International Review of Entrepreneurship 8(4): 303-336.

Co-Movement and Causality Between Self-Employment, Unemployment and the Business Cycle in the EU-12

Mónica Carmona, Emilio Congregado and Antonio A. Golpe
University of Huelva

Abstract. The current crisis has generated a renewed interest in the business cycle. In particular, the search of alternative solutions to the traditional ones has lead to a re-examination of the role of certain key economic variables in the business cycle: this search has put the relationship between entrepreneurship and business cycle into the centre of attention, turning it in a highly hot policy issue at the time of writing. However, this relationship has been a traditional source of controversy in the Economics of Entrepreneurship since there is mixed evidence about how aggregate self-employment rates vary over the cycle. The lack of homogeneous long term time-series data for most countries, until recent years allow now to reconsider empirically this relationship. Like other recent works (Farias et al. 2009 or Koellinger and Thurik, 2009), this work treats to fill at least partially this gap adding new evidence about this relationship. To carry out this task, this paper examines the co-movement and causality between self-employment and business cycle in the EU-12 countries using annual data spanning the years 1983 to 2008, evaluating the robustness of this relationship. In addition, it is a common practice in previous empirical research to consider self-employment as a homogeneous group. However, we will argue that there are several reasons for supposing that the relationship between the business cycle and self-employment can be different for entrepreneurs who hire external labor –employers- and for those ones who work on their own –own-account workers-. Our empirical estimates below will shed light on these conjectures. Three key findings emerge: i) the relation between self-employment and the business cycle differs across the two components of self-employment, i.e. employers and own-account workers; ii) the relation between self-employment and the business cycle is dominated by the own-account workers development over the cycle; and iii) the relation between self-employment (own-account workers) and the business cycle differs across countries.

Keywords: business cycle, entrepreneurship, self-employment, time series, co-movement, causality, employers, own-account workers.

1. Introduction

The current crisis has generated a renewed interest in the business cycle. In particular, the search of alternative solutions to the traditional ones has lead to a re-examination of the role of certain key economic variables in the business cycle: this search has put the relationship between entrepreneurship and business cycle into the centre of attention, turning it in a highly 'hot' policy issue at the time of writing.

The correlation between macroeconomic variables (such us employment/ unemployment and GDP) and self-employment has been a traditional source of controversy among economists. This controversy is not only caused by the existence of opposite theoretical arguments, but also by a weak and mixed empirical evidence about these relationships. The fact remains that the knowledge about these relationships is in nowadays one of the most important gap in the Economics of Self-employment[1]. From a theoretical perspective, this controversy can be summarized reviewing the basic arguments which are present in the recession-push and prosperity-pull theories. As it is well-known, the 'recession-push' theory supports the idea that unemployment reduces the opportunities of gaining paid-employment and the expected gains from job search, which "pushes" people into self-employment. Therefore, this theory suggests the existence of a positive relationship between self-employment and unemployment, that is, an opposite relation between the business cycle and the self-employment rate. Opposite to the previous one, the 'prosperity-pull' hypothesis considers that at times of high unemployment firms face a lower market demand. This reduces self-employment incomes pulling out of self-employment those marginal entrepreneurs who cannot resist these new economic conditions. As a result, a negative relationship between self-employment and unemployment is predicted, that is a pro-cyclical pattern over the cycle.

Empirical evidence should be the natural way to solve a controversy of this nature. However, the relatively scarce empirical literature has not provided unambiguous results. In this sense, most microeconometric studies[2] appear to support a "prosperity-pull" hypothesis, whereas macroeconometric analyses[3] usually generate ambiguous results or weak evidence in favor of the "recession-push" hypothesis.[4]

1. As Parker point out there is mixed evidence about how aggregate self-employment vary over the business cycle (Parker, 2004, p.98).
2. See Hamilton (1989), Blanchflower and Oswald (1998), Taylor (1996), and Clark and Drinkwater (1998, 2000) for the UK; Van Praag and Van Ophem (1995), and Bruce (2000) for the US; Lindh and Ohlsoon (1996) for Sweden; Carrasco (1999) for Spain; and Reynolds *et al*. (1994) for an international picture.
3. Harrison and Hart (1983), Binks and Jennings (1986) and Hamilton (1989) are UK examples. US examples include Ray (1975), Highfield and Smiley (1987), Steinmetz and Wright (1989), Hudson (1989) and Audretsch and Acs (1994). Other examples include Bögenhold and Staber (1991), Meager (1994), Storey (1991, 1994), Robson (1991, 1996, 1998a, 1998b); Black, De Meza and Jeffreys (1996), Parker (1996), Cowling and Mitchell (1997), Storey and Jones (1987), Acs *et al*. (1994), Foti and Vivarelli (1994), Lin *et al*. (2000), Cullen and Gordon (2002), Parker and Robson (2004) and Georgellis and Wall (2005).
4. In this sense a correct interpretation of the scope of microeconometric results should play a key role for conciliating the apparently contradictory microeconometric and macroeconometric evidence. For instance, the usual finding of a significant business cycle effect on the probability to become entrepreneur should be well-interpreted. The usual microeconometric estimates are done on the basis of a conditioned probability. Hence, the scope of a significant business cycle effect should be limited only to individuals who have a certain range of characteristics. An incorrect extrapolation of this type of results is a frequent source of misinterpretations.

For instance, Acs, Audretsch and Evans (1994) show that from the sixties to the nineties, the most part of the OECD countries experienced a "U-shapped" pattern of growth in the rate of non-agricultural self-employment. In general, a positive relationship between the self-employment and the rate of unemployment is found, which suggests that "recession-push" effects have been predominant, whereas Blanchflower and Oswald (1998), argued that the UK growth in self-employment during the eighties might be attributed to the good evolution in the macroeconomic environment. On the other hand, Crouchley, Abell and Smeaton (1994) estimate time series-models using UK quarterly data finding that the probability of self-employment is negatively related to the level of unemployment but is insensitive to cyclical fluctuations in GNP, putting in doubt the validity of the de la "recession-push" hypothesis to account for movements in self-employment. On the other hand, Parker (1996) using cointegration methods finds evidence for a positive relationship between self-employment and the rate of unemployment in line with previous results obtained by Blau (1987) or Evans and Leighton (1989) using US data.

Leaving aside the accurate of different estimation strategies used for analyzing the validity of these hypotheses we will agree in that, empirical estimates of the self-employment/unemployment(GDP) relationship captures invariably a "net" effect of the recession-push and the prosperity-pull effects (see Parker, 2004, p.95 or Thurik *et al.*, 2008).

However and importantly, we will also argue that a third cause of the current evidence about these relationships is related to a common practice in this field of research: the operationalization of entrepreneurship concept by means of self-employment, as a whole, overlooking the distinction between its components – i.e. employers and own-account workers[5]. We are not putting in doubt the process of defining entrepreneurship into a measurable factor, such as the self-employment, but the fact to suppose a common pattern of each self-employment component over the cycle.

In particular, we argue that entrepreneurs who employ external labour (employers) might exhibit different cyclical behaviour compared with entrepreneurs who work on their own (own-account workers): while both types of entrepreneur benefit from higher demand (national income), employers who run larger ventures and so benefit from economies of scale are likely to gain the most. At the same time, employers bid up wages which draw the low-value own-account entrepreneurs out of entrepreneurship and into paid-employment (Lucas, 1978). But also, in expansions some own-account workers will switch to an employer's status. In which case, one might expect the number of employer entrepreneurs to rise relative to the number of own-account entrepreneurs, making cyclical effects positive for employer entrepreneurs and negative for

5. We refer to the distinction between entrepreneurs who hire external labor –employers- as a related but distinct group compared with entrepreneurs who work on their own –i.e. own-account workers.

own-account entrepreneurs. Our empirical estimates below will shed light on this conjecture, giving arguments for understanding the weak evidence provided using self-employment, a magnitude defined as the sum of two components with opposite patterns over the cycle.

In spite of the study of entrepreneurship and business cycle is a field of great interest at the time of writing, studies concerning the co-movement and causality between self-employment and its components and output/unemployment are limited, however. Like other recent works (Farias et al. 2009 or Koellinger and Thurik, 2009), this work treats to fill at least partially this gap adding new evidence about this relationship re-examining these relationships. This re-examination is now possible given the availability of new and long time series for a wide set of countries thanks to efforts to improve self-employment statistics carried out by the OECD, Eurostat, or the pioneer effort of harmonization carried out by van Stel et al. (2010).[6]

In sum, this paper examines the co-movement and causality between self-employment and business cycle in the EU-12 countries using annual data spanning the years 1983 to 2008, evaluating the robustness of this relationship.[7] In particular, we measure output by the log level of real GDP, and the self-employment by the log level of non-agricultural self-employment or any of its components –that is, employers and own-account workers[8]. The data are observed annually and cover the period 1983 to 2007. The data are made available from EuroStat and MEI-OECD.[9]

To obtain the most robust result possible, we apply a number of alternative empirical methodologies and we report the results based on two competing leading data decomposition procedures (namely the Hodrick-Prescott filter –henceforth HP- and the First differences filter –henceforth FD-) as a way to evaluate the relationships robustness, and perform our analysis for two different business cycle's proxies (unemployment and real GDP) as a way to explore the sensitivity of model estimates. First, we will provide, as starting point, empirical evidence on the correlation of self-employment and its components over the cycle using the traditional approach, that is in the short-run. Second, we derive measures of time-varying correlations between the self-employment and its components and the business cycle (output and unemployment) using the framework proposed by den Haan (2000) for analysing co-movement for the

6. EIM's COMPENDIA data base.
7. The only theoretical proposition derived from a business cycle model is provided by Rampini (2004) who states that the risk associated with entrepreneurial activity implies that the amount of such activity should be procyclical. However, there is weak empirical evidence supporting this proposition. Recently, Koellinger and Thurik (2009) using data of 23-OECD rejects this hypothesis suggesting that entrepreneurial activity is a leading indicator of the business cycle.
8. For Belgium and Luxembourg, self-employment includes agriculture.
9. See Appendix A, for a more detailed description of the data. MEI (Main economic indicators). These data base is chosen given that allows us to decompose between employers and own-account workers.

short- and medium-run. Third, the long-run relationship is analysed using the usual cointegration analysis. Finally, the paper also includes an analysis of causality. In particular, we will run instantaneous and Granger causality tests.

Our findings can be summarized as follows: the paper reports first, the relation between self-employment and the business cycle differs across the two components of self-employment, i.e. employers and own-account workers. Second, we show that the relation between self-employment and the business cycle is dominated by the own-account workers development over the cycle. Third, the relationship between the self-employment (own-account workers) and the business cycle differs across countries.

The remainder of the chapter is organized as follows. The second section reports empirical evidence on the correlation of self-employment and its components over the business cycle, reporting the results obtained when the co-movement is analysed by using traditional statistics. The third section discusses the empirical results derived when the den Haan's methodology is applied allowing us to distinguish between medium and long-term co-movements. The fourth section studies the long-term relationship or long-term co-movement among non-stationary variables by analyzing the presence of cointegration relationships. Using this approach we focus on long-term co-movements rather than co-movements at the business cycle frequency, but it can be seen as further evidence on long-run correlations. The fifth section is devoted to the analysis of causality, whereas the last section contains concluding remarks and suggestions for further research.

2. Measuring Co-movement with Traditional Statistics

In this section we focus on co-movements of detrended measures of self-employment and business cycle proxies, as it is general practice in the empirical business cycle literature, by using the standard methodology developed by Burns and Mitchell (1946) –i.e. using the magnitude of the correlation coefficient, $\rho(j), j \in \{0,\pm 1,\pm 2\}$ as a measure of the degree of co-movement between each pair of time series- using two detrending methods.

In particular, the contemporaneous correlation coefficient $\rho(0)$, gives information on the degree of contemporaneous co-movement whereas the cross-correlation coefficient $\rho(j), j \in \{\pm 1,\pm 2\}$ gives information on the phase shift of one series relative to another.

Therefore, the co-movement between a variable *X* and a variable *Y*, is defined by means of the non-contemporaneous cross-correlation coefficients; if the coefficients are positive (negative), the variable is pro-cyclical (counter-cyclical) and a low number in absolute value represents *uncorrelated with the cycle.*

We say that the variable is leading, contemporaneous or lagging the business cycle as the absolute value of $\rho(j)$ is the maximum one for a negative, zero, or positive value, respectively. A large number in (absolute terms) appearing in column *t+i (t-i)* indicates that the series lags (leads) the cycle by *i* years. If the variable's value of the cross-correlation is highest at *i=0*, then, the variable will be defined to move contemporaneously with the cycle.

For each pair of variables, the correlation coefficient computed using different detrending methods yield different information. As regards detrending methods, we we take the Hodrick-Prescott filter and the the first differences filter (see table B2).

Table B1[10] reports correlations between the HP-filtered self-employment and output, for the EU-12 countries at different lags and leads. We also report, the correlations for the two components of self-employment (employers and own-account workers), in order to test the existence of different co-movements between them and output.

Following the previous discussion, it is said that the two variables commove in the same direction over the cycle if the maximum value, in absolute terms, of the estimated correlation coefficient of the detrended series (namely, dominant correlation) is positive, they commove in opposite directions if it is negative, and they do not commove if it is close to zero. Following the standard practice, we will take maximum values of the combined correlations in the ranges $(0{,}2-0{,}4)$ and $(0{,}4-0{,}5)$ as evidence of weak and moderate correlation respectively. We will refer to strong correlation if in absolute terms it is equal or larger than 0,5. Finally, the self-employment (or its components) is said to be leading (lagging) the GDP if the maximum correlation coefficient is reached for negative (positive) values of *i*.

The results can be summarized as follows: for self-employment, we don't find a dominant pattern. Only four countries (Germany, Ireland, Portugal and the UK) present moderate or strong and positive correlations whereas the rest of countries analysed (except France) show weak correlations[11].

Focusing now, on each component of self-employment the interpretation is mixed and more complex. For employers, we find a dominant strong and positive lead or contemporaneous correlation for most countries. For instance, for Denmark, Germany, Portugal and the UK, GDP movements lead (precede) employers movements, whereas in Spain, the pattern of contemporaneous correlations is dominant. The only exceptions are Italy and The Netherlands, in which the dominant correlation is negative. By contrast, analyzing the annual correlation between GDP and own-account workers, only two countries (Ireland

10. In annex B, we also include the correlation coefficients for the relationship between self-employment and the unemployment, (see tables B3 and B4).
11. Results are, in general, quite robust to the detrending method used. However, the cross-correlation coefficient for Portugal –positive using FD- has opposite signs for each filter.

and the UK) show a strong or moderate correlation (positive and contemporaneous)[12].

As we suggested before, the relationship is also analyzed by using unemployment as an alternative proxy in order to explore the sensitivity of correlations estimates (see table B2). As one would expect, results are consistent with the previous ones, that is, for each country we find an inverse relationship between the self-employment (and its components) and the unemployment with regard to the previously one obtained using GDP. In particular, Greece, Italy, Ireland, Portugal and the UK show strong and negative correlations.

In sum, the analysis reveals the existence of different self-employment patterns over the cycle, independently of the proxy used to capture the business cycle. However, the annual correlation between employers and GDP is a robust and generalized feature of our data. Finally, it is worth noting that within the sample we have two opposite patterns with regard to own-account workers.

3. Measuring Co-Movement with VAR Forecast Errors

As we mentioned before, another contribution of this paper is an evaluation of the relationship robustness. As it is well known, the co-movement between business cycle and the self-employment series can be also described using the methodology suggested by den Haan (2000) in order to measure correlations at different forecast horizons. In this section we report the estimates obtained using this procedure for analyzing the co-movement between self-employment and output (unemployment) in the EU-12.

As compared to the cross-correlation approach, den Haan's method focuses on the correlations between the irregular components, after having removed the trend and the inertia of the series.

To illustrate den Haan's (2000) dynamic conditional correlation model for our purposes, let $x_t = (y_t, s_t)'$ be a 2×1 vector containing the log of the real GDP (log of unemployment in the alternative specification) and the log of self-employment (or either of its components)[13]. Following den Haan (2000) we calculate correlation coefficients of forecast errors at different forecast horizons, obtained from estimations of various specifications of the following VAR model:

$$X_t = \alpha + \beta t + \gamma t^2 + \sum_{l=1}^{L} A_l X_{t-l} + \varepsilon_t \qquad (1)$$

12. By contrast, Germany and Luxembourg show positive coefficients.
13. This model will be also estimated using employers and own-account workers.

where α, β and γ are *2x1* vectors of constants, A_l is an *2x2* matrix of regression coefficients, ε_t is an *2x1* vector of innovations following a white noise process and the total number of lags included is equal to *l*.

The *K*-period ahead forecast and the *K*-period ahead forecast error of the random variable y_t (henceforth GDP or unemployment) are denoted by $E_t y_{t+K}$ and $y^{ue}_{t+K,t}$, where $y^{ue}_{t+K,t}$ can be obtained as follows:

$$y^{ue}_{t+K,t} = y_{t+K,t} - E_t y_{t+K} \tag{2}$$

Similarly, we can define $E_t s_{t+K}$ and $s^{ue}_{t+K,t}$, where *s* denotes the self-employment measure. Then, we calculate the correlation between these *K*-period forecast errors and denote it by *Corr(K)*.[14]

Using the correlation coefficient of the forecast error to analyse the output/ unemployment-self-employment relationship at a particular horizon *K*, can be interpreted as a trend-cycle decomposition where the trend component of output/ unemployment and self-employment are given by $E_t y_{t+K}$ and $E_t s_{t+K}$, respectively; whereas the cycle components of output/unemployment and self-employment are given by $y^{ue}_{t+K,t}$ and $s^{ue}_{t+K,t}$ respectively.

Therefore, when we analyze the VAR error forecast error correlation at different horizons, we are studying the co-movement between the cyclical components of output (unemployment) and self-employment.

At this point, one question that arises is whether or not to impose a unit root in the estimation of the VAR. Given that all series considered exhibit a single unit root, this has been imposed. The Akaike information criterion was used to determine the number of lags for each VAR system and whether deterministic trends terms should be included.[15]

To save space, the results for our annual data are represented in figures B1 and B2 (in the annex B). Charts B1 plots the correlation coefficients of the *K*-period ahead self-employment/employers/own-account workers and output forecast errors when a unit root is imposed. The open squares (circles or triangles) indicate that the estimate is significant at the 10% level and the solid squares (circles or triangles) indicate that the estimate is significant at the 5% level.

The results are as follows. The co-movement between self-employment, own-account workers and employers and output or unemployment at horizon 1 are very similar than for the detrending series. These charts also display the correlation of forecast errors at larger horizons, which gives an idea of medium

14. As pointed out den Haan (2000), if all time series included in X_t are stationary, then the correlation coefficient of the forecast errors will converge to the unconditional correlation coefficient between y_t and s_t as *K* goes to infinity. If X_t includes integrated processes, then correlation coefficient may not converge but they can be estimated consistently for fixed *K*
15. The lag lengths and inclusion of linear and quadratic trends are based on the Akaike information criterion.

term co-movements. In that sense, there is unequivocal evidence of positive correlation for the medium term forecast errors when the relation employers-output is analyzed (except for Greece, Italy and Portugal) and these correlation coefficients tend to become larger when the forecast horizon increases, and then stabilize (except for the Netherlands).

However evidence about the relationship between own-account workers and output is mixed. On the one hand, a small group of countries shows positive and weak correlation coefficients for the long run forecast horizon (Germany, Ireland, Italy, Portugal and the UK), whereas Denmark, The Netherlands and Spain shows a negative correlation which become larger in the Spanish case. Therefore we have two groups of countries. On the one hand those countries which destroy own-account works in expansions (Denmark, The Netherlands and Spain) – i.e. those ones in which the Lucas' effect is predominant, given that the new opportunities of gaining paid-employment and the expected gains from job search, reduces the own-account work[16] – and those ones in which a positive demand shock increases own-account workers.

Some candidates to explain these opposite patterns of own-account workers across countries might goes from the presence of certain structural factors to the use of entrepreneurship promotion as instrument of active labour market policies, not forgetting the role of concentration/distraction processes or the role of labour market institutions. However, further research is needed to determine whether these hypotheses can explain the diverse findings.

Finally, the observed relationship between self-employment and output are conditioned by the own-account workers evolution. Results are very similar across countries to those previously obtained for the relationship between own-account workers and GDP. The sign of correlation coefficients for the short- and long-run forecast horizons are marked by the own-account worker pattern given the high relative weight of own-account workers within self-employment.

As in the previous section we have completed our analysis using unemployment instead of GDP, for testing the robustness of our results. The results for unemployment data are represented in figures B2. The results are as follows. In general, results are consistent with co-movements founded by using GDP. The correlation coefficients between self-employment and output growth rates are marked by the pattern of own-account workers. The most interesting result emerges in relation to own-account workers. For the most part of countries own-account workers presents a negative correlation and the short-run correlation coefficients are smaller than the coefficients in the long-run. However, a group of countries (Belgium, Denmark, Germany, and Spain) shows an opposite pattern. It seems that in these last countries own-account workers show a counter-cyclical pattern in the short-run –i.e. the push-effect combined with transitions from own-account work to an employer' status might be dominant in these cases-.

16. An alternative explanation can be given by a high number of transitions to employer.

4. Long-Run Relationships: Testing for Cointegration

For completing our analysis, this section focuses on long-term co-movements rather than co-movements at the business cycle frequency. Our objective is now to estimate a model which is capable of identifying the long-run forces which have shaped the evolution of EU-12 self-employment whilst taking satisfactory account of these short-run dynamics.

As it is well-known, cointegration reflects the long-term co-movement among non-stationary variables, and thus testing for cointegration can be considered as a way to obtain further evidence on long-run correlations presented in previous sections.

There are, at least two ways of achieving this objective. The first, using an autoregressive model of self-employment reparameterised to achieve the best parsimonious error correction model. The second, assuming that individual data series are non-stationary –or integrated-, is to search for a cointegrating relationships among the variables of interest. There are a variety of ways of estimating the parameters of such a cointegrating relationship. Following Johansen (1988), using a maximum likelihood procedure allows for the possibility that there may be more than one cointegrating relationship amongst a set of integrated variables.

Prior to the applications of this method, we must to be able to establish the integration properties of the each variable under study. To this end, we report in table B3 the results of Ng-Perron tests, $\overline{MZ}_{\alpha}^{GLS}$, $\overline{MZ}_{t}^{GLS}$, $\overline{MSB}^{GLS}$, $\overline{MPT}^{GLS}$ and *ADF* tests. All test statistics formally examine the unit root null hypothesis against the alternative of stationary. The null hypothesis of non-stationarity for series in level, *S, E, O, GDP and U* cannot be rejected, regardless of the test. Accordingly, these five series would be *I(1)* that is that they require differencing once in order to make them stationary.

The real GDP and self-employment exhibit a unit root test as confirmed by a battery of tests under different specifications and thus we test for the presence of cointegrating relationships within a vector error correction model. To determine the optimal number of lags we estimated a *VAR* using the data in levels, and then we chosen the appropriate lag length using the Akaike, Schwarz and Hannan-Quinn information criteria.

Johansen's methodology takes its starting point in the vector autoregression (VAR) of order *p* given by

$$x_t = \mu + A_1 x_{t-1} + ... + A_p x_{t-p} + \varepsilon_t \qquad (3)$$

where x_t is an $nx1$ vector of variables that are integrated of order one and ε_t is an $nx1$ vector of innovations. Then we can rewrite the *VAR(p)* in error correction form as:

$$\Delta x_t = \mu + \Pi x_{t-1} + \sum_{i=1}^{p} \Gamma_i \Delta x_{t-i} + \varepsilon_t \tag{4}$$

where $\Pi = \sum_{i=1}^{p} A_i - I$ and $\Gamma i = -\sum_{j=i+1}^{p} A_j$

If the coefficient matrix Π has reduced rank -i.e. $r < n$-, then there exist nxr matrices α and β each with rank r such that $\Pi = \alpha\beta'$ and $\beta' x_t$ is stationary. r is the number of cointegrating relationships, the elements of α are known as the adjustment parameters in the vector error correction model and each column of β is a cointegrating vector. It can be shown that for a given r, the maximum likelihood estimator of β defines the combination of x_{t-1} that yields the r largest canonical correlations of Δx_t with x_{t-1} after correcting for lagged differences and deterministic variables when present. Johansen (1995) proposed two different likelihood ratio tests of the significance of these canonical correlations and thereby the reduced rank of the Π matrix: the trace test and maximum eigenvalue test, shown in equations (5) and (6) respectively,

$$J_{trace} = -T \sum_{i=r+1}^{n} \ln\left(1 - \hat{\lambda}_i\right) \tag{5}$$

$$J_{\max} = -T \ln\left(1 - \hat{\lambda}_{r+1}\right) \tag{6}$$

where T is the sample size and $\hat{\lambda}_i$ is the *i-th* largest canonical correlation. The trace test tests the null hypothesis of r cointegrating vectors against the alternative hypothesis of n cointegrating vectors. The maximum eigenvalue test, on the other hand, tests the null hypothesis of r cointegrating vectors against the alternative hypothesis of $r+1$ cointegrating vectors.

Table B4 shows the results of Johansen's Maximal Eigenvalue and Trace tests for a second order vector autoregression. We find, that for Denmark, Greece, Italy, The Netherlands, Portugal and the UK employers and GDP are cointegrated, given that the null hypothesis $H_0 : rank(\Pi) = 0$ is rejected. Italy is the only case in which according to both cointegration tests $H_0 : rank(\Pi) = 0$ is rejected. On the other hand, DP and own-account workers are cointegrated only for two countries: the Netherlands and the UK. However, own-account workers and unemployment are cointegrated in France, Greece, Italy, the Netherlands, Portugal and Spain. Finally, self-employment has a similar pattern to employers (own-account workers) when the cointegration relationships with regard GDP (unemployment) are analysed. Once again the distinction between the two self-

employment components is revealed as crucial for a better understanding of the relationship between self-employment and the business cycle.

5. Causality

If we interpret the presence of cross-correlation between real the output growth or the cyclical unemployment and the self-employment/own-account work/ employers cycle, we should conclude that we find unequivocal evidence that output transmits their cycles to the employers cycles, and two groups of countries with opposite co-movements between unemployment and own-account workers.

Our objective now, is to analyze the causality using the *VAR*'s parameters, given that they were a transformation of the cross-correlation function, allowing us to do inference about two types of causality: the instantaneous causality and the Granger causality.

The *instantaneous causality* concept refers to the possible instantaneous correlation between the cyclical components of several variables. Roughly speaking a variable a_t is said to be instantaneously causal for another time series variable b_t if knowing the value of a_t in the forecast period helps to improve the forecasts of b_t.[17] In sum, if the innovation to b_t and the innovation to a_t are correlated we say there is instantaneous causality.

Let us suppose that the cyclical components of each variable can be represented by means of a VAR. The time series representation of each VAR's for each pair of variables have the following form:

$$x_t = \gamma + \phi_1 x_{t-1} + ... + \phi_p x_{t-p} + \varepsilon_t \qquad (7)$$

where x_t is a vector of cycles (using HP-filtered series or First-difference transformation), ϕ_p are different matrices of coefficients, γ_t is a vector of deterministic terms and finally, ε_t is the vector of innovations.

An important issue is the lag length selection of the VAR. Unfortunately, it does not exist a generally best method for choosing the lag length. The approach taken here is the following, in estimating the reduced form of the VAR, the lag length was set at 1 on the basis of Akaike's and Schwartz's Information Criterion for a multivariate system. Consequently, we estimate 68 VAR systems, 34 for series detrended by using a Hodrick-Prescott filter and 34 by using a first-differences filter.

In order to show the results, we first, showed the instantaneous causality results, and later, the granger causality results (tables B6 and B7). This order has it origin in the nature of the two causality tests. Let's remember that while

17. Formally y_t is said to be instantaneously noncausal for x_t if and only if $x_{t+1|\Omega} = x_{t+1|\Omega \cup y_{t+1}}$

instantaneous causality captures the contemporaneous transmission between the cycles of each variable, the causality à la Granger needs a certain time for the transmission between the cycles of the different variables.

Results are qualitatively identical for the two filters. For employers the dominant pattern is one in which the business cycle cause employers movements. This is correct for Denmark, Germany, The Netherlands, Portugal, and the UK. In addition for Ireland and Germany, we can observe an instantaneous causality between both variables. However, only four countries (Denmark, Ireland, Germany and the UK), show instantaneous or Granger-causality with regard own-account workers, and only four of them (Germany, Ireland, Portugal and the UK), presents a causality relationship with regard to self-employment.

6. Conclusions and Implications

As we mentioned before the re-examination of the relationship between entrepreneurship and business cycles is a highly topical policy issue at the time of writing, when the economy is in a recession and governments across the world are looking at entrepreneurship as a alternative response to the unfavorable economic conditions.

In this context, our statistical results might become a good guideline for trying to build a model of business cycles and entrepreneurship, given that they provide some useful stylized facts which should help us to understand the complex relationship between the self-employment and the business cycle.

In particular, our analysis reveals that to a certain extent, some controversies associated to previous empirical evidence had been caused by the lack of distinction between the potential opposite patterns of each self-employment component over the cycle given that the relation between self-employment and the business cycle is dominated by the own-account workers. Our results also provide robust evidence of procyclicality in employer self-employment rates whereas own-account self-employment rates evolve counter-cyclically, in most countries.

However, this last relation between own-account and self-employment rates differs across countries. This might reflect the existence of different structural and/or institutional factors, such as the weight of certain sectors in the economic activity, the intensity of certain phenomena such as the outsourcing or by contrast, the changes operated in certain sectors oriented to achieve larger size for exploiting advantages associated to larger scales might be behind these results. This also might reflect the difference nature of labour market institutions, the intensity and persistence of the unemployment problem, or even the use of the entrepreneurship promotion policy as an instrument of an active labour market policy. In any case, further research is needed to determine whether it is different national and institutional conditions, which explain the diverse findings across countries.

References:

Acs, Z.J., Audretsch, D.B. and D.S. Evans (1994), "The determinants of variation in the self-employment rates across countries and over time", *CEPR Discussion Paper*, 871.

Audretsh, D. B. and Z. J. Acs (1994), "New firm start-ups, technology and macroeconomic fluctuations", *Small Business Economics*, 6: 439-449.

Binks, M. and Jennings, A. (1986), "Small firms as a source of economics rejuvenation", in Currant, J. et al. (eds.), *The Survival of the Small Firm*, 1, Aldershot, Gower, 19-37.

Black, J., de Meza D. and D. Jeffreys (1996), "House prices, the supply of collateral and the enterprise economy", *Economic Journal*, 106: 60-75.

Blau, D.M. (1987), "A time series analysis of self-employment in the United States", *Journal of Political Economy*, 95(3):445-467.

Blanchflower, D.G. and Oswald, A.J. (1998), "What makes an entrepreneur", *Journal of Labour Economics*, 16: 26-60.

Bögenhold, D. and Staber, U. (1991), "The decline and rise of self-employment", *Work Employment and Society*, 5: 223-239.

Bruce, D. (2000), "Effects of the United States tax system on transitions into self-employment", *Labour Economics*, 7: 545-574.

Burns, F. and Mitchell, W. (1946), *Measuring Business Cycles*, New York: NBER.

Carrasco, R. (1999), "Transitions to and from self-employment in Spain: an empirical analysis", *Oxford Bulletin of Economics and Statistics*, 61(3): 315-41.

Clark, K. and Drinkwater, S. (1998), "Ethnicity and Self-employment in Britain", *Oxford Economic Bulletin of Economics and Statistics*, 60: 383-407.

Clark, K. and Drinkwater, S. (2000), "Pushed out or Pulled in? Self-employment among minorities in England and Wales", *Labour Economics*, 7: 603-28.

Cowling, M. and Mitchell, P. (1997), "The evolution of UK self-employment: a study of government policy and the role of the macroeconomy", *Manchester School*, 65: 427-442.

Cullen, J. B. and Gordon, R.H. (2002), "Taxes and entreprenurial activity: theory and evidence for the US", *NBER Working Paper*, 9015, National Bureau of Economic Research.

Crouchley, R., Abell, P. and Smeaton, D. (1994), "An aggregate time series analysis of non-agricultural self-employment in the UK", *CEPDP, 209. Centre for Economic Performance*, London School of Economics and Political Science, London, UK

den Haan, W.J. (2000), "The comovement between output and prices", *Journal of Monetary Economics*, 46: 3-30

den Haan, W.J. (2000), Program. http://dge.repec.org/codes/sumner/calcorr.m

den Haan, W.J. and Sumner, S. (2004), "The comovement between real activity and prices in the G7", *European Economic Review*, 48: 1333-1347.

Dickey, D. and Fuller, W. (1981), "A likelihood ratio test for autoregressive time series with a unit root", *Econometrica,* 49: 1057-1072.

Evans, D. and Leighton, L. (1989), "Some empirical aspects of entrepreneurship", *American Economic Review*, 79: 519-535.

Faria, J.R., Cuestas, J.C. and Gil-Alana, L.A. (2009), "Unemployment and entrepreneurship: A cyclical relation?," *Economics Letters*, 105(3): 318-320.

Foti, A. and Vivarelli, M. (1994), "An econometric test of the self-employment model: the case of Italy", *Small Business Economics,* 6: 81-93.

Georgellis, Y. and Wall, H.J. (2005), "Gender differences in self-employment", *International Review of Applied Economics*, 19(3): 321-42.

Hamilton, J. (1989), "A new approach to the economic analysis of non-stationary time series and the business cycle", *Econometrica*, 57: 357-384.

Hamilton, J.D. (1994), *Time Series Analysis*, Princeton NJ: Princeton University Press.

Hamilton, R.T. (1989), "Unemployment and Business formation rates: reconciling time series and cross-section evidence", *Environment and Planning*, 21: 249-55.

Harrison, R.T. and Hart, M. (1983), "Factors influencing new business formation: a case study of Northern Ireland", *Environment and Planning,* 15: 1395-1412.

Highfield, R. and Smiley, R. (1987), "New business starts and economic activity: an empirical investigation", *International Journal of Industrial Organization*, 5: 51-66.

Hodrick, R. and Prescott, E. (1997), "Postwar US business cycles: An empirical investigation", *Journal of Money, Credit, and Banking,* 29: 1-16.
Hudson, J. (1989), "The birth and death of firms", *Quarterly Review of Economics and Business*, 29: 68-86.
Johansen, S. (1988), "Statistical analysis of cointegration vectors", *Journal of Economic Dynamics and Control,* 12 (2): 231-54.
Johansen, S. (1991), "Estimation and Hypothesis testing of cointegration vectors in gaussian vector autoregressive models", *Econometrica* 59: 1551-81.
Johansen, S. (1995), Likelihood-based Inference in Cointegrated Vector Autoregressive Models. Oxford. Oxford University Press.
Kydland, F. and Prescott, E. (1990), Business cycles: real facts and a monetary myth. *Federal Reserve Bank of Minneapolis Quarterly Review*, 3-18.
Koelllinger P.D. and Thurik, A.R. (2009), "Entrepreneurship and the business cycle", *Tinbergen Institute Discussion Paper*, TI 2009-032/3.
Lin, Z., Picot, G. and Compton, J. (2000), "The entry and exit dynamics of self-employment in Canada", *Small Business Economics*, 15: 105-125.
Lindh, T. and Ohlsoon, H. (1996), "Self-employment and windfall gains: evidence from the Swedish lottery", *Economic Journal*, 106: 1515-26.
Lucas, R.E. (1978), "On the size distribution of business firms", *Bell Journal of Economics,* 9: 508-23.
Lütkepol, H. and Krätzig, M. (2004), *Applied Time Series Econometrics*. Cambridge University Press, New York.
Meager, N. (1994), "Self-employment schemes for the unemployed in the European Community", in G. Schmid (ed.), *Labour Market Institutions in Europe*, New York: M. E. Sharpe, 183-242.
Ng, S. and Perron, P. (1997), "Estimation and inference in nearly unbalanced cointegrated systems", *Journal of econometrics* 79: 53-81.
Parker, S.C. (1996), "A time series model of self-employment under uncertainty", *Economica*, 63: 459-75.
Parker, S.C. (2004), *The Economics of Self-employment*, Cambridge University Press.
Parker, S.C. and Robson, M. T. (2004), "Explaining international variations in self-employment: evidence from a panel of OECD countries", *Southern Economic Journal*, 71: 287-301.
Rampini, A.A. (2004), "Entrepreneurial activity, risk and the business cycle", *Journal of Monetary Economics*, 51: 555-73.
Ray, R.N. (1975), "Self-Employed Americans in 1973", *Monthly Labor Review*, 98: 49-54.
Reynolds, P.D., D.J. Storey and Westhead, P. (1994), "Cross-national comparisons of the variation in new firm formation rates", *Regional Studies*, 28: 443-56.
Robson, M.T. (1991), "Self-employment and new firm formation", *Scottish Journal of Political Economy*, 38: 352-68.
Robson, M.T. (1996), "Macroeconomic factors in the birth and death of UK firms: evidence from quarterly VAT registrations", *Manchester School*, 64: 170-88.
Robson, M.T. (1998a), "Self-employment in the UK regions", *Applied Economics*, 30: 313-22.
Robson, M.T. (1998b), "The rise in self-employment amongst UK males", *Small Business Economics*, 10: 199-212.
Steinmetz, G. and Wright, E.O. (1989), "The fall and rise of the petty bourgeoisie: changing patterns of self-employment in the postwar United States", *American Journal of Sociology*, 94: 973-1018.
Storey, D.J. (1991), "The birth of new firms – does unemployment matter? A review of the evidence", *Small Business Economics*, 3: 167-78.
Storey, D.J. (1994), Understanding the Small Business Sector, London, Routledge.
Storey, D.J. and Jones, A.M. (1987), "New firm formation: a labour market approach to industrial entry", *Scottish Journal of Political Economy*, 34: 37-51.
Taylor, M. (1996), "Earnings, independence or unemployment: why become self-employed?", *Oxford Bulletin of Economics and Statistics*, 58: 253-66.
Thurik, A.R., Carree, M.A., Van Stel, A.J., and Audretsch, D.B. (2008), "Does Self-Employment Reduce Unemployment?", *Journal of Business Venturing*, 23(6): 673-86.

Van Praag, C.M. and Van Ophem, H. (1995), "Determinants of willingness and opportunity to start as an entrepreneur", *Kyklos*, 48: 513-40.

Van Stel, A., Hartog, C., and Cieslik, J. (2010), "Measuring Business Ownership Across Countries and Over Time: Extending the COMPENDIA Data Base", *EIM Business and Policy Research, Scales Research Reports*, No. H201019.

Appendix A

Data

The empirical analysis uses annual data on self-employment for the EU-12 countries. The self-employment level (*St*), and its components, the employers (*Et*) and the own-account workers (*OAt*) are drawn from the *Labour Force Survey (LFS)*. The common sample starts in 1983 and concludes in 2007. European data allows distinguish between own-account workers and employers in their basic observations following the standards set by the *International Labor Organization*. In the *LFS* workers are asked questions about their main job or business, including "Were you an employee or self employed?" If self-employed, the respondent is further asked whether they had any employees. The self-employed can then be classified as incorporated with or without employees, and unincorporated with or without employees.

Finally, regarding the rest of the data used in our empirical work, the real GDP (*Yt*) -Gross Domestic Product, constant prices, constant *PPPs*, reference year 2000, expressed in millions of US $- is taken from *OECD Statistics* -Main Economic Indicators-, whereas unemployment, (*Ut*) and paid-employment data (*Wt*), are drawn from the *LFS*.

Data sources

The annual ouput data used were downloaded from the OECD Statistics available in http://stats.oecd.org/wbos/Index.aspx?datasetcode=SNA_TABLE1 on December 25, 2008. For all countries we used "Gross Domestic Product, constant prices, constant PPPs, reference year 2000, expressed in millions of US $.
On the other hand, employment, unemployment and self-employment data were downloaded from the *LFS* collected by Eurostat on January 12, 2009.
http://epp.eurostat.ec.europa.eu/portal/
page?_pageid=1996,45323734&_dad=portal&_schema=PORTAL&screen=welcomeref&open=/data/popul/labour/
employ&language=en&product=EU_MAIN_TREE&root=EU_MAIN_TREE&scrollto=236

Appendix B: Results and Statistical Tests

In this appendix we present results and several statistical tests which guided us throughout our empirical analysis. First, we show results using traditional cross-correlations and the results of the Den haan's approach. Second, we report the results from unit root tests to see whether or not the variables from our model are stationary or not. Third and finally, we pre-sent the Johansen's reduced rank regression approach.

Table B1. Correlation between self-employment growth and output growth at different leads and lags (HP filter)

Country	σ_X	$\frac{\sigma_x}{\sigma_y}$	ρ_T	ΔX_t	$cor\left(X_t^{HP}, GDP_{t+k}^{HP}\right)$				
					-2	**-1**	**0**	**1**	**2**
Belgium *83-07*	0,030	2,644	0.244	*S*	**-0,255**	0,025	0,090	0,110	0,109
	0,202	17,47	0.380	*E*	0,234	**0,318**	0,180	0,094	-0,183
	0,064	5,511	0.464	*O*	**-0,292**	-0,217	-0,174	-0,083	0,178
Denmark *84-07*	0,035	2,15	0,210	*S*	-0,052	0,090	0,124	**0,271**	0,218
	0,050	3,07	0,136	*E*	0,225	**0,438**	0,430	0,223	-0,046
	0,061	3,74	0,291	*O*	-0,267	-0,298	-0,253	0,117	**0,305**
France *83-07*	0,028	1,96	0,443	*S*	0,085	0,063	**0,070**	-0,034	-0,122
	0,030	2,11	0,516	*E*	**0,194**	0,129	0,048	-0,071	-0,159
	0,036	2,53	0,259	*O*	-0,018	0,004	**0,075**	0,007	-0,068
Germany *83-07*	0,040	2,78	0,629	*S*	0,378	**0,487**	0,446	0,102	-0,293
	0,043	2,99	0,596	*E*	0,544	**0,641**	0,536	0,103	-0,349
	0,046	3,20	0,496	*O*	0,115	0,228	**0,252**	0,056	-0,180
Greece *83-07*	0,016	1,12	0,290	*S*	0,304	0,185	-0,141	-0,294	**-0,358**
	0,042	2,95	0,256	*E*	0,212	0,240	-0,026	**-0,305**	-0,218
	0,019	1,33	0,150	*O*	0,175	0,003	-0,151	-0,072	**-0,230**
Italy *83-07*	0,023	1,89	0,313	*S*	0,091	0,151	**0,368**	0,269	0,136
	0,482	39,58	0,443	*E*	-0,010	-0,328	-0,613	**-0,680**	-0,321
	0,177	14,54	0,371	*O*	-0,027	0,204	0,489	**0,567**	0,309
Ireland *83-07*	0,031	1,04	0,112	*S*	0,197	0,369	**0,532**	0,347	0,212
	0,060	2,01	0,261	*E*	0,310	0,366	**0,453**	0,272	0,194
	0,022	0,74	-0,250	*O*	-0,149	0,136	**0,384**	0,286	0,143
Luxembourg *83-07*	0,049	1,853	0.036	*S*	0,007	-0,033	0,055	**-0,123**	-0,098
	0,234	8,828	0.100	*E*	-0,131	-0,155	-0,065	**-0,173**	-0,153
	0,214	8,078	0.339	*O*	0,108	0,124	0,134	**0,176**	0,120
Netherlands *87-07*	0,027	1,67	-0,025	*S*	-0,222	-0,201	-0,178	**-0,262**	0,000
	0,050	3,09	0,339	*E*	-0,484	**-0,610**	-0,436	-0,079	0,395
	0,031	1,92	0,041	*O*	0,136	0,270	0,140	-0,287	**-0,355**
Portugal *86-07*	0,034	1,22	0,398	*S*	0,519	0,450	0,162	-0,282	**-0,576**
	0,058	2,08	0,668	*E*	**0,740**	0,567	0,114	-0,435	-0,731
	0,035	1,26	0,094	*O*	0,115	0,195	0,173	-0,024	**-0,224**
Spain *86-07*	0,026	1,32	0,095	*S*	-0,101	-0,136	**0,163**	0,031	0,046
	0,043	2,18	0,027	*E*	0,077	0,215	**0,420**	0,214	0,037
	0,037	1,87	0,268	*O*	-0,092	-0,210	-0,047	**-0,125**	-0,044
UK *83-07*	0,042	2,27	0,553	*S*	0,383	0,614	**0,625**	0,295	-0,172
	0,053	2,86	0,580	*E*	0,550	**0,773**	0,737	0,419	0,013
	0,046	2,48	0,541	*O*	0,275	0,463	**0,486**	0,190	-0,245

*In bold the highest correlation coefficient

Table B1 (cont) Correlation between self-employment growth and output growth at different leads and lags (FD filter)

Country	σ_X	$\frac{\sigma_x}{\sigma_y}$	ρ_Γ	ΔX_t	$cor(\Delta X_t, \Delta GDP_{t+k})$				
					-2	**-1**	**0**	**1**	**2**
Belgium *83-07*	0,030	0,237	0,244	*S*	0,271	**0,320**	0,264	0,012	-0,136
	0,202	1,567	0,380	*E*	-0,068	-0,196	-0,337	**-0,373**	-0,184
	0,064	0,494	0,464	*O*	0,165	0,316	**0,459**	0,370	0,113
Denmark *84-07*	0,045	2,913	-0,093	*S*	**-0,196**	0,134	-0,071	0,194	0,078
	0,067	4,361	-0,212	*E*	-0,166	**0,291**	0,144	0,134	-0,020
	0,074	4,817	-0,014	*O*	-0,087	-0,127	**-0,241**	0,111	0,117
France *83-07*	0,031	2,659	-0,086	*S*	0,051	-0,007	**0,166**	-0,033	0,037
	0,031	2,709	-0,006	*E*	0,057	0,046	0,085	-0,032	**0,121**
	0,044	3,784	-0,135	*O*	0,035	-0,034	**0,169**	-0,019	-0,036
Germany *83-07*	0,038	2,533	0,127	*S*	0,222	0,306	**0,442**	0,146	-0,235
	0,044	2,933	0,050	*E*	0,347	0,391	**0,518**	0,200	-0,154
	0,048	3,201	0,074	*O*	0,043	0,145	0,233	0,020	**-0,237**
Greece *83-07*	0,020	1,025	-0,394	*S*	0,060	0,038	**-0,153**	-0,121	-0,046
	0,050	2,563	-0,074	*E*	-0,060	0,103	0,017	**-0,258**	0,039
	0,026	1,333	-0,371	*O*	0,086	-0,065	**-0,198**	0,058	-0,087
Italy *83-07*	0,028	2,028	-0,152	*S*	-0,087	-0,121	**0,265**	0,074	0,012
	0,541	39,180	-0,048	*E*	0,079	-0,009	-0,161	**-0,427**	0,046
	0,213	15,425	-0,104	*O*	-0,143	-0,095	0,116	**0,296**	-0,020
Ireland *83-07*	0,043	3,114	-0,330	*S*	0,064	0,070	**0,396**	0,044	0,277
	0,075	5,432	-0,204	*E*	0,090	0,070	0,312	-0,001	**0,357**
	0,034	2,462	-0,456	*O*	-0,013	0,005	**0,361**	0,069	0,057
Luxembourg *83-07*	0,049	0,227	0.036	*S*	0,020	0,276	**0,476**	0,172	0,012
	0,234	1,083	0.100	*E*	**0,482**	0,201	-0,041	-0,194	-0,065
	0,214	0,991	0.339	*O*	**-0,417**	-0,008	0,284	0,271	0,069
Netherlands *87-07*	0,039	3,019	-0,461	*S*	-0,046	-0,021	0,091	**-0,305**	0,021
	0,060	4,644	-0,226	*E*	-0,103	-0,330	-0,181	-0,091	**0,337**
	0,044	3,406	-0,257	*O*	0,018	0,220	0,256	**-0,349**	-0,230
Portugal *86-07*	0,024	0,472	0,175	*S*	0,390	**0,409**	0,378	0,057	-0,187
	0,045	0,893	0,542	*E*	**0,625**	0,565	0,382	-0,036	-0,212
	0,064	1,281	-0,107	*O*	0,113	0,204	**0,282**	0,121	-0,106
Spain *86-07*	0,032	2,201	-0,058	*S*	-0,034	0,046	**0,278**	0,015	0,219
	0,062	4,240	-0,341	*E*	0,051	0,076	**0,314**	0,007	-0,017
	0,043	2,912	0,127	*O*	-0,037	0,021	0,114	-0,032	**0,197**
UK *83-07*	0,042	1,561	0,345	*S*	0,243	**0,506**	0,485	0,240	-0,250
	0,050	1,858	0,108	*E*	0,342	**0,582**	0,464	0,231	-0,157
	0,048	1,784	0,354	*O*	0,171	0,397	**0,416**	0,205	-0,249

*In bold the highest correlation coefficient

Table B2 Correlation between self-employment growth and unemployment growth at different leads and lags (HP filter)

Country	σ_X	$\frac{\sigma_x}{\sigma_y}$	ρ_T	ΔX_t	$cor\left(X_t^{HP}, U_{t+k}^{HP}\right)$				
					-2	**-1**	**0**	**1**	**2**
Belgium *83-07*	0,030	0,237	0.244	*S*	0,271	**0,320**	0,264	0,012	-0,136
	0,202	1,567	0.380	*E*	-0,068	-0,196	-0,337	**-0,373**	-0,184
	0,064	0,494	0.464	*O*	0,165	0,316	**0,459**	0,370	0,113
Denmark *84-07*	0,035	0,232	0,210	*S*	0,054	-0,15	-0,039	-0,17	**-0,197**
	0,050	0,331	0,136	*E*	-0,077	**-0,52**	-0,492	-0,203	0,01
	0,061	0,404	0,291	*O*	0,138	0,304	**0,412**	-0,013	-0,237
France *83-07*	0,028	0,317	0,443	*S*	-0,045	0,046	-0,007	0,107	**0,171**
	0,030	0,340	0,516	*E*	**-0,312**	-0,153	0,069	0,206	0,223
	0,036	0,408	0,259	*O*	0,177	**0,187**	-0,069	-0,005	0,087
Germany *83-07*	0,040	0,302	0,629	*S*	-0,106	0,203	0,609	**0,612**	0,515
	0,043	0,325	0,596	*E*	-0,223	0,075	0,472	0,587	**0,666**
	0,046	0,348	0,496	*O*	0,036	0,27	**0,603**	0,509	0,234
Greece *83-07*	0,016	0,231	0,290	*S*	**-0,536**	-0,502	-0,043	0,069	0,035
	0,042	0,607	0,256	*E*	**-0,294**	-0,137	0,117	0,105	0,01
	0,019	0,274	0,150	*O*	-0,422	**-0,511**	-0,159	0,018	0,076
Italy *83-07*	0,023	0,350	0,313	*S*	0,276	0,206	-0,011	-0,298	**-0,529**
	0,482	7,343	0,443	*E*	**-0,562**	-0,395	-0,343	0,185	0,497
	0,177	2,696	0,371	*O*	0,469	0,325	0,278	-0,186	-0,505
Ireland *83-07*	0,031	0,219	0,112	*S*	-0,003	-0,253	-0,547	**-0,552**	-0,396
	0,060	0,423	0,261	*E*	-0,074	-0,286	**-0,565**	-0,538	-0,404
	0,022	0,155	-0,250	*O*	0,149	-0,018	-0,196	**-0,274**	-0,168
Luxembourg *83-07*	0,049	0,227	0.036	*S*	0,020	0,276	**0,476**	0,172	0,012
	0,234	1,083	0.100	*E*	**0,482**	0,201	-0,041	-0,194	-0,065
	0,214	0,991	0.339	*O*	**-0,417**	-0,008	0,284	0,271	0,069
Netherlands *87-07*	0,027	0,129	-0,025	*S*	0,154	0,107	0,046	**0,254**	0,191
	0,050	0,239	0,339	*E*	0,253	0,419	**0,47**	0,412	-0,07
	0,031	0,148	0,041	*O*	-0,024	-0,227	**-0,346**	-0,019	0,322
Portugal *86-07*	0,034	0,173	0,398	*S*	**-0,484**	-0,476	-0,227	0,19	0,452
	0,058	0,296	0,668	*E*	**-0,716**	-0,643	-0,308	0,254	0,623
	0,035	0,178	0,094	*O*	-0,073	**-0,154**	-0,085	0,042	0,118
Spain *86-07*	0,026	0,201	0,095	*S*	**0,168**	0,12	-0,011	0,082	-0,001
	0,043	0,333	0,027	*E*	0,061	-0,21	**-0,365**	-0,261	-0,236
	0,037	0,287	0,268	*O*	0,13	0,207	0,164	**0,255**	0,209
UK *83-07*	0,042	0,354	0,553	*S*	0,089	-0,224	**-0,387**	-0,327	-0,052
	0,053	0,447	0,580	*E*	-0,199	-0,502	**-0,586**	-0,458	-0,168
	0,046	0,388	0,541	*O*	0,192	-0,082	**-0,259**	-0,231	0,008

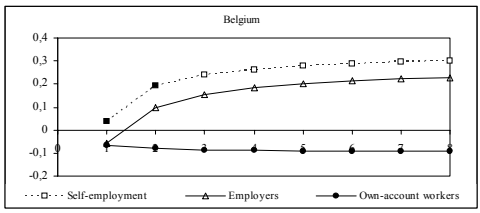
*In bold the highest correlation coefficient

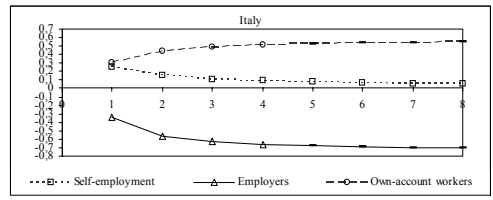
Table B2 (cont) Correlation between self-employment growth and unemployment growth at different leads and lags (FD filter)

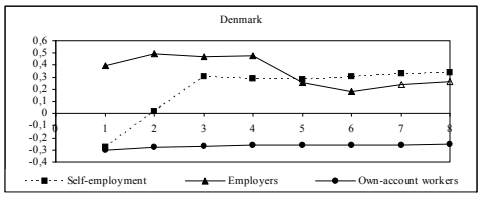
Country	σ_X	$\frac{\sigma_x}{\sigma_y}$	ρ_Γ	ΔX_t	$cor(\Delta X_t, \Delta U_{t+k})$				
					-2	**-1**	**0**	**1**	**2**
Belgium *83-07*	0,038	0,336	-0.036	*S*	0,134	0,105	**0,168**	-0,089	-0,256
	0,237	2,097	0,032	*E*	0,094	0,044	-0,098	**-0,219**	-0,168
	0,070	0,619	0,017	*O*	-0,009	-0,022	**0,238**	0,181	-0,076
Denmark *84-07*	0,045	0,314	-0,093	*S*	0,064	**-0,257**	0,164	-0,105	-0,164
	0,067	0,468	-0,212	*E*	0,233	**-0,440**	-0,211	0,029	-0,063
	0,074	0,517	-0,014	*O*	-0,148	0,122	**0,426**	-0,167	-0,131
France *83-07*	0,031	0,362	-0,086	*S*	-0,019	0,037	**-0,152**	0,042	0,079
	0,031	0,362	-0,006	*E*	**-0,198**	-0,039	0,137	0,186	0,129
	0,044	0,514	-0,135	*O*	0,104	0,076	**-0,296**	-0,075	0,021
Germany *83-07*	0,038	0,318	0,127	*S*	-0,116	-0,076	**0,583**	0,250	0,271
	0,044	0,369	0,050	*E*	-0,126	-0,103	0,420	0,145	**0,448**
	0,048	0,402	0,074	*O*	-0,084	-0,035	**0,517**	0,312	-0,008
Greece *83-07*	0,020	0,276	-0,394	*S*	-0,061	**-0,390**	0,220	0,106	0,036
	0,050	0,690	-0,074	*E*	-0,041	-0,044	**0,196**	0,072	0,006
	0,026	0,359	-0,371	*O*	-0,071	**-0,384**	0,085	0,075	0,094
Italy *83-07*	0,028	0,371	-0,152	*S*	0,198	0,066	-0,053	-0,085	**-0,327**
	0,541	7,165	-0,048	*E*	-0,280	0,164	-0,253	0,251	**0,305**
	0,213	2,821	-0,104	*O*	0,260	-0,175	0,155	-0,211	**-0,349**
Ireland *83-07*	0,043	0,358	-0,330	*S*	0,032	0,002	**-0,354**	-0,129	-0,307
	0,075	0,624	-0,204	*E*	0,018	-0,043	-0,359	-0,175	**-0,386**
	0,034	0,283	-0,456	*O*	0,036	0,094	**-0,177**	-0,005	-0,064
Luxembourg *83-07*	0,070	0,320	-0,411	*S*	0,060	0,029	**0,350**	-0,083	-0,102
	0,325	1,484	-0,439	*E*	**0,344**	-0,060	-0,065	-0,234	0,059
	0,258	1,178	-0,086	*O*	**-0,303**	0,129	0,266	0,201	-0,103
Netherlands *87-07*	0,039	0,218	-0,461	*S*	0,027	-0,011	-0,193	**0,214**	0,037
	0,060	0,335	-0,226	*E*	-0,093	0,113	0,138	**0,425**	-0,152
	0,044	0,245	-0,257	*O*	0,108	-0,098	**-0,363**	-0,027	0,168
Portugal *86-07*	0,024	0,144	0,175	*S*	-0,237	**-0,391**	-0,339	-0,011	0,072
	0,045	0,270	0,542	*E*	**-0,528**	-0,502	-0,473	0,022	0,124
	0,064	0,384	-0,107	*O*	0,043	**-0,218**	-0,152	-0,048	0,003
Spain *86-07*	0,032	0,276	-0,058	*S*	0,071	-0,028	-0,169	**0,185**	-0,046
	0,062	0,535	-0,341	*E*	0,106	-0,094	-0,156	0,092	**-0,242**
	0,043	0,371	0,127	*O*	0,037	0,024	-0,107	0,162	**0,191**
UK *83-07*	0,042	0,407	0,345	*S*	0,036	0,094	**-0,177**	-0,005	-0,064
	0,050	0,485	0,108	*E*	0,027	-0,296	**-0,350**	-0,206	0,201
	0,048	0,465	0,354	*O*	0,274	-0,014	-0,253	-0,167	0,057

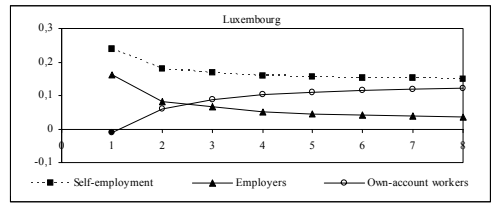
*In bold the highest correlation coefficient

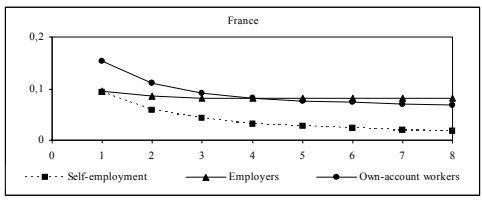
Figures B1: Correlation coefficients of the k-period ahead self-employment and output forecast error.

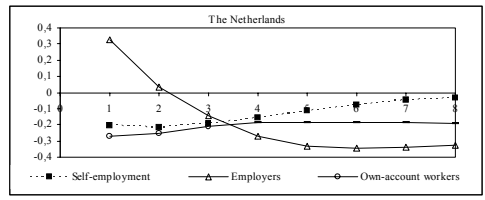


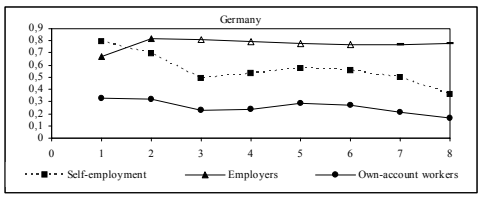


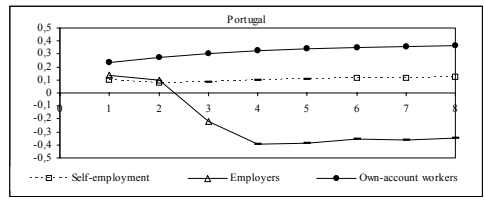


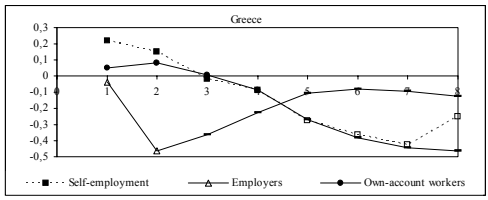


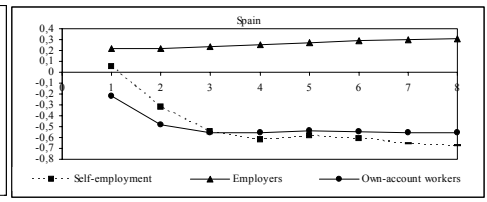


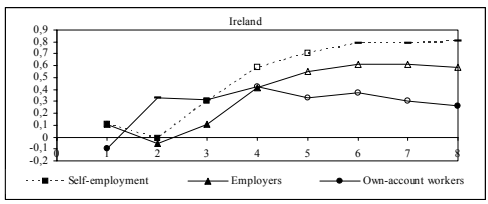


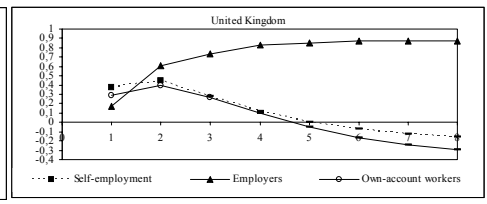






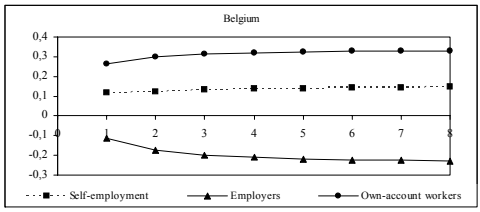


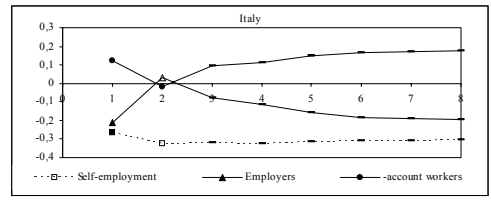


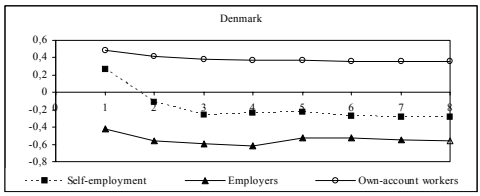


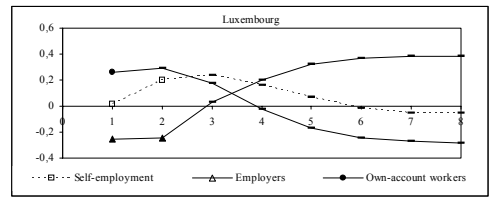
The open squares/circles/triangles indicate that the estimate is significant at the 10% level and the closed indicate that the estimate is significant at the 5% level. A broken line indicates that the estimate is not significant at the 10% level

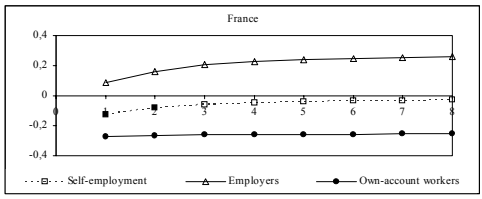
Figures B2: Correlation coefficients of the k-period ahead self-employment and unemployment forecast error.

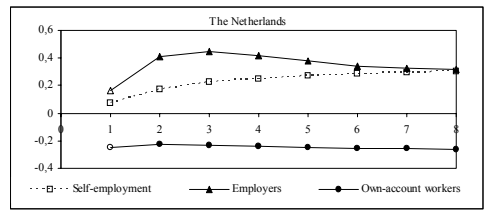


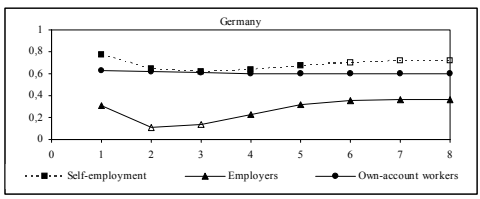


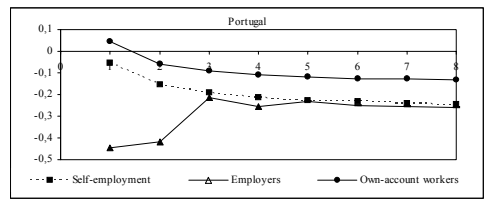


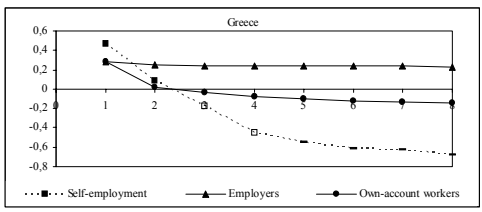


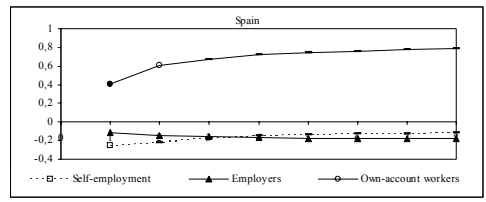


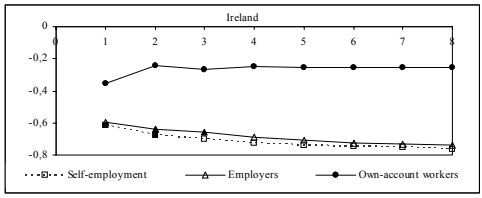


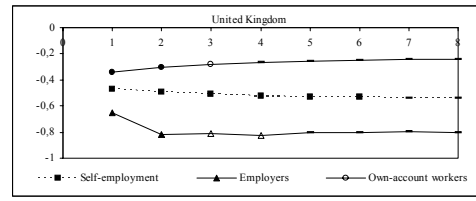












The open squares/circles/triangles indicate that the estimate is significant at the 10% level and the closed indicate that the estimate is significant at the 5% level. A broken line indicates that the estimate is not significant at the 10% level

Unit root tests

When using time series data, it is often assumed that the data are non-stationary and thus that a stationary cointegration relationship needs to be found in order to avoid the problem of spurious regression. For these reasons, we begin by examining the time-series properties of the series. We use a modified version of the Dickey and Fuller (1979, 1981) test (DF) and a modified version of the Philips and Perron (1988) tests (PP) proposed by Ng and Perron (2001) for the null of a unit root, in order to solve the traditional problems associated to conventional unit root tests. Ng and Perron (2001) propose a class of modified tests, $\overline{M}$, with GLS detrending of the data and using the modified Akaike information Criteria to select the autoregressive truncation lag.

Table B3 reports the results of Ng-Perron tests, $\overline{MZ}_{\alpha}^{GLS}$, $\overline{MZ}_{t}^{GLS}$, $\overline{MSB}^{GLS}$, $\overline{MPT}^{GLS}$ and ADF tests. All test statistics formally examine the unit root null hypothesis against the alternative of stationary. The null hypothesis of non-stationarity for series in level, *S and W* cannot be rejected, regardless of the test. Accordingly, these two series would be *I(1)*.

Table B3. Unit root tests Ng-Perron

Country	Variable	$\overline{M}Z_{\alpha}^{GLS}$	$\overline{M}Z_{t}^{GLS}$	$\overline{M}SB^{GLS}$	$\overline{M}PT^{GLS}$	Lags
Belgium *83-07*	*S*	-5.08*	-1.41*	0.28*	5.23*	0
	E	-1.12*	-0.52*	0.46*	14.05*	0
	O	-2.35*	-1.01*	0.43*	9.93*	0
	GDP	-6.58**	-1.58*	0.24**	4.42**	2
	U	-3.95*	-1.39*	0.35*	6.21*	0
Denmark *84-07*	*S*	-4,07	-1,07	0,26	6,31	0
	E	-10,84	-2,30	0,21	8,53	0
	O	-2,76	-0,87	0,31	7,87	0
	GDP	0.82	0.55	0.67	33.68	2
	U	-1.34	-0.55	0.41	11.99	0
France *83-07*	*S*	-1,93	-0,53	0,27	8,44	0
	E	-1,04	-0,44	0,42	13,02	0
	O	-5,82	-1,29	0,22	5,28	0
	GDP	-3.68	-1.10	0.30	6.68	1
	U	-2.77	-1.17	0.42	8.81	0
Germany *83-07*	*S*	0,17	0,11	0,64	28,00	0
	E	-0,19	-0,15	0,78	34,67	0
	O	0,29	0,17	0,60	25,94	1
	GDP	-1.58	-0.63	0.40	11.22	1
	U	-0.85	-0.52	0.61	20.71	0
Greece *83-07*	*S*	-5.28	-1.40	0.27	5.17	2
	E	0.91	0.77	0.84	49.92	0
	O	-0.71	-0.33	0.47	15.58	0
	GDP	-98.41	-6.91	0.07	0.43	5
	U	-1.01*	-0.66*	0.65*	21.72*	0
Italy *83-07*	*S*	1.14	0.70	0.61	31.04	0
	E	-1.81	-0.89	0.49	12.65	0
	O	-4.12	-1.40	0.34	5.98	0
	GDP	-0.99*	-0.44*	0.44*	13.71*	1
	U	-0.28*	-0.12*	0.44*	15.46*	0
Ireland *83-07*	*S*	0.46	0.25	0.54	23.10	2
	E	-2.76	-0.92	0.33	8.03	3
	O	0.42	0.20	0.49	19.72	2
	GDP	-3.85*	-1.13*	0.29*	6.49*	5
	U	-2.87*	-1.12*	0.39*	8.30*	1
Luxembourg *83-07*	*S*	-7.37**	-1.92**	0.26**	3.32**	1
	E	-4.12*	-1.43*	0.35*	5.94*	1
	O	-6.27**	-1.77**	0.28*	3.91**	0
	GDP	-1.79*	-0.66*	0.37*	10.09*	5
	U	-3.28*	-1.12*	0.34*	7.29*	3
Netherlands *87-07*	*S*	-4.38	-1.22	0.28	5.93	3
	E	0.32	0.21	0.67	30.55	0
	O	-0.97	-0.38	0.40	12.37	2
	GDP	-8.73***	-1.91**	0.22***	3.43**	1
	U	-2.37*	-0.96*	0.41*	9.56*	3

Portugal *86-07*	*S*	-0.61	-0.46	0.75	29.95	0
	E	-2.17	-0.97	0.45	10.69	1
	O	-2.21	-1.01	0.46	10.74	0
	GDP	-1.57*	-0.66*	0.42*	11.54*	1
	U	-2.50*	-0.98	0.39*	9.10*	0
Spain *86-07*	*S*	1.92	1.26	0.66	38.95	2
	E	-0.61	-0.29	0.47	15.77	2
	O	2.03	0.80	0.39	18.33	1
	GDP	-1.72*	-0.62*	0.36	10.02	1
	U	-1.40*	-0.61*	0.44*	12.41*	0
UK *83-07*	*S*	-0.68	-0.31	0.45	14.78	1
	E	-3.23	-1.25	0.39	7.57	0
	O	0.07	0.04	0.55	21.84	1
	GDP	-7.85**	-1.76**	0.22***	3.87**	1
	U	-3.83*	-1.29*	0.34*	6.43*	1
Critical values	*1%*	*-13.80*	*-2.58*	*0.17*	*1.78*	
	5%	*-8.10*	*-1.98*	*0.23*	*3.17*	
	10%	*-5.70*	*-1.62*	*0.27*	*4.45*	

Testing for cointegration

The results obtained from applying the Johansen reduced rank regression approach to our model are given in tables B5 and B6. The two hypothesis tested, from no cointegration r=0 (alternatively n-r=2) to the presence of one cointegration vector (r=1) are presented in columns 3 and 4. The eigenvalues associated with the combinations of the *I(1)* levels of x_t are in column 3. Next come the $\lambda_{\max}$ statistics that test whether r=0 against r=1. That is, a test of the significance of the largest λ_r is performed. The results suggest that the hypothesis of no cointegration (r=0) can be rejected at the 5% level (with the 5% critical value given in column 5). The λ_{trace} statistics test the null that $r=q$, where $q=0,1$ against the unrestrictive alternative that $r=2$. On the basis of this test the null hypothesis is rejected for employers for most part of countries (except, Belgium, Spain and Germany and Luxembourg). By contrast, following the tests for cointegration rank suggest the rejection of the null hypothesis of no cointegration for self-employment only in five of the twelve countries.

Table B4. Johansen Cointegration test: Self-employment-GDP

GDP	Var.	$H_o : r$	$n - r$	λ_{trace} test	λ_{trace} (.95)	$\lambda_{\max}$ test	$\lambda_{\max}$ (.95)
Belgium	*S*	0	2	7.62	15.49	7.52	14.27
		1	1	0.10	3.84	0.10	3.84
	E	0	2	16.75	25.87	10.78	19.39
		1	1	5.98	12.52	5.98	12.52
	O	0	2	4.35	15.49	4.07	14.26
		1	1	0.28	3.84	0.28	3.84
Denmark	*S*	0	2	13.41	15.49	13.38*	14.26
		1	1	0.03	3.84	0.03	3.84
	E	0	2	16.25**	15.49	16.19**	14.26
		1	1	0.07	3.84	0.07	3.84
	O	0	2	11.85	15.49	11.67	14.26
		1	1	0.18	3.84	0.18	3.84
France	*S*	0	2	12.84	25.87	10.88	19.39
		1	1	1.96	12.52	1.96	12.52
	E	0	2	15.59	25.87	11.36	19.39
		1	1	4.23	12.52	4.23	12.52
	O	0	2	12.38	25.87	10.46	19.39
		1	1	1.92	12.52	1.92	12.52
Germany	*S*	0	2	14.91*	15.49	11.72	14.26
		1	1	3.18	3.84	3.18	3.84
	E	0	2	4.73	15.49	4.39	14.26
		1	1	0.34	3.84	0.34	3.84
	O	0	2	9.71	15.49	8.49	14.26
		1	1	1.22	3.84	1.22	3.84
Greece	*S*	0	2	31.23***	25.87	22.87**	19.39
		1	1	8.36	12.52	8.36	12.52
	E	0	2	32.56***	25.87	25.42***	19.39
		1	1	7.14	12.52	7.14	12.52
	O	0	2	25.09*	25.87	17.98*	19.39
		1	1	7.11	12.52	7.11	12.52
Italy	*S*	0	2	6.58	15.49	5.39	14.26
		1	1	1.20	3.84	1.20	3.84
	E	0	2	14.44*	15,49	9.74	14,26
		1	1	4.70	3,84	4.70	3,84
	O	0	2	10.28	15.49	8.46	14,26
		1	1	1.82	3,84	1.82	3,84

Ireland	*S*	0	2	22.48	25.87	14.35	19.39
		1	1	8.13	12.52	8.13	12.52
	E	0	2	12.96	15.49	12.82	14.26
		1	1	0.13	3.84	0.13	3.84
	O	0	2	18.72	25.87	13.79	19.39
		1	1	4.94	12.52	4.94	12.52
Luxembourg	*S*	0	2	29.61**	25.87	20.17**	19.39
		1	1	9.44	12.52	9.44	12.52
	E	0	2	18.10	25.87	15.27	19.39
		1	1	2.83	12.52	2.83	12.52
	O	0	2	18.60	25.87	15.70	19.39
		1	1	2.90	12.52	2.90	12.52
Netherlands	*S*	0	2	20.15***	15.49	19.97***	14.26
		1	1	0.17	3.84	0.17	3.84
	E	0	2	26.95**	25.87	22.48**	19.39
		1	1	4.47	12.52	4.47	12.52
	O	0	2	31.37***	25.87	22.10**	19.39
		1	1	9.28	12.52	9.28	12.52
Portugal	*S*	0	2	15.99**	15.49	11.64	14.26
		1	1	4.35	3.84	4.35	3.84
	E	0	2	17.53**	15.49	13.64*	14.26
		1	1	3.89	3.84	3.89	3.84
	O	0	2	7.48	15.49	5.88	14.26
		1	1	1.60	3.84	1.60	3.84
Spain	*S*	0	2	16.74**	15.49	9.82	14.26
		1	1	6.92	3.84	6.92	3.84
	E	0	2	19.11	25.87	15.06	19.39
		1	1	4.05	12.52	4.05	12.52
	O	0	2	8.13	15.49	6.22	14.26
		1	1	1.91	3.84	1.91	3.84
UK	*S*	0	2	27.32**	25.87	21.77**	19.39
		1	1	5.55	12.52	5.55	12.52
	E	0	2	36.84***	25.87	25.34***	19.39
		1	1	11.50	12.52	11.50	12.52
	O	0	2	29.05**	25.87	25.22***	19.39
		1	1	3.83	12.52	3.83	12.52

Note: An asterisk denotes significances at the 10% significance level, two asterisks denote significance at the 5% significance level and three asterisks denote significance at the 1% significance level.

Table B5. Johansen Cointegration test: Self-employment-Unemployment

Unemployment	Var.	$H_o : r$	$n - r$	λ_{trace} test	λ_{trace} (.95)	$\lambda_{\max}$ test	$\lambda_{\max}$ (.95)
Belgium	*S*	0	2	15.39*	15.49	9.77	14.26
		1	1	5.62	3.84	5.62	3.84
	E	0	2	10.12	15.49	9.98	14.26
		1	1	0.15	3.84	0.15	3.84
	O	0	2	11.38	15.49	10.24	14.26
		1	1	1.14	3.84	1.14	3.84
Denmark	*S*	0	2	10.96	15.49	10.61	14.26
		1	1	0.35	3.84	0.35	3.84
	E	0	2	15.55**	15.49	14.64**	14.26
		1	1	0.91	3.84	0.91	3.84
	O	0	2	8.47	15.49	8.43	14.26
		1	1	0.04	3.84	0.04	3.84
France	*S*	0	2	14.58*	15.49	10.85	14.26
		1	1	3.73	3.84	3.73	3.84
	E	0	2	8.07	15.49	6.66	14.26
		1	1	1.41	3.84	1.41	3.84
	O	0	2	15.14*	15.49	10.87	14.26
		1	1	4.28	3.84	4.28	3.84
Germany	*S*	0	2	15.73**	15.49	15.50**	14.26
		1	1	0.23	3.84	0.23	3.84
	E	0	2	22.04***	15.49	20.03***	14.26
		1	1	2.01	3.84	2.01	3.84
	O	0	2	7.59	15.49	7.56	14.26
		1	1	0.03	3.84	0.03	3.84
Greece	*S*	0	2	26.09**	25.87	21.81**	19.39
		1	1	4.27	12.52	4.27	12.52
	E	0	2	3.89	15.49	3.26	14.26
		1	1	0.63	3.84	0.63	3.84
	O	0	2	20.54	25.87	17.66*	19.39
		1	1	2.88	12.52	2.88	12.52
Italy	*S*	0	2	12.45	15.49	12.45*	14.26
		1	1	0.00	3.84	0.00	3.84
	E	0	2	28.66**	25.87	25.73***	19.39
		1	1	2.93	12.52	2.93	12.52
	O	0	2	26.71**	25.87	23.64**	19.39
		1	1	3.06	12.52	3.06	12.52

Ireland	*S*	0	2	6.07	15.49	5.14	14.26
		1	1	0.94	3.84	0.94	3.84
	E	0	2	23.28	25.87	18.26*	19.39
		1	1	5.02	12.52	5.02	12.52
	O	0	2	11.44	15.49	7.06	14.26
		1	1	4.37	3.84	4.37	3.84
Luxembourg	*S*	0	2	17.33**	15.49	14.94**	14.26
		1	1	2.39	3.84	2.39	3.84
	E	0	2	20.78	25.87	17.53*	19.39
		1	1	3.25	12.52	3.25	12.52
	O	0	2	20.23	25.87	17.52*	19.39
		1	1	2.71	12.52	2.71	12.52
Netherlands	*S*	0	2	14.77*	15.49	14.64**	14.26
		1	1	0.13	3.84	0.13	3.84
	E	0	2	25.37***	15.49	23.28***	14.26
		1	1	2.09	3.84	2.09	3.84
	O	0	2	26.10**	25.87	19.54**	19.39
		1	1	6.56	12.52	6.56	12.52
Portugal	*S*	0	2	28.01***	15.49	21.05***	14.26
		1	1	6.96	3.84	6.96	3.84
	E	0	2	28.25***	15.49	21.66***	14.26
		1	1	6.59	3.84	6.59	3.84
	O	0	2	20.95***	15.49	14.60**	14.26
		1	1	6.34	3.84	6.34	3.84
Spain	*S*	0	2	12.54	15.49	8.46	14.26
		1	1	4.08	3.84	4.08	3.84
	E	0	2	9.00	15.49	6.38	14.26
		1	1	2.63	3.84	2.63	3.84
	O	0	2	13.49*	15.49	11.44	14.26
		1	1	2.05	3.84	2.05	3.84
UK	*S*	0	2	16.67	25.87	11.96	19.39
		1	1	4.71	12.52	4.71	12.52
	E	0	2	21.23	25.87	14.28	19.39
		1	1	6.95	12.52	6.95	12.52
	O	0	2	15.86	25.87	12.21	19.39
		1	1	3.65	12.52	3.65	12.52

Note: An asterisk denotes significances at the 10% significance level, two asterisks denote significance at the 5% significance level and three asterisks denote significance at the 1% significance level.

Table B6. Causality between GDP and Self-employment

			Granger		Instantaneous
Country	**Variable**	**Filter**	$\rightarrow GDP$	$\leftarrow GDP$	$\leftrightarrow GDP$
Belgium	S	*First difference*	0.819	0.346	0.898
		Hodrick Prescott	0.657	0.958	0.671
	E	*First difference*	0.520	0.425	0.790
		Hodrick Prescott	0.960	0.193	0.931
	O	*First difference*	0.606	0.799	0.757
		Hodrick Prescott	0.881	0.499	0.670
Denmark	S	*First difference*	0.392	0.176	0.840
		Hodrick Prescott	0.200	0.716	0.704
	E	*First difference*	0.856	**0.099**	0.775
		Hodrick Prescott	0.904	**0.032**	0.346
	O	*First difference*	0.427	0.701	0.688
		Hodrick Prescott	0.511	0.673	0.343
France	S	*First difference*	0.598	0.971	0.407
		Hodrick Prescott	0.489	0.959	0.510
	E	*First difference*	0.736	0.832	0.640
		Hodrick Prescott	0.447	0.597	0.862
	O	*First difference*	0.642	0.964	0.407
		Hodrick Prescott	0.656	0.846	0.466
Germany	S	*First difference*	0.373	0.450	**0.081**
		Hodrick Prescott	0.142	0.260	**0.074**
	E	*First difference*	0.808	**0.033**	**0.076**
		Hodrick Prescott	**0.084**	**0.013**	**0.060**
	O	*First difference*	0.624	0.557	0.357
		Hodrick Prescott	0.590	0.564	0.312
Greece	S	*First difference*	0.711	0.942	0.226
		Hodrick Prescott	0.429	**0.099**	0.696
	E	*First difference*	0.189	0.572	0.650
		Hodrick Prescott	0.117	0.163	0.725
	O	*First difference*	0.557	0.503	0.488
		Hodrick Prescott	0.971	0.903	0.389
Italy	S	*First difference*	0.825	0.702	0.111
		Hodrick Prescott	0.991	0.866	**0.064**
	E	*First difference*	**0.048**	0.939	0.319
		Hodrick Prescott	**0.012**	0.711	**0.042**
	O	*First difference*	0.192	0.709	0.314
		Hodrick Prescott	**0.054**	0.894	**0.078**
Ireland	S	*First difference*	0.292	0.259	**0.088**
		Hodrick Prescott	0.739	**0.080**	**0.059**
	E	*First difference*	0.125	0.712	**0.077**
		Hodrick Prescott	0.498	0.213	**0.051**
	O	*First difference*	0.428	0.220	**0.041**
		Hodrick Prescott	0.996	0.215	**0.016**

Luxembourg	S	*First difference*	0.397	0.924	0.417
		Hodrick Prescott	0.336	0.869	0.605
	E	*First difference*	0.599	0.906	0.595
		Hodrick Prescott	0.441	0.484	0.787
	O	*First difference*	0.676	0.940	0.993
		Hodrick Prescott	0.590	0.701	0.855
Netherlands	S	*First difference*	**0.002**	0.943	0.619
		Hodrick Prescott	0.421	0.356	0.936
	E	*First difference*	0.880	**0.099**	0.747
		Hodrick Prescott	**0.057**	**0.008**	0.930
	O	*First difference*	**0.000**	0.192	0.773
		Hodrick Prescott	**0.004**	0.238	0.764
Portugal	S	*First difference*	0.175	0.101	0.401
		Hodrick Prescott	**0.001**	**0.043**	0.701
	E	*First difference*	**0.034**	**0.038**	0.233
		Hodrick Prescott	**0.000**	**0.000**	0.748
	O	*First difference*	0.659	0.302	0.370
		Hodrick Prescott	0.309	0.420	0.780
Spain	S	*First difference*	0.030	0.833	0.861
		Hodrick Prescott	0.524	0.411	0.528
	E	*First difference*	0.308	0.608	0.552
		Hodrick Prescott	0.497	0.309	0.169
	O	*First difference*	0.139	0.983	0.807
		Hodrick Prescott	0.495	0.308	0.718
UK	S	*First difference*	0.637	**0.016**	0.122
		Hodrick Prescott	**0.057**	**0.013**	**0.075**
	E	*First difference*	0.662	**0.001**	0.498
		Hodrick Prescott	**0.096**	**0.000**	0.174
	O	*First difference*	0.689	**0.084**	0.114
		Hodrick Prescott	**0.094**	0.142	**0.098**

Note: In bold p-values smaller than 10%.

Table B7. Causality between unemployment and Self-employment

			Granger		Instantaneous
Country	**Variable**	**Filter**	$\rightarrow U$	$\leftarrow U$	$\leftrightarrow U$
Belgium	S	*First difference*	0.451	0.562	0.621
		Hodrick Prescott	0.251	0.166	0.636
	E	*First difference*	0.377	0.830	0.606
		Hodrick Prescott	0.315	0.719	0.283
	O	*First difference*	0.650	0.905	0.253
		Hodrick Prescott	0.646	0.537	0.121
Denmark	S	*First difference*	0.561	0.269	0.381
		Hodrick Prescott	0.351	0.492	0.729
	E	*First difference*	0.783	**0.014**	0.516
		Hodrick Prescott	0.586	**0.006**	0.291
	O	*First difference*	0.245	0.516	**0.086**
		Hodrick Prescott	**0.076**	0.306	**0.116**
France	S	*First difference*	0.705	0.896	0.392
		Hodrick Prescott	0.498	0.833	0.554
	E	*First difference*	0.458	0.864	0.689
		Hodrick Prescott	0.299	0.272	0.631
	O	*First difference*	0.977	0.840	0.143
		Hodrick Prescott	0.883	0.313	0.254
Germany	S	*First difference*	0.810	0.388	**0.007**
		Hodrick Prescott	**0.084**	0.138	**0.016**
	E	*First difference*	**0.014**	0.324	**0.100**
		Hodrick Prescott	**0.041**	0.132	**0.062**
	O	*First difference*	0.856	0.987	**0.020**
		Hodrick Prescott	0.350	0.866	**0.018**
Greece	S	*First difference*	0.785	**0.077**	**0.043**
		Hodrick Prescott	0.594	**0.003**	0.125
	E	*First difference*	0.897	0.849	0.160
		Hodrick Prescott	0.841	0.327	0.326
	O	*First difference*	0.786	**0.059**	0.255
		Hodrick Prescott	0.509	**0.006**	0.310
Italy	S	*First difference*	0.750	0.796	0.610
		Hodrick Prescott	**0.082**	0.260	0.636
	E	*First difference*	**0.023**	**0.100**	0.708
		Hodrick Prescott	**0.002**	**0.013**	0.357
	O	*First difference*	**0.044**	0.257	0.958
		Hodrick Prescott	**0.004**	**0.085**	0.495
Ireland	S	*First difference*	0.251	0.520	**0.017**
		Hodrick Prescott	0.298	0.233	**0.016**
	E	*First difference*	0.162	0.705	**0.031**
		Hodrick Prescott	0.313	0.375	**0.031**
	O	*First difference*	0.821	0.795	0.144
		Hodrick Prescott	0.645	0.595	**0.097**

Luxembourg	S	*First difference*	0.691	0.367	**0.078**
		Hodrick Prescott	0.576	0.153	**0.070**
	E	*First difference*	0.608	0.280	**0.091**
		Hodrick Prescott	0.645	**0.058***	0.408
	O	*First difference*	0.328	0.478	0.141
		Hodrick Prescott	0.468	0.601	0.127
Netherlands	S	*First difference*	0.130	0.663	0.784
		Hodrick Prescott	0.206	0.635	0.882
	E	*First difference*	**0.078**	0.541	0.348
		Hodrick Prescott	**0.008**	0.389	0.207
	O	*First difference*	0.456	0.378	0.154
		Hodrick Prescott	0.188	0.321	0.233
Portugal	S	*First difference*	0.433	0.122	0.359
		Hodrick Prescott	**0.010**	**0.042**	0.935
	E	*First difference*	0.159	0.155	**0.037**
		Hodrick Prescott	**0.000**	**0.001**	**0.070**
	O	*First difference*	0.905	0.318	0.815
		Hodrick Prescott	0.516	0.520	0.883
Spain	S	*First difference*	0.289	0.816	0.234
		Hodrick Prescott	0.533	0.516	0.700
	E	*First difference*	0.543	0.486	0.609
		Hodrick Prescott	0.916	0.329	0.199
	O	*First difference*	0.387	0.851	0.332
		Hodrick Prescott	0.324	0.389	0.841
UK	S	*First difference*	0.725	0.984	**0.095**
		Hodrick Prescott	0.731	0.995	**0.032**
	E	*First difference*	0.358	0.136	**0.020**
		Hodrick Prescott	0.358	**0.099**	**0.078**
	O	*First difference*	0.748	0.641	**0.091**
		Hodrick Prescott	0.797	0.615	**0.058**

Note: In bold p-values smaller than 10%.