Growth adjustments through non-price competitiveness and productivity. A cumulative causation approach

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Abstract

Increasing returns to scale are important for economic growth, generating higher levels of productivity. This view was earlier suggested by Verdoorn (1949) and Kaldor (1966) in formulating the basic Laws of economic growth. The later demand-orientated approach based on the export-led growth, gave higher importance to the non-price competitiveness reflected in the income elasticities of trade, as the main determinants of the long-term economic growth, along with external demand. This view was expressed in Thirlwall's Law (1979) on the balance-of-payments equilibrium growth inspired from the early Harrodian concept of the foreign trade multiplier. This paper aims at considering both concepts, that is, increasing returns to scale (through the Verdoorn's Law) and non-price competition (through the Thirlwall's Law) in order to access whether growth adjustments over time are due mostly to productivity changes or due to changes in competitiveness. To do so, we employ a regression analysis which comprises a set of 23 OECD countries over the period 1980-2016. The estimation approach sheds light on whether growth adjustments between the balance-of-payments growth rate and that of actual or potential income are driven by improvements in productivity or improvements in non-price competiveness, or in both.

Keywords: increasing returns to scale, non-price competitiveness, income gap adjustments, regression analysis.

JEL code: C23, D24, F10, O47

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1. Introduction

Kaldor (1966) established three Laws of economic growth.[1] One of them was inspired by Verdoorn's Law (1949), stating that the growth of labour productivity is determined by the growth of manufacturing output, arguing that the industrial sector is the only one exhibiting increasing returns to scale characteristics. According to this, the economy's productivity tends to grow faster the faster the industrial output expands, recognizing that the industrial sector is responsible for the increase in productivity in other sectors. The relation between the growth of labour productivity and manufacturing output captures both 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 are due to spill-over effects and positive externalities.

The simple Verdoorn-Kaldor relationship can be presented as

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

where q is the rate of growth of labour productivity, y is the rate of growth of manufacturing output, α_0 is autonomous productivity and $\beta<1$ the Verdoorn's coefficient capturing the increasing returns to scale effects which are exclusive to the manufacturing sector[2].

According to this view, increasing returns to scale (mainly in manufacturing) are responsible for the higher growth in the whole economy, contradicting the neo-classical orthodoxy of decreasing returns to scale in the production process explained by the declining marginal productivity of the producible factors. Therefore, adjustments in income are due mainly to changes in productivity and the intensity of increasing returns to scale in the production process. Differences in growth rates between countries can be explained by differences in increasing returns to scale achievements. Countries that allocate means of production to activities with increasing returns to scale will grow faster. The division of labour which depends on the market

[1] Kaldor (1957) developed his growth theory using many of Myrdal's (1957) ideas about the process of cumulative causation growth. Kaldor´s first law relates the growth of real output with the growth of manufacturing production, attributing a special role to this sector in the economy. The second law relates the growth of labour productivity with the growth of manufacturing output (the Verdoorn Law) capturing increasing returns to scale properties, and the third law accesses that the growth of non-manufacturing output depends on the growth of manufacturing production, capturing the externality effects that manufacturing has on the increase in productivity of other sectors.

[2] $\beta = 0$ indicates constant returns to scale and this is in line with the neo-classical assumption of constant or diminishing returns to scale explained by the diminishing marginal productivity of the factors of production.

size and export orientation are important for achieving increasing returns to scale and therefore higher growth[3].

The early post-Keynesian approach on the importance of increasing returns to scale for higher growth has been complemented by Thirlwall (1979), establishing a simple rule: the growth rate of domestic output can be explained by the product of the growth rate of foreign income and the ratio of the income elasticity of exports to that of imports, and this became known as Thirlwall's Law. This relation defines the growth rate of a country that is consistent with the balance of payments equilibrium (on current account). Thirlwall's model comprises two equations (the import and export demand functions) and one identity given by the current account balance:

$m=\pi y+\delta(p_f+e-p_d)$ the import demand function (2)

$x=\varepsilon y^*+\eta(p_f+e-p_d)$ the export demand function (3)

$p_d+x=m+p_f+e$ the current account balance (4)

where m and x are the growth rates of imports and exports (goods and services), y and y^* are the growth rates of domestic and foreign income, pf and pd are growth rates of foreign and domestic prices respectively, and e is the exchange rate. The parameters π and ε express the domestic and foreign income elasticity of the demand for imports and exports, respectively, and δ and η are the elasticities of relative prices in the import and export functions.

Combining the three above relations and solving for the domestic income growth, under the assumption that relative prices are constant in the long-term[4], that is, $p_f+e-p_d=0$, we derive

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

Equation (5) is the well-known Thirlwall's Law stating that domestic income growth (compatible with the Balance-of-Payments equilibrium on current account) depends on the growth of external demand y^* and the non-price competitiveness, given by the ratio of the income elasticity of exports to that of imports, ε/π. In other words, the increase of domestic income depends on two main factors: one factor is internal, increasing the non-price competiveness by either turning exports more attractive to international markets (increasing the

[3] The meaning of Verdoorn´s Law has been discussed extensively in McCombie et al., (2003).

[4] This hypothesis has been criticised in the literature (e.g. McGregor and Swales (1985; 1991); Alonso and Garcímartin (1998-99); López and Cruz (2000)). However, in most studies relative prices have been shown to be statistically insignificant and even when they are significant, the price elasticities are relatively low in size.

[5] If we substitute equation (3) into (5), assuming that relative prices are constant, Thirlwall´s Law can be defined alternatively as $y_{BP}=x/\pi$, 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.

income elasticity of exports, ε) or reducing the import appetite in domestic market (decreasing the income elasticity of imports, π), or a combination of both. The other factor is external, depending on the strength of economic growth of other countries who interchange products with the domestic country.

As Thirlwall argues, if a country does not respect the equilibrium condition given in (5), sooner or later it will accumulate external deficits which will be difficult to finance in the absence of capital inflows from abroad. In this case, domestic income must adjust downwards in order to bring the economy into equilibrium. Differences in growth rates between countries are explained mainly by differences in the non-price competitiveness. In particular, countries with higher income elasticity of the demand for exports relatively to that of imports ($\varepsilon>\pi$) will grow faster than the rest of the world[6]. In the same line of thought Hausmann et al (2007) in a cross – country and by product study show that the specialization patterns and the quality of exports have important implications for economic growth.

The connection between the two above approaches, that is, between Kaldor-Verdoorn's Law and Thirlwall's Law is apparent. One would expect that countries with higher economies of scale and therefore higher productivity would show higher non-price competitiveness. As Setterfield (2012) points out, if productivity gains (through the Verdoorn's Law) are used to improve the quality characteristics of the produced output, rather than to reduce costs and hence prices, and if consumers show higher preference towards quality rather than to price, then it makes sense to assume that the non-price competitiveness - captured in the income elasticity of demand for exports and imports - is more sensitive to the levels of productivity at home and abroad, respectively. The basic argument here is that the higher the level of productivity, the higher the quality of goods produced, and so the higher the demand for domestic output, both at home and foreign markets. According to Thirlwall, the non-price competitiveness is reflected in the size of the income elasticities of imports and exports which capture the supply characteristics of the produced goods associated with quality, design, product differentiation, liability, practicality, renovation, among others. All these supply characteristics are closely related to increasing returns to scale properties in the production process, where learning by doing aspects, innovation, technical progress, human capital qualification, among others, influence both productivity and non-price competitiveness.

Recognizing the importance of increasing returns to scale through the Verdoorn coefficient, equation (1), and the non-price competitiveness reflected in the income elasticities of trade, equation (5) in explaining economic growth, the aim of this study is twofold: first, to confirm

[6] Several extensions to Thirlwall's Law consider capital flows (Thirlwall and Hussain, 1982), internal constraints (Soukiazis *et al.*, 2012) or even employing an analysis at the sectoral level (Dias and Antunes, 2015).

empirically whether countries with higher non-price competitiveness, that is ε>π, exhibit higher productivity levels; second, to verify whether income adjustments over time are due to productivity gains or due to non-price competitiveness or due to both. To our knowledge, these hypotheses have not been tested in the relevant literature yet, although the theoretical aspects have been discussed by Setterfield (2012).

In doing so, we structure the paper as follows: Besides the introduction, section 2 explains the cumulative causation growth approach which links the ideas of increasing returns to scale and non-price competitiveness. Section 3 provides empirical evidence on the connection between productivity and non-price competitiveness. Section 4 explains the adjustment process in income through shifts in non-price competitiveness or changes in productivity on the basis of a cumulative causation growth process. Section 5 provides evidence on the contribution of non-price and productivity in closing the gap between the growth rate compatible with the balance-of-payments equilibrium (on current account) and actual or potential growth, considering a sample of 23 OECD countries, over the period 1980-2016. The last section concludes, discussing the main findings.

2. The connection between productivity and competitiveness through a cumulative causation growth process.

Following Setterfield (2012), the close relation between productivity and non-price competiveness can be explained through a cumulative causation process, described as follows.

As we have discussed previously, there is theoretical consensus about the assumption that the income elasticities of the demand for exports and imports, are related to home productivity level Q, and foreign productivity level Q*, respectively. Therefore, we can write

$$\varepsilon=\gamma Q \tag{6}$$

$$\pi=\delta Q^* \tag{7}$$

The non-price competitiveness in Thirlwall`s Law is given by the ratio of the two income elasticities, that is

$$\frac{\varepsilon}{\pi}=\frac{\gamma Q}{\delta Q^*}=k \tag{8}$$

Taking rates of growth, we get

$$\dot{k}=k(q-q^*) \tag{9}$$

Equation (9) states that the change in non-price competitiveness is a function of the difference in relative productivity growth between the home q and foreign countries q^*.

Let's now turn to the Verdoorn's Law recalling equation (1) and define

$$q = \alpha_0 + \beta y \quad (10)$$

$$q^* = \alpha_0 + \beta y^* \quad (11)$$

Equation (10) relates productivity growth q to the growth rate of domestic output y in the home country, and equation (11) relates productivity growth q^* to the growth of output y^* of the foreign countries (rest of the world). Substituting these two equations into (9), we arrive at

$$\dot{k} = k\beta(y - y^*) \quad (12)$$

Equation (12) now relates the change in non-price competiveness to the relative growth of output between the home country and abroad, and the coefficient of Verdoorn β, which captures returns to scale properties.

Recalling Thirlwall's Law as given in equation (5) we can write:

$$y_{BP} = \frac{\varepsilon}{\pi} y^* = k y^* \quad (13)$$

and substituting into (12) we arrive at the following expression

$$\dot{k} = k\beta(k-1) y^* \quad (14)^7$$

Equation (14) can be used to distinguish the following cases:

(i) If $k=1$ which means that the income elasticity of exports equal to that of imports $\varepsilon=\pi$, then there will be no change in the non-price competitiveness ($\dot{k} = 0$) and therefore, from (13) $y_{BP} = y^*$ and $q=q^*$ from (9). In this case the home country will grow at the same rate as its trade partners abroad, and this growth rate will be self-perpetuating. Productivity growth will also be equal in the home country and abroad.

(ii) If $k>1$, so that $\varepsilon>\pi$, this implies that $y_{BP} > y^*$ and then we will observe $\dot{k} > 0$ from (14). In this case, the initial advantage in non-price competitiveness - and productivity growth $q>q^*$ from (9) - of the home country relative to its trade partners will reinforce its growth rate to higher levels than abroad, following a growth process with cumulative causation characteristics (a virtuous circle). There will be a divergence in growth rates in favour of the home country with self-

[7] We assume here that the balance of payments equilibrium growth rate y_{BP} is close to the actual growth y.

sustaining tendencies, as long as, the advantage in non-price competitiveness (and productivity growth) is preserved.

(iii) If $k<1$, then $\varepsilon<\pi$ and therefore $y_{BP} < y^*$ as well as $q<q^*$. In this case, the initial disadvantage in non-price competitiveness (and productivity growth) of the home country relatively to its trade partners will reinforce a lower cumulative causation growth rate in the home country.

The above scenarios analysis illustrates two important aspects. The first is the clear connection between Thirlwall's Law and Verdoorn's Law through the interaction of the non-price competitiveness and economies of scale (gains in productivity) captured in the latter. The second is the cumulative causation characteristics of the growth process - as discussed earlier by Kaldor (1970; 1981) and formalized by Dixon and Thirlwall (1975) - resulting from the simultaneous interaction of non-price competitiveness and productivity growth that could enhance higher self-sustaining growth for the home country, as long as the advantages on non-price competitiveness and productivity are preserved[8]. The empirical approach of this paper will shed light on the validity of these hypotheses.

3. Empirical evidence on the connection between non-price competitiveness and productivity.

In order to show that non-price competitiveness and productivity are closely related, the import and export functions as given in equations (2) and (3) and the Verdoorn Law as given in equation (1) must be estimated. We use a sample of 23 OECD countries (see Table 1) where data is available for a period that covers recent data from 1980 to 2016. The import and export equations are estimated by including the terms of trade variable[9] (proxy for relative prices) and a dummy variable that assumes the value of one from 2008 onwards to capture the influence of the financial crisis (and debt crisis in the UE members). The import and export equations are estimated by *3SLS* as the most efficient full information method that captures the interconnection of trade flows through the cross-equation error terms. The Verdoorn's Law is estimated by OLS (with robust standard errors) also including the dummy variable for the

[8] For a comparison on studies about cumulative causation growth models, see Soukiazis and Antunes (2013).

[9] In most cases the coefficient of the terms of trade variable displayed no statistical significance confirming the price pessimism hypothesis that trade competitiveness is mostly driven by non-price characteristics (quality, variety, innovation, etc.) which are captured in the income elasticity of trade. The terms of trade variable is included in the regressions to avoid omitted variable bias.

financial crisis period. All variables are in growth rates to capture dynamic tendencies and to ensure that the series are stationary[10].

The results obtained from the regression analysis are summarized[11] in Table 1 along with other variables (average annual growth rates), namely the growth of domestic and foreign income and the growth of domestic and foreign productivity.

Table 1. Non-price competitiveness and productivity (1980-2016)

	Country	ε (1)	π (2)	ε/π (3)	y_{BP} (4)	y (5)	y* (6)	q (7)	q* (8)	β (9)	α_0 (10)
1	Australia	1.18**	2.96***	0.40	0.92	3.16	2.30	1.36	1.43	0.38***	0.19***
2	Austria	2.12***	1.46***	1.45	3.42	1.91	2.36	1.27	1.43	0.60***	0.25***
3	Belgium	1.53***	1.81***	0.85	1.99	1.84	2.36	1.17	1.43	0.54***	0.37***
4	Canada	3.12***	2.26***	1.38	3.22	2.40	2.33	1.00	1.45	0.39***	0.05***
5	Denmark	1.67***	1.96***	0.85	2.03	1.60	2.39	1.37	1.43	0.51***	0.62***
6	Finland	2.25***	1.70***	1.32	3.11	2.06	2.35	1.82	1.41	0.39***	1.40***
7	France	2.32***	2.94***	0.79	1.86	1.78	2.36	1.49	1.43	0.79***	0.18***
8	Germany	1.97***	1.71***	1.15	2.73	1.69	2.37	1.26	1.45	0.62***	0.47***
9	Iceland[c]	1.27*	1.83***	0.69	1.61	2.84	2.32	1.14	1.43	0.53***	-0.39***
10	Ireland	1.10**	1.11***	0.99	2.22	4.16	2.25	2.66	1.36	0.31***	1.07***
11	Italy	2.41***	3.10***	0.78	1.86	1.21	2.39	0.82	1.45	0.74***	-0.004***
12	Japan	3.58***	1.76***	2.03	4.79	1.98	2.36	1.55	1.42	0.76***	0.05***
13	Luxembourg	2.43***	0.92***	2.64	5.98	4.13	2.27	1.72	1.43	0.89***	-1.88***
14	Netherlands	1.80***	1.25***	1.44	3.39	2.07	2.35	0.98	1.43	0.47***	0.03***
15	New Zealand[a]	1.36***	1.66***	0.82	1.91	2.55	2.33	1.33	1.44	0.38***	0.44***
16	Norway	1.24***	1.84***	0.67	1.57	2.48	2.33	1.50	1.43	0.54***	0.42***
17	Portugal	2.05***	2.28***	0.90	2.11	2.13	2.35	1.63	1.40	0.44***	0.82***
18	Spain	1.66***	3.14***	0.53	1.24	2.31	2.34	1.20	1.43	-0.44***	2.51***
19	Sweden[a]	2.98***	2.01***	1.48	3.48	2.33	2.35	1.78	1.41	0.47***	1.01***
20	Switzerland	1.72***	1.32***	1.30	3.07	1.81	2.36	0.54	1.47	0.77***	-0.85***
21	U.K.	1.46***	1.74***	0.84	1.97	2.16	2.35	1.65	1.42	0.43***	0.95***
22	U.S.	2.60***	3.08***	0.84	1.96	2.64	2.33	1.54	1.43	0.38***	0.52***
23	Turkey	2.44*	2.76***	0.88	2.00	4.14	2.26	2.63	1.38	1.09***	-1.47***
	All countries[b]	2.25***	2.12***	1.06	2.48	2.41	2.34	1.39	1.43	0.49***	0.34***

Notes: Estimated equations:

Import function: $m_t=\gamma_0+\pi y_t+\eta(tt)_t+\gamma D_t$

Export function: $x_t=\delta_0+\varepsilon y^*_t+\psi(tt)_t+\lambda D_t$

Verdoorn's equation: $q_t=\alpha_0+\beta y_t+\theta D_t$

with *m* and *x* the growth of real imports and exports of goods and services, *y* and *y** the growth of real domestic and foreign income (average OECD countries), *q* the growth of labour productivity (product per employee), *tt* the growth of terms of trade (export prices to import prices) and *D* the dummy variable for the financial crisis since 2008 onward (data source: AMECO)

ε- income elasticity of the demand for exports

π- income elasticity of the demand for imports

y_{BP} – domestic income growth consistent with the BP equilibrium (given by Thirlwall`s Law)

*y**- foreign income growth (22 OECD countries) not including the country of reference

*q**- foreign productivity growth (22 OECD countries) not including the country of reference

β- Verdoorn's coefficient

α_0 – autonomous productivity

***, ***, * statistical significance of coefficient at the 1%, 5%, 10% level, respectively

[a] OLS estimation with robust standard errors

[b] panel data, fixed effects (23 OECD countries)

[c] no dummy variable was included

[10] Growth rates are first differences in logs which in most cases are stationary.

[11] The full regression results can be provided by the authors upon request.

The last row of Table 1 reports the results for the total of the 23 OECD countries considered in our sample, where the import and export functions as well as the Verdoorn equation are estimated using panel data and the fixed effects estimation approach.

As it can be seen, the majority of the income elasticity of exports ε (column 1) is statistically significant at the highest 1% level, while for Iceland and Turkey the statistical significance is only verified at the 10% level and for Australia at the 5% level. The income elasticity of imports π (column 2) is statistically significant at the highest 1% level in all cases.

All income elasticities are higher than one as expected, except for Luxembourg where the income elasticity of imports is 0.92. As we explained before, a high income elasticity of imports reveals a higher import penetration in the domestic market, and in this category are countries like Australia, Canada, France, Italy, Portugal, Spain, the US and Turkey, where the income elasticity of imports is higher than two. On the other hand, a high income elasticity of exports indicates higher penetration of domestic products and services to external markets and in this category are countries like Austria, Canada, Finland, Japan, Luxembourg and Sweden displaying an income elasticity of exports that is higher than two (and also higher than the import elasticity).

What matters most in international trade is the non-price competitiveness given by the ratio of the income elasticity of the demand for exports to the income elasticity of the demand for imports ε/π, which must exceed one in order not to create problems in the balance-of payments and achieve higher growth relatively to other trade partners. Countries like Austria, Canada, Finland, Germany, Japan, Luxembourg, the Netherlands, Sweden, and Switzerland, as well as the 23 OECD countries as a whole fulfil this condition. As we explained in the previous section, this is the case (ii) where $k>1$ as a result of ε being higher than π, and one would expect that the growth rate consistent with the Balance-of-Payments equilibrium given by Thirlwall's Law (equation 5) surpasses the growth rate of foreign income, that is $y_{BP} > y^*$. If we check these values in Table 1 (columns 4 and 6) all countries falling in this category fulfil this condition. These countries have an advantage in non-price competitiveness relative to their trade partners, and therefore, they will reinforce their growth rate to higher levels, through a growth process with cumulative causation characteristics (a virtuous circle). The growth rates attained in these countries will show self-sustaining tendencies, as long as, the advantage in non-price competitiveness is preserved. The case (iii) of the previous section where $k<1$ as a result of ε being less than π is also verified for the rest of the countries (Australia, Belgium, Denmark, France, Iceland, Ireland, Italy, New Zealand, Norway, Portugal, Spain, the U.K, the US and

Turkey). In this case one would expect that $y_{BP} < y^*$ and this condition is fulfilled for all countries. This disadvantage in non-price competitiveness of the home country relatively to its trade partners will reinforce a lower cumulative causation growth rate in the home country.

Regarding productivity, the Verdoorn's coefficient β [column (9) of Table 1] also displays statistical significance at the 1% level in all cases. The value of this coefficient is positive and less than one (except for Turkey) giving evidence of increasing returns to scale in aggregate production. For Spain the Verdoorn's coefficient is found to be negative, not respecting therefore the interval $0 \leq \beta \leq 1$ as has been suggested by Kaldor for increasing returns to scale to occur[12]. The closer the Verdoorn`s coefficient β is to one the higher the increasing returns to scale, given by $1/(1-\beta)$.

Another issue to address is whether countries with higher non-price competiveness (higher ε/π ratio) exhibit higher increasing returns to scale in aggregate production. We can check this result by using the linear correlation coefficient between the ε/π ratio and the Verdoorn's coefficient β which in fact shows a positive correlation (0.39) and it is statistically significant at almost 5% level (p-value=0.0562). Alternatively, regressing ε/π on β, the slope coefficient is equal to 0.699 and statistically significant at the 10% level (p-value of the t-statistic=0.082)[13]. Although the evidence is not very strong, we have signs of the positive relation between the non-price competiveness and productivity gains, suggesting that the higher the increasing returns to scale in aggregate production (through labour) the higher the non-price competitiveness, which will help to attain higher growth rates of domestic income relatively to other competitors.

4. Growth adjustments through shifts in non-price competitiveness and productivity.

After explaining the connection between Thirlwall's and Verdoorn's Law it is important to describe whether adjustments of actual growth to its potential rate are due to shifts in non-price competiveness (changes in the income elasticities of trade) or to shifts in productivity through the Verdoorn's coefficient.

To show this, we employ two kind of constraints in the balance of payments equilibrium growth rate as has been defined by Thirlwall's Law in equation (5): the first is an external constraint on

[12] The Verdoorn´s Law is given by $q=\alpha_0+\beta y$ where labour productivity is given by the difference between the growth of output y and 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 (through labour) if $0<\beta<1$ and constant returns to scale if $\beta=0$.

[13] With robust standard error to heteroscedasticity

growth that trade is balanced (on the current account), that is $x=m$[14]. The second is an internal constraint that actual growth (or that predicted from Thirlwall's Law) is the same with potential real output, defined as the maximum output that the economy can attain with the available resources and production technology, given as

$$y_p=q+n \qquad (15)$$

where y_p denotes the growth of potential output[15], 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).

Following Setterfield (2012), it can be shown that Thirlwall's Law describes a sustainable steady-state rate of growth which is consistent with the maintenance of external and internal balances. 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)[16] is higher than the potential growth rate that is, $y_{BP}>y_p$. As Palley (2002) suggests, in this case bottlenecks emerge in domestic production (due to labour tightening) so that imports will increase to meet domestic demand, and therefore the income elasticity of the demand for imports will rise. Consequently, the increase in π will reduce the balance-of-payments equilibrium growth rate y_{BP} 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 (decrease in this case) in order for domestic income to adjust to its potential level, at which point we have sustainable steady-state growth.

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

$$y_{BP} = \frac{\varepsilon}{\pi} y^* \qquad (16)[17]$$

$$y_{pot} = a_0 + n + \beta \frac{\varepsilon}{\pi} y^* \qquad (17)[18]$$

$$\dot{\lambda} = \lambda(y_{BP} - y_{pot}) \qquad (18)[19]$$

[14] With relative prices, this external constraint is given as $p_d+x=p_f+m+e$.
[15] Potential output is also equivalent to Harrod´s natural rate of growth – the maximum rate of growth that the economy can achieve in the long run – which constitutes a growth ceiling.
[16] We assume here that Thirlwall´s Law makes an accurate prediction so that y_{BP} is approximately equal to the actual growth rate y.
[17] Equation (16) is the same as equation (5), the Thirlwall´s Law.
[18] Equation (17) is obtained by substituting into Equation (15) the Verdoorn´s Law as given in Equation (1) and replacing actual income growth y by the equivalent as given in Thirlwall´s Law (equation (5)).

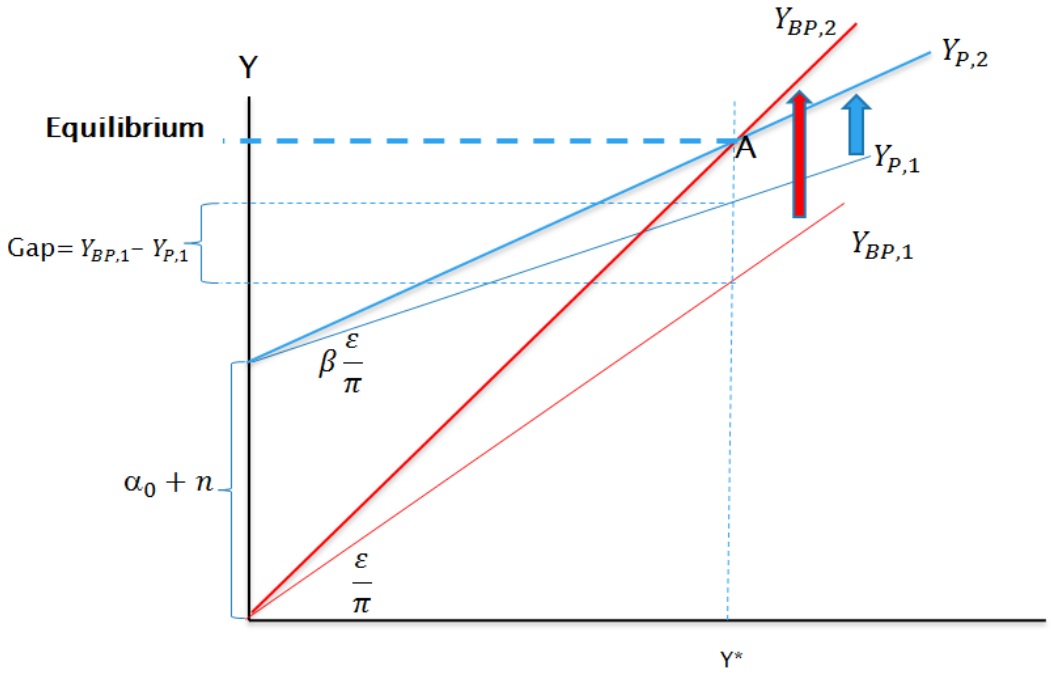
$$\pi = \pi(\lambda), \pi' > 0 \qquad \text{Palley's argument} \qquad (19a)$$

$$\beta = \beta(\lambda), \beta' > 0 \qquad \text{Setterfield's argument} \qquad (19b)$$

From an initial disequilibrium situation in equation (18) of the type $y_{BP}<y_{pot}$, λ will decrease and therefore π will fall, through (19a). The reduction of the income elasticity of the demand for imports will reduce the balance-of-payments equilibrium growth rate (through equation (16)) and therefore actual income will become equal to the potential (or natural) rate. The adjustment in growth rate is made through changes in non-price competitiveness.

The Palley's argument and the adjustment process can be seen in Figure 1. Starting from a negative gap where potential income y_{p1} is higher that the balance-of-payment growth rate y_{bp1}, that is y_{bp1}-$y_{p1}<0$, to restore equilibrium π must decrease shifting therefore 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 $0<\beta<1$. A new equilibrium will be reached 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.

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



[19] Equation (18) is obtained by defining the ratio of actual income level to the potential one, as $\lambda=Y/Y_{pot}$ and then taking growth rates (assuming that actual growth is given by Thirlwall´s Law).

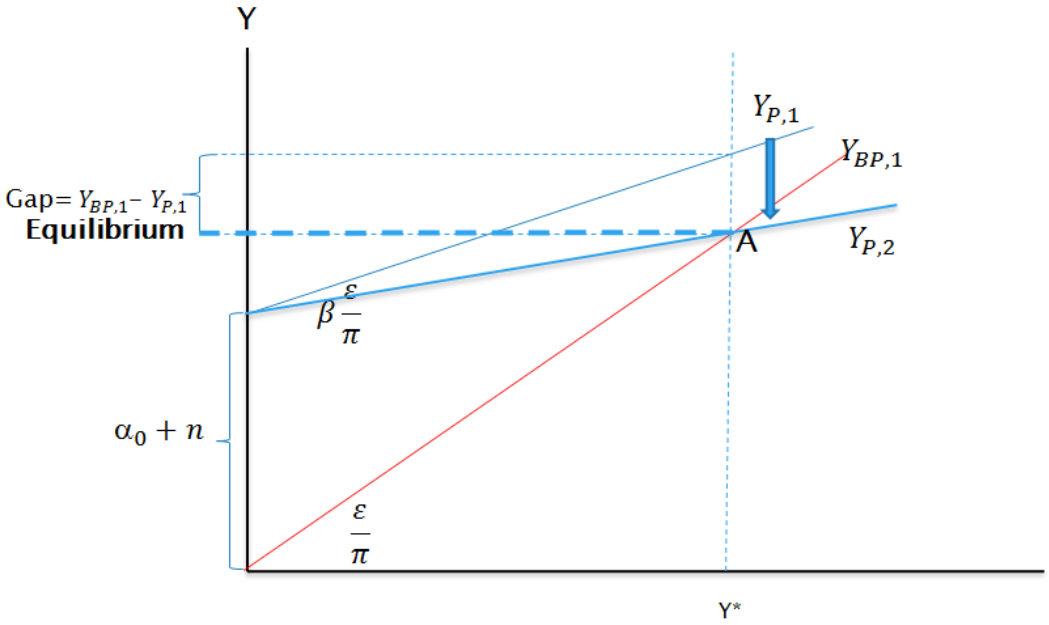
(ii) Growth adjustment through changes in productivity

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 ($y_{BP}>y_{pot}$), the tightening of labour and therefore the shortage of supply in 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 (16), (17), (18) and (19b).

As it can be seen from (18) any initial growth disequilibrium given by $y_{BP}>y_{pot}$ will increase λ and therefore the Verdoorn's coefficient β in (19b) and also potential growth rate in (17). This process of adjustment will continue until actual growth becomes equal to potential growth, 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 Verdoorn's Law.

The adjustment process according to Setterfield's argument can be described in Figure 2.

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



Given an initial disequilibrium y_{bp1}-$y_{p1}<0$, the Verdoorn 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. The opposite movement will occur (upwards shift in potential income curve through the increase in Verdoorn's coefficient β) when the gap is positive, that is $y_{bp1}>y_{p1}$.

The two growth adjustments described above have not been tested empirically in the relevant literature and this is the main goal of our study which will be the subject of analysis in the following sections.

5. The adjustment mechanism in income gap

In this section we show how the income gap is ruled out by changes in non-price competitiveness and productivity. Income gap is defined in two alternative manners: (i) as the difference between the balance-of-payments equilibrium growth rate (given by Thirlwall's Law) and the growth rate of actual income, (ii) as the difference between the balance-of-payments equilibrium growth rate and the growth of potential output. The regression analysis will shed light on these approaches indicating what the responsibility of non-price competitiveness and productivity is in closing the income gap in both cases.

(i) Explaining the gap between the Balance-of-Payments equilibrium growth rate and Actual income growth

The previous explanation about the growth adjustment mechanism with cumulative characteristics is based on the assumption that Thirlwall's Law as given by equation (16) is a good predictor to actual growth. However, checking the results reported in Table 3, the gap between the growth rate consistent with the balance-of-payments equilibrium y_{BP} and actual growth y is far from being close to zero in many cases (in 13 countries the absolute value is greater than one in absolute terms, see column 8). According to Thirlwall this gap is not sustainable in the long term (unless capital flows help to tolerate this situation) and an adjustment must be made in the long term in order to avoid undesirable external imbalances, especially when the gap is negative, showing that the country grows faster than the rate consistent with the balance-of-payments equilibrium (on the current account).

Table 3. Balance-of-Payments/Actual Income gap (1980-2016)

	Country	ε/π (1)	β (2)	y_{BP} (3)	y (4)	q (5)	q^* (6)	$q-q^*$ (7)	$y_{BP}-y$ (8)
1	Australia	0.40	0.38	0.92	3.16	1.36	1.430	-0.070	-2.24
2	Austria	1.45	0.60	3.42	1.91	1.27	1.432	-0.162	1.51
3	Belgium	0.85	0.54	1.99	1.84	1.17	1.433	-0.263	0.15
4	Canada	1.38	0.39	3.22	2.40	1.00	1.451	-0.451	0.82
5	Denmark	0.85	0.51	2.03	1.60	1.37	1.434	-0.064	0.43
6	Finland	1.32	0.39	3.11	2.06	1.82	1.408	0.412	1.05
7	France	0.79	0.79	1.86	1.78	1.49	1.434	0.056	0.08
8	Germany	1.15	0.62	2.73	1.69	1.26	1.447	-0.187	1.04
9	Iceland	0.69	0.53	1.61	2.84	1.14	1.429	-0.289	-1.23
10	Ireland	0.99	0.31	2.22	4.16	2.66	1.360	1.300	-1.94
11	Italy	0.78	0.74	1.86	1.21	0.82	1.447	-0.627	0.65

12	Japan	2.03	0.76	4.79	1.98	1.55	1.418	0.132	2.81
13	Luxembourg	2.64	0.89	5.98	4.13	1.72	1.433	0.287	1.85
14	Netherlands	1.44	0.47	3.39	2.07	0.98	1.434	-0.454	1.32
15	New Zealand	0.82	0.38	1.91	2.55	1.33	1.441	-0.111	-0.64
16	Norway	0.67	0.54	1.57	2.48	1.50	1.425	0.075	-0.91
17	Portugal	0.90	0.44	2.11	2.13	1.63	1.402	0.228	-0.02
18	Spain	0.53	-0.44	1.24	2.31	1.20	1.431	-0.231	-1.07
19	Sweden	1.48	0.47	3.48	2.33	1.78	1.413	0.367	1.15
20	Switzerland	1.30	0.77	3.07	1.81	0.54	1.467	-0.927	1.26
21	U.K.	0.84	0.43	1.97	2.16	1.65	1.422	0.228	-0.19
22	U.S.	0.84	0.38	1.96	2.64	1.54	1.426	0.114	-0.68
23	Turkey	0.88	1.09	2.00	4.14	2.63	1.375	1.255	-2.14
	All countries	1.06	0.49	2.48	2.41	1.39	1.426	-0.036	0.07

Notes:
ε/π – is the non-price competitiveness given by the ratio of the income elasticity of exports to that of imports
β – is the Verdoorn coefficient [the slop of the Verdoorn's equation (1)]
y – is the growth of actual domestic income
y_{BP} – is the growth rate consistent with the balance of payments equilibrium as given in equation (16)
q – is domestic productivity growth
q^* - is foreign productivity growth (average of 22 OECD countries)
q-q^*- is relative productivity growth between the home and foreign countries
y_{BP}-y – is the gap between the balance-of-payments equilibrium growth rate and actual growth rate

An interesting issue to address is whether this adjustment in income gap is ruled out by the non-price competitiveness (ε/π) or by changes in productivity. For that, we estimated the Balance-of-Payments/Actual income gap given by the difference y_{BP}-y, as a function of the non-price competitiveness and of productivity indicators. The results are reported in Table 4.

Table 4. Balance-of-Payments/Actual Income gap and its determinants

variables	Model 1	Model 2	Model 3	Model 4	Model 5
constant	-2.054 (-3.945)***	-0.419 (-0.721)	-2.126 (-4.739)***	3.594 (5.021)***	1.967 (2.825)**
ε/π	2.073 (3.783)***	2.114 (4.908)***	2.108 (4.847)***		
β	-0.121 (-0.139)				
π				-0.892 (-2.923)***	-0.892 (-2.939)***
q		-1.201 (-5.736)***		-1.139 (-2.586)**	
q-q^*			-1.148 (-5.744)***		-1.099 (-2.623)**
R^2	0.606	0.799	0.798	0.357	0.360
F-test$_{(2,21)}$ p-value	8.850 [0.0016]	36.264 [0.000]	35.82 [0.000]	13.053 [0.000]	13.220 [0.000]
Specification p-value	$F_{(2,19)}$=3.061 [0.0704]	$F_{(2,19)}$=16.10 [0.000]	$F_{(2,19)}$=16.54 [0.000]	$F_{(2,19)}$=0.215 [0.808]	$F_{(2,19)}$=0.217 [0.807]

Notes:
The dependent variable is the Balance-of-Payments/Actual income gap, y_{BP}-y
ε/π, β, π and q and q^* are all taken from Table 1.
Numbers in parenthesis are t-ratio and numbers in square brackets are p-values
Robust standard errors to heterosscedasticity are used in the regressions
*** , ** indicate that coefficients are statistically significant at the 1% and 5% level, respectively

The F-test indicates the joint statistical significance of the slope coefficients
The specification test is the Ramsey (RESET) test for correct specification of the model

In the above Table, Model 1 relates the income gap y_{BP}-y to the non-price competiveness ε/π and the Verdoorn's coefficient β. As it can be seen the non-price competitiveness contributes significantly to narrow the income gap, through the increase in the income elasticity of the demand for imports π[20] and this is in line with Palley's argument that, it is this parameter responsible for the growth adjustment. On the other hand, the Verdoorn's coefficient has not statistical relevance in closing the income gap, although it carries the expected negative sign.

Model 2 replaces the Verdoorn coefficient by the productivity growth as an explanatory factor. Now it is shown that both the non-price competitiveness (through the increase in π) and productivity growth are responsible for correcting the gap in income (both coefficients statistically significant at the 1% level). However the impact of the non-price competitiveness is more pronounced (higher elasticity) than the impact of the productivity growth (lower elasticity). Model 2 shows that both factors are important in closing the gap between the growth rate consistent with balance-of-payments equilibrium and actual growth rate.

Model 3 uses the relative productivity growth variable q-q^* as an alternative factor to explain the closing-up of the income gap. The evidence shows again that both factors are important for the income adjustment, carrying the correct signs. More specifically, if productivity in a country grows faster than abroad, this contributes to narrowing the gap in income. The same is true with the increase in the income elasticity of the demand for imports which will reduce y_{BP} towards the actual growth value y.

Model 4, replaces the non-price competitiveness ε/π with the income elasticity of demand for imports, π. The results reinforce Palley's argument, that it is this factor responsible for the income adjustment path. Its negative impact shows that as π increases (higher appetite for imports) the growth rate consistent with the balance-of-payments equilibrium becomes closer to the actual growth. But on the other hand, it is shown that productivity growth (with negative and statistically significant impact) is also responsible for closing the income gap, being in line with Setterfield's argument. Therefore, both arguments are valid in explaining the income adjustment mechanism. The same conclusion can be derived from Model 5 where the productivity growth q is replaced by the relative productivity growth q-q^*.

[20] The non-price competitiveness given by ε/π declines either because the income elasticity of exports ε decreases or because the income elasticity of imports π increases.

The general conclusion from this regression analysis is that both the non-price competiveness (through the increase in the income elasticity of demand for imports) and productivity growth or relative productivity growth are important factors for closing the gap in income, given by the difference between the growth rate consistent with the balance-of-payments equilibrium (Thirlwall's Law) and that of actual growth.

(ii) Explaining the gap between the Balance-of-Payments equilibrium growth rate and potential income growth

In section 4, we explained that Palley and Setterfield offer different explanations about the mechanism that rules out the closing up of the gap between the Balance-of-Payments equilibrium growth rate and the rate of growth of potential output, y_{BP}-y_{pot}. Palley argues that this adjustment is made by changes in the income elasticity of the demand for imports, π (equation 19a) while Setterfield considers adjustments in productivity (equation 19b). However, this adjustment mechanism has not been tested empirically before. In order to shed light to this issue we first need to compute potential income growth as given by equation (17). The results are reported in Table 5 (column 10).

Table 5. Balance-of-Payments/Potential Income gap (1980-2016)

	Country	ε/π (1)	β (2)	α_0 (3)	y (4)	y^* (5)	y_{BP} (6)	q (7)	q-q^* (8)	n (9)	y_{pot} (10)	y_{BP}-y_{pot} (11)
1	Australia	0.40	0.38	0.19	3.16	2.304	0.92	1.36	-0.070	1.27	1.81	-0.89
2	Austria	1.45	0.60	0.25	1.91	2.355	3.42	1.27	-0.162	0.38	2.68	0.74
3	Belgium	0.85	0.54	0.37	1.84	2.359	1.99	1.17	-0.263	0.39	1.84	0.15
4	Canada	1.38	0.39	0.05	2.40	2.332	3.22	1.00	-0.451	1.02	2.33	0.89
5	Denmark	0.85	0.51	0.62	1.60	2.385	2.03	1.37	-0.064	0.30	1.95	0.08
6	Finland	1.32	0.39	1.40	2.06	2.347	3.11	1.82	0.412	0.39	2.99	0.11
7	France	0.79	0.79	0.18	1.78	2.363	1.86	1.49	0.056	0.53	2.20	-0.34
8	Germany	1.15	0.62	0.47	1.69	2.366	2.73	1.26	-0.187	0.14	2.30	0.43
9	Iceland	0.69	0.53	-0.39	2.84	2.316	1.61	1.14	-0.289	1.06	1.52	0.18
10	Ireland	0.99	0.31	1.07	4.16	2.245	2.22	2.66	1.300	0.90	2.66	-0.44
11	Italy	0.78	0.74	-0.004	1.21	2.387	1.86	0.82	-0.627	0.20	1.57	0.29
12	Japan	2.03	0.76	0.05	1.98	2.355	4.79	1.55	0.132	0.24	3.92	0.87
13	Luxembourg	2.64	0.89	-1.88	4.13	2.266	5.98	1.72	0.287	1.28	4.72	1.26
14	Netherlands	1.44	0.47	0.03	2.07	2.352	3.39	0.98	-0.454	0.52	2.14	1.25
15	New Zealand	0.82	0.38	0.44	2.55	2.332	1.91	1.33	-0.111	1.01	2.18	-0.27
16	Norway	0.67	0.54	0.42	2.48	2.331	1.57	1.50	0.075	0.64	1.90	-0.33
17	Portugal	0.90	0.44	0.82	2.13	2.351	2.11	1.63	0.228	0.17	1.92	0.19
18	Spain	0.53	-0.44	2.51	2.31	2.342	1.24	1.20	-0.231	0.60	2.56	-1.32
19	Sweden	1.48	0.47	1.01	2.33	2.345	3.48	1.78	0.367	0.49	3.13	0.35
20	Switzerland	1.30	0.77	-0.85	1.81	2.362	3.07	0.54	-0.927	0.74	2.25	0.82
21	U.K.	0.84	0.43	0.95	2.16	2.346	1.97	1.65	0.228	0.42	2.22	-0.25
22	U.S.	0.84	0.38	0.52	2.64	2.326	1.96	1.54	0.114	0.99	2.25	-0.29
23	Turkey	0.88	1.09	-1.47	4.14	2.260	2.00	2.63	1.255	1.63	2.33	-0.33
	All countries	1.06	0.49	0.34	2.41	2.336	2.48	1.39	-0.036	0.67	2.22	0.26

Notes:
ε/π – is the non-price competitiveness given by the ratio of the income elasticity of exports to that of imports
β – is the Verdoorn coefficient [the slope of the Verdoorn's equation (1)]
α_0 – autonomous productivity [the intercept of the Verdoorn's equation (1)]
y – is the growth of actual income
y^* - is the growth of foreign income (average of 22 OECD countries)

y_{BP} – is the growth rate consistent with the balance of payments equilibrium as given in equation (16)
q – is domestic productivity growth
q-q*- is relative productivity growth between the home and foreign countries
n – is the population growth rate (average of the total period considered)
y_{pot} – is potential income as has been defined in equation (17), given as (10)=(3)+(9)+(2)*(1)*(5)
y_{BP}-y_{pot} – is the gap between the balance-of-payments equilibrium growth rate and potential growth rate

This table contains all the necessary figures that allow us to determine potential income, in particular, the non-price competiveness ε/π, the Verdoorn coefficient β, autonomous productivity α_0 [the intercept of Verdoorn's equation (1)], population growth n, and foreign income growth y*. Defining potential income in this manner, the next step is to explain the gap between the Balance-of-Payments equilibrium growth rate and potential income growth which is given in the last column (11) of Table 5, through a regression analysis reported in Table 6.

Model 1 relates the income gap y_{BP}-y_{pot} to the non-price competitiveness ε/π (the Palley argument) and the Verdoorn coefficient β (the Setterfield argument). As it can be seen only the former contributes significantly to reduce the income gap. According to Palley this can be achieved by the increase in the income elasticity of demand for imports and this is shown clearly in Models (4) and (5). On the other hand, the Verdoorn's coefficient is not statistically relevant in explaining the income gap.

Table 6. The Balance-of-Payments/Potential Income gap and its determinants

variables	Model 1	Model 2	Model 3	Model 4	Model 5
constant	-1.113 (-4.915)***	-0.289 (-0.953)	-0,978 (-4.483)***	2.032 (4.904)***	1.367 (3.907)***
ε/π	0.897 (4.300)***	1.045 (6.027)***	1.042 (5.968)***		
β	0.543 (1.335)				
π				-0.599 (-3.430)***	-0.599 (-3.437)***
q		-0.484 (-4.241)***		-0.465 (-2.096)**	
q-q*			-0.460 (-4.259)***		-0.447 (-2.108)**
R^2	0.679	0.763	0.761	0.485	0.486
F-test$_{(2,21)}$ p-value	16.329 [0.000]	32.963 [0.000]	32.695 [0.000]	10.227 [0.000]	10.174 [0.000]
Specification p-value	$F_{(2,19)}$=4.256 [0.0297]	$F_{(2,19)}$=2.313 [0.126]	$F_{(2,19)}$=2.324 [0.125]	$F_{(2,19)}$=0.704 [0.507]	$F_{(2,19)}$=0.691 [0.513]

Notes:
The dependent variable is the income Balance-of-Payments/Potential income gap y_{BP}-y_{pot}
ε/π, β, π and q are all taken from Table 1.
Numbers in parenthesis are t-ratio and numbers in square brackets are p-values
Robust standard errors to heteroscedasticity are used in the regressions
*** , ** indicate that coefficients are statistically significant at the 1% and 5% level, respectively
The F-test indicates the joint statistical significance of the slope coefficients
The specification test is the Ramsey (RESET) test for correct specification of the model

However, if we consider Model 2 where the Verdoorn's coefficient is replaced by the productivity growth q, the results become more interesting. Both factors are statistically relevant (the non-price competitiveness and productivity growth) suggesting that the adjustment mechanism in income is ruled out not only by changes in the non-price competitiveness (increase in the income elasticity of imports according to Palley) but also by changes in productivity growth. The higher the productivity growth the closer the Balance-of-Payments equilibrium growth rate to that of potential income growth. Therefore, Setterfield's argument is also valid, that the adjustment mechanism in income is governed by changes in productivity growth (but not through the Verdoorn's coefficient). The same evidence is obtained considering Model (3) where productivity growth is replaced by relative productivity growth, q-q*. Nevertheless, in Models (2) and (3) it is shown that the impact of the non-price competitiveness is higher than that of the productivity growth, comparing the respective elasticities, which is higher than one in the former and lower than one in the latter (in absolute value). Therefore, changes in non-price competitiveness are predominant in explaining income adjustments.

Models (4) and (5) reinforce Palley's idea that changes in income elasticity of the demand for imports contribute to reducing the income gap jointly with productivity growth or, alternatively, with relative productivity growth (Setterfield's idea). Both factors have a negative and statistically significant impact on the income gap, and once more the impact of the former is slightly stronger than the latter (both in terms of magnitude and statistical significance).

Generally speaking, our evidence supports two main conclusions: (i) both the non-price competitiveness (Palley's argument) and productivity growth (Setterfield's argument) are responsible for explaining the income gap mechanism between the Balance-of-Payments equilibrium growth and actual or potential growth, (ii) the contribution of the non-price competitiveness is stronger than the contribution of productivity growth or relative productivity growth.

6. Concluding remarks

In this study we provide empirical evidence that the non-price competitiveness (given by the ratio of the income elasticity of exports to that of imports) and productivity growth are both important for explaining the gap between the balance-of-payments equilibrium growth and actual or potential income growth. In doing so we contribute to the debate of whether the non-price competitiveness is the responsible for closing the income gap (Palley's argument) or alternatively it is productivity that plays such a role (Setterfield's argument). These hypotheses have not been tested before in the relevant literature.

To derive this evidence we have considered a set of 23 OECD countries during the period 1980-2016. The import and export equations are estimated by *3SLS*, the most efficient approach to obtain the income elasticities that define the non-price competitiveness. It is argued that these elasticities capture the supply characteristics of the produced goods associated with quality, innovation, product differentiation, reliability, among others, and that international competition is focused on these features rather than on price competition. The income elasticities of trade are used to define the balance-of-payments equilibrium growth rate for each country, in line with Thirlwall's Law.

According to Thirlwall's model the growth rate consistent with the balance of payments equilibrium (on current account) - obtained by the product of the ratio of the income elasticity of exports to that of imports and the growth of foreign demand – is a good predictor for actual growth. However, our evidence shows that there is a significant difference between the two. Employing a cross-country regression approach we show that the non-price competitiveness (especially through changes in the income elasticity of imports) and productivity growth are responsible for the closing-up of the income gap. On the other hand we do not have significant evidence that the Verdoorn coefficient (that captures increasing returns to scale) affects directly this adjustment process in income.

Another issue we address is the income gap, given now between the balance-of-payments equilibrium growth and that of potential output. We estimate potential output as the sum of autonomous productivity, the population growth and the Verdoorn's coefficient, with the latter being multiplied by the non-price competitiveness and the growth of foreign demand, as suggested by Setterfield. From a cross-country estimation approach for 23 OECD countries we show again that both the non-price competitiveness (especially through the income elasticity of imports) and productivity growth (or relative productivity growth) are responsible for reducing the income gap, being in line both with the arguments of Palley and Setterfield. However, we find evidence that the Palley effect (through the income elasticity of imports) is slightly stronger in magnitude and statistical significance than the Setterfield effect (through productivity growth).

The adjustment mechanism in income is described by a model driven by a cumulative causation principle where changes in non-price competitiveness and productivity are responsible for closing the income gap.

Annex - 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

Data Source:

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

(Data extracted on 12th May 2016)

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