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TESTING FOR CONVERGENCE OF THE OKUN'S LAW COEFFICIENT IN EUROPE

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Testing for convergence of the Okun's Law coefficient in Europe

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1. INTRODUCTION

A large number of papers have considered the question of whether the European Union (EU) is an optimal currency area by analysing either the dispersion (and/or the correlation) of observable variables such as output, output per head, and GDP growth rates or the dispersion (and/or the correlation) of unobservable variables such as demand and supply shocks. This approach typically leads to a division of countries between a core and a periphery.
We move to a quantitative approach that focuses on asymmetry stemming from differences in the way countries react to symmetric euro area shocks. Without convergence of macroeconomic "parameters" representative of the nature of adjustment mechanisms, even a common shock to the union can lead to different macro-economic consequences across the EU members and, eventually, to the need for more or less co-ordinated specific policies.

In this paper, we test for the presence of convergence of the Okun's Law coefficient (OLC hereafter). This constitutes one of the main macro-economic parameters underlying the sensitivity of unemployment variations to fluctuations in economic activity.

The choice of the OLC is motivated by several considerations. First, although the negative relationship between the unemployment rate gap and the real output gap has remained quite stable, the absolute value of the OLC seems to be varying over time and from country to country. The stability of the OLC has been recently tested by several authors and with different statistical methodologies, and empirical results seem to reveal strong evidence of structural change and temporal instability of the OLC (see, for example, Moosa 1997, Sögner and Stiassny 2000 or Lee 2000).

Secondly, the Okun's Law empirical relationship is a major part of traditional macro-models, as the aggregate supply curve is derived by combining Okun's Law with the Phillips curve. Moreover, this relationship also has important implications for macroeconomic policy since the size of the OLC is an important indicator of the degree of interdependence of output and labour movements around their long-run paths and is regarded as a benchmark for policy-

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makers to measure the cost of higher unemployment. Furthermore, the effectiveness of disinflation policy depends on the responsiveness of unemployment to the output growth rate (sacrifice ratio). This point is an important one since it helps explain interest in the analysis of the convergence of the OLC for groups of countries which are (or might become) members of a monetary union with common monetary policy shocks.

Thirdly, the basic Okun's Law involves the deviation of real output and unemployment rates from their long run or full employment levels. As a result, one may assume that national macro-economic structures (such as tastes or labour market rigidities) lead to heterogeneous country-specific levels of potential output and natural unemployment rates, despite possible convergence in the size of the co-variation between the output gap and the unemployment gap over the business cycle.

Fourthly, the OLC can be considered as a reduced-form, or semi-reduced form, parameter (or less technically, as a "mongrel" parameter according to Weber 1995) which incorporates several fundamental structural parameters from the firms' optimal demand for labour, the macroeconomic production function and the labour force participation equation. As a result, and despite the limits inherent in the analysis of reduced-form relationships, the OLC may be considered as the net effect of several macro-economic structural parameters representative of the macro-economic behaviour of the country under examination and of the characteristics of the adjustment mechanisms lying behind the inverse relationship between output gaps and unemployment gaps over the business cycle. Fifthly, estimators of the OLC can be obtained with rather simple econometric models which can be estimated quite routinely for many countries and with standardised data series.

The empirical strategy adopted in this paper is based on the evaluation of the time path of rolling regression estimates of the Okun's Law coefficients for European countries. We then use the testing procedure suggested by Evans (1996) to investigate the convergence or the non-convergence properties of the OLC in several groups of country by examining how the cross-country variance of the OLC evolves over time in theses groups.

The plan of the paper is as follows. Section 2 outlines the theoretical background and Section 3 presents the empirical strategy. Section 4 reports the results and Section 5 contains some concluding remarks.

2. THEORETICAL BACKGROUND

The search for a quantifiable relationship between output fluctuations and variations in unemployment suitable for policy analysis emerged with Okun (1962) and the so-called Okun's Law relationship claims that the correlation of the cyclical components of output and the unemployment rate is negative. Using more or less sophisticated versions of the Okun's Law relationship, many recent empirical papers have analysed the stability of the OLC in European and non European countries. Harris and Silverstone (2001), Mayes and Virén (2002) and Virén (2001) have tested for asymmetry of the OLC. Lee (2000), Weber (1995) and Sögner and Stiassny (2000) have tested for structural change in the OLC and Schanel (2002) has used rolling regression-estimate of the OLC to analyse its time dependence.

Taken as a whole, those papers show without ambiguity that the quantitative as opposed to the qualitative estimates of the OLC are unstable over recent decades in European countries.

Moreover several countries exhibit an overall increase in the absolute value of the unemployment-output trade-off in recent decades. Once observed, this instability of the OLC in European countries has to be interpreted further and some macroeconomic explanations have to be found for the possible origins of this instability. Two hypotheses are examined in this paper.

The first hypothesis (retained as the null hypothesis in the adopted testing procedure) states that European countries have different OLC trends stemming from domestic-specific labour and goods market structural dynamics and macroeconomic policies. In this case, the OLC's should wander away from each other at positive rates and hence their cross-country variance should be integrated of order one around an upward quadratic trend.

By contrast, an alternative hypothesis is that OLC's follow parallel paths. In this case, OLC's share a common trend arising because of financial and goods market integration, reduction of trade barriers, harmonisation of VAT, pressures of international competition and convergent macroeconomic policies. In this case, OLC's should not wander away from each other and hence their cross-country variance should be stationary around a constant positive mean.

To illustrate the idea, consider Figures 1a and 1b, which depict the hypothesis of non-convergence of the OLC (Figure 1a) and the hypothesis of convergence (Figure 1b) in the case of two countries labelled 1 and 2 respectively.

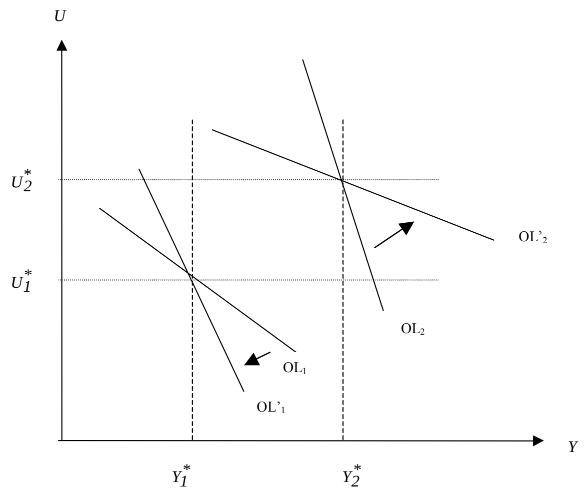


Figure 1a: Non-convergence of the OLC

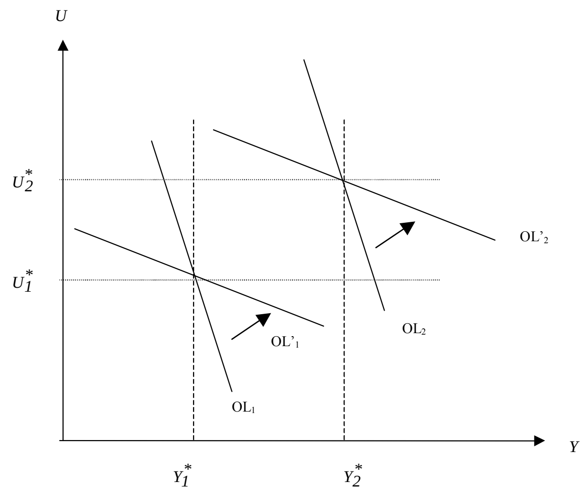


Figure 1b: Convergence of the OLC

Natural rates of output and unemployment are represented by the U_1^* and Y_1^* lines in country 1 and by the U_2^* and Y_2^* lines in country 2. The initial and final Okun's Law relationships are depicted by the OL_1 and OL_1' curves in country 1 and by the OL_2 and OL_2' curves in country 2. In the case of non-convergence, depicted in Figure 1a, OL relationships are not parallel and rotate non symmetrically from OL_1 to OL_1' in country 1 and from OL_2 to OL_2' following an exogenous shock. In the case of convergence, initially parallel OL relationships rotate symmetrically after a shock and stay parallel after the shift. Note that both cases involve no changes in the natural rates of output and unemployment. Convergence (or non-convergence) of the OLC is not at all synonymous with convergence (or absence of convergence) of the natural rates of unemployment and/or of potential output.

In this case, we can speak about a conditional convergence process since the convergence of the OLC is conditional upon the disparities of the levels of potential output and full employment unemployment rate across countries.

3. ECONOMETRIC CONSIDERATIONS

The Okun's Law models

Let Y_t and Y_t^* represent, respectively, the logs of the observed and potential GNP. Similarly, let U_t and U_t^* represent the observed and natural rates of unemployment. In its simplest form, the empirical relationship between unemployment and output suggested by Okun is a "gap" equation of the type:

$$U_t^c = a.Y_t^c + \omega_t \text{ with } \alpha < 0 \qquad (1)$$

where $Y_t^c = Y_t - Y_t^*$ is cyclical GNP, $U_t^c = U_t - U_t^*$ is the cyclical unemployment rate, and ω_t is a stochastic error term. In Equation (1) the parameter a is known as the Okun's Law coefficient.

Equation (1) is a static, standard version of Okun's Law which assumes that the relationship is totally contemporaneous, which may not be plausible theoretically. It may also be inadequate empirically owing to the omission of significant time lags, especially in the reaction of labour demand. As the retained dynamic specification varies substantially across studies, we use two different specifications of the Okun's Law equation. This strategy permits some indication to be given of the sensitivity of empirical results to the maintained specification, and avoids potential criticism that the empirical results are particular to one chosen specification.

Following Hendry, Pagan and Sargan (1984) the first dynamic model used here is the Autoregressive Distributed Lag (or ADL) model :

$$U_t^c = \sum_{s=0}^{p} a_{0,s} Y_{t-s}^c + \sum_{s=1}^{q} a_{1,s} U_{t-s}^c + \omega_t \qquad (2)$$

where the contemporaneous (impact or short-run) effect of output on unemployment is measured by the coefficient $a_{0,0}$ while the total (or what is called here "medium-run") effect is given by

$$a_{ADL} = \frac{a_{0,0} + \cdots + a_{0,p}}{1 - (a_{1,1} + \cdots + a_{1,q})} \qquad (3)$$

The second specification is adapted from Blanchard (1989) and Weber (1995). We assume that the joint time series behaviour of the vector $Z_t = (Y_t^c,\ U_t^c)'$ has a structural vector autoregressive (SVAR) representation of the form (disregarding for simplicity deterministic variables such as dummies):

$$A(L)Z_t = \varepsilon_t \qquad (4)$$

where $A(L) = A_0 + A_1 L + \cdots + A_p L^p$ is a matrix polynomial in the lag operator L, $\varepsilon_t = (\varepsilon_t^D, \varepsilon_t^S)'$ is the vector of the structural residuals with ε_t^D denoting aggregate demand shocks and ε_t^S aggregate supply shocks. ε_t is serially uncorrelated and $Var(\varepsilon_t) = \Lambda$ diagonal.

The elements of A_0 are the structural parameters on the contemporaneous endogenous variables. The reduced form of the system can be written as

$$\Phi(L)Z_t = v_t \qquad (5)$$

with $\Phi(L) = I - \Phi_1 L - \cdots - \Phi_p L^p$ and $v_t = (v_t^Y, v_t^U)'$ is a (2×1) vector of reduced-form residuals and $Var(v_t) = \Sigma$.

The relationship between the reduced form and the SVAR representation is given by

$$\Phi_i = A_0^{-1} A_i \quad \text{for } i = 1, \cdots, p$$

$$\text{and} \qquad v_t = A_0^{-1}\varepsilon_t \text{ (or } A_0 v_t = \varepsilon_t\text{)}.$$

As the coefficients in A_0 and Λ are unknown, identification of the structural parameters is achieved in the SVAR approach by imposing theoretical restrictions to reduce the number of unknown structural parameters to be less than or equal to the number of estimated parameters of the variance-covariance matrix of the VAR residuals. As the vector Z_t contains two variables, only one theoretical constraint is needed to achieve identification.

Following Blanchard (1989) and Giannini, Lanzarotti and Seghelini (1995), the imposed restriction can be represented by the following set of equations :

$$\begin{pmatrix} 1 & 0 \\ a_{2,1}^{(0)} & 1 \end{pmatrix} \begin{pmatrix} v_t^Y \\ v_t^U \end{pmatrix} = \begin{pmatrix} \varepsilon_t^D \\ \varepsilon_t^S \end{pmatrix} \quad \text{or} \quad \begin{cases} v_t^Y = \varepsilon_t^D \\ v_t^U + a_{2,1}^{(0)} v_t^Y = \varepsilon_t^S \end{cases} \qquad (6)$$

where $a_{2,1}^{(0)}$ is the (2,1) element of the A_0 matrix.

The first equation states that real GNP innovations are driven entirely by aggregate demand disturbances within the corresponding time period as a result of nominal rigidities. In other words, this equation imposes a ‘minimum delay restriction’. Unemployment is then determined in the second equation according to an Okun’s Law relationship. Innovations in unemployment, given output, are attributed to supply shocks, reflecting changes in productivity or labour supply.

The OLC evaluated with the VAR approach is thus given by:

$$a_{VAR} = -a_{2,1}^{(0)}$$

In this version of the OLC, innovations to cyclical output are assumed to be entirely attributable to aggregate demand innovations. The second equation of the SVAR model is the Okun’s Law equation. The imposed restrictions referred to above imply that innovations in unemployment given output are attributable to supply innovations. In this framework, supply innovations include both shocks to labour supply (i.e. changes in the labour force which affect unemployment given employment) and technology shocks (changes in productivity which affect employment given output).

Note that the lower triangular structure in the A_0 matrix implies the special case of the Wold causal chain. As a consequence, the estimated residuals from the first equation can be used as an optimal instrument to estimate the parameter $a_{21}^{(0)}$. The Okun's Law coefficient may then be obtained by estimating

$$v_t^U = a_{VAR} v_t^Y + \eta_t \qquad (7)$$

where η_t is a white noise process.

A major step in the estimation of the OLC is the determination of potential output and the natural rate of unemployment. Unfortunately, these values are not observable and have to be estimated. Generally, there is no simple and straightforward way of doing this that guarantees the accuracy of the estimates. Well known approaches to this problem include differencing and the removal of deterministic linear, quadratic or broken trends.

The usual problem with some of the relatively simple methods is the fact that they fail to account adequately for the stochastic components of unemployment and real output in determining their potential components. As noted by Freeman (2000), the choice of detrending methodology can account for the failure to reject non-stationarity in the variables being used in the regression, resulting in a misspecification of the regression model.

The Hodrick and Prescott (1980, 1997) filter (hereafter, the HP filter) has become a standard method in the business cycle literature for removing trend movements. It decomposes an integrated time series into a stochastic trend and an cyclical component by minimising the variance of the cyclical component subject to a penalty for variations in the second difference of the trend component.

Although the use of the HP filter may be subject to criticism and somewhat more sophisticated decomposition procedures have been developed (see for instance the Beveridge-Nelson (1981) method, the Harvey (1985) structural time series approach, or the Baxter and King (1995) band-pass filter), the HP filter remains one of the standard methods for detrending. This is the main reason why we have chosen to use the HP filter in this paper. Moreover, this filter allows us to take account of the possible existence of stochastic trends in the original output and unemployment series.

Rolling regression estimates of the OLC are obtained by estimating Equations (2), (5) and (7) for each country *i* separately and for the initial sub sample $t = 1,...,T_1$ with $T_1 < T$ and T being the last observation in the full sample. Next, Equations (2), (5) and (7) are estimated for each country *i* separately and for each rolling regression sub sample $t = 2,...,(T_1 + 1)$, $t = 3,...,(T_1 + 2)$, …, $t = S,...,T$ (with $T = T_1 + S$) respectively. Note that in this case T_1 is the dimension of the fixed window size used throughout the rolling regressions.

Testing for convergence of the OLC

We admit the possibility that Europe might be divided into convergence clubs (i.e. distinct groups of countries that revert toward different OLC common trends) or that some countries revert toward a common trend while others diverge from that common trend and from each other. We thus set up K groups of European countries. Each group $k = 1,...,K$ is formed on the basis of specific macroeconomic considerations which motivate examining the OLC convergence process across the countries included in this group.

It is now possible to examine the behaviour of each group's OLC differentials over time and ascertain whether there is any evidence of convergence within them. The conventional, cross-country regression method for determining convergence has recently been criticised by Friedman (1992) and Quah (1993) among others. Moreover, such an approach would not be sensible in our case in which the primary focus of the convergence analysis is on groups with sizes varying between four to twelve European countries. Even were regression to be feasible, the very limited degrees of freedom would severely limit the power of our results.

In line with numerous recent studies on convergence (see, for example, Bernard and Durlauf, 1995) we avoid cross-country regressions and rely instead on time series information for determining the existence, or lack thereof, of convergence. More precisely, we use the test statistic suggested by Evans (1996). In order to deal simultaneously with the time and cross-section dimensions of series of estimated OLC, we investigate convergence of the OLC by examining how the cross-country variance of this coefficient evolves over time. The testing procedure suggested by Evans (1996) seems to be adequate for the problem at hand. This procedure amounts to estimate the following regression:

$$\Delta V_t^k = \alpha_k + \beta_k t_t + \rho_k V_{t-1}^k + \sum_{i=1}^{r_k} \gamma_{k,i} \Delta V_{t-i}^k + \eta_t^k \qquad (8)$$

where V_t^k is the variance of the k^{th} group's estimated OLC ($V_t^k = (1/N_k)\sum_{i \in k}(a_{i,t}^k - \bar{a}_t^k)^2$ with $\bar{a}_t^k = (1/N_k)\sum_{i \in k} a_{i,t}^k$, and N_k is the number of countries included in the k^{th} group), t_t is a time trend and η_t^k is a white noise process.

Within this statistical framework, the hypothesis of non-convergence is defined as the hypothesis that the processes $(a_{1,t}^k, a_{2,t}^k, \cdots, a_{N_k,t}^k)$ are difference stationary with no cointegration among themselves, and $\Delta a_{1,t}^k, \Delta a_{2,t}^k, \cdots, \Delta a_{N_k,t}^k$ have different unconditional means. In Equation (8), this hypothesis imposes the restrictions:

$$\rho_k = 0, \quad \beta_k > 0 ,$$

The alternative hypothesis of convergence is defined as the hypothesis that a unique difference stationary series π_t^k exists such that $a_{1,t}^k - \pi_t^k$, $a_{2,t}^k - \pi_t^k, \ldots, a_{N_k,t}^k - \pi_t^k$ are stationary with nonzero means and the unconditional mean of $\sum_{i \in k}(a_{i,t}^k - \pi_t^k)$ is zero. In Equation (8), the restrictions imposed by this hypothesis are given by:

$$\rho_k < 0, \quad \beta_k = 0, \quad \alpha_k > 0 .$$

In the convergence case, it may be assumed that the common trend π_t^k arises because of the growing integration of goods and financial markets in Europe. In this case, the unification of the European Community (EC) market induced by the progressive reduction in trade barriers, the harmonisation of the VAT and competition constraints or the pressure of international competition are considered as mechanisms leading to convergence of national OLC's toward parallel long-run levels.

Note that the failure of V_t to exhibit a decrease towards zero cannot be considered as evidence against convergence (or reversion toward a common trend) of the OLC within the statistical framework suggested by Evans. Rather, reversion is supported if V_t fluctuates around a positive mean and is rejected when V_t contains a quadratic positive trend. The data – generating process retained in the Evans framework is not consistent with a variance, V_t, declining toward zero.

Let $\hat{\rho}_k$ be the estimators of ρ_k obtained by applying ordinary least squares to Equation (8) and let $\tau(\hat{\rho}_k)$ be the corresponding t-ratio. According to Theorems 2, 3 and 4 in the Evans paper, the non-convergence hypothesis can be tested by treating it as the null against an alternative of convergence. In this statistical framework, the non-convergence hypothesis is rejected if $\tau(\hat{\rho}_k)$ exceeds an appropriately chosen critical value. Under non-convergence null $\tau(\hat{\rho}_k)$ converges in distribution to N(0,1) as T approaches infinity. However, the critical values of these statistics may be very different from the fractiles of the theoretical asymptotic distribution in finite samples. Fortunately, adequate critical values can be estimated using Monte Carlo simulations.

4. EMPIRICAL RESULTS

This study uses semestrial (biannual) data for 17 European countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom. The sample period runs from the first semester of 1970 to the second semester of 2002 and the data are taken from the OECD Economic Outlook database.

As suggested by Rven and Uhling (2002) the smoothing parameter, λ, of the HP filter is adjusted according to the fourth power of the sampling frequency. For semestrial observations, this implies that $\lambda = 1600 / 2^4 = 100$. In order to adequately capture the dynamic characteristics of the OL equation without losing too many degrees of freedom, we introduce some limited dynamics in the ADL and VAR models by setting the maximal number of lags equal to 4. In each case, the optimal lag length (subject to the maximum restriction) is selected with the Akaike criterion for all countries.

The ADL model is estimated with the technique of Seemingly Unrelated Regressions (SUR). A 17 equation-system is formed by stacking the equations associated with each of the seventeen retained countries. In contrast to OLS, the SUR technique takes into account potential cross-country residuals correlations due, for example, to European common shocks. The VAR model is estimated with OLS.

The rolling regressions are performed by first estimating the OLC with an initial span of observations running from the first half of 1970 to the second half of 1989 ($T_1 = 1989/2$). Starting from this 40-observations initial sub-sample, successive sub-samples are formed by simultaneously adding one observation at the end of the sample and dropping one observation at the beginning of the sample so that the number of observations in each regression is constant and equal to 40.

The degree of convergence of the OLC is examined for several groupings of European countries. The first grouping includes all the retained EC countries. The second basis for grouping is given by the level of GNP of each European country. We retain three GNP-based groups of countries:

- countries with the highest level of GNP (France, Germany, Italy, United Kingdom)
- countries with an intermediate level of GNP (Austria, Belgium, Netherlands, Spain, Sweden, Switzerland)
- countries with the lowest level of GNP (Denmark, Finland, Greece, Ireland, Norway, Portugal)

The third set of groups is constructed on the basis of geographical considerations:

- Septentrional countries (Denmark, Finland, Ireland, Norway, Switzerland, United Kingdom)
- Occidental countries (Austria, Belgium, France, Germany, Luxembourg, Netherlands)
- Meridional countries (Greece, Italy, Portugal, Spain).

The fourth grouping is made on the basis of the Bayoumi-Eichengreen (1993) classification of European countries according to the degree of correlation of demand and supply shocks across countries (a high degree of correlation being considered as a prerequisite for the existence of an optimal monetary zone):

- EMU core-countries are characterised by similar supply and demand shocks (Belgium, Denmark, France, Germany, Luxembourg, Netherlands)
- EMU periphery-countries are characterised by asymmetric macroeconomic shocks (Greece, Ireland, Italy, Portugal, Spain, United Kingdom).

A summary of statistics from the country-specific Okun's Law regressions is presented in Table 1. For both the SUR estimated ADL model and the VAR model, the table gives - for each country - the across-windows mean value of the estimated OLC, the mean value of the associated t-statistic and the mean value of the regression R^2.

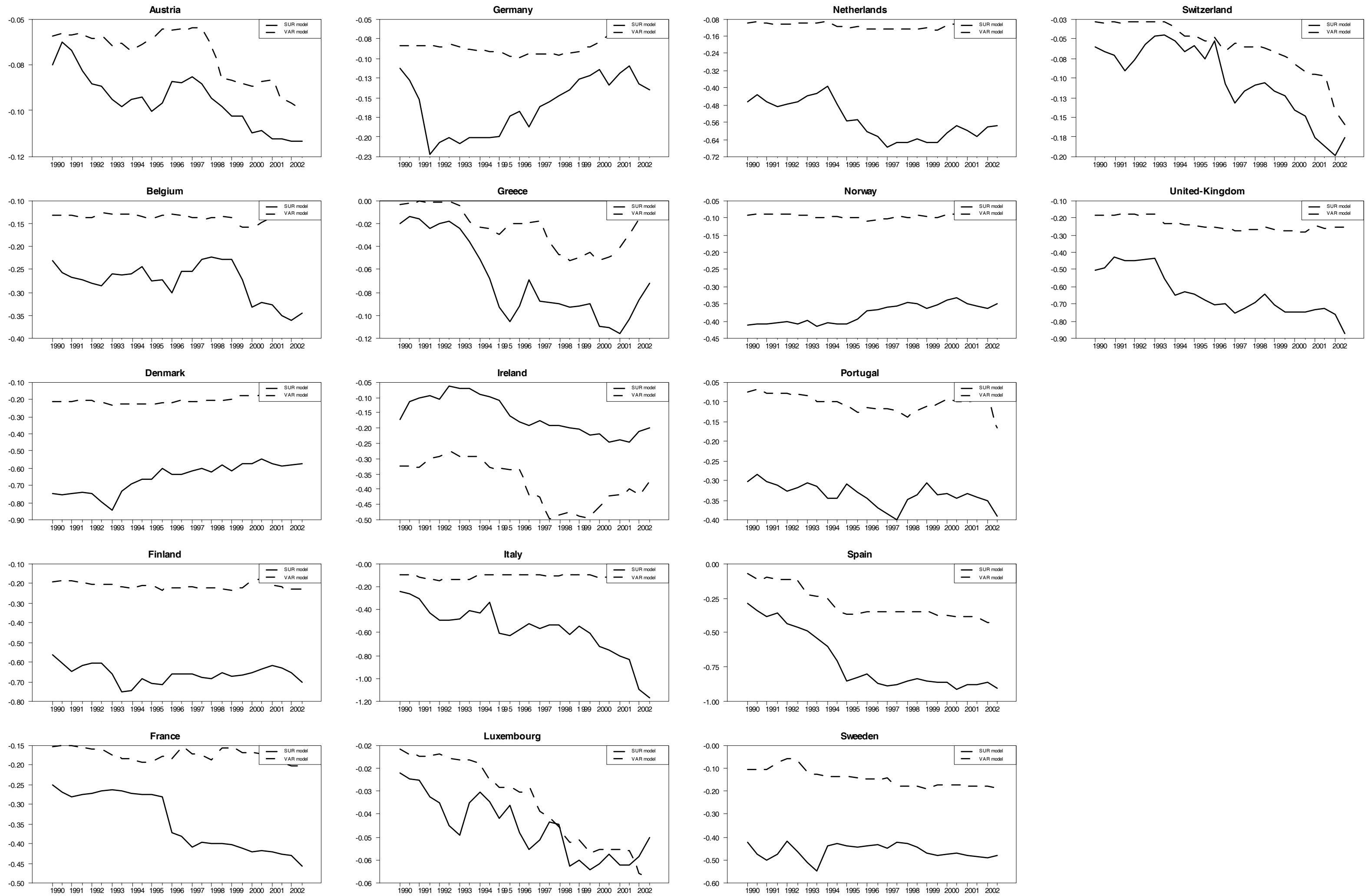
Table 1: OLC estimators and model statistical indicators

	ADL Model			VAR Model		
Country	$\hat{a}_{ADL}$	*t-stat* (1)	R^2 (2)	$\hat{a}_{VAR}$	*t-stat.* (3)	R^2
Austria	-0.100	-4.727	0.937	-0.070	-3.012	0.139
Belgium	-0.277	-12.890	0.937	-0.137	-5.950	0.208
Denmark	-0.655	-13.253	0.937	-0.207	-3.408	0.224
Finland	-0.659	-7.498	0.937	-0.212	-4.718	0.381
France	-0.346	–11.261	0.937	-0.173	-5.739	0.176
Germany	-0.160	-2.026	0.937	-0.085	-2.997	0.344
Greece	-0.070	-2.860	0.937	-0.024	-0.735	0.030
Ireland	-0.161	-3.519	0.937	-0.378	-4.304	0.218
Italy	-0.575	-5.176	0.937	-0.112	-2.024	0.131
Luxembourg	-0.045	-2.551	0.937	-0.036	-2.889	0.041
Netherlands	-0.552	–13.905	0.937	-0.113	-5.098	0.311
Norway	-0.378	–35.689	0.937	-0.100	-3.987	0.115
Portugal	-0.335	–13.020	0.937	-0.102	-3.126	0.087
Spain	-0.708	-8.018	0.937	-0.293	-3.377	0.204
Sweden	-0.461	-31.406	0.937	-0.142	-3.350	0.263
Switzerland	-0.102	-4.833	0.937	-0.060	-2.365	0.126
United-Kingdom	-0.639	–12.953	0.937	-0.238	-5.481	0.304

(1) As the a_{ADL} parameter involves a non-linear function of the regression coefficients, the estimated variances (and so the associated t-statistics) are computed using the Delta method.
(2) R^2s are the same for each country because of the SUR estimation.
(3) t-statistics associated with the a_{VAR} coefficient in Equation (6).

Whichever model is used, the *t*-statistics reveal that the mean value of the Okun's Law coefficient is negative and significantly different from zero at the 5% confidence level for all countries except Greece. With one exception, the absolute value of the VAR-estimated OLC is lower than the corresponding value from the ADL model. This can be confirmed by visual inspection of Figure 2 which plots the temporal evolution of the estimated value of the OLC for each country. The graph of the time evolution of the VAR-estimated OLC value is located above that for the SUR-ADL model except for Ireland (the exception referred to above) and Luxembourg (during the last two periods of the sample only). The exceptional cases may be explained by the fact the two-variable VAR model is not always fully appropriate for the case of a small open economy. In line with the empirical results found in Lee (2000), twelve out of the seventeen countries exhibit an increase in the absolute value of the OLC in the decade from 1990.

Figure 2: Time evolution of the estimated value of the OLC



Convergence test statistics

The Evans statistic $\tau(\hat{\rho})$ is obtained by estimating Equation (8) after selecting the optimal number of lags with the Akaike criterion, subject to the constraint of a maximal lag length of four semesters. Finite sample critical values of $\tau(\hat{\rho})$ are then estimated by Monte Carlo simulations performed as follows. Let $a_{i,t}$ denote the estimator of the Okun's Law coefficient in country *i* at time *t*. We first obtain 10,000 samples of a's generated according to

$$a_{i,t} = \lambda_i + a_{i,t-1} + u_{i,t} \quad i = 1,\cdots,N\,, \qquad t = T_1,\cdots,T \qquad (9)$$

with $u_{i,t} \approx NIID(0,\sigma_i^2)$, $a_{i,T_1-1} \approx NIID(0,\theta_i^2)$, and $\lambda_i \approx NIID(0,\kappa_i^2)$.

The parameter σ_i is taken equal to the minimal standard error obtained by fitting $a_{i,t}$ to fixed country and time effects and up to 4 lags of itself. The parameter θ_i is equal to the cross-country standard error of $a_{i,t}$ in 1990:1. Finally, κ_i represents the cross-country standard deviation of the Okun's Law coefficient drift term. As this parameter cannot be estimated directly, samples of a's were generated for κ_i = 0.000, 0.005 and 0.010. Note that simulations are performed with no lags of ΔV_t^k as regressors in Equation (9) because i) the asymptotic distribution of $\tau(\hat{\rho})$ does not depend on the nuisance parameters $\{\gamma_k\}$, ii) the finite-sample distribution depends on these parameters only slightly.

The estimated values of the variance parameters involved in the estimation of the finite-sample critical values of $\tau(\hat{\rho})$ are presented in Table A.1 in the Appendix. Tables 2A and 2B report the values of $\hat{\rho}$ and $\tau(\hat{\rho})$ in the second and third columns, and estimates of the marginal significance levels of $\tau(\hat{\rho})$ for κ_i = 0.000, 0.005 and 0.010 in the fourth, fifth and sixth columns.

Table 2A: Evans test for non-convergence of the ADL-estimated OLC

	$\hat{\rho}$	$\tau(\hat{\rho})$	Marginal significance level for $\kappa_i =$ 0.000	0.005	0.010
All EC countries	-0.748	-1.674	0.584	0.728	0.397
Euro zone	-0.683	-2.011	0.580	0.569	0.229
High GDP	0.260	0.402	0.978	0.997	0.969
Intermediate GDP	-0.272	-1.648	0.741	0.686	0.170
Low GDP	-0.693	-2.535	0.316	0.320	0.136
Septentrional	-0.813	-2.660	0.265	0.266	0.148
Occidental	-0.562	-2.552	0.313	0.225	0.027
Meridional	-0.762	-1.686	0.726	0.726	0.486
B-E core	-0.948	-2.675	0.249	0.252	0.158
B-E periphery	-0.613	-1.639	0.748	0.749	0.468

Table 2B: Evans test for non-convergence of the VAR-estimated OLC

	$\hat{\rho}$	$\tau(\hat{\rho})$	Marginal significance level for $\kappa_i =$ 0.000	0.005	0.010
All EC countries	-0.270	-0.927	0.933	0.214	0.195
Euro zone	-0.407	-1.329	0.842	0.138	0.119
High GDP	-0.192	-0.633	0.962	0.728	0.705
Intermediate GDP	-0.407	-2.106	0.526	0.035	0.042
Low GDP	-0.504	-1.688	0.728	0.118	0.057
Septentrional	-0.382	-1.520	0.785	0.136	0.080
Occidental	-0.625	-2.099	0.522	0.033	0.038
Meridional	-0.567	-2.201	0.479	0.036	0.038
B-E core	-0.613	-2.971	0.175	0.005	0.005
B-E periphery	-0.391	-1.187	0.888	0.250	0.161

The marginal significance levels reported in Table 2A imply that, with only one exception, the null of non-convergence of the ADL-estimated OLC is never rejected at the 5% significance level. The single exception is that of the Occidental countries-group, and then only if the cross-country standard deviation of OLC drifts is assumed to be equal to 0.010.

As the ADL-estimated OLC is the total multiplier effect of output gap variations on cyclical unemployment, there is no evidence of any parallel movements in the medium-run correlation of unemployment and output gaps in most country groupings. Apart from the Occidental group, the instability of the ADL-estimated OLC in European countries cannot be related to the movements of an underlying European (or group-specific) common trend. On the contrary, this instability seems to originate from country-specific disturbances such as changes in labor market rigidities, technological adoption rates, preferences, market structures and government policies. This evidence of non-convergence of the medium-run multiplier effect of GNP on unemployment in the groups consisting of European countries and in the groups consisting of EMU countries highlights how counterproductive the monetary policy of the EMU might be even in the case of symmetric shocks. This situation may become worse as and when EMU is enlarged to incorporate one or more of the countries which acceded to EU membership in 2004, as that incorporation may result in a higher degree of asymmetry of macroeconomic structural parameters.

Moreover, the absence of an OLC common trend in the group consisting of high-GDP countries reduces the scope and the incentives for possible common macroeconomic strategies among the sub-group of EMU rich countries. As EMU enlargement has raised the possibility that some sub-groups of countries (France and Germany, for instance) might set up specific macroeconomic co-ordinated policies, the non convergence of the OLC in the group of rich countries casts doubt on the wisdom of such a strategy.

Turning next to the case of the VAR-estimated OLC, the null of non-convergence is never rejected by the data when κ_i = 0.00. However, this null hypothesis is rejected at the 5% confidence level for the Intermediate GDP, Occidental, Meridional, and Bayoumi-Eichengreen core countries when the variance parameter κ_i is increased to 0.01. At that variance parameter level, non-convergence cannot be rejected at the 10% confidence level for the groups consisting of all retained EC countries, the EMU countries, the high GDP countries, and the Bayoumi-Eichengreen periphery countries.

As the VAR-estimated OLC measures the contemporaneous link between VAR innovations associated with the output gap and unemployment rate gap equations, empirical results presented in Table 2B show that there is convergence of the short run correlation of the unexpected components of output and unemployment fluctuations in many country groups in Europe. This statistical result may be interpreted as the existence of a common trend underlying the time path of the coefficient of what might be called the short-run version of the Okun's Law relationship. In several country groups such as "Intermediate GDP", "Low GDP", "Septentrional", "Occidental", "Meridional" and "Bayoumi-Eichengreen core", the instantaneous impact of GNP innovations on unemployment innovations seems to be conjointly determined by European-wide macroeconomic structural evolutions during the last decade. This parallel evolution of the "short-run" Okun coefficient in many European country groups might be related to rather similar degrees of labor market rigidities, high levels of unionisation and real wage downward inflexibility (see for instance Nickell, 1997 on this point). Moreover, we may also conjecture that restructuring from manufacturing to service industries and the adoption of new technologies in countries with generous welfare and social insurance programs can explain a major part of this parallel evolution of the short-run OLC through the nineties.

Lastly, note that the hypothesis of non-convergence of the VAR estimate of the OLC is rejected by the data for the Bayoumi-Eichengreen core group but this hypothesis is not rejected for the periphery group. This empirical result gives additional insight into the relevance of the country groupings suggested by Bayoumi and Eichengreen. Their suggested grouping seems to be also valid when analysing the convergence of the VAR estimate of the OLC instead of the correlation of supply and demand shocks as performed in these authors' initial paper.

5. CONCLUSION

This paper re-examines the question of whether some subgroups of European countries constitute an optimal zone by testing for convergence of short-run and medium-run version of the OLC with a two-step strategy involving the testing procedure suggested by Evans (1996).

Empirical evidence suggests that short-run OLC's follow parallel paths in several sub-groups of European countries but there is no strong evidence of any parallel movements in the estimated values of the medium-run OLC. Only the Occidental countries-group exhibits convergence of both the short-run and medium-run OLC.

The parallel evolution of the short-run OLC in several country groups may reveal the existence of a common trend underlying the time path of the short-run multiplier effect of output gap movements on unemployment gaps in Europe. However, the time evolution of the medium-run version of the OLC seems to be primarily influenced by country-specific disturbances (such as disturbances on labor markets rigidities, technology adoption rates, or market structures) rather than by European-wide structural evolutions.

As considerable evidence is found for non-convergence of the medium-run OLC, a common shock on European output can be expected to result in diverging unemployment rate movements in European countries. Moreover, this non parallel response of unemployment rates may also make the resulting monetary policy response problematic and lends some weight to the contention that Europe is not an optimal zone.

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APPENDIX A.

Table A.1: Values retained for parameters σ_i and θ_i for Monte-Carlo simulation of finite–sample distribution of the Evans statistic $\tau(\hat{\rho})$

		ADL Model		VAR Model	
Groups k	N_k	σ_i	θ_i	σ_i	θ_i
ALL EC	17	0.0038	0.2010	0.0006	0.0782
Euro zone	12	0.0040	0.1585	0.0006	0.0822
High GDP	4	0.0051	0.1420	0.0002	0.0418
Interm. GDP	6	0.0019	0.1551	0.0004	0.0331
Low GDP	6	0.0022	0.2407	0.0006	0.1051
Septentrional	6	0.0027	0.2328	0.0006	0.0932
Occidental	6	0.0014	0.1457	0.0001	0.0449
Meridional	4	0.0056	0.1141	0.0006	0.0359
B-E core	6	0.0028	0.2400	0.0001	0.0602
B-E periphery	6	0.0045	0.1460	0.0013	0.1033

N_k : number of countries in each group

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