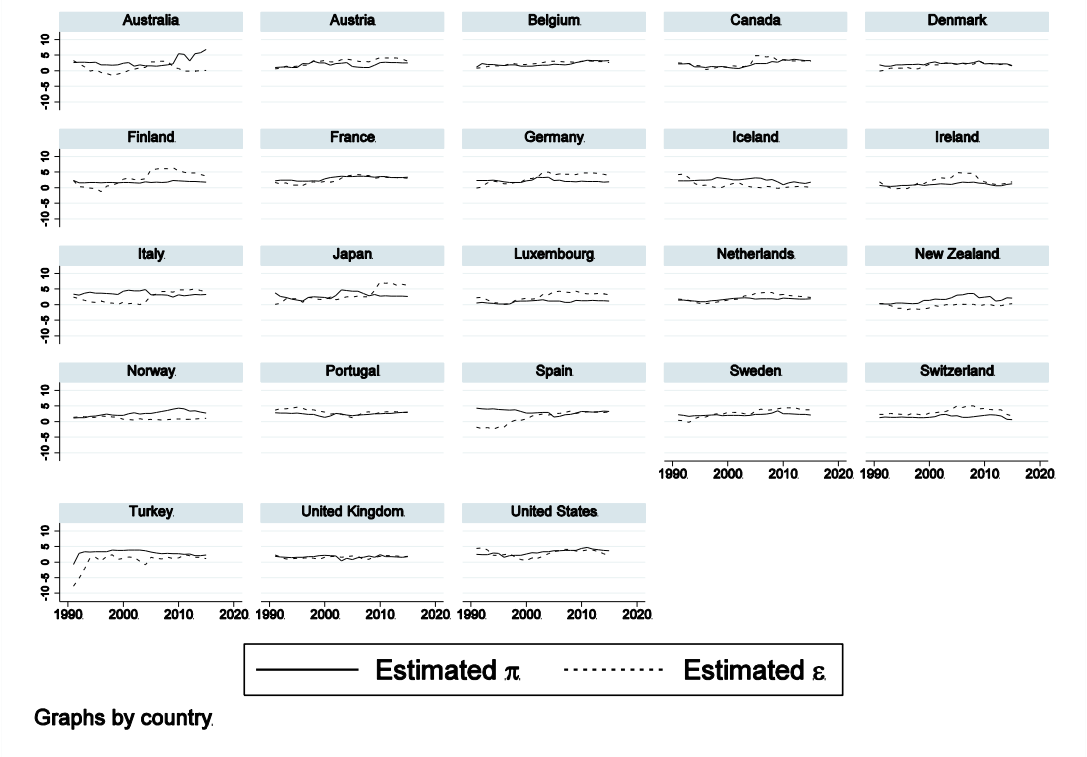
Source: Own Configuration

Figure B: Estimated β for the overlapping rollwing windows estimations



Source: Own Configuration

Figure C: Estimated π (import elasticity) and ε (export elasticity) for the overlapping rolling windows estimations



Source: Own Configuration

Table A: Estimated values of π, ε and β for the non-overlapping periods

Country	Period	π	se(π)	ε	se(ε)	β	se(β)
Australia	1980-91	2.645	0.832	3.224	1.272	0.570	0.190
Australia	1992-03	1.929	1.919	1.033	1.023	2.348	0.494
Australia	2004-15	6.888	2.104	0.094	0.192	0.827	0.204
Austria	1980-91	1.099	0.637	0.679	0.774	0.605	0.149
Austria	1992-03	2.443	0.930	3.537	0.477	0.655	0.145
Austria	2004-15	2.552	0.455	3.146	0.529	0.681	0.070
Belgium	1980-91	1.117	0.544	0.816	0.456	0.406	0.130
Belgium	1992-03	1.791	0.494	2.647	0.505	0.519	0.156
Belgium	2004-15	3.305	0.333	2.610	0.323	0.782	0.122
Canada	1980-91	2.216	0.520	2.537	1.039	0.215	0.086
Canada	1992-03	1.260	0.681	1.405	1.012	0.333	0.122
Canada	2004-15	3.291	0.465	3.001	0.419	0.480	0.100
Denmark	1980-91	1.885	0.398	-0.075	0.552	0.503	0.104
Denmark	1992-03	2.471	0.599	2.511	0.761	0.443	0.132
Denmark	2004-15	1.707	0.352	1.555	0.443	0.761	0.199
Finland	1980-91	2.311	0.199	2.354	0.938	0.471	0.063
Finland	1992-03	1.475	0.292	2.526	1.319	0.002	0.135
Finland	2004-15	1.775	0.267	3.686	0.645	0.827	0.091
France	1980-91	2.232	0.515	1.682	0.795	0.494	0.088
France	1992-03	3.703	0.460	3.090	0.673	0.098	0.144
France	2004-15	3.348	0.339	3.038	0.318	0.698	0.091
Germany	1980-91	2.283	0.238	-0.088	1.205	0.411	0.122
Germany	1992-03	3.298	0.813	4.902	0.635	0.319	0.184
Germany	2004-15	1.907	0.231	3.883	0.520	0.873	0.054
Iceland	1980-91	2.252	0.538	4.242	1.226	0.344	0.123
Iceland	1992-03	2.746	0.721	0.700	0.906	0.579	0.143
Iceland	2004-15	1.762	1.161	0.151	1.085	0.290	0.211
Ireland	1980-91	0.738	0.584	1.941	0.958	0.535	0.199
Ireland	1992-03	1.152	0.474	3.012	1.192	0.410	0.130
Ireland	2004-15	1.205	0.231	1.862	0.535	0.223	0.149
Italy	1980-91	3.360	0.830	2.428	0.944	0.944	0.090
Italy	1992-03	4.424	0.845	-0.040	1.092	0.041	0.210
Italy	2004-15	3.247	0.349	4.256	0.447	0.558	0.113
Japan	1980-91	3.787	1.304	0.116	1.777	0.961	0.115
Japan	1992-03	4.681	0.728	1.900	1.293	0.696	0.159
Japan	2004-15	2.574	0.383	6.167	1.013	0.822	0.052
Luxembourg	1980-91	0.484	0.280	2.244	1.331	0.605	0.090
Luxembourg	1992-03	1.516	0.360	3.215	0.841	0.672	0.118
Luxembourg	2004-15	1.195	0.377	3.189	0.366	0.948	0.082
Netherlands	1980-91	1.486	0.265	1.723	0.643	0.212	0.167
Netherlands	1992-03	2.151	0.351	2.776	0.589	0.233	0.126
Netherlands	2004-15	1.844	0.352	2.262	0.278	0.488	0.149

New Zealand	1980-91	0.271	0.750	0.342	0.966	1.017	0.231
New Zealand	1992-03	1.653	0.627	0.006	0.544	0.237	0.312
New Zealand	2004-15	2.057	1.450	0.273	0.366	0.852	0.356
Norway	1980-91	1.178	0.627	1.352	0.366	0.365	0.104
Norway	1992-03	2.354	0.540	0.909	0.843	0.289	0.170
Norway	2004-15	2.714	0.852	1.003	0.205	0.794	0.331
Portugal	1980-91	2.842	0.503	3.652	0.902	0.550	0.149
Portugal	1992-03	2.349	0.403	2.411	0.659	0.340	0.154
Portugal	2004-15	3.042	0.428	2.877	0.477	0.291	0.161
Spain	1980-91	4.338	0.532	-1.840	0.919	-0.491	0.178
Spain	1992-03	2.879	0.617	2.383	0.818	-0.298	0.102
Spain	2004-15	3.237	0.705	3.040	0.244	-0.328	0.067
Sweden	1980-91	2.235	0.501	0.423	0.881	0.562	0.105
Sweden	1992-03	1.826	0.457	2.537	0.849	0.003	0.155
Sweden	2004-15	2.077	0.259	3.719	0.456	0.638	0.098
Switzerland	1980-91	1.254	0.417	2.252	0.771	1.102	0.251
Switzerland	1992-03	2.276	0.615	3.199	0.888	0.478	0.151
Switzerland	2004-15	0.561	1.012	1.745	0.844	0.642	0.168
United Kingdom	1980-91	1.833	0.298	2.312	0.545	0.313	0.165
United Kingdom	1992-03	0.335	0.760	1.588	0.665	0.141	0.217
United Kingdom	2004-15	1.753	0.488	1.861	0.595	0.566	0.070
United States	1980-91	2.517	0.414	4.380	1.197	0.475	0.064
United States	1992-03	3.310	0.463	1.841	1.181	0.477	0.131
United States	2004-15	3.621	0.434	2.076	0.475	0.157	0.149
Turkey	1980-91	-0.732	1.690	-7.679	4.606	0.987	0.062
Turkey	1992-03	3.856	0.272	0.299	1.712	1.380	0.143
Turkey	2004-15	2.226	0.279	1.081	0.969	0.693	0.237

Source: own estimations

Table B: Actual and Potential income GAP for 23 OECD countries for the non-overlapping periods

Period	1980-91	1992-03	2004-15	1980-91	1992-03	2004-15
Country	Australia			Luxembourg		
Actual Gap	0.383	-2.365	-2.749	6.897	1.755	1.064
Potential Gap	0.353	3.838	1.125	4.063	2.715	1.432
Country	Austria			Netherlands		
Actual Gap	-0.660	1.904	0.561	0.923	0.870	0.794
Potential Gap	-0.117	0.729	0.551	0.900	1.354	0.331
Country	Belgium			New Zealand		
Actual Gap	-0.249	2.216	-0.212	2.020	-3.803	-2.019
Potential Gap	-0.100	1.399	0.252	-0.850	-2.019	1.246
Country	Canada			Norway		
Actual Gap	0.822	0.009	-0.487	0.247	-2.104	-1.068
Potential Gap	1.072	0.578	0.418	0.365	-0.998	0.791
Country	Denmark			Portugal		
Actual Gap	-1.937	0.678	0.730	-0.379	0.545	1.452
Potential Gap	-0.753	0.451	0.634	-0.059	0.501	-0.187
Country	Finland			Spain		
Actual Gap	0.106	1.835	2.346	-3.904	-0.635	0.526
Potential Gap	-0.140	1.601	1.022	-5.484	0.532	-0.398
Country	France			Sweden		
Actual Gap	-0.280	0.392	0.395	-1.386	1.538	0.647
Potential Gap	-0.220	0.547	0.024	-0.340	0.962	-0.224
Country	Germany			Switzerland		
Actual Gap	-2.596	2.974	1.881	2.658	2.836	2.765
Potential Gap	-0.466	1.857	0.950	1.503	1.017	0.979
Country	Iceland			UK		
Actual Gap	2.218	-2.092	-2.756	1.207	10.510	0.161
Potential Gap	2.042	-0.687	-2.821	0.934	9.412	-0.148
Country	Ireland			United States		
Actual Gap	3.514	-0.439	-0.346	1.847	-1.790	-0.868
Potential Gap	1.137	2.521	0.555	1.477	-0.817	-1.086
Country	Italy			Turkey		
Actual Gap	-0.496	-1.459	2.359	22.931	-3.328	-3.996
Potential Gap	0.669	-1.323	0.626	-0.013	0.455	-4.005
Country	Japan					
Actual Gap	-4.303	0.313	3.118			
Potential Gap	0.304	-0.304	0.954			

Source: own estimations

APPENDIX B- Description of the variables and data sources

y – Annual growth rate of real domestic income. Computed by the authors from data on "Gross domestic product at 2010 reference levels"

m – Annual growth rate of real imports. Computed by the authors from data on "Imports of goods and services at 2010 prices"

x - Annual growth rate of real exports. Computed by the authors from data on "Exports of goods and services at 2010 prices"

q - Annual growth rate of real productivity. Computed by the authors from data on Gross domestic product at 2010 reference levels per person employed"

tt- Annual growth rate of terms of trade. Computed by the authors from data on "Terms of trade goods and services (National accounts)"

*y** - Annual growth rate of real foreign domestic income. Computed by the authors from data on "Gross domestic product at 2010 reference levels". For each year and each of the 23 OECD countries, it was computed the average for the remaining 22 OECD countries.

*q** - Annual growth rate of real foreign productivity. Computed by the authors from data on "Gross domestic product at 2010 reference levels". For each year and each of the 23 OECD countries, it was computed the average for the remaining 22 OECD countries.

n – Annual growth of population. Computed by the authors from data on "Total population"

Data Source:

Ameco http://ec.europa.eu/economy_finance/ameco/user/serie/SelectSerie.cfm

(Data extracted on 12th May 2016)

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