

Self-employment and Okun's Law relationship: the Spanish case

María Sylvina Porras^{*}
Universidad de la República, Uruguay

Ángel L. Martín-Román[†]
Universidad de Valladolid, Spain

Abstract

The present research provides evidence on the determinants driving the differences in the unemployment-output relationship in Spanish regions. We followed a two-step approach. First, we estimated a set of time-varying Okun's coefficients (*rolling-window*) for the autonomous communities in Spain (1981-2013) showing significant regional differences as well as important changes over time. At the second step, we estimated FMOLS and DOLS models to explain regional differences in Okun's law. The results obtained lead to the conclusion that differences in the weight of self-employment and its variations over time prove relevant when accounting for differences in Okun's law between Spanish regions, and its effect (in standard deviations) is greater than that of variations in labour productivity per worker, which so far had been considered the main driver of regional discrepancies. The economic policy implications of this outcome are huge due to the fact that Spanish regional and national authorities are promoting self-employment.

Keywords

Okun's Law, self-employment, unemployment, GDP, Spanish regions.

JEL Codes

C23, R11, R23, E24, J64

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^{*}*Instituto de Economía. Joaquín Requena 1375, CP 11200, Montevideo, Uruguay.*

sylvina@iecon.ccee.edu.uy

[†]*Facultad de CC. Sociales, Jurídicas y de la Comunicación., Plaza del Alto del León de Castilla, 1, 40005 Segovia, Spain. angellm@eco.uva.es*

1. Introduction

The considerable regional disparity in how unemployment reacts to economic growth (Okun's Law) reported amongst Spanish regions is an issue that has attracted the research interest of certain authors (Villaverde and Maza, 2007 and 2009). It is logical since the vastly differing unemployment rates amongst the various autonomous communities means that regional factors should be taken account of when devising economic policies aimed at solving the unemployment problem.¹

As a “rule of thumb”, Okun's law is a fundamental empirical relation for policy-making decisions and is a key tool in anticipating the consequences of some of these policies. As a result, gaining an insight into the determinants of such a relationship is a major goal of devising economic policy. In this vein, the main goal of the present research is to gain a deeper understanding of the determinants underlying the differences in Okun's coefficients in Spanish regions.

Prior literature has shown that, in Spain, the different growth rates in labour productivity amongst regions are an important factor explaining regional differences in Okun's law (Villaverde and Maza, 2009). In this article, we provide empirical evidence of another factor that is quantitatively more important than the former for explaining such differences: the weight of self-employment.

This is justified since in many instances self-employment is a “refuge employment”, showing countercyclical behaviour or weakly pro-cyclical. In the presence of a high level of self-employment, the destruction of salaried employment during economic downturns will have weaker effects on the aggregate unemployment rate. In addition, the effects on unemployment will be weak if workers leaving self-employment take up salaried jobs created during economic upturns. Such situations will lead to a weak unemployment-output relation.

In fact, since the Spanish government and, at a higher instance, the European Union itself are promoting initiatives to encourage self-employment, it becomes very important to know if such kind of work has a significant influence on Okun's law. In the case of Spain, a country with a high unemployment rate, laws have been passed to change the legislation governing self-employment: *“Encouraging self-employment, both individually and collectively, has been one of the main focuses of the policies implemented over the last few years in the area of employment.”* (Law 31/2015 of 9 September 2015).

The article is organised as follows. Section 2 provides the background to Okun's law and self-employment. The methodology used in the research is presented in section 3, and the data in section 4. Section 5 provides the empirical results, and the main conclusions are given in section 6.

¹ Autonomous communities are an administrative division of the Spanish territory at NUT 2 level. We will use the terms autonomous communities and regions interchangeably throughout the paper.

2. Background

2.1. Okun's law

The existence of an inverse and statistically significant relation between unemployment and output was established by Arthur Okun (1962) in a study conducted for the United States (1947:2 - 1960:4). He used three different specifications of the law and concluded that for each one percent of real GDP growth, the unemployment rate would fall by 0.3 percentage points (pp), once productivity gains and the labour force growth had been taken into account. Such finding had important implications since it provided an approximate measure of the cost in output terms of high levels of unemployment and, at the same time, offered a mechanism to evaluate policies in terms of their impact on unemployment. It is worth pointing out that Okun interpreted the relation in both directions, from output to unemployment and from unemployment to output. He even used the inverse of the estimated coefficient to indicate that for each pp the US unemployment rate rose above its natural level (estimated to be 4%), output moved away from its potential level by around 3%. This led to the use of the estimated coefficient in both directions (the obtained value and its inverse) in subsequent research, and also to the estimation of the Okun's law with GDP as the dependent variable.²

Based on Okun's pioneering work, the topic was embraced by economic policy debate and has been the subject of ongoing inquiry on the economic research agenda. Some scholars have focused on ascertaining to what extent it is valid for other countries or regions outside the USA, replicating some of the original versions of the law or questioning some of the aspects involved in the original versions or seeking to explain differences between countries, regions or to account for changes over time. The international economic crisis which began in late 2008, with devastating consequences in terms of job losses and a sharp rise in unemployment in certain countries, particularly Spain, sparked a fresh political and scholarly debate concerning the degree to which said law and its determining factors are valid, with the issue coming once more to the fore at an international scale (Daly et al, 2014, Ballet et al, 2013, Daly and Hobijni, 2010, amongst others).

Labour laws or labour institutions are often cited in the literature as determining factors to account for differences between countries or time variations of Okun's coefficient. This is because they may impose certain rigidity in the labour market and pose a greater obstacle to adjust employment and thereby influence the impact of output growth on unemployment (Blanchard, 1997, Sögner and Stiassny, 2002 and Balkrishnan, *et al.*, 2010).

At a regional level, research on Okun's law has only emerged quite recently, with the relation in most cases being estimated from unemployment to output, and

² Based on econometric foundations, Barreto and Howland (1993) criticise the use of the inverse of the slope of the regression of unemployment on output when making a prediction of output given an unemployment level. They maintain that the coefficient may only be interpreted regarding the specified model, and claim that the choice of direct versus inverse regression depends on the question the researcher is asking.

focusing on ascertaining to what degree the law applies in territorial units below the national scale. Only on rare occasions, an effort has been made to provide an explanation for the regional pinpointed differences.

The pioneering study is Freeman (2000), who explored Okun's relation in eight regions of the United States, finding support for it in all cases but without significant differences among regions. Nevertheless, in a recent study also for the United States, Guisinger *et al.* (2015) do find regional differences in Okun's law when it is estimated for the 50 states. They point out that the high level of regional aggregation used by Freeman (2000) is most likely the reason why regional differences disappear. On the other hand, in a study into eight regions in Greece, Apergis and Rezitis (2003) report that only in two regions were the estimated coefficients significantly different to those in the remaining regions, while Christopoulos (2004) verifies Okun's relation in six of thirteen Greek regions, reporting major differences among them. It should be also pointed out that the coefficients estimated by Christopoulos differ substantially from those of Apergis and Rezitis (2003), which might be due to the different methodological approach they adopt.

Adanu (2005) estimates Okun's coefficient for ten regions of Canada and finds that the greatest estimated cost of unemployment in terms of real GDP loss is mostly located in the larger and more industrialised regions. In a study using French data, Binet and Facchini (2013) obtain a significant Okun's relation for 14 of the 22 regions analysed. They find that a common factor in the regions where the law does not hold is a high percentage of public employment. Durech *et al.* (2014) study the law for 14 regions of the Czech Republic and eight regions of Slovakia, with the findings evidencing disparities: i) regions where the law was confirmed regardless of the estimation method, ii) those in which it was never confirmed or only weakly so, and iii) those which yielded mixed results. Based on these findings, they report that the law does not appear to be statistically significant in regions that evidence high long-term unemployment rates and low levels of economic growth. These regions are also characterised by their low levels of domestic and external investment.

Very few studies carry out a posterior econometric analysis so as to pinpoint which are the key explanatory variables to understand regional differences in Okun's coefficients. One such study is Herwartz and Niebuhr (2011). These authors delve into the differences in regional labour market responsiveness and their potential determinants for a cross-section of European regions (192 EU15, NUTS 2 level), following a two-step approach. After estimating region specific labour market responses to output growth in the first stage, they explain those regional responses making use of exogenous regional/national characteristics in the second stage. According to these authors, the variables which seem to display the greatest explanatory power are those related to national labour market laws or institutions and to structural change in employment between industries at a regional scale. In a study for the 50 states of United States, Guisinger *et al.* (2015) find that those indicators of more flexible labour markets (higher levels of educational achievement in the population, a lower rate of

unionization, and a higher share of non-manufacturing employment) drive most differences in Okun's coefficient across states. However, they show that Okun's relationship is not stable across specifications, which might lead to inaccurate estimates of the potential determinants of Okun's coefficient.

As regards studies analysing Okun's law in Spanish regions, Pérez *et al.* (2003) estimate the relation for Spain and Andalusia and find that cyclical unemployment is less sensitive to the output cycle in Andalusia than in the Spanish economy as a whole, suggesting the possible existence of differences in the said relationship among the various Spanish autonomous communities. Villaverde and Maza (2007 and 2009) estimate Okun's coefficient (from unemployment to output) for Spain and its 17 regions, finding that they are quite diverse. They point out that this is related to the different growth rates in labour productivity observed in the regions. In a more recent study, Melguizo (2015) finds significant differences in the relationship at the provincial level in Spain. This seems to suggest that taking into account a greater territorial division (50 provinces instead of 17 regions) also merits inquiry. Finally, the results obtained in Clar-López *et al.* (2014) offer additional elements concerning the relative importance of studying Okun's law at the regional level in Spain, since it finds that using this relationship enhances the forecasting ability of the econometric models so as to predict the unemployment rate in most regions.

2.2. Self-employment, business cycles and Okun's law

No evidence has been found connecting self-employment and Okun's law. Nevertheless, the inherent features of self-employment, and its different evolution compared to salaried employment suggest a link between them. This paper provides empirical support for an important association linking unemployment-output sensitiveness and the relative weight of self-employment within the total employment.

Self-employment embraces a wide range of heterogeneous workers, with diverse degrees of working conditions and economic self-sufficiency. These might be business people who run firms and employ other staff, business people with or without business premises and without paid employees, professionals, independent workers, workers who have a business contract but with a labour relationship which is similar to dependent work, or family employees who are not paid directly for their work.

Such a disparity means that the ups and downs of economic activity might spark vastly differing effects, both in sign and scale, on the various types of self-employed workers and that, in turn, such effects might differ substantially to those on salaried employment.³ If the predominant effect amongst self-employed is countercyclical or

³Román *et al.* (2011) report different behaviour among the self-employed among those they call dependent self-employed, in other words those who go from being dependent salaried workers to self-employed workers but who are hired by their former employees, and those who are truly independent workers.

weakly pro-cyclical compared to dependent work, the greater the weight of self-employment in the economy, the less intense the relation between unemployment and output.⁴

There is empirical evidence showing how self-employment and paid-employment evolve differently. Congregado et al (2012a) conclude that there is a positive relation between salaried work and the self-employed employing others in the EU-12 countries, at least in the long-term and to quite a generalised extent in the short term. On the other hand, they find that the relationship between self-employed without employees and salaried employment differs across countries. In addition, they also find that the relation between self-employment and salaried work is dominated by the self-employed without employees.

In Spain, the number of self-employed people working rose by 11.4% between 1980 and 2004, whereas the number of salaried workers grew by 66.8% over the same period. This was due to two opposite effects on self-employment. The number of self-employed without employees (the majority) fell by 11.4%, whereas those self-employed employing others rose by 132.2% (Millán, 2009). The prevalent profile of the self-employed worker in Spain was one without employees, male, over 40 years old, with intermediate academic qualifications, working in retailing, transport, or the hospitality sector (Rodríguez Folgar, 2006, González Morales, 2008 and Millán, 2009).

In many instances, self-employment acts as “refuge” employment. In other words, it is an alternative for salaried workers who lose their job during periods of economic recession. In Spain, Cuadrado et al. (2005) find that self-employment is (weakly) counter-cyclically related to GDP with a lag. Put differently, cyclical GDP movements are followed later and with the opposite sign in self-employment. Ariza-Montes *et al.* (2013) estimate that at least a subset of individuals who in 2007 chose to be wage-earners would have resorted to self-employment in 2011 when the economic crisis reached its peak. Certain findings in Millán et al (2012) seem to concur with the notion that self-employment plays the role of last resort for low-skilled unemployed workers.

For Congregado et al. (2010a), there are arguments to both support and refute the pro-cyclical nature of self-employment. On the side of the “supporting view”, we might find those factors related to business risk, which would justify the pro-cyclical nature of self-employed entrepreneurship. According to the authors, the counter-cyclical behaviour of self-employment is linked to the notion of “refuge” employment when unemployment is high and the availability of salaried work is low. In addition, an inertia effect could be operating for existing self-employed workers due partly to sunk costs and limited opportunities for alternative employment. Such authors analyse the case of Spain and the United States and reject the pro-cyclicity of self-employment as a

⁴Parker *et al.* (2012) find structural changes in the cyclical relation between unemployment, output and self-employment in the UK.

whole, although they do find evidence of this in the case of self-employed with employees in Spain. Similar results are found in Congregado et al. (2012b).

In a similar vein, we could mention the results obtained by Golpe and van Stel (2008) when studying the link between self-employment and unemployment in Spanish regions. They find the empirical support of what they call the “entrepreneurial” effect, meaning that having a greater number of business people (entrepreneurs) contributes to generating higher levels of competition which, in the long run, might lead to increases in productivity and less unemployment. They report mixed findings for the “refuge” effect of self-employment. In another study for 23 OECD countries (Thurik et al., 2008), the authors also report evidence to support the “entrepreneurial” and “refuge” effects, with the former seemingly greater than the latter. Congregado et al. (2010b) suggest that during upturns in Spain very few self-employed without employees succeed in finding high-quality salaried jobs, as a result of which the stock of self-employed workers might become too great during downturns, when, additionally, many new individuals try to start businesses according to the “refuge” effect.

If self-employment displays countercyclical or weakly procyclical behaviour and, simultaneously, is the occupation of a large part of the population, the destruction of salaried employment during recessions will be reflected more weakly in terms of increased unemployment. At the same time, the drop in unemployment will be to a lesser extent if some of the jobs created during upturns are occupied by workers who leave self-employment. Situations such as these will lead to a weak unemployment-output relationship.

3. Empirical methodology

We follow a two-step approach. In the first step, we estimate Okun’s coefficients for each Spanish autonomous community in order to confirm the law at the regional level and as an input for the second step. Then, we make use of these estimates as dependent variables in a subsequent econometric regression, testing the power of the weight of self-employment to explain regional differences in Okun’s law.

3.1. First step

Following Blanchard (1997), the first-difference model of Okun’s law is:

$$u_t - u_{t-1} = -\beta(g_{yt} - g_y^*) \quad (1)$$

where u_t is the unemployment rate, g_{yt} the output growth rate at time t and g_y^* its “normal” growth rate keeping constant the unemployment rate. This relation states that if the actual output growth is one percentage point higher (lower) than the “normal” growth rate, then the unemployment rate falls (increases) β percentage points. The

“normal” output growth rate would be determined by the labour supply and labour productivity “normal” growth rates. Since g_y^* is unknown, the following model is estimated:

$$\Delta u_t = \alpha + \beta g_{yt} + \varepsilon_t \quad (2)$$

where ε_t is the random error of the model and α is a constant equal to $-\beta g_y^*$ indicating the linear trend of the unemployment rate. As a result, g_y^* can be estimated based on the following expression: $g_y^* = -\alpha/\beta$. As we are working with the first difference in the unemployment rate and we measure the economic activity as a growth rate, both variables are expected to be stationary.⁵ The estimation can thus be carried out using Ordinary Least Squares (OLS).

In order to measure the variation of Okun's coefficient in the Spanish regions, we make use of the so-called *rolling regression* or *rolling window* technique. We estimate the Okun's law for each region over a “continuum” of sample periods (15-year windows). If the relationship were stable over time, then the estimated coefficients should be relatively similar from one regression to the next. The first rolling window estimates the coefficients by using the sample period from 1981 to 1995. The sample period is then moved forward one year, and the regression is re-estimated to produce a second set of estimated coefficients using data from 1982 to 1996. This process is repeated again and again until making use of the last window (i.e. data from 1995 to 2013). Thus, we obtain 19 observations of Okun's coefficient for the 17 Spanish regions ($\hat{\beta}_{it}$, with i indicating the region and t the moment in time).

3.2. Second step

The second stage consists of the estimation of explanatory models by applying the macro-panel or *long-panel* technique. The results obtained in the first step (Okun's coefficients) become the dependent variable in this second step. This kind of panel is characterised by having few individuals (small N) whose characteristics are observed in T periods, with $T > N$. In this case, N corresponds to the 17 autonomous communities in Spain and T to the 19 time-varying observations corresponding to the 15-year windows defined in the first step.⁶ The panel contains the dependent variable ($\hat{\beta}_{it}$) and the explanatory variables: weight of self-employed (SE), and labour productivity growth (lpg). The last variable was included as a control variable since prior literature has shown that it proves relevant for explaining differences in Okun's coefficient. As a result, the following model is estimated:

$$\hat{\beta}_{it} = z_i + \tau_1 SE_{it} + \tau_2 lpg_{it} + \varepsilon_{it} \quad (3)$$

⁵ Anyhow this assumption will be tested later on.

⁶ This gives a total of 329 observations (17*19), which allows for more robust estimations.

where z_i captures unobserved heterogeneity amongst individuals and ϵ_{it} is the random disturbance term. The coefficient of interest in this model is τ_1 , which would reflect how much the weight of self-employment explains Okun's coefficient regional differences and its variations over time. A significant and negative τ_1 coefficient is expected, which would support the hypothesis that the greater the weight of self-employment in the total number of workers, the lesser the effect of output changes on unemployment.

When estimating long-panel data, it should be borne in mind that this type of panel contains time series. As a result, this type of modelling involves similar problems to those of time series modelling (i.e. non-stationarity, autocorrelation and spurious relations, etc.). The steps to be taken are thus: 1) testing for unit root, 2) testing for cointegration and 3) estimating the model according to the results obtained in the previous steps.

3.2.1. Panel unit root test

In order to investigate the possibility of panel cointegration, we need to verify that all variables are integrated into the same order. With this aim, we have chosen the panel unit root tests proposed by Im *et al.* (2003)-IPS-, Levin *et al.* (2002)-LL-, Breitung (2000)-B-, Maddala and Wu (1999) -Fisher-ADF- and Choi (2001) -Fisher-PP-.

The main advantage of these tests is that their power is significantly greater compared to the standard time-series unit root tests because they combine cross-section and time series data increasing in this way the number of degrees of freedom. On the other hand, they allow unobserved heterogeneity to be taken into account. The tests assume an AR(1) process in the variables, and the existence of a unit root based on an ADF type model is shown:

$$\Delta y_{it} = \theta_i y_{it-1} + \sum_{j=1}^{p_i} \phi_{ij} \Delta y_{it-j} + z'_{it} \varphi_i + \epsilon_{it} \quad (4)$$

with z'_{it} being the cross-sectional deterministic component, $\theta_i = \gamma_i - 1$, with γ_i being the autoregressive coefficient of y_{it} , and ϵ_{it} the model residuals well-behaved. If $|\gamma_i| = 1$ (i.e. $\theta_i = 0$), y_{it} would have a unit root, and if $|\gamma_i| < 1$ it would be weakly stationary ($\theta_i \neq 0$). Some tests assume a common autoregressive process amongst individuals ($\gamma_i = \gamma$ or $\theta_i = \theta$), (LL and B). In other words, the null hypothesis is that the series have a unit root, whereas the alternative hypothesis is that all series are stationary. Others tests allow the parameter to differ (IPS, Fisher-ADF and Fisher-PP) and the alternative hypothesis is that at least one of the individual series in the panel is stationary.

The procedure used by LL and B involves estimating θ by means of proxy variables for Δy_{it} and y_{it-1} . The difference between one another is how they define these two variables. Under the null hypothesis, the t_θ statistic is asymptotically normally distributed. Regarding IPS, Fisher-ADF and Fisher-PP, they estimate (4) for each

individual, allowing p_i to be different in each case. The IPS test is based on the average of individual ADF unit root test statistics, whose distribution is asymptotically normal under the null hypothesis. On the other hand, Fisher's tests are based on combining the observed significant levels from the individual tests (p-values). More specifically, in the case of Fisher-ADF, the statistic is chi-squared distributed (with $2N$ degrees of freedom). As for the case of Fisher-PP, the statistic is standard normally distributed.

If the variables have a unit root $-I(1)-$, in other words, they are not stationary at levels and but are stationary in the first differences, it must be determined whether there is a cointegration relation amongst them (long-term relation), since this affects the procedure for estimating the relation. If the null hypothesis of no cointegration is rejected, the method for estimating the model will consist of finding a stationary relation. If they are not, the series in first differences will have to be used and a VAR type model should be estimated.

3.2.2. Panel cointegration test

Cointegration tests for panel data display the same advantages as already mentioned for panel unit root tests. We applied Kao (1999) and Pedroni (1995, 1999, 2004) cointegration tests methodology, based on Engle-Granger's two-step cointegration test. The null hypothesis in all instances is that variables are non-cointegrated. Pedroni's proposal is less restrictive than Kao's since it allows for considerable heterogeneity. First, the following relation between variables y and x is estimated (in this case with x : x_1 and x_2), which are assumed to be $I(1)$:

$$y_{it} = \alpha_i + \delta_i t + \tau_{1i} x_{1it} + \tau_{2i} x_{2it} + e_{it} \quad (5)$$

The parameters α_i and δ_i allow for the possibility of individual-specific fixed effects and deterministic trends, respectively. Under the null of no cointegration the residual e_{it} will also be $I(1)$ and the following model is estimated to check the existence of unit root:

$$\hat{e}_{it} = \rho_i \hat{e}_{it-1} + \sum_{j=1}^p \vartheta_{ij} \Delta \hat{e}_{it-1} + v_{it} \quad (6)$$

Pedroni proposes parametric and non-parametric statistics to test that hypothesis, which takes into account various dynamics to correct problems of autocorrelation. In addition, the tests are classified into two groups: 1) based on pooling the residuals along the within-dimension of the panel, 2) based on pooling the residuals along the between-dimension of the panel. The former has the null hypotheses for cointegrated tests H_0 : $\rho_i=1$ and the alternative H_a : $(\rho_i \neq \rho) < 1$ (homogeneity). The latter allows for the existence of heterogeneity since H_a : $\rho_i < 1$. Seven statistics were generated and the decision criterion to reject the null of non-cointegration was that at least half of the statistics rejected such a hypothesis.

Kao's estimation procedure is similar to Pedroni's. In other words, an equation such as (5) is estimated and the existence of the unit root in the residuals is analysed.

Kao's test assumes $\delta_i = 0$ and homogeneity in the long-run relation ($\tau_{1i} = \tau_1$ and $\tau_{2i} = \tau_2$), although it allows heterogeneity in the constant term (α_i). The cointegration test is based on DF and ADF-type unit root tests for e_{it} .

3.2.3. Estimating a cointegrated regression in panel data

There are estimation biases when applying OLS to a cointegrated panel in the presence of endogeneity of variables. This makes it difficult to draw inferences since the t-statistics do not follow a t-Student distribution (Kao, 1999). To solve these problems, two estimators are proposed: FMOLS (fully modified OLS) and DOLS (dynamic OLS). The basic idea behind both FMOLS and DOLS estimators is to correct for endogeneity bias and serial correlation and thereby allow for standard normal inference.

Consider the following model:

$$y_{it} = X'_{it}\pi + \gamma_i + v_{1it} \quad (7)$$

$$\Delta X_{it} = v_{2it}$$

The cointegrating relationship between y and X is assumed to be homogeneous across cross-sections and allows for cross-section specific deterministic effects. π is a $k \times 1$ vector of the slopes, X_{it} is a $k \times 1$ vector of the integrated regressors, γ_i is the individual fixed effect and $\omega_{it} = (v_{1it}, v_{2it})'$ are the errors in the cross-section. Ω_i are the errors long-run covariance matrix, $\Sigma_i = E(\omega_{it}\omega_{it}')$ is the contemporaneous covariance matrix and $\Gamma_i = \sum_{j=0}^{\infty} E(\omega_{it}\omega_{it-j}')$ is the one-sided long-run covariance matrix, with $\Omega_i = \sum_{j=-\infty}^{\infty} E(\omega_{it}\omega_{it-j}')$.

In order to solve the above-mentioned problems, FMOLS estimates long-run covariance matrix for the model (7) and uses this to correct for endogeneity bias and serial correlation problems, thus allowing doing the standard normal inference when vector π is estimated. The DOLS method employs a parametric correction for the endogeneity achieved by augmenting (7) with lags and leads of the X_{it} as additional regressors. This correction gives a solution to the endogeneity problem in the regressors, correcting at the same time the correlation between v_{1it} and v_{2it} .

4. Data

To estimate Okun's law in Spanish regions, we used annual data from *Instituto Nacional de Estadística* -INE – (National Statistics Institute) database. Information on unemployment rate was taken from the Economically Active Population Survey (EPA) and on regional GDP from the Spanish Regional Accounts for the period 1980-2013.

The Spanish unemployment rate at the regional level has changed a lot during the analysed period. In 1980, the national unemployment rate was 11.4% and evidenced

substantial differences amongst the regions, ranging from 4.9% in Galicia to 17.1% in Andalucía (Table 1). By the mid-1990s, unemployment in Spain had climbed to 24%: Andalucía once again being the region with the highest rate (32.2%) and Navarra at the opposite end of the scale (13.4%). This was followed by a period lasting almost 13 years during which unemployment fell in all regions in Spain. With the exception of Extremadura (13%), Andalucía (12.8%) and the Canarias (10.5%), the unemployment rate fell into single digit figures in the other autonomous communities and stood at 8.3% for the country as a whole. Then, the international financial crisis that started in 2008 and which seriously affected Spain sparked a dramatic rise in unemployment in the following years and led to unemployment rates in 2013 that more than tripled the 2007 rates in most regions.

The regional economic growth rates did not have shown significant cross-sectional differences during the analysed period, particularly after the second half of the 1990s. In the 1980s and the first half of the 1990s, the regional dispersion was greater than in the subsequent years, despite average growth for the whole period did not differ significantly amongst regions (between 2% and 2.9% in most cases). In following years, regional differences in growth rates fell, reaching a minimum between 2004 and 2008.

For the second stage explanatory model, *rolling-windows* estimations from the first stage of Okun's coefficients were used as well as information on the relative weight of self-employment from the INE (*SE*) and regional labour productivity growth (*lpg*). The last variable was constructed using data on the number of workers and regional GDP.

In line with the INE classification, self-employed workers include: business people with employees ("employers"), people who work on their own ("own-account workers"), member of a cooperative, and family help. In the current research, self-employed workers are deemed to be business people both with and without other salaried employees, who account for some 92% of all the self-employed in Spain. At regional level, the information available from the INE was used for the period 2001-2013. In previous years, the information used was that presented in the appendix charts of the document: "Structure and dynamics of self-employment", Carlos III University of Madrid, Employment Outlook (*Panorama Laboral*) 2008, whose source is also the EPA.⁷

Differences amongst Spanish regions in the weight of self-employment have fallen over the years at the same time as the proportion has tended to decline in almost all the regions in Spain. In 1980, 34% of the population working in Galicia were self-employed, whereas in Madrid the figure was only 11%. Up until the early 90s, regional differences remained unchanged with only minor variations in just a few cases. It was after the second half of the 90s that the weight of self-employment clearly started to drop, with the exception of Madrid. Regional differences also diminished during what

7. The data for the period 2001-2007 are the same as those available in the INE for Spanish regions, and for the full period for Spain.

was a period of high economic and more evenly spread growth rates amongst the regions. The years of the economic crisis after 2008 led to a slight increase in self-employment in most Spanish regions.

As regards labour productivity, three markedly different periods also emerge: one period with positive growth rates (1980-1994) but with a greater dispersion amongst regions, followed by a downturn in productivity or little growth in many autonomous communities (1994-2007) tending towards a reduction in regional differences, and finally the period spanning the economic crisis in which positive productivity growth rate was recorded in all regions in Spain.

Table 1 - Regional statistics (%)

	Unemployment rate				GDP growth			Weight of self-employed				Labour productivity growth		
	1980	1994	2007	2013	1980-	1994-	2007-	1980	1994	2007	2013	1980-	1994-	2007-
					1980-	1994-	2007-					1980-	1994-	2007-
Andalucía	17.1	32.2	12.8	36.2	2.6	3.9	-1.7	21.8	20.8	16.0	18.0	2.4	-0.9	2.6
Aragón	8.3	15.4	5.3	21.4	2.6	3.7	-1.3	26.2	23.6	17.0	16.9	2.3	0.5	2.5
Asturias	8.1	18.0	8.4	24.1	2.1	2.6	-2.2	22.9	23.2	18.3	20.4	2.6	0.3	1.7
Baleares	7.9	16.8	7.2	22.3	4.1	3.2	-1.0	22.0	23.4	17.2	19.5	2.5	-1.7	0.6
Canarias	12.1	24.3	10.5	33.7	2.7	3.5	-1.2	19.3	16.7	12.7	14.4	1.2	-1.6	2.6
Cantabria	7.3	20.9	6.0	20.4	2.0	3.0	-2.1	25.1	24.7	17.8	17.1	2.9	-0.8	1.7
Castilla y León	8.3	19.2	7.1	21.7	2.1	2.6	-1.5	29.8	27.9	20.0	21.7	2.8	0.3	2.2
Castilla La Mancha	10.3	16.9	7.7	30.0	2.4	4.0	-1.3	29.0	26.7	17.9	19.7	2.4	-0.1	2.3
Cataluña	12.2	20.9	6.5	23.1	2.5	3.6	-1.5	17.7	17.7	15.4	16.1	2.1	-0.3	2.3
Com. Valenciana	9.6	23.1	8.7	28.1	2.3	3.9	-2.0	19.0	21.7	16.4	18.1	1.8	-0.7	2.5
Extremadura	14.4	26.1	13.0	33.9	3.3	3.4	-1.0	30.8	24.8	18.5	19.2	3.8	-0.2	2.4
Galicia	4.9	18.1	7.6	22.0	1.5	3.1	-1.3	34.3	32.9	20.8	21.9	3.1	1.1	2.5
Madrid	12.1	17.3	6.2	19.8	2.9	4.4	-0.5	11.3	11.1	12.6	12.6	1.9	-0.2	1.9
Murcia	9.7	24.2	7.5	29.0	2.1	4.3	-1.3	20.1	20.8	15.7	16.7	1.9	-0.4	2.5
Navarra	11.7	13.4	4.7	17.9	2.1	3.8	-1.0	21.1	21.5	17.4	16.8	1.6	0.3	2.1
País Vasco	12.2	23.0	6.2	16.6	1.1	3.4	-1.2	13.5	18.7	16.3	15.6	1.7	0.2	1.7
Rioja	5.0	14.1	5.8	20.0	3.5	3.6	-1.7	29.8	27.3	19.6	19.7	3.0	-0.6	2.2

Note: Growth variables are average annual growth.

Given that the sequential estimations of Okun's coefficient reflect the information of 15-year periods, the *SE* and *lpg* variables used in the explanatory model also reflect the information for the same period. In other words, the values of the series of each year of the *SE* variable correspond to the average weight of self-employment in the same 15-year period, and in the case of *lpg*, correspond to the annualized growth rate (average growth rate measured over a year) for the same period.

5. Empirical results

Unit root tests were performed on variables Δu_t and g_{yt} in order to test their stationarity. In all cases, the null hypothesis of a unit root for Δu_t series was rejected at a significance level of 0.05. When ADF test was not conclusive on g_{yt} series, KPSS test was applied, no rejecting the null hypothesis of stationarity at the same significance level (Table A1 of the Statistics Annex).

Table 2
Estimates of Okun's Coefficient for Annual Data for Spanish Regions
from 1981 to 2013 : $\Delta u_t = \alpha + \beta g_{yt} + \varepsilon_t$

	β_i	$g_y^* = -\alpha/\beta$	R^2
AND - Andalucía	-0.770 ***	2.98	0.708
AR - Aragón	-0.586 ***	3.00	0.565
AST - Asturias	-0.456 ***	3.09	0.524
BAL - Baleares	-0.577 ***	3.67	0.392
CAN - Canarias	-0.775 ***	2.91	0.762
CANT - Cantabria	-0.539 ***	2.37	0.476
CyL - Castilla y León	-0.358 ***	3.04	0.262
CLM - Castilla La Mancha	-0.372 ***	3.41	0.593
CAT - Cataluña	-0.910 ***	2.63	0.764
VAL - Comunidad Valenciana	-0.785 ***	2.94	0.707
EX - Extremadura	-0.466 ***	2.19	0.790
GAL - Galicia	-0.521 ***	2.67	0.404
MAD - Madrid	-0.612 ***	3.17	0.671
MUR - Murcia	-0.677 ***	3.03	0.687
NAV - Navarra	-0.388 ***	2.83	0.487
PV - País Vasco	-0.618 ***	1.94	0.660
RIO - La Rioja	-0.179 *	4.61	0.089

Note: *, ** and *** are significant level: 0.10; 0.05 and 0.01 respectively.

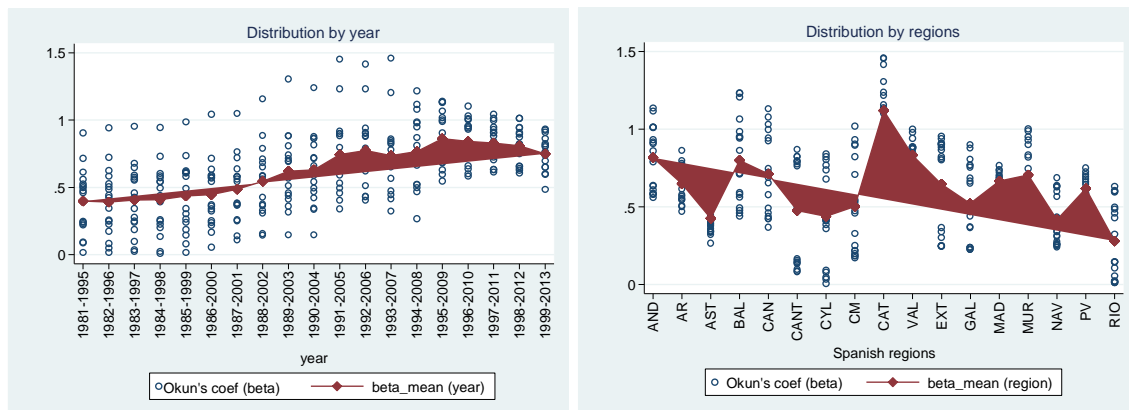
5.1. Regional Okun coefficients

Table 2 shows the results of estimating regional Okun's coefficients for the period 1981-2013. As can be seen, there are significant differences between regions, ranging from a value of -0.18 in La Rioja to -0.91 in Cataluña.

The *rolling-windows* estimations of Okun's coefficient also reflect its differences amongst regions in addition to their evolution over time (Figure 1). In the

left-hand graph, the points corresponding to a particular period represent the estimations of Okun's coefficient for the 17 autonomous communities for that period. First, a greater dispersion of the coefficients in the early years can be seen, ranging from an absolute value nearly 0 to 1. In other words, unemployment response to GDP growth was very slight or virtually non-existent in certain regions (Castilla y León and La Rioja), whereas in at least one region (Cataluña) the reaction was almost 1 percentage point (pp). This dispersion fell steadily over the years as more updated information was gradually incorporated and older data removed. This graph also shows a general upward trend of the coefficient in absolute value in the middle of the period, indicating a greater response of unemployment to output growth in most Spanish regions, and a certain stability in recent years.

Figure 1
Rolling regressions estimates of Okun's coefficient. Spanish regions
(1981-1995 to 1999-2013) (absolute value)

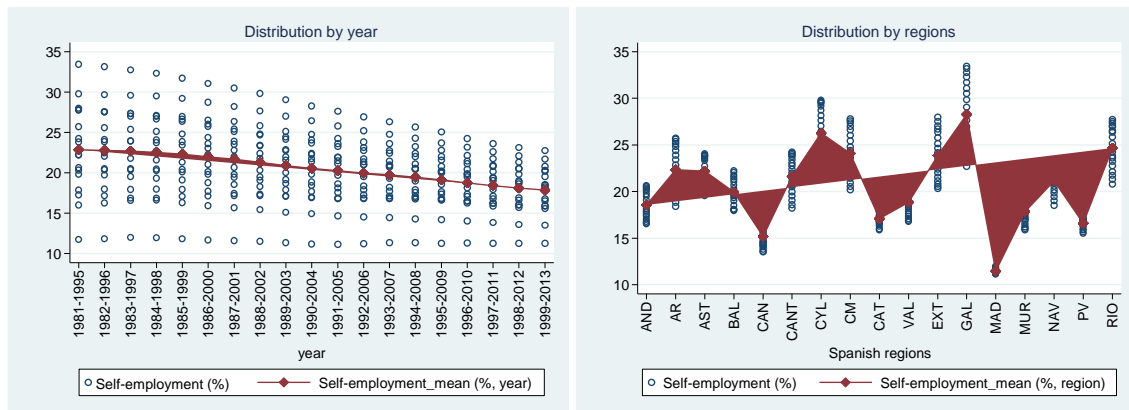


The graph on the right of Figure 1 shows the data distributed by regions, such that the points of the graph corresponding to one autonomous community are the *rolling-windows* estimations of Okun's coefficient for that region for each period from 1981-1995 to 1999-2013. If the points are widely dispersed in one region on the graph, means that Okun's coefficient experienced significant changes over the analysed period. It is the case of Castilla La Mancha (CM) and Castilla y León (CYL). In other regions, the points are more concentrated, indicating a greater stability in the unemployment-output relationship (Madrid –MAD- and País Vasco -PV-). Furthermore, the graph also reflects regional differences in Okun's relation. The strong reaction of unemployment to output growth in Cataluña (CAT) contrasts with the slighter reaction in Navarra (NAV).

5.2. How much does self-employment explain Okun's law?

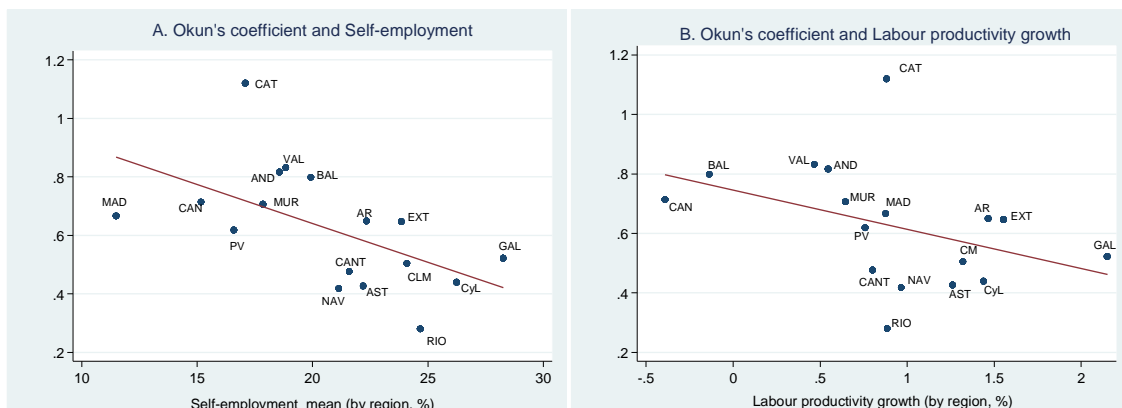
Figure 2 shows the information on the weight of self-employment on total employed, as in the previous figure, in terms of distribution by year or region.

Figure 2
Self-employment. Spanish regions
(Variables in means, % of total employed, 1981-1995 to 1999-2013)



In the figure on the left, we see that regional disparities of the weight of self-employment fell. The mean of the period 1981-1995 was around 11% in Madrid to 34% in Galicia, whereas in 1999-2013 the values were from 11% to 23%. The graph also shows a downward trend in the weight of this type of work in most regions. In the graph on the right, the more dispersed the data points by region, the more change in the weight of self-employment during the analysis period. In Madrid, País Vasco and Cataluña the points are more concentrated, evidencing greater stability. On the opposite side is Galicia.

Figure 3
Okun's coefficient, Self-employment and Labour productivity growth
(variables in means, from 1981-1995 to 1999-2013)



A simple exploratory analysis shows a possible correlation between Okun's coefficient and self-employment (Figure 3.A). Regions with the greatest weight of self-employment have at the same time weaker unemployment-output relationship, which is the hypothesis being tested.

We also included in the model the growth in labour productivity per worker (*lpg*) since, as already pointed out by other authors (Villaverde and Maza, 2009) and as can also be seen in Figure 3.B., it seems to exist a negative correlation between these variables, so that it might lead to biases omitting it.

Table 3
Estimation Results.
(dependent variable: Okun's coefficient)

	FMOLS	DOLS
Pooled estimation		
<i>SE</i>	-0.05 ***	-0.04 ***
<i>lpg</i>	-0.12 ***	-0.17 ***
R ²	0.84	0.94
Weighted estimation		
<i>SE</i>	-0.05 ***	-0.05 ***
<i>lpg</i>	-0.16 ***	-0.12 ***
R ²	0.83	0.94

Notes: Weighted estimation gives estimators for heterogeneous cointegrated panels where the long-run variances differ across cross-sections. *, ** and *** coefficient significant at the 0.01; 0.05 and 0.10 level. SE: Self-employment, *lpg*: labour productivity growth.

As indicated in the methodological section, the estimation procedure first involves testing the stationarity of the panel series and then checking for a cointegration link between the variables. Table A2 of the Annex shows results of unit root tests for panel data applied to the variables: β (Okun's coefficient), *SE* (self-employment) and *lpg* (growth in labour productivity per worker) at levels and first differences. For the three variables, the results of the tests mostly point to non-rejection of the null hypothesis of a unit root for the series in levels and rejection for the series in first differences.

After not rejecting that series are I(1), cointegration tests for panel data were then applied. As we can see in Table A3, more than 50% of Pedroni's test statistics indicate rejection of non-cointegration. Kao's test goes in the same direction; allowing to estimate the long-run relation applying FMOLS and DOLS.

Table 3 shows the results of the estimations. Regardless estimation method, both variables proved significant in all cases for explaining differences in Okun's coefficient amongst regions and its changes over time and the coefficients took the expected sign.

As can be seen, the estimated coefficient of the *SE* variable is approximately -0.05, which indicates that for each additional percentage point (pp) of the weight of self-employment, Okun's coefficient falls by 0.05 pp. This means, for example, that if Okun's coefficient were 0.8 in absolute value in a region at a given moment in time, it is to be expected (*ceteris paribus*) that if the percentage of self-employment increases by 1pp, unemployment reaction to output would change to 0.75 pp.

Put differently, if self-employment were the only explanatory variable, regions with the same percentage of self-employment would have the same reaction of unemployment to output. For instance, if Andalucía had had the same weight of self-employment as Asturias in 1999-2013 (approximately 18.5%), Okun's coefficient would be around 0.7 pp in both regions, which was the estimation for Asturias for that period. Nevertheless, as Andalucía had fewer self-employed workers (16.5%) in that period, a greater reaction to output of the unemployment rate should be expected, somewhere around 0.8 pp (the estimation for Andalucía was 0.82).

As expected, the labour productivity growth is also a significant variable to explain regional differences in Okun's law. The estimated coefficient varies between -0.12 and -0.17. In other words, taking the mean value of the estimations (-0.14), if the difference in growth in labour productivity per worker between two regions were 1pp (*ceteris paribus*) the difference in the unemployment reaction to output between said regions is expected to be 0.14pp. That region showing a greater Okun's coefficient would display the lowest growth in productivity.

The results obtained reflect a great capacity of *SE* variable to explain the evolution of Okun's coefficients and its regional differences. This can be seen by calculating the standardized coefficients of the equation, which provides information on the explanatory power of each regressor:

$$\tau'_{SE} = \tau_{SE} \left(\frac{S_{SE}}{S_{\beta}} \right) \quad \tau'_{lpg} = \tau_{lpg} \left(\frac{S_{lpg}}{S_{\beta}} \right)$$

τ' and τ are the standardized and non-standardized coefficients of *SE* and *lpg* variables, and S the standard deviation of the variables. The advantage of using standardized coefficients is the possibility to analyse and compare the explanatory power of each regressor in the equation since the coefficients are directly comparable. This is impossible through the direct coefficients of the regression given that they depend on each variable's measurement unit. Standardized coefficients convert all the variables into standard deviation units. We interpret the effects as the number of standard deviation units dependent variable changes with an increase in one standard deviation in explanatory variable.

In Table 4, we can see that the variable *SE* explains to a greater extent than *lpg* the differences in Okun's coefficient. In other words, the expected effect on Okun's coefficients (in standard deviations) of changes on the percentage of self-employment is 0.302 standard deviations more (0.792-0.490) than the expected by the labour productivity growth rate changes.

Table 4
Standardized coefficient

	Coefficient	Standard deviation	Standardized coefficient
Okun's coefficient		0.29	
<i>SE</i>	0.05	4.56	0.792
<i>lpg</i>	0.14	1.01	0.490

6. Conclusions

The present research seeks to gain a greater understanding of the determinants of differences in Okun's coefficients in Spanish regions, Okun's law being an important empirical variable for economic policy.

First, Okun's coefficients were estimated for each region confirming significant regional differences. Values ranged between -0.18 in La Rioja and -0.91 in Cataluña for the whole period. Based on *rolling windows* estimations we can see a lower dispersion of Okun's coefficients between regions over the last few periods and an Okun's relation which has varied significantly over time in certain regions (Castilla La Mancha and Castilla y León) whilst in others, it displayed greater stability (Madrid and País Vasco).

At a second stage, explanatory models of Okun's regional coefficients were estimated using the macro-panel or *long-panel* approach. FMOLS and DOLS models were estimated in an effort to test the explanatory power of self-employment of these differences. In line with previous literature, the growth in labour productivity per worker was also included as an explanatory variable. Both variables proved significant in all estimated models.

The results obtained point to a negative relationship between the weight of self-employment and Okun's coefficients (in absolute value). Then, two regions with a difference of 1pp in the percentage of self-employment should be expected (*ceteris paribus*) to have Okun's coefficients that differ by approximately 0.05 pp. If the difference in the growth in labour productivity per worker between two regions were

1pp, (*ceteris paribus*) the difference in the unemployment reaction to output between said regions would be expected to be about 0.14pp.

Finally, estimating the standardized regression coefficients allows us to conclude that the expected effect on Okun's coefficients (in standard deviations) of changes in self-employment weight is greater than the expected change due to the effect of changes in labour productivity growth.

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Annex

Table A1
Unit Root Test

	Unemployment rate		GDP growth (g_{yt})		
	First difference (Δu_t)		ADF		KPSS test
	Statistic	p-value	Statistic	p-value	LM-stat
Andalucía - AND	-2.7210	0.0084	-3.1010	0.0376	
Aragón - AR	-3.1464	0.0028	-2.9316	0.0544	0.1313
Asturias - AST	-4.1701	0.0002	-4.2846	0.0022	
Baleares - BAL	-3.2248	0.0022	-3.2444	0.0274	
Canarias - CAN	-2.9803	0.0043	-3.2200	0.0290	
Cantabria - CANT	-3.5837	0.0008	-3.3539	0.0214	
Castilla y León - CyL	-3.3340	0.0017	-2.8822	0.0602	0.0891
Castilla La Mancha - CLM	-3.4022	0.0014	-3.5659	0.0131	
Cataluña - CAT	-2.8891	0.0054	-2.5786	0.1088	0.1353
Comunidad Valenciana - VAL	-3.2714	0.0020	-2.7498	0.0781	0.1358
Extremadura - EX	-4.7338	0.0000	-4.3704	0.0018	
Galicia - GAL	-2.8953	0.0053	-3.7942	0.0076	
Madrid - MAD	-2.7405	0.0079	-2.7240	0.0822	0.1205
Murcia - MUR	-2.8909	0.0054	-3.0836	0.0390	
Navarra - NAV	-3.0189	0.0039	-3.8916	0.0060	
País Vasco - PV	-3.3469	0.0016	-2.9411	0.0529	0.1556
La Rioja - RIO	-3.7098	0.0006	-4.9099	0.0004	

Notes: The ADF tests on unemployment rates were without constant or trend and only with constant on GDP growth. The null (unit root) of ADF tests is rejected if the p-value is below 0,05. The null (serie is stationary) of KPSS tests is not rejected if the stastic is below 0,463 (5%).

Table A2
Panel Unit Root Tests (lag length: 1)

Method	Okun's coefficient (β)		Self-employment (SE)		Labour productivity growth (lpg)		Exogenous variables	
	level	first diff.	level	first diff.	level	first diff.		
	Null: Unit root (assumes common unit root process) Alternative: all series are stationary							
Levin, Lin & Chu t*	-1.838 **	-5.816 ***	-1.531 *	-5.138 ***	-5.080 ***	-3.435 ***	Individual effects	
	Null: Unit root (assumes individual unit root process) Alternative: some series are stationary							
Im, Pesaran and Shin W-stat	1.041	-6.522 ***	4.890	-5.313 ***	-1.771 **	-3.192 ***		
ADF - Fisher Chi-square	18.706	106.219 ***	22.338	83.250 ***	43.533	83.250 ***		
PP - Fisher Chi-square	22.816	418.438 ***	8.691	66.580 ***	47.340	105.400 ***		
	Null: Unit root (assumes common unit root process) Alternative: all series are stationary							
Levin, Lin & Chu t*	1.512	-5.071 ***	-3.033 *	-4.377 ***	3.149	-5.749 ***	Individual effects and individual linear trends	
Breitung t-stat	0.550	-4.433 ***	4.035	0.190	5.081	-2.995 ***		
	Null: Unit root (assumes individual unit root process) Alternative: some series are stationary							
Im, Pesaran and Shin W-stat	0.976	-4.075 ***	-3.108 ***	-3.250 ***	5.528	-4.527 ***		
ADF - Fisher Chi-square	26.509	72.525 ***	66.845 ***	55.733 **	4.815	55.733 **		
PP - Fisher Chi-square	35.671	168.552 ***	49.416 **	49.148 **	2.568	136.431 ***		

Notes: Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality. Total number of observations (NT) ranged between 275 and 306. Estimations undertaken with Eviews 8.0. *, ** and *** indicates the rejection of the null of unit root at 10%, 5% and 1%.

Table A3
Residual Cointegration Test. H_0 : no cointegration

Pedroni

H_1 : common AR coefs. (within-dimension)

	Statistic	Weighted Statistic
Panel v-Statistic	0.3062	-0.6650
Panel rho-Statistic	-0.3640	-0.9380
Panel PP-Statistic	-1.9657 **	-3.4001 ***
Panel ADF-Statistic	-3.1047 ***	-4.4348 ***

H_1 : individual AR coefs. (between-dimension)

	Statistic
Group rho-Statistic	0.7692
Group PP-Statistic	-2.8314 ***
Group ADF-Statistic	-4.5930 ***

Kao

	t-Statistic
ADF	-2.8129 ***

Notes: The tests assume "no deterministic trend", but results do not change if assumption is "deterministic intercept and trend". ***, ** and * indicates the rejection of the null of no cointegration at 10%, 5% and 1%.