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Till Labor Cost Do Us Part
A Vecm Model of Unit Labor Cost Convergence in the Euro Area*

Francesca Pancotto† and Filippo Pericoli‡

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Abstract

A sustainable path of relative competitiveness among the EMU countries is a key factor for the survivorship of the currency union in the long run. We analyze unit labor costs in the European Union with VECM methodology to evaluate relative competitiveness of euro area countries, controlling for exchange rate on the adjustment dynamics, for the economy as a whole and for the manufacturing sector, considered as a proxy of the tradable sector. Results show a lack of convergence of member countries, which is more pronounced for the tradable sector. Persisting idiosyncratic dynamics may be driven by different bargaining policies and institutional structures of national labor markets, and by differential path of technological advance deterring convergence of long run productivity.

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1 Introduction

Competitiveness in the euro area is a key issue for the survivorship of the Monetary Union. Indeed, competitiveness is not only related to the growth of the single countries but also to the economic cohesion of the union itself, given the very high level of interdependence that the single currency has created among member countries. European countries are characterized by an intrinsic diversity that in many ways is a richness and an opportunity: nonetheless, it is fundamental that this diversity does not lead to large and persistent divergences that can undermine the future of the union itself. To this purpose since 2007, the European Central Bank has established rules for a systematic surveillance of member states relative competitiveness, within their specific national settings, aimed at maintaining a common framework that should help countries to identify imbalances and consolidate relative competitiveness. Convergence is monitored by means of seven indicators of competitive gaps: current account deficits, unit labor costs, the stock of a country's net external debt as a ratio to GDP, the national inflation rate, the current account deficit as a ratio to GDP, the private and government debt ratios, the stock of private sector credit (CBE, 2005; Bank, 2007).

Any sign of divergence of these indicators from the union average, is a signal that should be taken into account when evaluating sustainability. Our choice is to analyze unit labor costs (ULC), that measures the average cost of labor per unit of output: it informs us on the relative dynamics of wages and productivity in the countries of the union and on the relationship among them. It represents a direct link between productivity and the cost of labor used in generating output. Unit labor cost dynamics corresponds to the difference between compensation of employees and productivity: as important component of inflation dynamics, it may undermine relative competitiveness of a country. ULC is moreover a relatively stable component of the price dynamics with respect to more volatile determinants

of price levels such as raw materials, commodity prices. In the perspective of a monetary union, the relationship between labor costs among member countries takes an even more important role as it expresses the degree of homogeneity, integration (and/or complementarity) of the member states. In a recent paper, Dullien and Fritsche (2007) analyze unit labor cost trends in the euro area with the aim to evaluate the degree of convergence of the member states in terms of both wage and productivity trends. They first examine unit labor cost developments before and after the introduction of the single currency and secondly compare the performance of the countries of the euro area with other currency unions, namely the regions of United States of America and Länder of the Federal Republic of Germany. They implement a cointegration approach on unit labor cost growth rates and test convergence with respect to the union average. The analysis finds evidence of cointegration and thus convergence of ULC but at the same time the comparison with the performance of the other currency unions is not in favor of euro area, where deviations from area-wide averages are much larger than in the US regions as well as in German Länders. Moreover, it is of their concern, the presence of a tendency towards deviation in the last years of the sample, in particular for Germany.

In this work, we extend their contribution on ULC convergence in two directions. First, we enlarge the data sample to observations up to 2010. Second, we inspect more deeply the components of ULC in a VECM model of growth rates examining ULC in both tradable and non tradable sectors. Bertola (2008) shows some concern related to the ability of ULC to provide information on the relative competitiveness of euro area members and wage dynamics, in particular in the comparison between tradable and non-tradable sector: his concerns are basically twofold. First, the comparability of data among member countries is affected by a low degree of homogeneity of data collection mechanisms; secondly,

the Balassa-Samuelson effect can bias the information contained in the available data. Notwithstanding these issues, we believe that an inspection of the behavior of ULC for the total economy and manufacturing sector, could give important insights on the dynamics of competitiveness of the currency union members.

A contribution similar to ours is the one of Tatierska (2008), which disaggregates ULC in 4 sub-sectors and uses quarterly data up to the second quarter of 2007. Our work adds to hers in the data sample considered and in the methodology used: while she assesses cointegration mainly by means of an Engle and Granger (1987) methodology applied to a single country of the area and a panel Pedroni test (Pedroni, 1999), we investigate over the existence of a long run relationship with the Johansen (1988) approach, which we believe to be the most appropriate tool in a contest of highly heterogeneous and interacting countries.

In this way we are able to answer the very fundamental research question of whether a single country has a competitiveness level which is in equilibrium with that experienced in the rest of the area as a whole. Moreover, within this framework we are able to test the hypothesis of weak exogeneity of ULC of country i with respect to the euro area value. The rejection of this hypothesis would imply that a country ULC does not affect the euro area ULC. The latter result would imply that the dynamics of ULC of that specific country does not have any effect on the adjustment toward the equilibrium of ULC of the euro area countries. Finally we are able to test if the cointegrating vector has an economically desirable content, i.e. it is of the form (1,-1): this hypothesis is equivalent to the two testable restrictions that the linear trend is excludable from the cointegrating vector and that the considered country has a stable relative competitiveness within the area.

We perform this analysis on both tradable and non-tradable sector ULC : the different pattern of the variable when the two sectors are considered, can to shed some light on the reasons of the persistent divergent dynamics of EMU labor

costs and identify at least some of the elements that cause the diverging relative competitiveness of the member countries.

The rest of the paper is organized as follows. In Section 2 we explore literature contributions related and relevant for our work. In Section 3 we describe the database used for the analysis with some preliminary statistical analysis and present the empirical methodology implemented in the following section. In Section 4 we report estimates results. In Section 5 we draw some conclusions and policy implications.

2 Literature Review

In a seminal paper, Baumol (1986) explains how convergence in industrialized economies is achieved when innovation and investment in one country generate spillover effects on near-by countries. Countries at a lower level of development absorb part of the effects of innovation and increase their productivity, fostering income growth and wage increases. Innovation and investment spillovers generate such effect if technology is identical or at least comparable in all the countries involved in the process. Indeed, countries with a lower technological advancement may not be completely capable to take advantage of these spillover effects and consequently not being able to catch up with the productivity advancements of the leader. The effects of this type of misalignment could be observed in the dynamics of labor costs, affected by productivity, by definition. If we hypothesize that tradable sector goods are more affected by innovation spillovers than non-tradable sector, we should observe a different behavior of the two labor costs when analyzed separately. Convergence in the tradable sector should consequently be more pronounced if the member countries are moving towards a similar technological pattern.

Had we to observe euro area countries on diverging technological patterns, this could be coherent in a framework with cumulative knowledge and increasing returns at the basis of innovation and technological change (Arthur, 1989): countries characterized by a higher initial technological development, and/or knowledge advancement, would be already in a diverging path leading to a systematic better competitiveness performance, once the scope for beggar-thy-neighbor policies are removed, as it is the case for economies with a unitary monetary policy.

Krugman (1991) points at *pecuniary external economies* as the source of possible divergence among regions in a core-periphery model characterized by increasing returns in the manufacturing sector. Convergence or divergence is determined by the dynamics of manufacturing labor force with respect to the wage rate. If the share of manufacturing workers decreases with the increase of the relative wage of the central region, the dynamics is convergent: workers migrate out of the region having a larger work force. If instead, the share of manufacturing workers in central region increases with the wage rate, workers will tend to migrate into the region that already has more workers, and this will cause divergence. The wage rate would be steadily higher in the economy with larger market. In the smaller region, to guarantee employment, a wage differential would be required in order to allow employment, thus justifying a persistent diverging dynamics of wages in peripheral countries.

Theoretical contribution just mentioned, explain us how the the comparison between tradable and non-tradable ULC can play an important role in signaling eventual divergence in the growth performance of the monetary union.

Another element that can affect this interaction is related to the possibility that unit labor cost increases in the non-tradable sector could impact unit labor costs in the tradable sector. Tradable goods are subject to higher degree of international competition and consequently adjust more strongly to shocks and fluctuations from

international markets. Non-tradable sectors instead, can benefit from a more protected price dynamics and consequently have guaranteed a higher average level of wages. Salido et al. (2005) explore determinants and macroeconomic implications of persistent inflation differentials in Spain within EMU. They show that larger demand of non-tradable goods and real-wage rigidities are crucial in explaining diverging price developments in Spain. Unit labor costs in non-tradable sector affect the productions costs of tradable goods and reduce the competitiveness of the tradable sector as well. Relatedly, Zemanek et al. (2010) analyze intra-euro area current account persistently divergent balances. In particular, they investigate how the impact of structural reforms from the public and the private sector affect the current account balance. They argue that current account divergences in the euro area may have been determined by inflationary pressures coming from the non-tradable sector: firstly as non tradable goods are used as inputs for tradable goods, thus influencing the price of tradable goods as well; secondly, through an imitation effect of the wages of the non-tradable (where wages are more rigid) from the wages of the tradable sector. They call it reversed Balassa-Samuelson effect, *"... where rising wages in the non-tradable sector trigger wage adjustment in the traded goods sector, which might reduce the current account balance (Zemanek et al., 2010)."*

In a different dimension, the comparison between tradable and non tradable unit labor costs, are relevant in the discussion related to the impact of the development of public sector wages on the convergence dynamics. Public sector wages account on average for more than 10% of GDP and more than 20% of the total compensation of employees. Clearly, public wage increases constitute a strong signal for private sector wage negotiations: the larger the public sector is, compared with the tradable sector, the stronger will be the signal for wages in the private sector, and therefore the influence on the unit labor costs in the private sector, taking

into account also productivity. Hence, the larger the public sector, the more important, and the more challenging, will be its role in the overall evolution of cost competitiveness (Trichet, 2011). Evidence reveals an important influence from public sector wages to private wages in many euro area countries. Public wage spillovers seem to be particularly important in countries that have experienced high and volatile public wage growth. Public sector wages may be responsible for rapid increases in unit labor costs and misaligned intra-euro area competitiveness (Pérez and Sanchez, 2010; Lamo et al., 2008). By taking into account tradable and non tradable labour costs, we could verify how far the observed divergences can be due to international competitiveness and or the load of a large and rigid public sector. In the following section, we introduce our analysis describing the variables that compose our database and the methodology implemented in the empirical analysis.

3 Data and Methodology

Data

For the purpose of our analysis we employ annual data for the following countries adhering to the European Monetary Union: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain. We included in the dataset all the eleven countries that entered the Union on January 1st 1999, plus Greece that joined the union two years later, on January 1st 2001. This choice has been done with the aim of considering a set of countries which are homogeneous as regards the duration of their membership to the common currency area.

The empirical analysis has been performed at yearly frequency and historical series have been obtained by the source AMECO, the on-line database provided

by the European Commission. Our empirical analysis focuses on unit labor cost figures for the whole economy and for the manufacturing sector. With regards to the total economy, we built unit labor cost figures as compensation of employees[1] divided by the gross national income at constant prices[2], while with regards to the manufacturing sector, unit labor cost figures have been obtained as the ratio of sectoral compensation of employee[3] to sectoral value added at constant prices[4]. Both variables, expressed in national currencies, have been converted in ecu/euro units by employing the figures for nominal bilateral exchange rate of a given national currency versus ecu/euro (units of national currency per ecu/euro).[5]

The key point of the empirical analysis consists in the comparison of unit labor costs in the i-th country of the euro area with unit labor costs figures registered in the remaining countries. To this aim, for every country of the sample we have computed average unit labor cost figures in the remaining countries by removing from the calculation the i-th country itself. Indeed, especially in the case of big countries such as Germany, France or Italy, a comparison with euro area average (included the country itself) may produce a biased picture of real underlying unit labor cost dynamics. The same calculation has been repeated for each country of the euro area, for the total economy and for the manufacturing sector. Lastly all variables included in the foregoing analysis have been expressed in logarithms in order to attenuate heteroskedasticity and to allow a simple economic interpretation for the estimated parameters.

[1] Ameco database code: UWCD.
[2] Ameco database code: OVGD.
[3] Ameco database code: ISIC D UWCM.
[4] Ameco database code: ISIC D OVGM.
[5] Ameco database code: XNE.

Preliminary data analysis

Let us define Unit Labor Costs, L, as

$$L \;=\; \frac{C}{Y} \tag{3.1}$$

where C is Compensation of employees and Y is Gross Domestic Product at constant prices. Dividing both the numerator and the denominator for total employment (E) and multiplying and dividing by by the number of Employees E^d , L can be rewritten as:

$$L \;=\; \frac{E^d}{E^d}\frac{C/E}{Y/E} = \;\frac{E^d}{E}\frac{(C/E^d)}{(Y/E)} = \;\bar{E}^d\,\frac{w}{q} \tag{3.2}$$

where q is average labor productivity, i.e. real output per person employed (included self-employees), with $q \;=\; Y/E$, $w \;=\; C/E^d$ is average compensation per employee and $\bar{E}^d$ is the ratio of employees to total employment. If we suppose that the share of employees is constant in time, the changes in the variable ULC are governed by changes in unitary wages and real work productivity (not corrected for capital stock). These two parts constitute the two components shaping the dynamics of ULC: the technological component, approximated by the evolution of labor productivity q, and the wage bargaining component, w. Rearranging (3.2), the growth rate of L reads:

$$\dot{l} \;=\; \gamma_w - \gamma_q, \tag{3.3}$$

where $\gamma_w = \frac{\dot{w}}{w}$ and $\gamma_q = \frac{\dot{q}}{q}$. Consequently:

$$\gamma_q = \gamma_w - \;\dot{l} \tag{3.4}$$

which means that from the difference between γ_w and $\dot{l}$ we obtain a measure of the dynamics of productivity. When productivity is growing at a positive rate, unit labor cost grows at a rate lower than the one of wages. This means that

when productivity is very high, ULC should comparatively fall, inducing a higher relative competitiveness of the country with respect to the others.

With these simple identities at hand, we explore the evolution of ULC in the euro area countries compared with the union average in Fig. 1. From the simple inspection of the log levels of ULC, in black, we observe how different is the behavior of the countries of the union with respect to the union average, reported in gray. Austria, Belgium, France, Luxembourg and Netherlands, show a pattern that is substantially in line with the euro area, while a different story can be told for the other countries. Finland, has a converging pattern from 1995 on, while before that date, values were substantially over the mean. Italy, Ireland and Greece show a level persistently below the euro area, while Spain and Portugal, present a crossing line with the union average, from lower to higher than the average pattern around year 2000. If we observe in the ratio of ULC in the i-th country to ULC in the rest of the euro area (see Figure 2), we can have a more precise idea of the dynamics of the variable with respect to the mean: northern countries show a substantial stability around the euro average, while the same cannot be told for the others. In particular the increasing trend of Portugal and Spain in the last years is quite evident, as well as for Greece but for a level well below the average of the union. Ireland and Italy are substantially below the average while a completely different picture is now clearer for Germany: with the creation of the currency union, the country has managed to obtain a substantial and systematic reduction of ULC, with a diverging pattern relatively to all the other countries.

With regards to the manufacturing sector (see Figure 3), figures are slightly different from those relative to the total economy previously observed. Austria, Belgium and Netherlands, keep a level of ULC in line with the area trend, while some difference is observed for Luxembourg, with a spike in ULC for manufacturing sector after the beginning of the currency union. Portugal and Spain on the

other hand, show a growing trend in a dynamics of catching up with the union average, with a final overcome in 2005 for Spain and 2007 for Portugal. The same catching up can be identified for Italy and Greece, despite the latter begins with a lower value. It is important to notice how Germany has improved its relative competitive position with the participation to the common currency area, France ha not registered substantial changes, while Italy, Greece, Portugal and Spain have suffered a significant worsening in their competitiveness dynamics with respect to tendencies observed before the institution of the common currency. From figure 4 we can also identify the peculiar cases of Ireland and Finland that during the timespan considered have experienced a negative trend in unit labor cost in the manufacturing sector. To sum up, a simple inspection of the time series of Unit labor costs reveals that southern countries are on a diverging path and that, on the opposite side, Germany is also strongly diverging from the rest of the area. Our results would confirm the analysis of Verspagen (2010) on patterns of technological and economic growth suggesting the presence of a dividing line between the southwest and northeast of Europe[6].

Methodology

We investigate over the existence and the shape of long run stable economic relationships within the multivariate approach to cointegration provided by Johansen (1988) and Johansen and Juselius (1990). The main advantage of this approach is that it provides a likelihood- ratio based test that can be applied to determine the cointegration rank which characterizes any arbitrary set of endogenous variables. It is a well known fact that the performance of this test in terms of size and power may be not optimal in small samples, given that the asymptotic distributions are

[6]It is noteworthy however that in this contribution the author considers a larger group of countries.

generally poor approximations to the true distributions (Juselius, 2006). In the following we apply the aforementioned methodology to a sample of 31 observations for the economy as a whole (years 1980-2010) and for the manufacturing sector (years 1979-2009). Even if this is not a large sample in terms of number of observations, there is a number of facts which make our analysis robust to small sample biases. Shiller and Perron (1985) have proven that when investigating over long run relationship the timespan considered is more relevant than the frequency of observations, which means that a sample of N yearly observations is more informative than a sample of N quarterly observations. The validity of this finding has been extended by Hu (2008), who shows, within the Johansen's framework by means of Monte Carlo simulations, that the performance of the test is better the longer the timespan considered. Moreover, Gonzalo and Pitarakis (1999) have shown that for a given sample size the performance of the cointegration test is better the lower the dimensionality of the system which in our case is only two. Last, we have verified that the results of the tests on the cointegration rank and the results of the tests on the restrictions on the cointegrating vectors remain valid[7] even if we take into account the small sample Bartlett correction proposed by Johansen (2002).

In order to investigate the existence of a stable relation between the euro area (excluded the i-th country) unit labor cost and the single i-th country dynamics, we test the presence of a cointegration relationship between these two elements. From an econometric point of view, we consider a bi-dimensional VAR model:

$$\mathbf{X_t} = \phi + A_1\mathbf{X_{t-1}} + ... \, A_k\mathbf{X_{t-k}} + \epsilon_t \tag{3.5}$$

where $\mathbf{X_t}$ is a (2x1) vector containing the two series for unit labor costs in ecu/euro for the i-th country and for the rest of the area, i.e. $\mathbf{X_t} = [l_t, leu_t]$, A_i is the generic (2x2) matrix of parameters with $i = (1, ..., k)$; ϕ is a vector of constants; ϵ_t is the error component of the model that is assumed to follow a multinormal distribution.

[7]Results unreported but available on request.

Juselius (2006) shows that if the variables included in the system are integrated of order one, the preceding model can be re-parametrized as:

$$\Delta \mathbf{X_t} = \alpha(\beta' \mathbf{X_{t-1}}) + \mu_0 + \mu_1 t + \Gamma_1 \Delta \mathbf{X_{t-1}} + ... \Gamma_{k-1} \mathbf{X_{t-k+1}} + \epsilon_t \tag{3.6}$$

where the product $\beta' \mathbf{X_{t-k}}$ is a vector of stationary cointegration relations which describe the long run behavior of the system, which can be at most $(n-1)$. The number of cointegrating relationships can be determined by investigating over the rank of the matrix $\Pi = \alpha\beta'$, by means of the likelihood ratio-based maximum eigenvalue (λ-max) and trace.

In general it is not known whether there are linear trends in some of the variables, or whether they cancel out in the cointegrating relations or not. Five different models are possible arising from the imposition of different restrictions on the deterministic components in Eq. (3.6). From the inspection of time series we can clearly exclude from the analysis those models which assume no linear trend in the data (two out of the five models proposed by Juselius (2006)). Moreover we can also exclude a model with a linear trend in the differenced variables, i.e. with a quadratic trend in data. Thus there remain two types of model available for the analysis. In the first type of model (model 1 thereafter) we include a constant in the VAR model in differences, a formulation which allows for a linear trend in data but without a trend in the cointegrating space. The other model available (model 2 thereafter) includes not only a constant in the VAR model in differences and thus a linear trend in data, but also a linear trend in the cointegrating space which is restricted to cancel out in the first-differenced parametrization of the model. As regards the lag length determination of the VAR model, we have chosen to follow the results arising from the Schwartz Information Criterium which almost always indicates an optimal lag of one for the VAR model in the levels of variables, which corresponds to an optimal lag of order zero for the model as expressed in the

VECM reparametrization. Only in few cases, in order to find cointegration, we have allowed for a lag length of two for the VAR in level which corresponds to a lag length of one for the VECM version of the model. Given the aforementioned choices, in our case the VECM model as from Eq. (3.6), becomes :

$$\Delta \mathbf{X_t} = \alpha(\beta' \mathbf{X_{t-k}}) + \mu_0 + \Gamma_1 \Delta \mathbf{X_{t-1}} + \epsilon_t \tag{3.7}$$

It is important to notice that cointegration analysis can be interpreted as a convergence test with some limitations: first, a country being on a catch up path might lack cointegration property with respect to the union average but being nonetheless on a fruitful pattern. Secondly, cointegration tests are sensitive to the particular sample considered: in our case we decided to use yearly data from 1980 to 2010 for the total economy and from 1979 to 2009 for the manufacturing sector. We believe that this is a period characterized by a relatively stable macroeconomic environment, and at the same time it guarantees us a minimal number of observations, at annual frequency for applying the Johansen's methodology and estimating the cointegrating vectors in a bidimensional system.

4 Empirical Analysis

Cointegration tests

The first step of the analysis consists in determining the cointegrating rank of the bidimensional system constituted by unit labor cost in the i-th country and unit labor cost in the rest of the euro area. In our case, the cointegrating rank can be 0, 1 or 2. From an economic point of view, the only interesting case is that of a system with rank equal to 1, which means that even though both series are non-stationary, there exists a linear combination of the two variables - domestic and external unit labor cost - which is stationary (or trend-stationary).

From the point of view of interpretation, the presence of a stable linear combination between the two series, imply that there exists a long run equilibrium relation between unit labor cost in the i-th country and the rest of the euro area.

To this purpose, in the following we investigate over the cointegrating rank and estimate the shape of the cointegrating vectors, when they exist. We restrict the analysis to the two types of model described in the preceding section, namely the one that allow for a linear trend in data and the one that allows eventually for a linear trend restricted to the cointegrating space.

The results of the sequential testing procedure proposed by Johansen and Juselius (1990) are reported in Table 1. For the total economy, the trace and the maximum eigenvalue statistics indicate that there exists cointegration in all the countries included in the sample, at 5% confidence level.

From these tests we conclude that for Austria, France, Germany, Greece, Ireland, Luxembourg, Netherlands, Portugal and Spain it is possible to accept the hypothesis of cointegration even without a linear trend in the cointegrating space, while in the case of Belgium, Finland and Italy we obtain that it is necessary to include a linear trend in the long run behavior of the system in order to achieve cointegration. The presence of a stable cointegrating relationship cannot be considered as an empirical evidence of euro are sustainability because the shape of the cointegrating space may produce diverging economic dynamics that can prove unsustainable in the long run.

We will investigate this issue more later: for the moment we are interested to compare the results of these tests for the total economy with those related to the manufacturing sector. As Table 2 shows, the results for the manufacturing sector are less favorable. Excluding Luxembourg for which there are not enough observations to make the test, we accept the hypothesis of cointegration in nine out of eleven countries (Austria, Finland, Germany, Greece, Ireland, Italy, Netherland,

Portugal and Spain), while in the case of Belgium and France we reject the hypothesis of cointegration. From the results of the tests it follows that we can accept the hypothesis of cointegration without a linear trend in the cases of Austria, Finland, Greece, Ireland, Italy and Spain, while in the cases of Germany, Netherlands and Portugal it is necessary to include a linear trend in the cointegrating space in order to achieve cointegration. The presence of a trend in the cointegrating space implies that despite the existence of a stable relationship between the two series, the trajectories are systematically diverging. In this sense, the cointegration analysis is a test of convergence when the stable relationship existing between the two series is obtained in a very peculiar way. In the next subsection we analyze relatedly the exact shape of the cointegrating vectors.

Cointegrating vectors

Table 3 reports the cointegrating vectors obtained from the reduced rank estimate of the VECM models normalized on the unit labor cost in the i-th country. As regards the estimates conducted for the total economy, it results that in all cases the coefficients have the *right* negative sign. The negative sign is positive because it implies that in the long run there exists a positive log-linear function which links unit labor cost in the i-th country and unit labor cost in the rest of the countries considered as a whole. Notwithstanding this positive result, the analysis reveals the existence of remarkable differences among countries in the long run.

Indeed, Germany and Austria are characterized by a stable tendency toward a relative decrease of unit labor costs while the rest of the countries considered are characterized by an opposite tendency. When the coefficient of the cointegrating vector is as in these cases, larger than 1, the countries involved are loosing competitiveness systematically.

The parameters of Belgium, Finland and Italy are not directly comparable in

terms of relative competitiveness due to the presence in the cointegrating space of a linear trend. The results are different in the case we consider relative unit labor cost dynamics in the manufacturing sector alone. In this case we find that Finland and Ireland are characterized by a cointegrating vectors with the wrong "positive" sign: the higher unit labor cost in other countries, the lower in these two countries. This result is clearly a synthetic transposition of the results evident from Figure 3 where we observe how for the two countries, figure for ULC systematically diverge from the euro area average. Moreover, it is confirmed the finding that Germany and Austria exhibit a stable tendency toward increasing their relative competitiveness. The path of Germany results even more divergent given the presence in the cointegrating space of a negative trend which sums to the effect arising from an elasticity less than unity.

Weak exogeneity tests

After having estimated the VECM models for the total economy and for the manufacturing sector, we proceeded to test some economically relevant hypothesis starting from the unrestricted versions of the models. First we have conducted a test of weak exogeneity for unit labor cost in the generic i-th country. This test is done by verifying the likelihood of the assumption that, in the equation for unit labor cost dynamics in the euro area, the loading factor of disequilibrium in the i-th country is equal to zero. In the following equation,

$$\Delta(L_i) = \alpha_{1,1}\left[\beta_{1,1}L_{i,-1} + \beta_{1,2}\, L_{eu,-1} + \beta_{1,3}\, t + \beta_{1,4}\right] \tag{4.1}$$

$$+c_{1,1}\, \Delta(L_{i,-1}) + c_{1,2}\, \Delta(L_{eu,-1}) + c_{1,3} \tag{4.2}$$

$$\Delta(L_e u) = \alpha_{2,1}[\beta_{1,1}\, L_{i,-1} + \beta_{1,2}\, L_{eu,-1} + \beta_{1,3}\, t + \beta_{1,4}] \tag{4.3}$$

$$+c_{2,1}\, \Delta(L_{i,-1}) + c_{2,2}\, \Delta(L_{eu,-1}) + c_{2,3} \tag{4.4}$$

where L_i is log of unit labor cost of country i, $L_{eu,-1}$ is the log of unit labor cost of euro area minus country i, t is the trend component, the weak exogeneity test corresponds to testing the null hypothesis of $\alpha_{2,1} = 0$. From the results of these tests, reported on table 4, it follows that the hypothesis of weak exogeneity is always rejected by the data for the total economy as well as for the manufacturing sector alone. This result may seem counterintuitive in a normal setting given that one generally expects that a small country such as Ireland or Belgium should not affect unit labor cost dynamics of a big country such as Germany. However we stress that our model is deliberately not structural as our goal consists in examining long run tendencies in unit labor cost dynamics rather than understanding real data generating processes. This means that the rejection of the hypothesis of weak exogeneity should not be regarded as an evidence of the economic importance of a given country. Rather we believe that there may exist common factors which drive unit labor cost dynamics in small as well as in big countries and that these factors render unit labor cost dynamics in small countries endogenous with respect to euro area average.

Relative convergence tests

The last test we perform is on the hypothesis that the β in Eq. (3.7) vector has the particular form (1,-1): if this is the case, in our model this means that the elasticity of unit labor cost in the generic i-th country with respect to unit labor cost in the rest of countries as a whole is unitary.

From an economic point of view this means that the relative competitiveness of a given country with respect to the euro average is constant in the long run.

Notwithstanding some limitations this test can be assimilated to a test of economic sustainability of the currency union. From the results of the test reported on table 5 it emerges that the hypothesis of relative convergence is always strongly re-

jected by the data. This means that even if we did find a stable statistical relation between country i unit labor cost and euro area ULC, the shape of the cointegrating vector is such that euro area countries exhibit tendency to diverge in terms of relative competitiveness. These diverging dynamics may produce unsustainable effects on intra-area trade balances and resource allocations given that unit labor costs represent the most important factor in the determination of producer prices.

5 Concluding remarks

The analysis performed underlines that euro area countries are characterized by diverging tendencies in unit labor cost dynamics which result in persistent differences in competitiveness with respect to the rest of countries of the area as a whole. A simple inspection of data reveals that after the introduction of the euro, divergences in relative competitive positions have increased. Our econometric analysis finds that this is a persistent, not mean-reverting process.

This finding is true for the economy as a whole but even more for the manufacturing sector, which produces the overwhelming majority of traded goods. Given the high degree of international competition currently reached we believe that these divergences are not sustainable and may result in a progressive reduction of the role played by the manufacturing sector in those countries which experience a relatively sustained trend in unit labor cost dynamics. Our econometric analysis supports this evidence by finding that relative competitiveness is not stable and this process is not mean-reverting. In our analysis observe unit labor cost dynamics in total economy and the manufacturing sector, trying to give an insight on the effects and the role played by wage bargaining policies and rather than technological progress, i.e. by productivity gains.

In fact, if the first element was the most relevant, relatedly to the ability of the

Union to generate a coherent wage bargaining policy, a committed political agenda could tackle this issue and enforce, in the medium run at least, a system of wage bargaining policies that allow the rates to convergence, and eliminate discrepancies that would be due to institutional and social infrastractures. On the other hand, if the divergence would be due primarily to a long run diverging path of technological development of the member countries, the policy to implement would be of a different nature. Countries engaging in more technologically advanced production would obtain a systematically increasing competitiveness gain that would be beneficial for the country itself but would constitute a threat to the sustainability of the union in the long run. As a matter of fact, this is what we are observing for example for Germany. With respect to this, we believe that the differentiated analysis of the unit labor cost for the total economy and the manufacturing sector alone, gives some preliminary understanding of this issue. We believe that, despite the substantial different institutional structures that characterize the different countries of the area, the divergence is mostly related to long run choices of industrial policies of the member countries. To this respect, it is important for the member countries to be aware of this issue and analyze which are the plans for the future of the union, acknowledging that the future of the price levels cannot ever be separated from the industrial patterns that each country decide for itself.

A more systematic identification of the drivers of technological development versus wage bargaining policies, and the impact on the economic growth of the union remains an issue open for future research.

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6 Appendix

6.1 Graphs and Tables

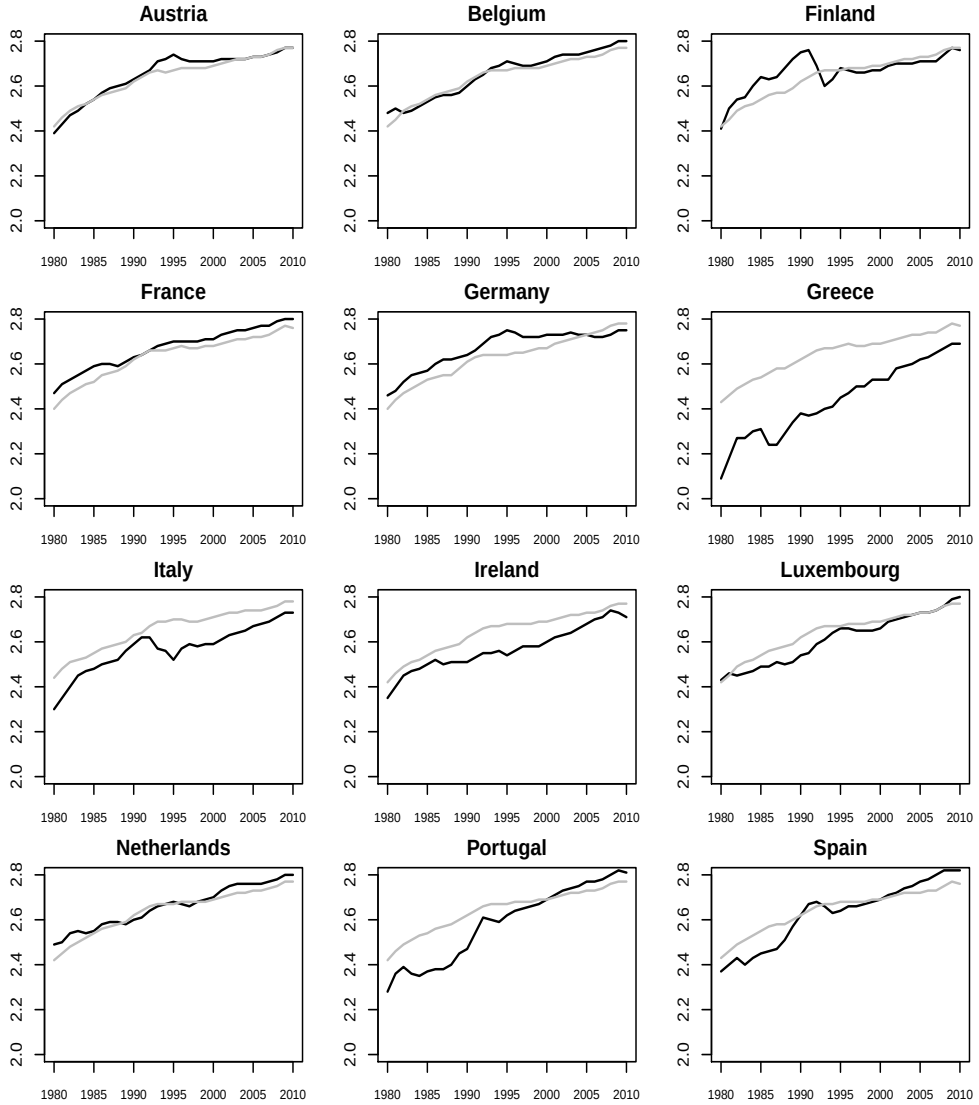

Figure 1: ULC in log levels of the i-th country in black; in grey log of ULC levels of the EMU average minus the i-th country.

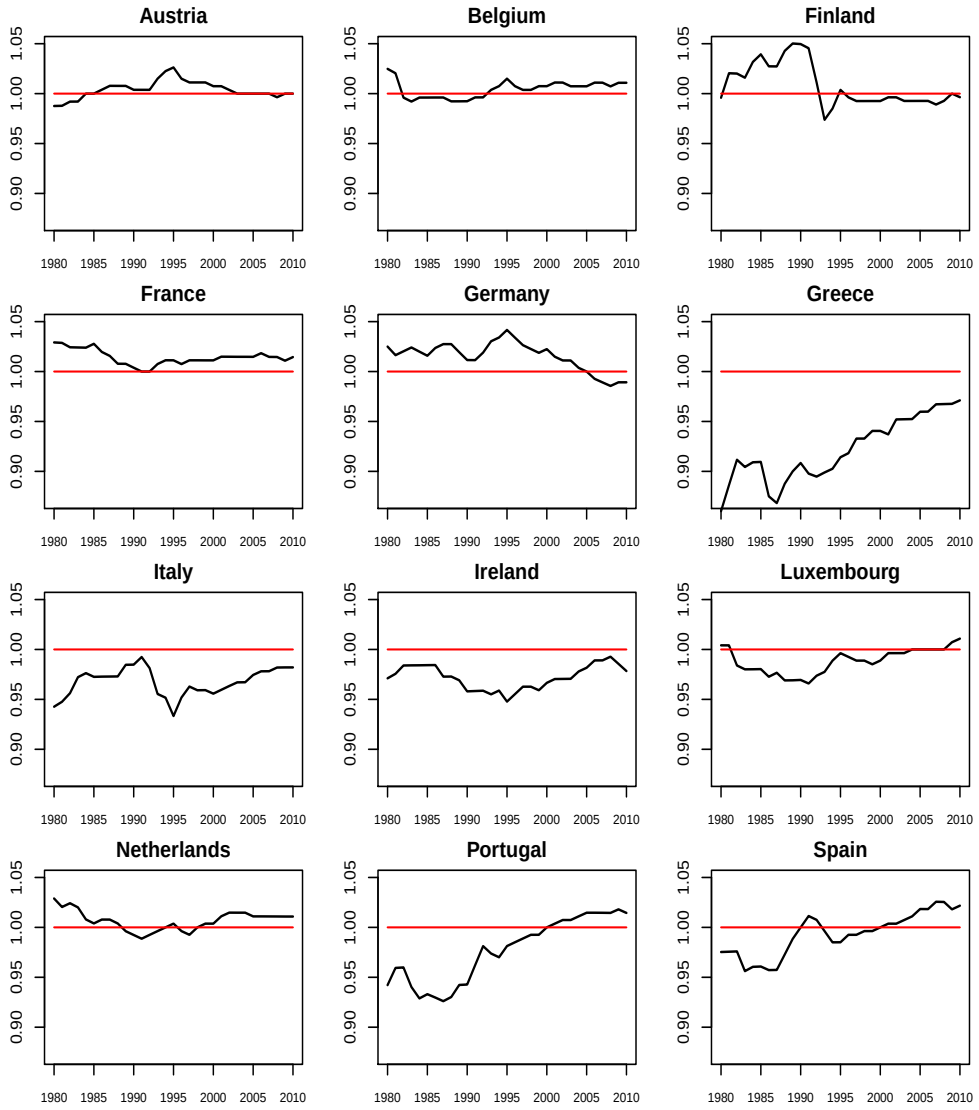

Figure 2: Ratio of ULC in log levels of the i-th country on log of ULC levels of the EMU average minus the i-th country.

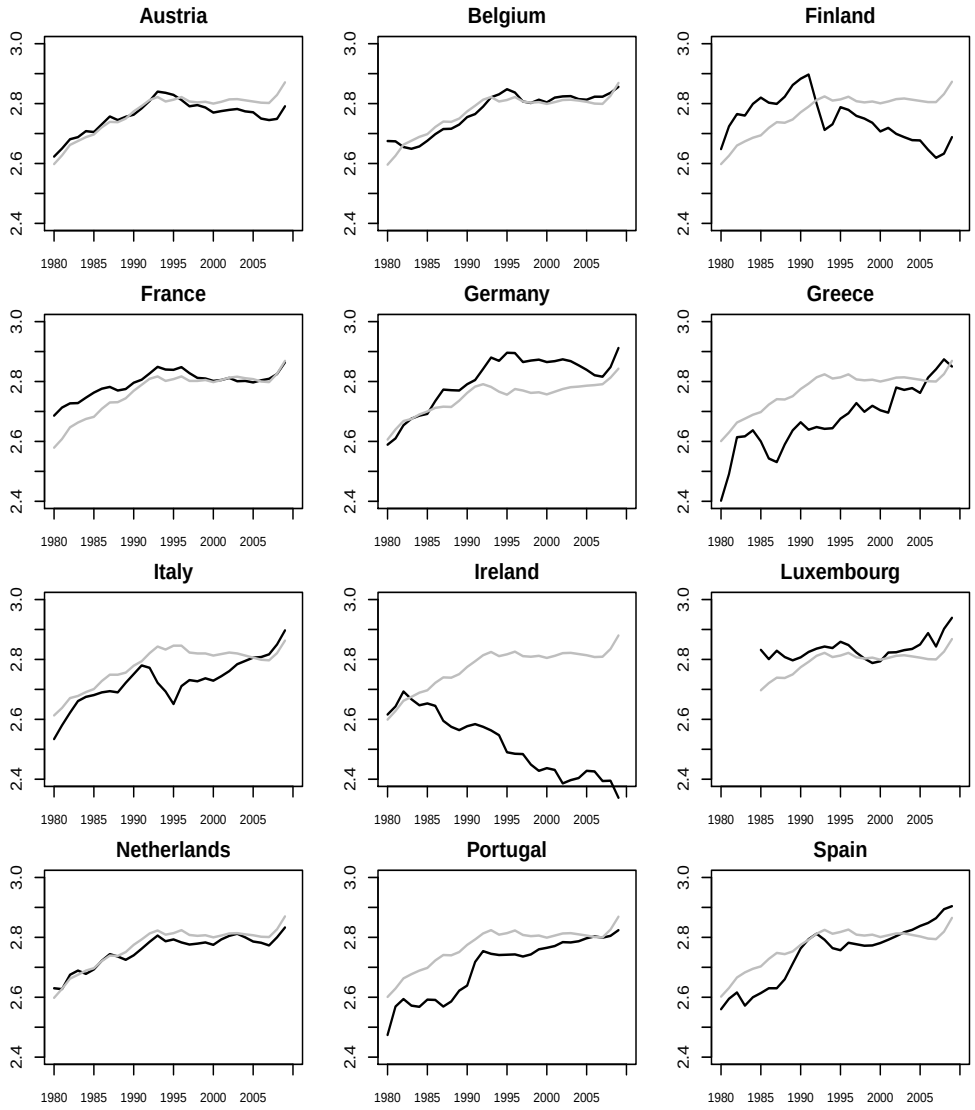

Figure 3: ULC of the manufacturing sector in log levels of the i-th country in black; in grey log of ULC levels of the EMU average minus the i-th country.

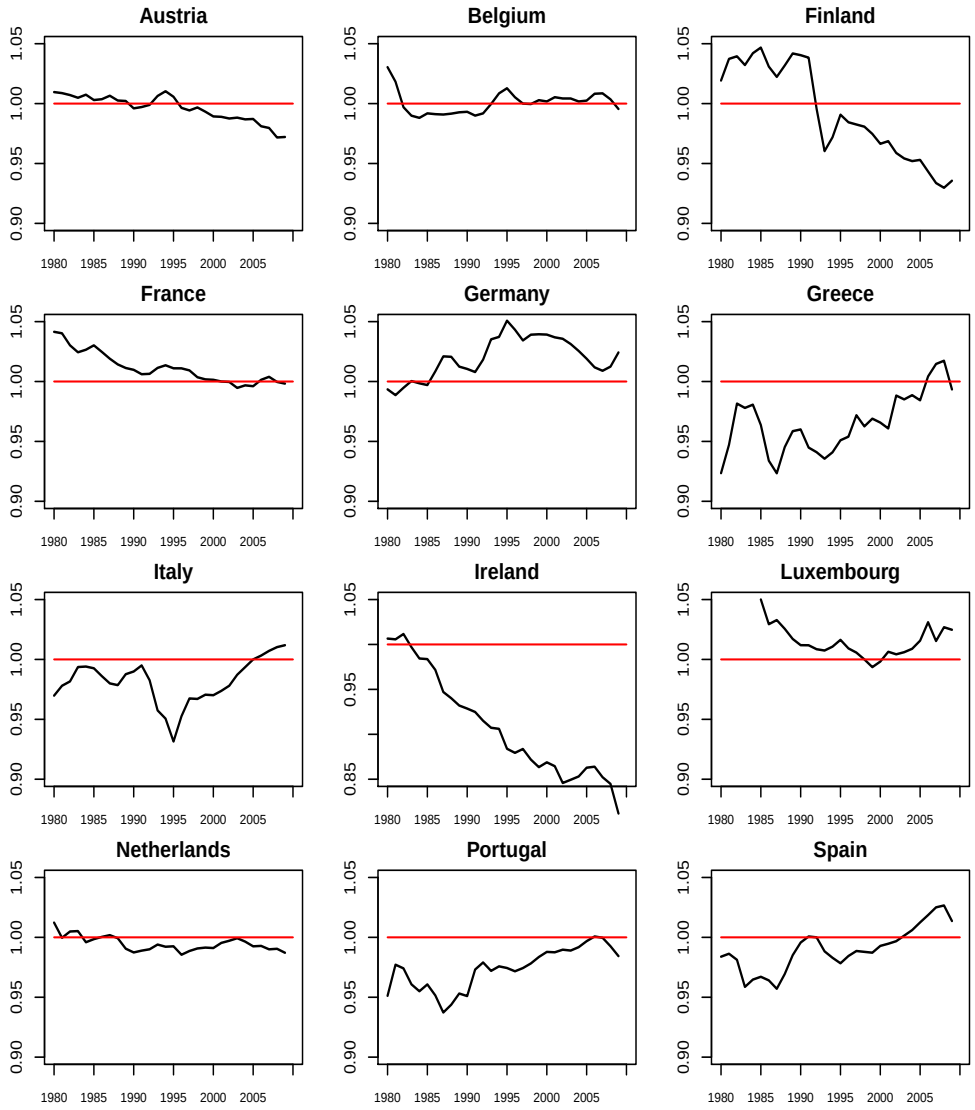

Figure 4: Ratio of ULC in log levels of the i-th country on log of ULC levels of the EMU average minus the i-th country. Manufacturing Sector.

Table 1: Johansen-Juselius Cointegration Test. ULC General Economy.

	Trace				λ-max			
	Model 1		Model 2		Model 1		Model 2	
	$H_0: r = 0$	$H_0: r \leq 1$	$H_0: r = 0$	$H_0: r \leq 1$	$H_0: r = 0$	$H_0: r \leq 1$	$H_0: r = 0$	$H_0: r \leq 1$
	$H_1: r = 1$	$H_1: r = 2$	$H_1: r = 1$	$H_1: r = 2$	$H_1: r = 1$	$H_1: r = 2$	$H_1: r = 1$	$H_1: r = 2$
Austria	38.85***	0.46	24.18**	10.52	38.39***	0.46	13.65	10.52
Belgium	40.80***	5.09**	45.55***	6.18	35.71***	5.09**	39.36***	6.18
Finland	37.21***	7.83***	53.17***	7.84	29.38***	7.83***	45.33***	7.84
France	28.99***	2.22	52.48***	8.42	26.76***	2.22	44.06***	8.42
Germany	38.26***	0.10	52.56***	14.35**	38.16***	0.10	38.21***	14.35**
Greece	31.88***	2.05	41.62***	7.87	29.82***	2.05	33.75***	7.87
Ireland	32.63***	3.79*	54.84***	12.04*	28.84***	3.79*	42.81***	12.04*
Italy	33.53***	5.17**	44.60***	7.35	28.36***	5.17**	37.25***	7.35
Luxembourg	33.79***	0.96	43.90***	4.80	32.84***	0.96	39.10***	4.80
Netherlands	35.02***	1.87	48.40***	7.61	33.15***	1.87	40.79***	7.61
Portugal	33.18***	1.53	38.20***	4.21	31.64***	1.53	33.99***	4.21
Spain	52.93***	1.67	54.27***	2.94	51.26***	1.67	51.33***	2.94

Notes:*, **, ***, denote statistical significance at the 10%, 5%, 1% levels, respectively.

Table 2: Johansen-Juselius Cointegration Test. ULC Manufacturing Sector.

	Trace				λ-max			
	Model 1		Model 2		Model 1		Model 2	
	$H_0 : r = 0$	$H_0 : r \leq 1$	$H_0 : r = 0$	$H_0 : r \leq 1$	$H_0 : r = 0$	$H_0 : r \leq 1$	$H_0 : r = 0$	$H_0 : r \leq 1$
	$H_1 : r = 1$	$H_1 : r = 2$	$H_1 : r = 1$	$H_1 : r = 2$	$H_1 : r = 1$	$H_1 : r = 2$	$H_1 : r = 1$ p-val	$H_1 : r = 2$
Austria	19.19***	0.12	40.84***	13.20**	19.07***	0.12	27.64***	13.20**
Belgium	20.73***	4.38**	22.21	4.83	16.35**	4.38**	17.38*	4.83
Finland	18.48**	2.20	25.04*	7.08	16.28**	2.20	17.95*	7.08
France	20.66***	6.10**	23.41*	8.31	14.56**	6.10**	15.10	8.31
Germany	26.00***	4.78**	33.26***	10.50	21.22***	4.78**	22.76**	10.50
Greece	18.71**	2.99*	24.33*	8,01	15.72**	2.99*	16.32	8,01
Ireland	33.59***	2.21	40.28***	8.27	31.37***	2.21	32.01***	8.27
Italy	18.69**	0.58	25.00**	6.89	18.11**	0.58	18.11*	6.89
Luxembourg°								
Netherlands	27.73***	11.69***	31.70***	12.49*	16.04**	11.69***	19.21*	12.49*
Portugal	10.72	4.66**	28.31**	6.01	6.07	4.66**	22.30**	6.01
Spain	21.78***	1.90	31.03**	9.54	19.88***	1.90	21.49**	9.54

Notes:*, **, ***, denote statistical significance at the 10%, 5%, 1% levels, respectively.

°We could not perform the test for Luxembourg because data availability was not sufficient to perform the test.

Table 3: Cointegrating Vectors: Total Economy and Manufacturing Sector.

Total Economy

	Ulc	UlcEU		Constant	Trend	
Austria	1	-0.65***	[-11.24]	-0.92	-	-
Belgium	1	-4.52***	[-6.01]	8.47	0.02***	[-6.00]
Finland	1	-6.09***	[-8.49]	11.91	0.04***	[5.09]
France	1	-2.34***	[-7.38]	3.49	-	-
Germany	1	-0.33***	[-5.04]	-1.79	-	-
Greece	1	-3.65***	[-11.43]	7.20	-	-
Ireland	1	-2.32***	[-9.38]	3.56	-	-
Italy	1	-14.70***	[-5.73]	33.05	0.09***	[3.28]
Luxembourg	1	-1.70***	[-19.51]	1.86	-	-
Netherlands	1	-1.82***	[-12.53]	2.14	-	-
Portugal	1	-2.58***	[-18.33]	4.23	-	-
Spain	1	-2.01***	[-20.69]	2.68	-	-

Manufacturing Sector

	Ulc	UlcEU		Constant	Trend	
Austria	1	-0.33***	[-3.39]	-1.85	-	-
Belgium - No cointegration					-	-
Finland	1	4.25***	[4.19]	-14.44	-	-
France - No cointegration						
Germany	1	-0.50***	[-2.36]	-1.88	0.00**	[2.29]
Greece	1	-3.91**	[-5.62]	8.12	-	-
Ireland	1	2.72***	[8.54]	-10.01	-	-
Italy	1	-2.24***	[-7.31]	3.47	-	-
Luxembourg - No data available					-	-
Netherlands	1	-0.25**	[-2.17]	-1.97	0.00**	[-2.15]
Portugal	1	-0.35***	[-2.94]	1.43	-0.01***	[-7.67]
Spain	1	-2.42***	[-1.77]	3.95	-	-

Note: *, **, ***, denote statistical significance at the 10%,
5%, 1% levels, respectively. T-stats in brackets.

Table 4: Weak Exogeneity Test: Total Economy and Manufacturing Sector.

	Total Economy		Manufacturing Sector	
	χ^2_1	p-value	χ^2_1	p-value
Austria	33.25***	0.00	19.37***	0.00
Belgium	24.11***	0.00	No cointegration	
Finland	32.91***	0.00	9.74***	0.00
France	14.56***	0.00	No cointegration	
Germany	24.31***	0.00	19.64***	0.00
Greece	28.34***	0.00	11.64***	0.00
Ireland	23.36***	0.00	9.92***	0.00
Italy	23.07***	0.00	16.00***	0.00
Luxembourg	9.77***	0.00	No data available	
Netherlands	23.77***	0.00	15.60***	0.00
Portugal	13.16***	0.00	5.10**	0.02
Spain	45.93***	0.00	17.56***	0.00

Note: *, **, ***, denote statistical significance at the 10%, 5%, 1% levels, respectively. T-stats in brackets.

Table 5: Relative Convergence Test: Total Economy and Manufacturing Sector.

	Total Economy		Manufacturing Sector	
	χ^2_1	p-value	χ^2_1	p-value
Austria	21.18***	0.00	18.71***	0.00
Belgium	9.88***	0.00	No cointegration	
Finland	28.06***	0.00	11.43***	0.00
France	10.61***	0.00	No cointegration	
Germany	37.96***	0.00	2.91*	0.09
Greece	19.09***	0.00	10.00***	0.00
Ireland	19.92***	0.00	21.89***	0.00
Italy	19.53***	0.00	12.99***	0.00
Luxembourg	24.88***	0.00	No data available	
Netherlands	19.56***	0.00	4.58**	0.03
Portugal	22.29***	0.00	12.83***	0.00
Spain	44.92***	0.00	17.77***	0.00

Note: *, **, ***, denote statistical significance at the 10%, 5%, 1% levels, respectively. T-stats in brackets.