Monetary integration vs. real disintegration: single currency and productivity divergence in the euro area

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MONETARY INTEGRATION VS. REAL DISINTEGRATION: SINGLE CURRENCY AND PRODUCTIVITY DIVERGENCE IN THE EURO AREA

1. Introduction

European monetary integration has long been considered as conducive to member countries' real convergence through two main mechanisms: firstly, because by abolishing transaction costs, it would foster trade and therefore synchronize member countries' business cycles (Frankel and Rose, 1997); secondly, because nominal convergence would drive interest rates to the lower levels experienced in core countries, thereby helping peripheral countries to consolidate their public finances, and to catch-up through higher private investment (Emerson *et al*., 1990). Interest rates convergence would not be a source of troubles, because business cycle convergence would make a "one-size-fits-all" monetary policy viable. Financial integration would favour resource pooling: in the euro area, national investment would not be constrained by national saving anymore. Market mechanism would therefore favour convergence in economic structures, bringing saving where it was much needed, while preventing financial crises by financing "all viable borrowers" (Emerson *et al*., 1990, p. 24).

It is fair to say that this description of the monetary unification benefits proved overly optimistic, confirming the criticisms expressed by a number of prominent economists, among which Kaldor (1971), Sala-i-Martin and Sachs (1991), and Krugman (1993). While the theory of optimal currency areas focuses mostly on the ability of member countries to deal effectively with asymmetric shocks, the historical experience shows that the ongoing crisis of European integration started when Europe was hit by a symmetric exogenous shock, namely the global recession induced by Lehman bankruptcy. This motivates Boltho and Carlin's (2013) remark that troubles to monetary unification were caused by asymmetries in economic behaviours and structures across member countries, rather than in the shocks hitting them. In particular, divergence in productivity dynamics (see Figure 1) is increasingly seen as a major source of structural asymmetry between euro area member countries: those with relatively thriving productivity, like Germany, were able to withstand the Lehman shock much better than the ones with languishing productivity, like Italy (Darvas et al., 2011).

[Figure 1 about here]

Boltho and Carlin (2013) prompt for a shift in perspective: the viability of a monetary union would not depend so much on the ability of monetary policy to deal effectively with asymmetric shocks in the short-run, as on the ability of monetary integration to promote real convergence in the long run.

This paper focuses on the latter issue. The idea that monetary union could lead to some real divergence has already been discussed in the literature. Lane (2006) identifies two mechanisms, both related to structural asymmetries among member countries: firstly, joining the euro has been a much larger shock for peripheral economies, since they experienced a much deeper fall in real interest rates, leading to the lending and housing booms whose consequences are now apparent; secondly, because the same variation in euro exchange rate has different impacts on the real economies of member countries, according to their degree of openness to trade with non-member countries.

Moreover, Lane stresses that different economic structures in euro area member countries would produce different trends in productivity, bringing about inflation differentials that might be seen as the result of market equilibrating forces.[1]

Two recent strands of literature suggest further mechanisms through which monetary integration might have adverse effects on productivity dynamics in the weakest members of a monetary union, thus fostering real divergence. The first one, initiated by Gopinath *et al*. (2015), focuses on the role of interest rates, pointing out that by lowering the cost of capital in weakest countries, monetary integration brings about capital misallocation, thereby undermining labour and total factor productivity growth. The second one focuses on the role of exchange rate misalignments in presence of economies of scale, arguing that by repressing external demand, an overvalued currency may reduce the scale of production and hence productivity (the converse is also true). This effect is stressed by the post-Keynesian growth model, where labour productivity depends on aggregate demand through the so-called Verdoorn's (1949) law, as well as by neoclassical models with heterogeneous agents (Tomlin and Fung, 2010). Besides these two direct effects of monetary integration, which we label "capital misallocation" and "scale" effect, the recent literature stresses an indirect one, "labour misallocation", linked to labour market reforms. It is known since Mundell (1961) that for a currency area to be viable, external devaluation (i.e., nominal exchange rate realignment) must be supplemented by internal devaluation (i.e., price and wage flexibility). Over the last two decades, a number of reforms have been undertaken in the euro area in order to enhance labour market flexibility. These reforms have recently come under criticism, for two main reasons: firstly, because by reducing labour cost they may have caused a misallocation of factors resulting in a fall in capital deepening (Gordon and Dew-Becker, 2008); secondly, because by increasing the number of temporary contracts, they discouraged the investment in skills (Damiani and Pompei, 2010). Both phenomena had adverse consequences on labour and total factor productivity.

The purpose of this paper is to assess the impact on labour productivity of these three effects: the "capital misallocation" effect, working through real interest rates, the "scale" effect, working through exchange rates, and the "labour misallocation" effect, working through labour market reforms. The closest empirical reference to our work is Cette *et al*. (2016), who measure the capital misallocation effect by estimating the long-run impact of real interest rate on the rate of growth of productivity. Our work extends their analysis in three directions: first of all, we take into account the scale and the labour misallocation effects, and check for the robustness of the results by augmenting our model with other variables usually related to productivity development; moreover, we extend the sample by considering a longer time span and a larger number of sectors; finally, we look for long-run relationships using the autoregressive distributed lags pooled mean group (ARDL-PMG) estimator by Pesaran et al. (1999). Our results indicate areas where a reform of the European policy framework should be undertaken in order to ensure the viability of the monetary unification project.

The paper falls in five sections. After this introduction, Section 2 surveys the recent theoretical and empirical evidence on productivity convergence in a monetary union, summarizing the results of previous studies on the three effects outlined above. Section 3 describes the data and the econometric methodology, and sets out the design

[1] Canzoneri et al. (2002) give a less benign interpretation of inflation differentials, seeing them as a structural phenomenon which might be a source of conflicts within the monetary union.

of the empirical experiment. Results are presented in Section 4. Section 5 draws some conclusions.

2. Productivity convergence in a monetary union: a survey of the recent literature

2.1 The capital misallocation effect

Low interest rates are often mentioned among the main benefits of the euro, both because they alleviate the burden of public debt in heavily indebted countries, such as Italy, and because they foster investment and thereby productivity and employment (see e.g. Emerson et al., 1990, Blanchard and Wolfers, 2001). This macroeconomic argument, focusing on the benefits of expansionary monetary policy in terms of aggregate demand management, is now challenged on microeconomic grounds. Recent explanations of the productivity slowdown in southern euro area countries suggest that low interest rates may have led to misallocation of capital among firms, lowering aggregate productivity. This explanation builds on the framework established by Hsieh and Klenow (2009), which measures misallocation by looking at the dispersion in revenue productivity among firms (defined as the product of physical productivity with a firm's output price). The rationale of this approach is that in the absence of market distortions, revenue productivity should be equated across firms, and the dispersion in revenue productivity should be low accordingly. A number of studies have ascertained the existence of capital misallocations across firms in southern Eurozone countries: see e.g. Gopinath et al. (2015, fig. 2) for Spain, Calligaris et al. (2015) for Italy, Dias et al. (2016) for Portugal.[2] The explanations of this stylized facts focus on the role of capital inflows, and hence of monetary and financial integration.

According to Gopinath *et al*. (2015), capital inflows, fostered by the decline of real interest rates in southern countries, were diverted towards firms with higher net worth. These firms, while being able to take more debt, were not necessarily more productive, which caused capital misallocations and a fall in productivity in aggregate terms. The theoretical model considers these effects as "transitional dynamics", but in the empirical analysis on aggregate data the VAR impulse response function features a *persistent* slowdown in the rate of total factor productivity growth in response to a permanent fall in real interest rate. Gopinath *et al.* (2015) relate explicitly this 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 or Germany, thereby establishing an asymmetry between the European northern and southern countries. Similar explanations are proposed by Challe *et al*. (2016), who stress also the role of low interest rates in softening the agents' budget constraints, thereby reducing the social cost of inefficient projects, and by Hoffmann and Schnabl (2016), who argue that in a low-interest rate environment the banking sector is unable to carry out its allocative function.

Calligaris *et al*. (2016) consider a large firm-level dataset of Italian firms grouped by size, sector and location. They find that "within" dispersion in marginal revenue productivity is larger than "between" dispersion. This rules out misallocation across sectors or geographical areas, as well as small size, as a major source of inefficiencies, as assumed by previous studies (e.g., Faini and Sapir, 2005). Another interesting finding

[2] Earlier work on Portugal by Reis (2013) focuses on misallocation across sectors rather than firms.

is that misallocation has significantly increased since the mid-Nineties. However, in their search for the possible causes of misallocation, they test through panel regressions the relevance of a number of possible exogenous variables, ranging from firm's size, to credit constraints, to workforce composition, to cronyism, all of which do not show significant breaks in the same period. Moreover, they do not consider the fall in real interest rates as a possible source of misallocations, and dismiss any impact of the euro on the basis of the statistical significance of a euro dummy variables that takes value one from 1999 onwards.[3]

Cette *et al*. (2016) follow a different line of research, focusing on the impact of real interest rate on TFP and labour productivity growth. They consider a panel of eighteen sectors in thirteen countries on a sample of annual data ranging from 1995 to 2008 and find a positive relation between the real interest rate and productivity growth (however measured), which implies that the fall in real interest rates following the adoption of the euro had an adverse effect on productivity. Although both the theoretical and empirical results by Gopinath *et al*. (2015) suggest that no misallocation occurred in core euro area countries, Cette's *et al*. (2016) conflate in the same panel countries coming from the euro area core and periphery. In so doing, they rule out by assumption any possible asymmetry between net creditor and net debtor countries, without taking into account their possible heterogeneity, which casts some doubts on the robustness of their results and prompts for further investigation.

2.2 The scale effect

Two different strands of theoretical literature relate exchange rate to productivity through the operation of economies of scale. In post-Keynesian economics, Verdoorn (1949) and Kaldor's (1966) established a positive feedback of aggregate demand growth on productivity growth, caused by increasing returns to scale. When this effect is introduced in an aggregate export-led model, the rate of change of real exchange rate affects the rate of change of productivity, through its impact on exports, and hence on aggregate demand (Thirlwall, 2002). Recent empirical analyses confirm the validity of Kaldor's (1966) laws of growth, and hence the relevance of exchange rate regime for output and productivity growth (Marconi *et al*., 2016). Returns to scale play a major role also in micro-founded models with heterogeneous agents à la Melitz and Ottaviano (2008). For instance, Tomlin and Fung (2010) argue that in presence of a persistent exchange rate appreciation, the scale effect (i.e., the reduction in productivity determined by the reduction in the scale of production) will prevail over the selection effect (i.e., the increase in average productivity determined by forcing less productive firms out of the market). These models lend theoretical support to a number of exploratory analyses such as Ostry et al. (1995), who find that countries with pegged regimes experience lower productivity growth, or Levi-Yeyati and Sturzenegger (2003), who find that in developing countries more rigid regimes are associated with less growth and more output volatility.

This literature suggests another possible cause for the southern countries' productivity slowdown. As a matter of fact, productivity in these countries flattens around 1997, the year in which the currencies of the euro candidate countries were pegged to the ECU at parities close to the irrevocable parities with the euro. Table 1

[3] The specification of this dummy variable is not entirely convincing, considering that the candidate currencies, including the Italian lira, were pegged to the ECU in 1997, in compliance with Art. 109j of Maastricht Treaty.

shows that the observance of this convergence criterion resulted in a major structural break, putting to an end a situation of persistent real depreciation (appreciation) in euro area southern (northern) countries. The shock was particularly relevant in Italy and, with an opposite sign, Germany. While the coincidence between this shock and the productivity slowdown stands out as a major stylized fact, and despite the existence of a theoretical literature, there is little or no empirical research on this topic.

2.3 The labour misallocation effect

In the run-up to the euro, a consensus view prevailed that monetary unification could address the European unemployment problem by favouring a mix of area-wide expansionary demand policies (through low interest rates) and coordinated supply-side policies aimed at introducing "a substantially higher degree of flexibility" in the European labour market (Modigliani *et al*., 1998). Almost two decades later, this view is challenged: not only low interest rates are seen as a potential source of capital misallocation, as mentioned in Section 2.1 above, but also labour market reforms are considered as a cause of the productivity slowdown. Despite a number of potentially positive effects of labour flexibility on productivity, including incentives to workers' effort and improvements in firms' screening procedures, in their analysis of European economies Gordon and Dew-Becker (2008) argue that labour market reforms had mostly adverse effects on aggregate productivity, because by lowering wage growth they encouraged entrepreneurs to adopt relatively more labour-intensive techniques. Further evidence on this misallocation effect is provided among others by Vergeer and Kleinknecht (2010) using a panel of 19 OECD countries, and Tridico (2015) using a panel of 27 EU member states, as well as by country-specific analyses (e.g. Lucidi, 2012; Adessi, 2014).

Besides the misallocation effect, working basically through a distortion in the cost of labour, recent research focusses on another source of productivity loss: the increasing use of temporary contracts, which discourages the investment in skills and may lower workers' effort. Damiani and Pompei (2010) analyse productivity growth in sixteen European countries from 1995 to 2005 and show that this effect is especially relevant in the more labour-intensive services sector. Parisi *et al.* (2015), using aggregate panel data on OECD countries from 1997 to 2010, show that this evidence is robust to the selection of countries.

3. Data and methodology

3.1 The data

Data on total factor productivity was extracted from the 2012 EU KLEMS database release (O'Mahony and Timmer, 2009), for a panel of 26 sectors observed in the four major euro area economies: France, Germany, Italy and Spain (see the Appendix). "Capital misallocation" was measured using the real interest rate, defined as the composite cost of borrowing indicator for nonfinancial corporations (ECB, 2016),[4] deflated by the sectorial value added deflators; since lower interest rate may cause misallocation, and hence a fall in productivity, we expect this variable to enter the

[4] Since this indicator is not available before 2003, we reconstructed it using the National retail interest rates (NRIR) N5 series (medium and long-term loans to enterprises) previously published by the European Central Bank. Where this was missing, we used the Lending rate data obtained from the World Bank.

equation with a positive sign. The scale effect was measured by the real effective exchange rate, which we expect to enter the equation with a negative sign.[5] Following Tridico (2015), the impact of labour market reforms was measured using the OECD indicator of "strictness of employment protection". Since a lower value indicates a more flexible (less protected) labour market, we expect this variable to enter the equation with a positive sign.[6]

In order to check for the robustness of the estimates, we augmented our model with other variables commonly related by the literature to the long-run growth of output or productivity. In particular, we considered the "Regulatory quality" indicator (extracted from the World Governance Indicator database; World Bank, 2016), which is seen, since the influential study by Nicoletti and Scarpetta (2003), as a measure of the economy-wide regulatory environment (on the basis of the assumption that an increased competitive pressure would result in productivity gains), and the share of computing equipment, communication equipment and software over total gross fixed capital formation (extracted from EU KLEMS), following the literature that relates ICT investment to productivity gains (e.g., Cardona *et al*., 2013).[7]

Some descriptive statistics of the data in the whole pre-crisis sample (1986-2007), as well as in the pre-EMU (1986-1998) and post-EMU (1999-2007) subsamples are reported in Table 1.

[Table 1 about here]

3.2 The estimation methodology

Since productivity growth is an intrinsically long-run phenomenon, we used an estimation methodology that allows to assess the existence of long-run relations between variables. The panel cointegration approach would be inappropriate in this context, because it requires that all the variables involved are integrated of order one, whereas at least one variable in our panel, the employment flexibility indicator, cannot possess a stochastic trend by construction. In order to cope with this feature of the data, we adopted the ARDL (autoregressive distributed lag) estimator proposed by Pesaran *et al*. (1999), which allows for estimation of long-run relationships using a panel of data, without requiring variables to be integrated of the same order.

Given a panel of N individuals, $i = 1, ..., N$, observed over T periods, $t = 1, ..., T$, the ARDL(p, q) model can be written as:

[5] http://www.bis.org/statistics/eer.htm (last accessed: 2016-05-01). We considered the narrow definition of the real effective exchange rate. The annual series were obtained by taking yearly averages of the monthly data.

[6] More specifically, we used an average of the epr_v1 and ept_v1 indicators, measuring the strictness of employment protection against individual dismissals for regular contracts and temporary employment, respectively. The average was weighted with the shares of temporary and permanent employment extracted from the OECD Labour Force Statistics (LFS). We used the version 1 of each indicator as this version is available for a longer sample.

[7] We tried to account for innovation by using variables such as the Business enterprise R&D expenditure and personnel by industry. However, the data provided by the OECD did not allow us to reconstruct a panel with enough observations in each sector for the estimation to be performed.

$$y_{it} = \sum_{j=1}^{p} \lambda_{ij} y_{i,t-j} + \sum_{j=0}^{q} \delta_{ij}' \mathbf{x}_{i,t-j} + \alpha_i + \varepsilon_{it} \quad \textbf{(1)}$$

where y_{it} is the dependent variable measured for individual i at time t, p is the number of lags of the dependent variable, $\mathbf{x}_{it}$ is a vector of k regressors, q is the number of lags of the regressors, λ_{ij} are the (scalar) coefficients of the lagged dependent variable, $\boldsymbol{\delta}_{ij}$ is a vector of k coefficients, α_i is and individual fixed effect and ε_{it} a well behaved disturbance.[8] Equation (1) can be reparameterised as follows:

$$\Delta y_{it} = \phi_i y_{i,t-1} + \boldsymbol{\beta}_i' \mathbf{x}_{i,t-1} + \sum_{j=1}^{p-1} \lambda_{ij}^{*} \Delta y_{i,t-j} + \sum_{j=0}^{q-1} \delta_{ij}'^{*} \Delta \mathbf{x}_{i,t-j} + \mu_i + \varepsilon_{it} \quad \textbf{(2)}$$

where $\phi_i = 1 - \sum_{j=1}^{p} \lambda_{ij}$, $\boldsymbol{\beta}_i$ is the vector of the k coefficients $\beta_{il} = \phi_i^{-1} \sum_{j=0}^{q} \delta_{ijl}$, and δ_{ijl} is the l-th element of the $\boldsymbol{\delta}_{ij}$ vector, $\lambda_{ij}^{*} = -\sum_{m=j+1}^{p} \lambda_{im}$ are scalar short-run coefficients, and $\delta_{ij}^{*} = -\sum_{m=j+1}^{q} \delta_{im}$ are vectors of short-run coefficients. If $\phi_i<0$, there are N individual long-run relationships $y_{it} = -(\boldsymbol{\beta}_i/\phi_i)'\mathbf{x}_{it} + \eta_{it} = \boldsymbol{\theta}_i'\mathbf{x}_{it} + \eta_{it}$, where $\boldsymbol{\theta}_i$ is the vector of long-run parameters for the i-th individual. The pooled mean group (PMG) estimation of Eq. 2 is obtained by assuming long-run homogeneity across individuals, i.e., $\boldsymbol{\theta}_i = \boldsymbol{\theta}$. This leads to the restricted ECM parameterisation:

$$\Delta y_{it} = \phi\left(y_{i,t-1} - \theta' \mathbf{x}_{i,t-1}\right) + \sum_{j=1}^{p-1} \lambda_j^{*} \Delta y_{i,t-j} + \sum_{j=0}^{q-1} \delta_j'^{*} \Delta \mathbf{x}_{i,t-j} + \mu_i + \varepsilon_{it} \quad \textbf{(3)}$$

The maximum likelihood estimator of Eq. (3) is defined as "pooled mean group" (PMG) estimator, because it pools the sample information in a single vector of long-run coefficients, while taking the group means of the individual error correction and short-run coefficients (which therefore needs to be estimated separately). Following Pesaran *et al*. (1999) various applications of the panel ARDL methodology assess the existence of a meaningful long-run relationship among the variables by testing for the presence of a negative and significant error-correcting coefficient ϕ (e.g., Landon and Smith, 2009; Lanzafame, 2014; Couharde et al., 2016).

All the equation estimates include an individual trend, which accounts for other sector-specific determinants of productivity growth, and the dynamic specification was automatically selected using the Akaike information criterion starting from a maximum number of lags $p = q = 2$.

The three effects outlined in the previous section are expected to have different impacts on different sectors. For instance, it has been argued that labour market reforms

[8] The panel need not to be balanced (i.e., T can vary across individuals), and both p and q can vary across individuals. Moreover, q can vary across regressors. The model can include individual deterministic components (such as a linear trends or dummies). We omit these further generalizations to avoid notational clutter. The only important restriction is that the number of parameters must be such as to allow separate estimation of the model for each individual.

had a larger impact in the productivity of the more labour-intensive services sector (Damiani and Pompei, 2010); at the same time, it can be argued that the scale effect should be larger in the tradable sector, which broadly coincides with manufacturing. For this reason, we estimated each equation for three different groups of sectors: the whole sample (including the primary sectors), manufacturing, and business services (see the Appendix for an exact definition of these groups).

4. Results

Table 2 presents the results of estimation of Eq. (3). With a limited number of exceptions, the automatic procedure selected an ARDL(2, 1) specification (i.e., a model with two lags of the dependent variable, and one lag for each regressor). While the EU KLEMS data starts in 1970, the employment protection index starts in 1985, and the World Governance Indicators time series in 1996. The sample length was determined accordingly.[9] In column (1), besides the trend, we include only the real interest rate and the log of the real effective exchange, whose coefficients show the expected signs. The estimated equation presents an extremely significant error correcting behaviour, pointing out the existence of a meaningful long-run relationship. The coefficients are robust to the addition in column (2) of the Labour protection index, whose elasticity is positive and significant.

On the contrary, the introduction in column (3) of the Regulatory quality index affects the size of the capital misallocation and scale effects. Moreover, the coefficient is negative, leading to the implausible conclusion that an increase in regulatory quality has detrimental effects on productivity. However, this specification suffers of some statistical issues. As mentioned above, the PMG method utilizes individual estimates. However, since World Governance Indicators are available from 1996 onwards, only 13 observations are available for individual estimation of the eight short-run parameters of the ARDL(2,1) specification selected by the Akaike information criterion. Furthermore, since "Regulatory quality" takes into account also the strength of labour regulation, it is significantly correlated with "Employment protection", which may cause multicollinearity problems.

In order to control for these sources of bias, in column (4) we replicated the estimates of column (3) without the Labour protection index. In this case Regulatory quality enters the equation with a positive coefficient, confirming that multicollinearity may explain the negative sign reported in column (3). In column (5) we re-estimate Equation (2) on the 1996-2010 sample, i.e., we replace Regulatory quality with Employment protection. The fit of the model improves, bringing the maximum log-likelihood from 3463.2 to 3623.0. We decide therefore to keep only "Employment protection" in the equation. In column (6) the model is estimated by adding the log-share of ICT over total gross fixed capital formation. This variable is strongly significant and with a positive sign, as expected. Its introduction, while improving the fit of the model, does not alter significantly the size of the capital misallocation, scale and labour misallocation effects.

The same pattern is observed in the Manufacturing (columns (7) to (9)) and Services sector (columns (10) to (12)), with some interesting differences. Firstly, in the manufacturing sector the capital misallocation effect is stronger, with coefficients of the

[9] The total number of observations depends among other things on the dynamic specification selected and is reported for each estimated equation.

real exchange rate ranging from 1.40 to 1.56. Secondly, in the Manufacturing sector, once the ICT investment is taken into account, the labour misallocation effect, while significant, is smaller than in the full sample (All sectors), while in the Services sector it is much larger (with a coefficient of 0.83). This confirms Damiani and Pompei (2010) hypothesis that loosening labour market regulation may be particularly detrimental for productivity in labour intensive services. Thirdly, ICT investment is much more significant in Manufacturing (with a coefficient of 0.18) than in Services (where its coefficient is wrongly signed and not statistically significant).

The same pattern emerges when productivity is measured as value added per employed person or value added per worked hour, and when "Control of corruption" indicator is used instead of "Regulatory quality".[10] The estimation results thus confirm that the capital misallocation, scale, and labour effect are statistically significant, sizeable, and robust to changes in the model specification. It may be useful to give some rough order of magnitudes for these effects, taking as references the two extreme cases of Germany and Italy, and applying our panel estimates to aggregate data, in order to check their consistency with the stylized facts.

As for the capital misallocation effect, the fall in real interest rate from 1997 (date of the pegging of national currencies to the ECU) to 2007 (the year before the onset of the global financial crisis) has been on average equal to -0.02% in Germany and -3.85% in Italy. With an estimated semi-elasticity around 1.3, this implies a negative long-run impact on total factor productivity equal to -0.03% in Germany and to -5% in Italy, thus confirming Lane's (2006) intuition that the asymmetry in the size of the shocks determined by joining the monetary union could have been a cause of real divergence.

The long-run elasticity of total factor productivity to real exchange rate is around –0.6, confirming the prevalence of the negative scale effect on the positive selection effect in firms' productivity. Once again, this may have been an important source of real divergence. In the 1997-2007 period the real effective exchange rate depreciated by –0.13% in Germany and appreciated by 6.60% in Italy. According to the model's estimates, this has brought about a long-run improvement in total factor productivity equal to 0.08% in the first country, and a long-run decrease equal to -4.16% in the second one.

Finally, the labour protection index has an elasticity of about 0.3. Since the "Employment protection indicator" fell by –8.5% in Germany and by –9% in Italy, this implies that labour market reforms have depressed productivity by –2.55% in Germany and by –3.0% in Italy.

While these are very rough calculations, which do not take into account the differences between sectors, they square with the aggregate stylized facts and point out that monetary unification may actually have fostered some degree of real divergence, by affecting total factor productivity trends.

5. Conclusions

The persistence of economic crisis in the euro area has revived the debate on the real consequences of monetary unions, shedding new light on the hypothesis that monetary integration would foster real convergence. In this paper we aimed at assessing three possible sources of real divergence among members of a monetary union: the capital misallocation effect, related to distortions in the costs of capital; the scale effect,

[10] Results available upon request.

determined by misalignment of the real exchange rate; and the labour misallocation effect, induced by labour market reforms. The recent literature has shown that these three effects work asymmetrically, by depressing more productivity in the weaker member countries, and depressing less, or enhancing it, in the stronger ones.

After reviewing the recent literature on these topics, we measured the extent and robustness of these effects using a panel of data ranging from 1986 to 2010 and covering 26 ISIC rev. 4 sectors in the four largest euro area countries, of which two belong to the core (France and Germany) and two to the periphery (Italy and Spain). The estimation was carried out using the ARDL-PMG estimator, which allows the estimation of long-run relationships among variables with different orders of integration. The results confirm that these three sources of potential divergence in productivity are sizeable and significant, and may have played a role in determining the productivity slowdown which occurred, at different paces, in the core and peripheral countries of the euro area before the last financial crisis.

These preliminary results leave many avenues for future research. Just to mention a few: the analysis should be extended to a larger number of countries; the impact of labour market reform could be measured by taking into account the share of temporary workers in the different sectors; the impact of technological progress could be measured using other variables mentioned in the literature (such as R&D personnel or expenditure by industry).

As far as the reform of the European economic governance is concerned, three messages seem to emerge from our estimates: firstly, the strategy of restoring competitiveness by enhancing labour market flexibility through "structural reforms" is confirmed to be counterproductive, because on average it depresses labour and total factor productivity. Secondly, the very loose "unconventional" monetary policies carried out by the ECB risk actually to undermine long-run sustainable growth by fostering capital misallocation. Thirdly, these adverse effects may be coped with, among other things, by increasing the share of their ICT investment. For instance, bringing the Italian share in line with the German one would result in a 6% long-run increase in total factor productivity in Italy. Taken together, these three prescriptions indicate a consistent package of policy measures, where aggregate demand should be stimulated by targeted fiscal, rather than monetary, policies. This reversal in austerity policies would naturally determine an increase in real interest rates, as well as a fall in unemployment, without necessarily undermining fiscal sustainability in distressed countries. Indeed, the recent literature on fiscal multipliers in recession (Canzoneri et al., 2016) implies that austerity policies may have counterintuitive effects on fiscal sustainability. This prompts for a wider reflection on the role of fiscal rules in relation to the public investment policies needed in member countries.

These conclusions bring together and confirm the results of a number of previous studies. While their economic rationale seems sound, their political implementation is more troublesome, because it requires a renewed sense of European solidarity that the persisting crisis seems to have wasted. A decisive action is urgently needed, before further real divergence puts at risk the sustainability of the monetary integration project, as foretold by Kaldor (1971).

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7. Appendix: the sectors considered

The 26 ISIC rev. 4 sectors considered in our panel are:

1. Agriculture, forestry and fishing (A);
2. Mining and quarrying (B);
3. Manufacture of food products, beverages, and tobacco (10-12);
4. Manufacture of textiles, wearing apparel, and leather and related products (13-15);
5. Manufacture of wood and products of wood and cork except furniture, paper and paper products, and printing and reproduction of recorded media (16-18);
6. Manufacture of chemicals and chemical products, and basic pharmaceutical products and pharmaceutical preparations (20-21);
7. Manufacture of rubber and plastic products, other non-metallic mineral products (22-23);
8. Manufacture of basic metals and fabricated metal products, except machinery and equipment (24-25);
9. Manufacture of computer, electronic and optical products, and electrical equipment (26-27);
10. Manufacture of machinery and equipment n.e.c. (28);
11. Manufacture of motor vehicles, trailers and semi-trailers, and other transport equipment (29-30);
12. Manufacture of furniture, other manufacturing, and repair and installation of machinery and equipment (31-33);
13. Electricity, gas and water supply (D-E);

14. Construction (F);
15. Wholesale and retail trade and repair of motor vehicles and motorcycles (45);
16. Wholesale trade, except of motor vehicles and motorcycles (46);
17. Retail trade, except of motor vehicles and motorcycles (47);
18. Transportation and storage (49-52);
19. Postal and courier activities (53);
20. Accommodation and food service activities (I);
21. Publishing, audiovisual and broadcasting (58-60);
22. Telecommunications (61);
23. IT and other information services (62-63);
24. Financial and insurance services (K);
25. Real estate activities (L);
26. Professional, scientific, technical, and administrative support services (M-N).

(sectors are followed by their ISIC codes).[11]

The three groups "Manufacturing", "Services", "All sectors", were defined as follows:

a) The Manufacturing group was defined by excluding the ISIC 19 sector (Manufacture of coke and refined petroleum products), which does not feature in the above list, and adding the utilities (ISIC code D and E).
b) The (business) Services group was defined by excluding non-business services (ISIC codes O through U), and financial and real estate activities (ISIC codes K and L, respectively).
c) The "All sectors" group features all the 26 sectors listed above.

The definition of the Manufacturing and Services groups match those of Cette *et al*. (2016), who exclude the "bubble" sectors, i.e., the sectors in which prices experienced massive swings because of commodity, real estate, and financial booms and busts. These sectors were included in the "All sectors" sample.[12]

[11] For the ISIC rev. 4 classification see: http://unstats.un.org/unsd/cr/registry/isic-4.asp.

[12] Cette et al. (2016) do not consider at all the primary and the construction sector, i.e. they drop the ISIC sectors A, B and F from their sample.

8. Figures

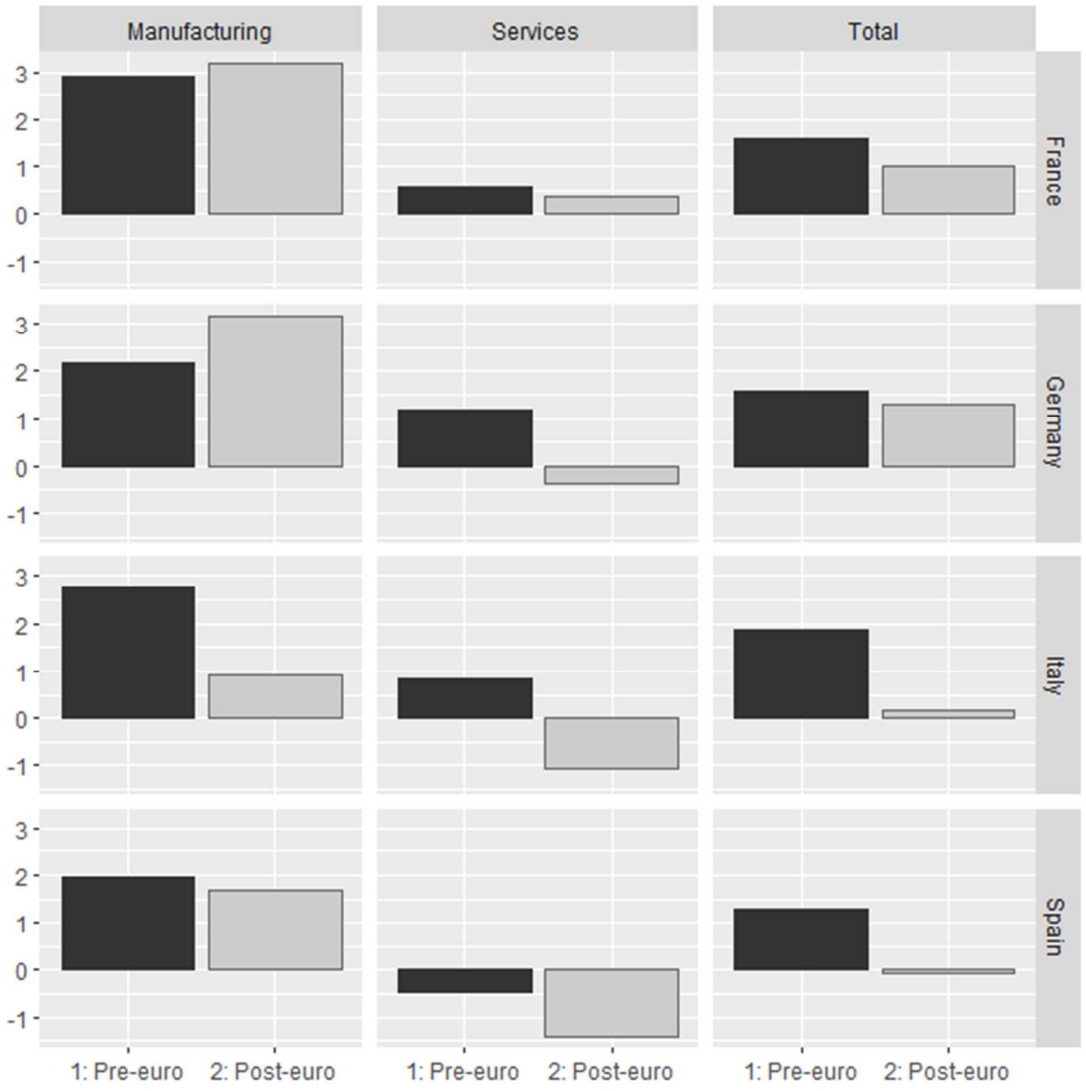

Figure 1 – The average annual rate of growth of real gross value added per person employed by main economic activity according to the ISIC rev. 4 classification (see the Appendix for the exact definition of the Sectors).

9. Tables

Table 1 – Descriptive statistics

	France			Germany			Italy			Spain		
Mean	86-07	86-98	99-07	86-07	86-98	99-07	86-07	86-98	99-07	86-07	86-98	99-07
Total factor productivity	1.39	1.34	1.44	1.92	1.20	2.92	0.46	1.08	-0.44	0.16	0.21	0.08
Real interest rate	4.31	5.67	2.34	2.25	0.53	4.74	6.37	8.64	3.09	2.88	4.25	0.90
Real effective exchange rate	0.62	0.87	0.26	1.19	1.76	0.38	-0.97	-1.80	0.22	-0.75	-1.37	0.14
Employment protection index	2.52	2.47	2.59	2.61	2.67	2.52	2.82	2.89	2.73	3.04	3.32	2.64
ICT investment	21.47	20.54	22.81	16.07	14.74	17.24	12.11	12.62	11.37	15.79	16.13	15.31
Regulatory quality	1.04	0.87	1.10	1.45	1.30	1.51	0.89	0.78	0.93	1.25	1.18	1.27
Median	86-07	86-98	99-07	86-07	86-98	99-07	86-07	86-98	99-07	86-07	86-98	99-07
Total factor productivity	1.00	1.02	0.97	1.60	1.60	1.58	0.12	0.97	-0.53	-0.32	-0.34	-0.24
Real interest rate	4.60	5.54	2.86	3.95	3.37	4.67	6.29	8.66	3.40	2.87	4.02	1.01
Real effective exchange rate	0.72	0.89	0.55	1.04	1.33	0.75	0.25	-0.17	0.62	0.09	-0.79	0.62
Employment protection index	2.51	2.48	2.62	2.65	2.66	2.53	2.87	2.90	2.69	2.66	3.60	2.64
ICT investment	14.41	12.64	15.34	12.86	11.64	14.00	8.43	8.09	8.71	10.40	10.14	10.77
Regulatory quality	0.97	0.87	1.22	1.49	1.30	1.51	0.90	0.78	0.93	1.26	1.18	1.29

Note: the table reports the sample averages and medians across the 26 sectors considered calculated in the full pre-crisis sample (1986-2007) and in the two subsamples pre- and post-EMU (1986-1998 and 1999-2007 respectively). The productivity measures (value added per person employed and total factor productivity), and the effective exchange rate indices, are expressed as rates of change.

Table 2 – Dependent variable: total factor productivity

	All sectors				Manufacturing				Services			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Real interest rate	1.38	1.33	0.76	0.98	0.72	1.25	1.40	1.56	1.45	2.06	1.56	1.07
	(11.17)	(11.00)	(17.04)	(17.69)	(13.58)	(10.46)	(7.25)	(6.93)	(8.35)	(7.26)	(6.93)	(6.00)
Real effective exchange rate	-0.73	-0.82	-0.36	-0.31	-0.42	-0.65	-0.71	-0.72	-0.67	-0.89	-0.72	-0.65
	(-15.13)	(-15.74)	(-13.92)	(-9.21)	(-15.79)	(-12.78)	(-10.48)	(-8.87)	(-10.32)	(-9.42)	(-8.87)	(-8.32)
Labour protection index		0.32	0.92		0.92	0.28		0.60	0.23		0.60	0.83
		(5.64)	(11.99)		(9.55)	(4.96)		(4.63)	(3.40)		(4.63)	(6.41)
Regulatory quality index			-0.03	0.02								
			(-3.02)	(1.77)								
ICT investment						0.11			0.18			-0.04
						(5.88)			(6.79)			(-1.53)
Trend	0.002	0.002	0.004	0.002	0.004	0.003	0.004	0.002	0.004	0.001	0.002	0.004
	(3.08)	(3.84)	(2.25)	(1.26)	(3.02)	(3.63)	(6.38)	(2.65)	(6.24)	(1.68)	(2.65)	(2.86)
ϕ	-0.26	-0.26	-0.52	-0.50	-0.49	-0.28	-0.33	-0.24	-0.33	-0.20	-0.24	-0.29
	(-17.17)	(-17.46)	(-10.55)	(11.69)	(-12.85)	(-16.81)	(-14.15)	(-11.73)	(-14.34)	(-11.12)	(-11.73)	(-8.16)
Log-likelihood	5340.6	5434.7	3638.4	3463.2	3623.0	4970.8	2255.6	2087.0	2214.7	2014.8	2087.1	1747.4
Number of observations	2571	2571	1404	1404	1404	2307	1056	939	990	942	939	777

Notes: *t*-statistics are reported in parentheses; *Trend* is a linear deterministic trend; ϕ is the error correction term.