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NEOCLASSICAL VERSUS KALDORIAN EXPLANATIONS OF SOUTHERN EUROPE'S PRODUCTIVITY SLOWDOWN*

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The productivity slowdown in European countries is among the major stylised facts of the last two decades. Several explanations have been proposed: some focus on demand-side effects, working through Kaldor's second law of economic growth (also known as Verdoorn's law), others on supply-side effects determined by a misallocation of the factors of production, caused either by labour market reforms or by perverse effects of financial integration (in Europe, related to the adoption of the euro). The latter explanation is put forward by some recent studies that stress how low interest rates brought about by the monetary union may have lowered productivity by inducing capital misallocation. The aim of this paper is to investigate the robustness of the latter empirical findings and to compare them with the alternative explanation offered by the post-Keynesian growth model, which instead emphasises the relation between foreign trade and productivity, along lines that go back to Adam Smith. To do so, we use a panel of industry-level data extracted from the EU KLEMS database, comparing these alternative explanations by panel cointegration techniques. The results shed some light on the role played by the single currency in the structural divergences among euro area member countries.

Keywords: firm behaviour, productivity, post-Keynesian model, economic integration, foreign exchange

JEL classification indices: D22, D24, E12, F15, F31

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1. INTRODUCTION

After the Lehman shock on September 15, 2008, the world economy, its growth already affected by the subprime mortgage crisis that started in December 2007, entered in its worst recession since World War II. The crisis was particularly severe in the euro area, where the real growth rate fell to –4.5% in 2009 (IMF 2016). Interestingly enough, the worst affected country among the four biggest euro area members (henceforth, EA4) was Germany (–5.6%), followed by Italy (–5.5%), Spain (–3.6%), and France (–2.9%). Euro area performance after the shock was also disappointing. While US GDP exceeded its pre-crisis level in 2011, two years after the shock, it took until 2015 (six years) for the whole euro area to return to its pre-crisis GDP level, and some euro area countries, including Italy and Spain, have not yet managed to recover. This poor performance can at least partly be explained by a remarkable stylised fact: since the mid-1990s, productivity in some major European countries has experienced a sudden slowdown.

An interesting pattern is illustrated in *Figure 1,* where only EA4 countries are considered. While average labour productivity kept growing at a relatively steady pace until the crisis in the two northern "champions" (France and Germany), the productivity index flattens somewhere in the biennium 1995–1997 in the two southern countries (Italy and Spain) and its growth remains subdued, not recovering at all in Italy (Mas et al. 2008).

The "sudden stop" in productivity experienced by countries like Italy and Spain affected their overall economic performance and, owing to their size, the performance of the euro area as a whole. As far as Italy is concerned, Daveri – Jona-Lasinio (2005) expected the relative GDP decline to herald an absolute GDP decline, which materialised in 2009. Moreover, the asymmetry of this sudden stop fostered the external imbalances now unanimously recognised as the main cause of the euro area crisis.[1] The negative effect of the productivity slowdown on southern countries' competitiveness was reinforced by the adoption of an overvalued currency.[2] The latter fostered external imbalances through a real channel (the real effective exchange rate appreciation of the southern countries

[1] Baldwin – Giavazzi (2015) propose their "new consensus" view, according to which the euro area crisis was caused by intra-area external imbalances, and therefore was "not a public-debt crisis". However, this analysis is not original. For instance, the ECB has stressed the crucial role of private external debt in the financial crisis since ECB (2011). Moreover, post-Keynesian economists immediately dismissed the "public debt" narrative of the crisis (e.g. Frenkel – Rapetti 2009; Cesaratto – Stirati 2010), at the same time in which mainstream economists used it to support the neoliberal "structural reforms" agenda.

[2] On the real effective exchange rate misalignment within the euro area, see, e.g., Coudert et al. (2013) or El-Shagi et al. (2016).

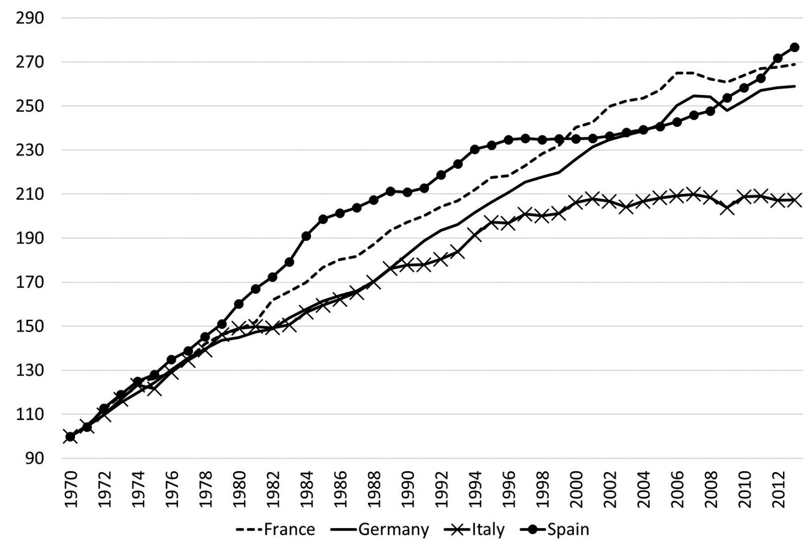

Figure 1. Average productivity of labour (GDP per hour worked, index: 1970 = 100) in the four largest euro area economies

Source: OECD Statistics (data extracted on September 17, 2016).

increased their net imports), and a financial channel (the low-interest rate environment created by the single currency made it easier to refinance increasingly large external deficits). This perverse loop of slowing productivity, falling competitiveness, increasing capital inflows, increasing inflation, and further falling competitiveness, combined with "credibility" bought by entering the euro (mostly determined by the abolition of exchange rate risk on intra-euro area cross-border lending), explains the huge accumulation of external imbalances that according to ECB (2011) were the main trigger of the euro area crisis.

The productivity slowdown has promoted much research, reviewed briefly in the first section of this paper. Most explanations rest on the neoclassical framework, which stresses the role of the supply side, indicating factor misallocation as a major source of productivity slowdown. In particular, Gopinath et al. (2015) argue that increased financial integration promoted by the euro could misallocate capital inflows towards firms with a higher net worth, but not necessarily with a higher productivity, thereby causing a fall in the average productivity of the economy. A similar perverse effect of financial integration, at a more aggregate level, is to divert resources from the tradable sector to the relatively more unproductive non-tradable sector (Reis 2013). In both cases, the testable implications at the macro level are that a fall in real interest rates will bring about an increase in the dispersion of the return to capital across firms, and a fall in the rate of productivity growth.[3]

Alternative explanations of the southern euro area productivity slowdown that consider the demand side have only recently been proposed. Bagnai (2016) explains Italy's decline using the post-Keynesian growth model, built along the lines set forth by Kaldor (1970) and Dixon – Thirlwall (1975). In the post-Keynesian framework, the slowdown in Italian productivity can be interpreted as the consequence of a tightening of the balance-of-payments constraint (Thirlwall 1979), feeding back through Verdoorn's (1949) law on productivity growth, along the lines set out in Thirlwall (2002). The testable implication at the macro level is that by reducing foreign demand for domestic goods, an increase in the rate of exchange rate appreciation will bring about a fall in the growth rate of productivity.

The purpose of this paper is to compare these two recent competing explanations of the southern euro area productivity slowdown: the post-Keynesian one, which stresses the circular and cumulative causation process between demand conditions and productivity and where exchange rate plays a major role, and the neoclassical one, which focuses on factor misallocation at the micro level and where the real interest rate is the main explanatory variable at the macro level. To do so, we build on the recent work of Cette et al. (2016) who find a strongly significant positive relation between the rate of productivity growth and the real rate of interest in a panel of industry-level data extracted from the EU KLEMS database.[4] We first investigate the robustness of their findings, using their own empirical specification, by analysing the sensitivity of the results to the choice of countries included in the sample. The neoclassical hypothesis is then compared directly with the post-Keynesian one by augmenting the estimated equation with the rate of change of the nominal effective exchange rate. To overcome some shortcomings of Cette et al.'s (2016) estimation methodology, we replicate the analysis by panel cointegration techniques.

The structure of the paper is as follows: the next section briefly surveys the literature on the southern European productivity slowdown, highlights the main features of the competing models, and reviews the available empirical evidence. Section 3 presents the data and the econometric estimation techniques. Section 4 presents the results. Section 5 draws some conclusions.

[3] Calligaris et al. (2016) describe the increased dispersion in the value of total factor productivity in a micro-level panel of Italian firms; Cette et al. (2016) explore the relation between the real interest rate and the rate of growth of productivity in a panel of industry-level data.

[4] The EU KLEMS database contains various economic variables (e.g. gross value added, labour and total factor productivity, labour and capital compensation) at industry level for European Union member countries (http://www.euklems.net/).

2. COMPETING EXPLANATIONS OF THE PRE-GREAT RECESSION PRODUCTIVITY SLOWDOWN: A SURVEY OF THEORY AND EVIDENCE

2.1. Neoclassical explanations

Mainstream explanations of the productivity slowdown are based on the neoclassical growth model, which considers economic growth an intrinsically supply-side phenomenon. In this framework, a fall in productivity may be caused by misallocation of factors of production determined by frictions that hinder smooth working of the market allocation mechanism. Two strands in this literature deal with the misallocation of labour and capital, respectively.

The role of the misallocation of labour has been stressed since Gordon – Dew-Becker (2008), who focus on the impact of European labour market reforms on labour productivity. The increased "flexibility" and lower wage growth achieved through these reforms may encourage entrepreneurs to adopt relatively more labour-intensive techniques. The positive effect of flexibility in reducing unemployment could therefore come at the expense of labour productivity, as observed for example by Enflo (2010). Using a micro level panel of Italian firms, Daveri – Parisi (2010) investigated the fall in labour productivity occurring between 2001 and 2003, finding support for this hypothesis: labour productivity appears to be lower in firms with a higher share of part-time or temporary workers. On the basis of this evidence, they explain the productivity slowdown in terms of the labour market reforms implemented since 1997 (Sciulli 2006; Barbieri – Scherer 2009).

The second strand of the mainstream literature focuses on capital misallocation, building on the framework established by Hsieh – Klenow (2009), where misallocations are detected at the level of firms by looking at the dispersion in revenue productivity (defined as the product of physical productivity and the firm's output price), since revenue productivity should be equated across firms in the absence of market distortions. According to Gopinath et al. (2015), the productivity slowdown in southern euro area countries can be explained by capital inflows favoured by the decline in real interest rates after the adoption of the euro. Since these inflows were diverted towards firms with a higher net worth, which are not necessarily more productive, they determined capital misallocation, signalled by increased dispersion in revenue productivity, producing a fall in average total factor productivity. While in their theoretical model these effects are seen as "transitional dynamics" towards a new equilibrium, the aggregate impulse response function of their model displays a persistent slowdown in the rate of total factor productivity growth in response to a permanent fall in the real interest rate, such as that experienced by euro area countries in the 1990s. It is worth noting that Gopinath et al. (2015) relate the fall in real interest rate, and hence in productivity, to the onset of the single currency; moreover, they find no evidence of misallocation effects in northern countries such as France, Germany, and Norway, thereby establishing an asymmetry between northern and southern countries.

Calligaris et al. (2016) apply Hsieh – Klenow's (2009) methodology to a large firm-level dataset of Italian firms. Their results confirm the findings of Gopinath et al. (2015). In particular, they find that dispersion in marginal revenue productivity has significantly increased since the mid-1990s and that "within" dispersion is larger than "between" dispersion (ruling out misallocation across sectors or geographical areas as a major source of inefficiencies, as assumed by previous studies such as Faini – Sapir 2005). Moreover, they use panel regressions to test the relevance of a number of possible "markers" for misallocation and productivity (the markers consider among other factors the firm's size, credit constraints, workforce composition, and cronyism). However, they do not consider the effect of real interest rates on misallocation and dismiss any impact of the euro on the basis of the statistical significance of euro dummy variables (equal to one from 1999 onwards).

Cette et al. (2016) focus on the impact of the real interest rate on TFP and labour productivity growth. They use a panel consisting of 18 sectors observed in 13 countries on a sample ranging from 1995 to 2008. Their results confirm Gopinath et al.'s (2015) findings of a positive relation between the real interest rate and productivity growth (however measured), which implies that the fall in real interest rate following adoption of the euro had a detrimental effect on aggregate productivity. Interestingly, although the theoretical and empirical results of Gopinath et al. (2015) suggest that no productivity slowdown was experienced in northern countries, Cette et al. (2016) include countries in the north and south of the euro area in the same panel, together with other major OECD countries. The decision to rule out any possible asymmetry between net creditor and net debtor countries by conflating them in the same panel, without taking into account their possible heterogeneity, casts some doubt on the robustness of their results and prompts further investigation.

2.2. Post-Keynesian explanations

Kaldor's (1966) second law of economic growth, also known as Verdoorn's (1949) law, establishes a positive relation between aggregate demand and productivity, due to the presence of dynamic increasing returns to scale (Thirlwall

1983).[5] The law is a building block of the post-Keynesian growth model, stemming from Kaldor (1970) and Dixon – Thirlwall (1975).[6] An interesting implication of the model is that the rate of the change of productivity, $\dot{q}_t$ is affected, among other things, by the rate of change of the nominal exchange rate, $\dot{e}_t$. The causal chain goes as follows: a sustained drop (increase) in $\dot{e}_t$ causes a sustained increase (drop) in the growth of exports and hence in the rate of growth of aggregate demand via the Hicks (1950) supermultiplier. Through Kaldor's second law, the increase (drop) in the rate of the growth of aggregate demand causes an increase (drop) in the rate of growth of labour productivity, which feeds back to competitiveness and hence exports, setting up a virtuous (vicious) circular and cumulative growth process.

This feature of the post-Keynesian growth model is particularly relevant for our analysis. As shown in *Figure 1*, a striking feature of labour productivity in southern countries is that it flattens around 1997. This is precisely the year in which the currencies of the euro area candidate countries were forced to observe the "normal fluctuation margins" of the European Monetary System in order to meet the convergence criterion established by article 109j of the Maastricht Treaty, which basically meant that the candidate currencies were pegged to the European Currency Unit (ECU). *Figure 2* shows that the observance of this convergence criterion resulted in a major structural break, putting to an end for more than two decades persistent nominal depreciation in southern countries and persistent nominal revaluation in some northern countries. In terms of the post-Keynesian model, in a country like Italy this resulted in a large positive shock to $\dot{e}_t$ (possibly with adverse consequences on $\dot{q}_t$), while in a country like Germany the shock was large and negative (*Table 1*).[7]

It is worth noting at this stage that the post-Keynesian model seems to account better for the observed divergence in labour productivity than the neoclassical one. As a matter of fact, since real interest rates have fallen everywhere in the euro area, their behaviour cannot really account for the diverging patterns of productivity between northern and southern countries shown in *Figure 1*. On the other hand, this diverging pattern is consistent with the persistent shocks to the rate of change of nominal exchange rates reported in *Table 1*.

5 Kaldor's second law follows a line of argument that can be traced back to Chapter 3 ("That the division of labour is limited by the extent of the market") of Book 1 in Smith (1776).

6 The structure of the model is set out in *Appendix A*, following Thirlwall (2002).

7 As far as Italy is concerned, Bagnai (2016) shows that this major shock (to an almost 5-point increase) lowered the average productivity growth rate.

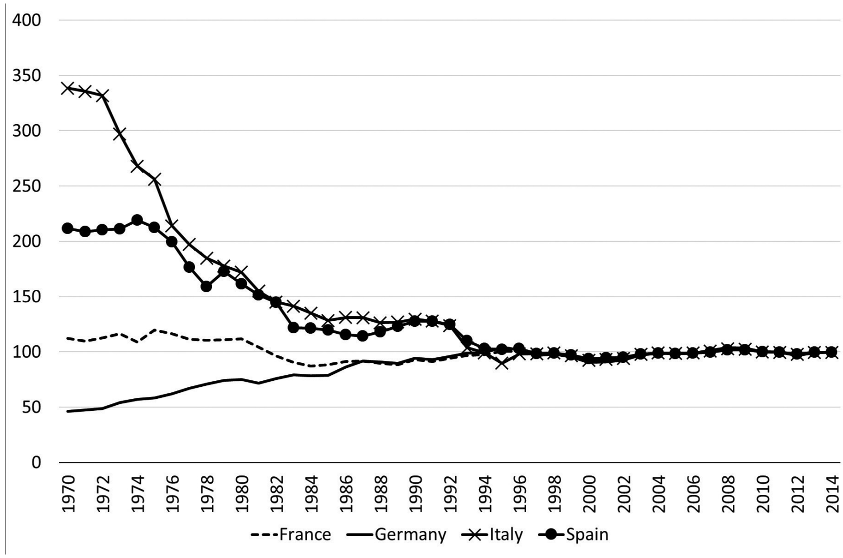

Figure 2. The nominal effective exchange rate index (2010 = 100) in the four largest euro area economies

Source: Bank for International Settlements, http://www.bis.org/statistics/eer.htm.

Table 1. Average rate of change of nominal effective exchange rate in EA4 countries, %

	France	Germany	Italy	Spain
1970–1996	–0.3	3.2	–4.5	–2.6
1997–2014	0.0	–0.1	0.1	–0.2
increase	0.3	–3.3	4.6	2.4

Source: Bank of International Settlements, http://www.bis.org/statistics/eer.htm.

3. DATA AND METHODOLOGY

3.1. The data

The previous discussion boils down to a simple empirical question: which of the following two variables provides a better explanation of the productivity trends: the real interest rate (as in the neoclassical "misallocation" hypothesis) or the nominal (effective) exchange rate (as in the post-Keynesian growth model)? In order to answer this question, we started with the database provided by Cette et al. (2016), which can be found in the supplementary material for their article.[8] The dataset covers 13 countries: Austria, Canada, Denmark, Finland, France, Germany, Italy, Japan, The Netherlands, Spain, Sweden, United Kingdom, and United States, and provides two productivity measures (labour productivity, measured as value added per worker, and total factor productivity) for 18 sectors.[9]

Along with this productivity data, the dataset provides real interest rate series measured as 10-year government interest rates (original source: Datastream), deflated by the country's consumer price index. We supplemented this database with the annual nominal effective exchange rate from the Bank of International Settlements (narrow definition).[10]

3.2. The estimated equations

As a first step, we replicated the results reported by Cette et al. (2016) in their Table 1, estimating the following equation:

$$(1-\gamma_1 L-\gamma_2 L^2)\Delta\log(q_{i,c,t})=\alpha_{i,c}+\delta_1 r_{c,t-1}+\delta_2\Delta r_{c,t-1}+\varepsilon_{i,c,t} \quad (1)$$

where $q_{i,c,t}$ is the average labour productivity index in industry i (i = 1, …, 18) and country c (c = 1, …, 13) at time t (t = 1995, …, 2008), $r_{c,t}$ is the real interest rate in country c at time t, L is the lag operator, $\alpha_{i,c}$ is a country/sector fixed effect, γ_s and δ_s are parameters (s = 1, 2), and $\varepsilon_{i,c,t}$ is a well-behaved residual.[11]

8 http://dx.doi.org/10.1016/j.euroecorev.2016.03.012. We used the Stata dataset available in the *Table_1_CFM_replication_progs.zip* file.

9 For the European countries, the original data source for the productivity measures is the EU KLEMS database (ISIC Rev. 4). Data sources for the other countries are indicated in Cette et al. (2016). The 18 sectors are: Food products, beverages and tobacco; Textiles, textile products, leather and footwear; Wood and products of wood and cork; Pulp, paper, paper products, printing and publishing; Chemical, rubber, plastics and fuel; Other non-metallic minerals; Basic metals and fabricated metal; Machinery, n.e.c.; Electrical and optical equipment; Transport equipment; Manufacturing n.e.c., recycling; Electricity, gas and water supply; Construction; Wholesale and retail trade; Repair of motor vehicles and motorcycles; Accommodation and food service activities; Transport and storage, post and telecommunications; Financial and insurance activities; Real estate activities.

10 http://www.bis.org/statistics/eer.htm (last accessed: May 1, 2016); the annual series was obtained by taking yearly averages of the monthly data.

11 Cette et al. (2016) present the results for average labour productivity ($lp_{i,c,t}$) and total factor productivity ($tfp_{i,c,t}$). The pattern of their results does not change significantly when *tfp* is utilised. However, since the measurement of *tfp* involves some degree of arbitrariness and is subject to the Cambridge capital controversy (see, e.g., Kurz 2013) because it requires estimation of a neoclassical aggregate production function, we decided to use *lp* as our productivity measure.

Some remarks on the peculiar functional form of Equation (1) are needed.[12] In the terminology of Hendry et al. (1984), Equation (1) is the "leading indicator" specification of a second order autoregressive-distributed lag equation, or AD(2,2). Considering only lagged values of the explanatory variable, the model implicitly assumes that the interest rate has no contemporaneous impact on productivity. This assumption, which could prove restrictive owing to the yearly frequency of the data, is adopted without theoretical or empirical justification. The inclusion of both the lagged explanatory variable and its first differences corresponds to the following reparameterisation of a distributed lag model:

$$\begin{aligned} y_t &= \beta_1 x_{t-1} + \beta_2 x_{t-2} + \varepsilon_t = \\ &= \beta_1 x_{t-1} + \beta_2 x_{t-1} - \beta_2 x_{t-1} + \beta_2 x_{t-2} + \varepsilon_t = \\ &= (\beta_1 + \beta_2) x_{t-1} - \beta_2 \Delta x_{t-1} + \varepsilon_t . \end{aligned}$$

Therefore, in Equation (1), $\delta_1 = \beta_1 + \beta_2$, and $\delta_2 = -\beta_2$. This reparameterisation presents the advantage of allowing the direct estimation of the sum of the distributed lag and of the associated standard error. However, the claim by Cette et al. (2016, note 28) that coefficient δ_1 in Equation (1) represents the "total effect" of $r_{c,t}$ on $\Delta\log(q_{i,c,t})$ is wrong, because the total multiplier of a dynamic model must consider the autoregressive component. As a consequence, all the total effects reported in Table 1 of Cette et al. (2016) need to be recalculated as shown in *Appendix B*, along with their standard errors, which now refer to a nonlinear function of regression coefficients. The latter calculations can be performed using the Delta method (Efron – Tibshirani 1986).[13]

In order to compare the neoclassical and post-Keynesian hypotheses, we augment Equation (1) with a measure of the nominal effective exchange rate variation as follows:

$$\begin{aligned} &(1 - \gamma_1 L - \gamma_2 L^2)\Delta \log(q_{i,c,t}) = \\ &= \alpha_{i,c} + \delta_1 r_{c,t-1} + \delta_2 \Delta r_{c,t-1} + \mu_1 \Delta \log(neer_{c,t-1}) + \mu_2 \Delta^2 \log(neer_{c,t-1}) + \varepsilon_{i,c,t} \end{aligned} \quad (2)$$

where $neer_{c,t}$ is the nominal effective exchange rate index in country *c* at time *t*. We did not perform any specification search and just added the new explanatory variable symmetrically to the existing one. We expect $neer_{c,t}$ to enter the equation with a negative sign, and possibly neutralise the statistical significance of the real interest rate.

12 Cette et al. (2016) do not specify the actual functional form of their estimated equation. However, this can easily be reconstructed from their Stata codes.

13 See also Papke – Wooldridge (2005) for an application in the context of a dynamic panel.

From a methodological point of view, Equations (1) and (2) have a number of shortcomings: the order of the lags is chosen arbitrarily; the LSDV estimation of a dynamic panel model is known to be subject to considerable bias;[14] the real interest rate is often found in empirical studies to be an $I(1)$ variable, which implies that a model relating it to the first differences of another $I(1)$ variable such as productivity may result in an unbalanced regression; finally, by differencing the dependent variable, any information on its long-run behaviour is filtered out. Since productivity is an intrinsically long-run phenomenon and the analysis revolves around the estimation of the "total effect" of the interest rate (i.e. of the total multiplier of the model), a more convenient modelling choice would be to estimate the total multipliers directly through cointegrating panel regression, rather than inferring it from a nonlinear function of (possibly) biased short-run coefficients.

Taking stock of these considerations, we estimated a panel cointegrating relation by means of Pedroni's (1999, Eq. 1) pooled FMOLS estimator, using the following specification:

$$\log(q_{i,c,t}) = \alpha_{i,c} + \delta_{i,c} t + \beta_{1,i,c} r_{c,t} + \beta_{2,i,c} \log(neer_{c,t}) + \varepsilon_{i,c,t} \quad (3)$$

where the variables are defined as before, $\alpha_{i,c}$ is an industry-country fixed effect and t is a deterministic trend. Equation (3) allows an individual trend to be included in every individual regression, thereby accounting for idiosyncratic exogenous factors that may affect productivity in industries in the different countries (such as industry- and country-specific patterns of technological progress). The variables included in Equation (3) were tested for a unit root through the usual battery of panel unit root tests (Levin et al. 2002; Im et al. 2003; Fisher χ^2 statistics constructed using ADF and PP statistics of individual equations, see Maddala – Wu 1999).[15] The existence of a cointegrating relation was tested using the group mean cointegration tests based on PP and ADF statistics of individual equations (considering a deterministic trend in the individual equations).

[14] The bias in the Least Squares Dummy Variables (LSDV) estimator of a dynamic panel model was studied by Nickell (1981). Although this bias is known to vanish asymptotically, the Monte Carlo analysis by Judson – Owen (1997) shows that it can be sizeable in samples where $T<20$.

[15] The order of lags was determined automatically on the basis of the Schwarz information criterion. A deterministic trend was included when the time series displayed trending behaviour (productivity, nominal effective exchange rate).

4. RESULTS

4.1. The robustness of the neoclassical hypothesis

Table 2 replicates the results of Cette et al. (2016) on the size and significance of the neoclassical "misallocation effect", providing a full account of the equation estimates and recalculating the total effect and associated standard errors along the lines set out in *Appendix B*. All in all, the pattern of the results is robust with respect to this modification. Since the coefficients of the lagged dependent variable are mostly negative, the correct total multiplier $\theta(1)$ is consistently lower than the sum of the distributed lag $\beta(1) = \beta_1 + \beta_2$ (labelled as "total effect" by Cette et al. 2016). However, this does not affect the statistical significance of the multiplier, and it is still true that the "total effect", however measured, is larger for the EA4 subset (France, Germany, Italy, and Spain) than for the whole sample.

Since the theoretical studies on which this empirical analysis rests propose capital misallocation as an explanation of productivity slowdown in southern euro area countries (not in the whole euro area or in OECD countries), it makes sense to check whether the "capital misallocation" explanation is actually robust when applied to the core euro area countries (instead of a panel including peripheral countries, i.e. the countries for which the hypothesis is advanced in the literature).

Table 2. Re-estimating the model of Cette et al. (2016)

13 countries: 3055 observations						
	All sectors		Manufacturing		Services	
	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value
γ_1	0.00	0.97	–0.02	0.45	0.05	0.26
γ_2	–0.15	0.00	–0.17	0.00	–0.14	0.00
δ_1	0.19	0.00	0.17	0.05	0.25	0.00
δ_2	–0.44	0.00	–0.52	0.00	–0.40	0.01
$\theta(1)$	0.17	0.00	0.14	0.05	0.23	0.00
R^2	0.43		0.43		0.33	
Euro area 4: 976 observations						
γ_1	0.02	0.46	0.00	0.93	0.11	0.13
γ_2	–0.14	0.00	–0.18	0.00	0.09	0.21
δ_1	0.27	0.00	0.39	0.00	0.19	0.15
δ_2	–0.46	0.01	–0.62	0.01	–0.12	0.60
$\theta(1)$	0.24	0.00	0.33	0.00	0.23	0.13
R^2	0.51		0.53		0.40	

Note: Dependent variable: Rate of change of labour productivity.

Table 3 shows the results of several robustness checks only in terms of the size and significance of the total multiplier of the equations. We first replicated the estimates with the panel of the seven euro area countries in the sample (Austria, Finland, France, Germany, Italy, The Netherlands, and Spain). The results are reported in the first row of *Table 3* and do not differ greatly from the EA4 results in the lower panel of *Table 2*, with the possible exception of the "Manufacturing" sectors, where the total multiplier θ(1) falls from 0.33 to 0.24, but remains strongly significant. We then split this sample into five "core" countries (Austria, Finland, France, Germany and The Netherlands) and two "peripheral" countries (Italy and Spain). When the euro area core and periphery are analysed separately, the results change dramatically. In the core, the total multiplier falls further (the most evident fall is in the "Services" sectors, where it drops from 0.23 to 0.06), losing statistical significance (*Table 3*, second row). On the other hand, despite the relatively limited number of observations (484 for the "All sectors" panel), the size of the effect in the periphery is robust to changes (it moves from 0.22 to 0.23 in the "All sectors" panel) and its statistical significance is unchanged or improves, as in the "Services" sectors (*Table 3,* third row).

This result calls for further investigation. Since as recalled in the Introduction, Italy is a negative outlier in terms of economic performance, one may wish to verify whether its exclusion from the panel affects the statistical significance of the results. The outcomes of this further analysis are shown in the fourth row of *Table 3*, and the answer is positive: once Italy is excluded from the sample, the size and statistical significance of the total multiplier are both lost. For instance, in the "All sectors" panel, the total multiplier falls from 0.22 in the euro area sample – first row – to 0.15, and becomes statistically insignificant at the 5% level. Curiously, the same does not occur when Spain is excluded from the sample (*Table 3*, fifth row). In this case, the size and significance of the total multiplier both improve, except in the "Services" sector. Conversely, by restricting the analysis to Italy (*Table 3*, sixth row), the total multipliers become larger and

Table 3. Core-periphery asymmetries in the model estimates

	All sectors		Manufacturing		Services	
7 euro area countries	0.22	(0.00)	0.24	(0.01)	0.23	(0.01)
5 core euro area countries	0.18	(0.06)	0.17	(0.20)	0.06	(0.58)
2 peripheral euro area countries	0.23	(0.01)	0.27	(0.01)	0.47	(0.00)
Euro area without Italy	0.15	(0.06)	0.17	(0.10)	0.13	(0.13)
Euro area without Spain	0.27	(0.00)	0.27	(0.01)	0.20	(0.06)
Italy	0.48	(0.00)	0.43	(0.00)	0.70	(0.04)
Spain	0.05	(0.66)	0.13	(0.33)	0.34	(0.00)

Notes: Estimates of the total multiplier θ(1); p-values are reported in parentheses. Dependent variable: Rate of change of labour productivity.

statistically more significant (in the "Manufacturing" sector the total multiplier goes from 0.24 in the euro area sample – first row – to 0.43 for Italy). On the other hand, if one considers Spain alone (*Table 3*, last row), the total multiplier in the "All sectors" specification drops to 0.05, with a *p*-value of 0.66, and the misallocation effect only seems to prevail in the "Services" sector, with a total multiplier of 0.34, significant at the 1% level.

The results so far seem to confirm the validity of the neoclassical hypothesis: there seems to be evidence of capital misallocation only in southern countries, as suggested by neoclassical theoretical studies. At the same time, these results disprove the validity of the empirical study carried out by Cette et al. (2016), because the overall significance of their estimates depends on conflating very heterogeneous countries in the same panel, and disappears once Italy is removed from the panel.

4.2. Assessing the role of the nominal exchange rate: the case of Italy

The previous check shows that the only country featuring distinct evidence of capital misallocation effects is Italy. It therefore makes sense to check the robustness of this evidence by controlling the estimates for the post-Keynesian effect. To do so, we augmented the model with the rate of change of the nominal effective exchange rate.

Table 4 shows the results of estimation of Equation (2) for Italy. Besides the symbols already defined, ω(1) is the total multiplier of the nominal effective exchange rate variation: $\omega(1) = \mu_1/(1-\gamma_1-\gamma_2)$. The estimates should be compared with those reported in the sixth row of *Table 3*. When the nominal exchange rate enters the picture, the coefficient of the real interest rate drops in size, and becomes statistically insignificant. Conversely, as envisaged by the post-Keynesian growth model, the rate of change of the nominal effective exchange rate has a negative impact on productivity, which is significant at the 10% level both in the manufacturing sector and in the whole economy.

While these results cast some doubt on the statistical robustness of the capital misallocation effect, they do not provide strong evidence of a post-Keynesian effect either. However, we must recognise that the specification of Equations (1) and (2) contains a number of oddities that might affect the significance of the estimates. Besides the four already mentioned in the methodological section (arbitrary choice of lag length; bias in LSDV estimates of dynamic panels; possibly unbalanced equation; loss of long-run information on productivity determined by adopting a first-differences filter), another feature of these estimates is particularly striking: the study of Cette et al. (2016) purports to explain a break in the

Table 4. Augmenting the model with the nominal effective exchange rate: Italy

	All sectors		Manufacturing		Services	
	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value
γ_1	0.10	0.15	0.11	0.17	0.17	0.37
γ_2	–0.28	0.00	–0.32	0.00	0.00	0.99
δ_1	0.30	0.10	0.14	0.51	0.65	0.13
δ_2	–1.02	0.00	–1.69	0.00	0.75	0.34
μ_1	–0.23	0.01	–0.34	0.00	0.11	0.57
μ_2	0.05	0.23	0.08	0.13	0.02	0.80
$\theta(1)$	0.25	0.14	0.12	0.18	0.79	0.44
$\omega(1)$	–0.20	0.07	–0.28	0.08	0.14	0.25
R^2	0.58		0.65		0.35	

Note: Dependent variable: Rate of change of labour productivity.

productivity trend occurring in the mid-1990s, but it mostly uses data from the post-break period (1995–2008), with little or no statistical information from the previous regime. One may legitimately wonder whether the data has enough variance to allow research into the causes of this structural change.

In order to address this and the other methodological issues outlined above, let us proceed to the panel cointegration estimates of the relation between productivity and the rates of interest and change.

4.3. Panel cointegration estimates

In order to examine the turning point in southern countries' productivity trend, we extended the sample back to 1988, thereby considering roughly a decade of data before and a decade after the date of the observed productivity slowdown. Moreover, since the theoretical explanations stress asymmetry between the northern (or "core") and the southern (or "peripheral") countries of the euro area, we restricted the panel cointegration analysis to the EA4 subset of countries, which includes two core countries (France and Germany) and two peripheral countries (Italy and Spain).

The panel cointegration approach has a number of distinct advantages in this case: (1) As mentioned above, it allows direct estimation of the parameters of interest (total multipliers). (2) Since the estimated long-run regression is static, there is no need to specify an arbitrary number of lags in the estimated equation. (3) The superconsistency of the cointegrating estimators prevails over any possible simultaneity bias, and the use of Fully Modified OLS estimators accommodates the possibility of endogeneity. (4) The estimator adopted takes hetero-

Table 5. Results of the panel unit root tests in the EA4 sample

	All sectors	Manufacturing	Services
$\log(q_{i,c,t})$			
LLC	0.00	0.01	0.22
IPS	0.12	0.09	0.76
ADF	0.08	0.05	0.74
PP	0.91	0.63	0.99
$r_{c,t}$			
LLC	0.39	0.39	0.39
IPS	0.92	0.92	0.92
ADF	0.92	0.92	0.92
PP	0.96	0.96	0.96
$\log(neer_{c,t})$			
LLC	0.40	0.40	0.40
IPS	0.93	0.93	0.93
ADF	0.83	0.83	0.83
PP	0.84	0.84	0.84

Notes: The table reports the *p*-values of the following panel unit root tests: the statistics of Levin et al. (2002), LLC; the W_{tbar} statistics of Im *et al*. (2003), IPS; the Fisher p_λ test of Maddala – Wu (1999) constructed with the individual equation ADF statistics, ADF; and the p_λ test constructed using PP statistics, PP. The lag length was selected automatically using the Schwarz Information Criterion. The tests on $\log(q_{i,c,t})$ and $\log(neer_{c,t})$ include an individual deterministic trend. A *p*-value below α indicates that the unit root null hypothesis is rejected at the α×100 level. Since the same real interest rate and nominal effective exchange rate apply to every industry, the results of their panel unit root tests do not change with the composition of the panel.

geneity among individuals into account, which in the present case seems quite relevant.

Table 5 shows the results of the panel unit root tests. The null hypothesis of a unit root in the data is never rejected, with the possible exception of the LLC test on productivity. It should be stressed, however, that this test rests on the particularly restrictive assumption that each individual has the same autoregressive coefficient under the alternative hypothesis. The tests allowing for individual heterogeneity (IPS, ADF, PP) consistently fail to reject the null hypothesis of a unit root even for labour productivity. We can therefore safely conclude that all the series have a unit root.[16]

Table 6 shows the cointegration estimates of Equation (3) performed using Pedroni's (2000) FMOLS estimator. The group-PP and group-ADF cointegration tests strongly reject the null hypothesis of no cointegration, which implies that the variables are related by a meaningful long-run relationship. The results

16 As recalled above, this suggests that Equations (1) and (2) may be misspecified, because they relate a *I*(0) variable (the first differences of an *I*(1) variable, namely, the log of productivity) to a *I*(1) variable (the real interest rate), thereby resulting in an unbalanced regression.

Table 6. Cointegration estimates for the EA4 sample

	All sectors		Manufacturing		Services	
All countries						
$r_{c,t}$	–0.41	(0.11)	–0.62	(0.05)	–0.46	(0.25)
$\log(neer_{c,t})$	–0.22	(0.00)	–0.28	(0.00)	–0.33	(0.00)
R^2	0.99		0.99		0.99	
SER	0.06		0.06		0.04	
group-PP	0.00		0.00		0.02	
group-ADF	0.00		0.00		0.00	
without Italy						
$r_{c,t}$	–0.04	(0.90)	–0.07	(0.86)	–0.38	(0.39)
$\log(neer_{c,t})$	–0.10	(0.04)	–0.21	(0.00)	–0.13	(0.07)
R^2	0.99		0.99		0.99	
SER	0.06		0.05		0.03	
group-PP	0.00		0.00		0.01	
group-ADF	0.00		0.00		0.00	

Notes: p-values of the asymptotic *t* statistics in brackets; *SER* is the standard error of the regression; group-PP is *p*-value of the $\tilde{Z}_{t_{N,T}}$ statistics by Pedroni (1999) for the null hypothesis of non-cointegration; group-ADF is the *p*-value of the $\tilde{Z}^*_{t_{N,T}}$ statistics for the same hypothesis. Dependent variables: $\log(q_{i,c,t})$.

show a consistent pattern: firstly, the coefficient of real interest rate changes its sign from positive to negative and becomes statistically insignificant (more precisely: it is marginally significant at the 10% level only in the Manufacturing sector); secondly, the elasticity of productivity to the nominal effective exchange rate has the expected negative sign and is strongly significant. These results hint at a picture completely different from that suggested by the misallocation hypothesis, one where persistent deviations of productivity from its deterministic trend (representing any exogenous force driving productivity) are explained by the stochastic trend in the nominal effective exchange rate, possibly with a negative impact of the real interest rate at least in the manufacturing sector. The latter effect is consistent with the standard assumption that a fall in real interest rates fosters investment, and that investment may contribute to the quality of the existing capital stock and hence to the productivity of labour. The estimates in *Table 6* therefore make any "counterintuitive" explanation of the negative effects of low interest rates completely unnecessary, while pointing out the intuitive dangers of an overvalued exchange rate for a country exporting manufactured goods.

Interestingly enough, unlike the evidence on the neoclassical "misallocation" effect, the results in *Table 6* are robust to the exclusion of Italy from the sample. The bottom panel of the table replicates the estimations after excluding Italy. While the elasticities are generally smaller, the pattern of the results is similar: all coefficients are negative and those of the real interest rate are not statistically significant, while those of the nominal effective exchange rate are significant at the 5% level (except for the Services sector, where they are only significant at the 10% level).

5. CONCLUSIONS

The purpose of this paper was to compare two alternative explanations of the pre-crisis productivity slowdown that affected the southern countries of the euro area. The first explanation, based on the neoclassical growth model, posits that the fall in productivity was due to capital misallocation effects, determined by a sudden fall in the real interest rate, which diverted financial resources to less productive firms. In other words, this explanation postulates the existence of a positive relation between the real interest rate and productivity (or its rate of growth). The second explanation is based on the post-Keynesian growth model, where Kaldor's (1966) second law of growth plays a crucial role. According to this model, a sustained increase in the rate of currency appreciation, as experienced in Italy since the adoption of the euro, compresses exports with negative feedback on aggregate demand and hence on productivity, setting off a vicious circle of deteriorating competitiveness and deteriorating productivity.

The replication of Cette et al.'s (2016) study on the relation between real interest rate and productivity growth shows that the empirical evidence supporting the misallocation effect is relatively fragile, being crucially affected by inclusion of Italy in the sample. Moreover, even in the case of Italy, this evidence fades when the nominal effective exchange rate enters the picture. We then move to panel cointegration estimates of the relation between productivity, the real interest rate, and the nominal effective exchange rate on the sample of EA4 countries from 1988 to 2008. Once the correct econometric techniques are applied, the "misallocation" effect disappears or changes sign (in some cases indicating a marginally significant negative impact of the interest rate on productivity), while the "post-Keynesian" effect (i.e. the negative impact of nominal effective exchange rate appreciation on productivity) is robust to specification changes, and in particular to the exclusion of Italy from the sample.

Of course, there is still a long way to go before definite conclusions can be reached. Firstly, formal causality tests should be applied because the negative relation between nominal exchange rates and productivity could depend on both the demand-side explanation based on Kaldor's second law of growth (a fall in the rate of change of nominal exchange rates stimulates the rate of growth of exports and hence of productivity via the growth of aggregate demand), as well as on a supply-side explanation (an exogenous improvement in productivity due to technical progress brings about a fall in unit labour costs and hence a fall in the real exchange rate, thereby stimulating exports and growth). Secondly, the model should be tested on an extended dataset (for instance, including the whole euro area), and its robustness to different measures of the cost of capital, as well as to other control variables, should be explored. For instance, it could be interesting to check whether controlling for the index of employment protection affects the results (as would be expected from Gordon – Dew- Becker 2008).

We leave these challenges for future research, and for the time being take stock of the present results in this paper by advancing a provisional conclusion: as far as the productivity slowdown in southern euro area countries is concerned, it is safe to state that our results do not disprove the prediction of the post-Keynesian growth model: the divergence between the productivities of northern and southern countries is explained by a persistent shock in the rate of change of the nominal exchange rate, determined by the adoption of the single currency.

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APPENDIX A: THE POST-KEYNESIAN GROWTH MODEL

Following Thirlwall (2002), the structural form of the post-Keynesian growth model consists of the following four equations:

$$\begin{cases} \dot{y}_t = \gamma \dot{x}_t & \gamma > 0 \\ \dot{x}_t = \eta(\dot{p}_{dt} + \dot{e}_t - \dot{p}_{ft}) + \varepsilon z_t & \eta < 0, \varepsilon > 0 \\ \dot{p}_{dt} = \dot{w}_t - \dot{q}_t + \dot{\tau}_t & \\ \dot{q}_t = \theta + \lambda \dot{y}_t & \lambda > 0 \end{cases}$$

where a dot over a variable indicates its rate of change, and Greek letters are parameters. The first equation is the Hicks (1950) supermultiplier, relating the rate of growth of real output, y_t, to the rate of growth of real exports, x_t. The second equation is a standard export function, where p_{dt} are domestic prices, e_t the nominal exchange rate (measured as foreign price of domestic currency), and p_{ft} foreign prices. The third equation is a mark-up pricing relation, where w_t is the nominal wage, q_t average labour productivity, and τ_t the mark-up. Finally, the fourth equation is Verdoorn's (1949) law, relating the rate of change of productivity to the rate of change of aggregate demand.

The reduced form of the rate of change of productivity is easily derived:

$$\dot{q}_t = \frac{\theta + \varepsilon \dot{z}_t + \gamma \eta \lambda (\dot{w}_t + \dot{e}_t + \dot{\tau}_t - \dot{p}_{ft})}{1 + \gamma\eta\lambda}$$

and its derivative with respect to the rate of change of nominal exchange rate is:

$$\frac{\partial \dot{q}_t}{\partial \dot{e}_t} = \frac{\gamma \eta \lambda}{1 + \gamma\eta\lambda} < 0$$

provided that $\gamma\eta\lambda > -1$, a reasonable hypothesis given the usual estimates of the relevant parameters (remember that elasticity of exports to the real exchange rate, η, is negative). As a consequence, a permanent increase in $\dot{e}_t$, i.e. an increase in the rate of nominal revaluation, brings about a permanent decrease in $\dot{q}_t$.

APPENDIX B: CALCULATING THE TOTAL MULTIPLIER OF AN AD MODEL

Equation (1) coincides with the following rational distributed lag model:

$$(1-\gamma_1 L-\gamma_2 L^2)\Delta\log(q_{i,c,t})=\alpha_{i,c}+(\beta_1 L+\beta_2 L^2)r_{c,t}+\varepsilon_{i,c,t}$$

say:

$$\Delta\log(q_{i,c,t})=\frac{\alpha_{i,c}}{1-\gamma_1-\gamma_2}+\frac{\beta_1 L+\beta_2 L^2}{1-\gamma_1 L-\gamma_2 L^2}r_{c,t-1}+\frac{\varepsilon_{i,c,t}}{1-\gamma_1 L-\gamma_2 L^2}$$

where the "total effect" (technically speaking, the total multiplier) is the sum of the infinite distributed lag θ(*L*) defined by:

$$\frac{\beta_1 L+\beta_2 L^2}{1-\gamma_1 L-\gamma_2 L^2}=\sum_{s=1}^{\infty}\theta_s L^s.$$

The total multiplier of Equation (1) can therefore be obtained by setting $L = 1$ in the above distributed lag, as follows:

$$\theta(1)=\frac{\beta_1+\beta_2}{1-\gamma_1-\gamma_2}=\frac{\delta_1}{1-\gamma_1-\gamma_2}.$$