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Self-employment and job creation in the EU-12

Autoempleo y creación de empleo en la UE-12

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Abstract

This paper examines the co-movement and causality between self-employment and paid-employment cycles in the EU-12 countries using annual data spanning the years 1983 to 2008. Using different strategies, the causality and correlations at different horizons are used to analyze the dynamics in the paid-employment-self-employment relationship. The paper touches a "hot topic", since the high European unemployment rate and the ineffectiveness showed by traditional active labour markets policies, have lead in a renewed interest in the promotion of new start-ups as a way of contributing to job creation. In that sense, this article provides some useful guidelines for devising and implementing this policy.

Keywords: Self-employment; Entrepreneurship; Spain; EU; Time Series models; Business cycles.

Resumen

Este trabajo examina el co-movimiento y la causalidad entre los ciclos del autoempleo y del empleo asalariado en los países de la UE-12 haciendo uso de datos anuales en el periodo 1983-2008. Utilizando diferentes estrategias, se analizan la causalidad y las correlaciones a diferentes horizontes, para analizar la relación dinámica entre el autoempleo y el empleo asalariado. El artículo toca un tópico de la máxima actualidad, dado que las elevadas tasas de desempleo Europeas y la inefectividad mostrada por las tradicionales políticas activas del mercado de trabajo han generado un renovado interés por la promoción del establecimiento de nuevas empresas como una forma de contribuir a la creación de empleo. En este sentido, este artículo proporciona algunas guías útiles para el diseño e implementación de esta política.

Palabras clave: Autoempleo; Entrepreneurship; España; UE; Series temporales; Ciclos económicos.

JEL Classification: L26, E32, M13, C32.

1. Introduction

Combating unemployment is a key policy challenge and maybe the major issue for European authorities, particularly in the current crisis. For that reason, much of the discussion on finding solutions to the unemployment problem is centred on stimulating job creation by promoting start-up companies –i.e. as an instrument of the active labour market policy (Pfeiffer and Reize, 2000a, 2000b; Reize, 2004, Congregado *et al.* 2010).

As it is well-known, policy makers regard entrepreneurship as a way to promote economic growth, innovation (Acs and Audretsch, 1990; Iyigun and Owen, 1998; Audretsch, 2003; Baumol, 2007) and the creation of new employment opportunities (Audretsch and Keilbach, 2004, 2007; Haltiwanger, 2006; van Stel, Carree and Thurik, 2008).

On this basis, governments have devised employment assistance programmes (Parker, 2009) which consist of helping to subsidise welfare recipients to start new ventures and leave the unemployment register (Bendick and Egan, 1987; Reize, 2004; Rissman, 2003; Baumgartner and Caliendo, 2007).

The entrepreneurship policy, in Europe, can be considered a paradigmatic example of this. Entrepreneurship promotion policy is set to boost the Union's levels of entrepreneurship as an explicit objective which must consequently lead to a reduction of unemployment.[1] Programs to foster entrepreneurship have been traditionally justified by the presence of barriers of entry into self-employment, (i.e. capital market failures; administrative burdens, and even the lower social security protection of the self-employed compared to wage earners). However these were considered, mainly, as an alternative to combat unemployment given the ineffectiveness of traditional active labour market policies. In fact, in accordance with the push-pull hypothesis an

[1] In 2000, in Lisbon, the European Council redefined its objectives in terms of employment and economic growth, and recognized the need for radical transformation of the economy, in order to create over 15 millions of new jobs by 2010. At the Barcelona Council in 2002, The Council took note of the Commission's intention to present a Green Paper on Entrepreneurship (European Commission, 2003). In this document the increase in self-employment is associated with the reduction of unemployment (European Commission, 2003, p. 6).

unemployed person may be pushed into self-employment because of the lack of opportunities in getting a job as a paid worker. In this way, as a reaction to the high number of unemployed people in Europe, the promotion of transitions from unemployment to self-employment has become a classical instrument of active labor market policy.

In practice, there are two channels through which self-employment can help to reduce unemployment. Firstly, there is the direct effect of removing a newly self-employed individual from the unemployment market. Moreover this effect is independent of the final status in self-employment –employer or own-account worker-. Secondly, there is an indirect effect of eventual job creation by entrepreneurs who succeed in running enterprises that require outside labour (as employers).

The first channel has been extensively covered in the literature on the determinants of entry into self-employment (see Parker, 2004 for a survey). However, the role of the self-employed as creators of additional paid-employment opportunities, has also been investigated using microdata from different countries. For instance, Carroll *et al.* (2000), Cowling and Taylor (2001), Burke *et al.* (2002) or Henley (2005) provide microeconometric evidence of this relationship using American and British data, in order to understand why entrepreneurs in some countries have a greater propensity to employ additional workers. Taking a theoretical perspective, the work of Cowling, Taylor and Mitchell (2004) is one of the scarce theoretical developments on self-employment which allows for the self-employed employees. This model predicts that the higher the endowment of human capital the greater the likelihood of the entrepreneur employing additional labour, subject to overcoming any capital constraints.

However, there is still a list of pending issues in the literature about the relationship between self-employment and paid-employment one of which is to contribute to a better understanding of the net effect of this relationship using aggregate data.

Unravelling the relationship between self-employment and paid-employment should be a crucial point in order to draw any meaningful conclusion as to why self-employed people in some countries have a greater propensity to employ additional workers. The key contribution of this paper is precisely this: to clear up the type of correlation and causality between self-employment and paid-employment, that is their capacity for contributing to job creation. In particular, we investigate whether self-employment influences subsequent employment performance or whether by contrast empirical evidence supports the reverse effect, i.e. the effect of paid-employment fluctuations on self-employment. We will investigate whether the self-employment dynamics is indeed one of the main determinants of paid-employment evolution as policy-makers implicitly suppose.

In this paper, we intend to partially fill this 'Economics of Self-employment' gap using European data. The lack of long term studies over a wide range of

countries and the lack of a common methodological framework for measuring self-employment have, until now, been two of the major difficulties faced by researchers. Recent efforts carried out by the OECD, Eurostat and the pioneer effort of harmonization carried out by van Stel *et al.*. (2010)[2], should allow us to overcome these obstacles. In particular, we measure the self-employment by the log level of non-agricultural self-employment or any of its components –that is, employers and own-account workers[3]. The data is observed annually and covers the period 1983 to 2007. The data is made available from Eurostat.[4]

In our work, we apply a number of alternative empirical methodologies as a way to evaluate the relationships' robustness and to explore the sensitivity of our estimates. Firstly, we derive measurements for time-varying correlations between the self-employment and its components and the paid-employment using the framework proposed by den Haan (2000) for analysing co-movement for the short- and medium-run. Secondly, the long-run relationship is analysed using the usual cointegration analysis. Finally, the paper also includes an analysis of causality. In particular, instantaneous and Granger causality tests are run.

Our findings can be summarized as follows: the paper reports firstly, a positive relationship between paid-employment and employers, at least in the long term, and quite generalized in the short-run. This result is robust across methods and quite general across countries. Secondly, the relation between own-account workers and paid-employment workers differs across countries. Thirdly, the relation between self-employment and paid-employment is dominated by the own-account workers.

The remainder of the paper is organized as follows. The second section reports a brief theoretical discussion about the relationship between self-employment and paid-employment. The third section reports empirical evidence on the correlation between self-employment and its components and paid-employment, 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 among non-stationary variables by analyzing the presence of cointegration relationships. The fifth section is devoted to the analysis of causality, and the last section contains concluding remarks and some suggestions for further research.

2. Theoretical arguments and hypotheses

In this section we provide different arguments for the effect of paid-employment performance on self-employment and also for the reverse relationship.

[2] EIM's COMPENDIA data base.
[3] For Belgium and Luxembourg, self-employment includes agriculture. Therefore, results of these two countries might be carefully interpreted.
[4] See Appendix A, for a more detailed description of the data. MEI (Main Economic Indicators)

As it is well-known, the correlation between macroeconomic variables, such us paid-employment, unemployment or GDP, and self-employment has been a traditional source of controversy amongst economists. This controversy is not only caused by the existence of opposite theoretical arguments but also by 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. 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). Overlooking this distinction, some opposite co-movements between these self-employment components and paid-employment could remain hidden, since the analysis of the interplay between self-employment and paid-employment only allows for the capture of the 'net' effect.

In principle, self-employment and paid-employment could have either a positive or negative relationship, depending on the balance of forces at work in the labour market.

Rampini (2004) suggests a risk-based reason why the number of entrepreneurs has a positive relationship with regard to paid-employment. When shocks to the economy are favourable, productivity and wealth in entrepreneurship increases, making agents more willing to bear risk and become entrepreneurs. In this process, and in order to face up to the demand expansion, some own-account workers will decide to hire employees and some employers will demand additional employees.

At the same time, employers provoke an increase in wages which draw the low-value own-account entrepreneurs out of entrepreneurship and back into paid-employment (Lucas, 1978). But also, in expansions some own-account workers will switch to an employers 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 own-account entrepreneurs.

However, when shocks are unfavourable, the opposite process occurs: wealth, investment and entrepreneurship all decline. However, because real wages fall during recession, individuals with relatively low ability now have incentives to enter entrepreneurship. This might explain the emergence of worker co-operatives and other "marginal" enterprises in recessions, which disappear in economic recoveries when conventional employment opportunities become more readily available (Lucas, 1978).

Therefore, the paid-employment cycle may have an influence on the occupational choice decision, altering the relative valuation of each alternative (Rissman, 2003), whereas self-employment cycles determine the level of job offers. The net effect could be different depending on the self-employment composition or on the labour market conditions prevailing in each country.

At this point three key questions emerge: Is the relationship between self-employment (and its components) and paid-employment homogeneous across

countries? Have these relationships an unequivocal outcome? And finally, could the self-employment contribution to job creation be different depending on the relative weight of the two components of self-employment?

Based on the above mentioned questions, three hypotheses should be tested:

H1: The self-employment contribution to paid-employment differs across countries.

H2: The relationship between self-employment and paid-employment can be different depending on the self-employment composition.

H3: The labour market situation influences occupational decisions, and the potential role of self-employed as job creators.

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

3. Measuring co-movement with VAR forecast errors

In this section we focus on co-movements of self-employment and paid-employment in the EU-12 by using the methodology developed by den Haan (2002)[5] in order to measure correlations at different forecast horizons.

3.1. Data

The empirical analysis uses annual data on self-employment and paid-employment for the EU-12 countries. The self-employment level (S_t), and its components, employers (E_t) and own-account workers (OA_t) are drawn from the European Labour Force Survey (LFS). The sample starts in 1983 and concludes in 2008. European data allows distinguishing between own-account workers and employers in their basic observations following the standards set by the International Labor Organization (ILO). 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. Therefore the self-employed workers can then be classified as incorporated with or without employees, and unincorporated with or without employees.

[5] This procedure offers advantages over traditional statistics given that using this method no prior detrending of the series is required.

3.2. CO-MOVEMENT

Den Haan`s methodology 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 $X_t = (w_t, s_t)'$ be a 2×1 vector containing the log of paid-employment and the log of self-employment or either of its components.[6] 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:

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

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 w_t are denoted by $E_t w_{t+K}$ and $w^{ue}_{t+K,t}$ where $w^{ue}_{t+K,t}$ can be obtained as follows:

$$w^{ue}_{t+K,t} = w_{t+K,t} - E_t w_{t+K} \qquad (2)$$

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)*.[7]

The correlation coefficient of the forecast error -used to analyse the paid-employment-self-employment relationship at a particular horizon *K*-, can be interpreted as a trend-cycle decomposition where the trend component of paid-employment and self-employment are given by $E_t w_{t+K}$ and $E_t s_{t+K}$, respectively; whereas the cycle components of paid-employment and self-employment are given by $w^{ue}_{t+K,t}$ and $s^{ue}_{t+K,t}$ respectively. Therefore, when analysing the VAR error forecast error correlation at different horizons, we are studying the co-movement between the cyclical components of paid-employment and self-employment.

[6] This model is also estimated using employers and own-account workers.

[7] 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 w_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*.

To save space, the results for our annual data are represented in figures B1 (in the annex B).[8] Charts B1 plots the correlation coefficients of the *K*-period ahead self-employment, employers and own-account workers –corr(Es_{t+i},Ew_{t+i})– and paid-employment forecast errors when a unit root is imposed.[9] The white shapes (diamonds, squares or triangles) indicate that the estimate is significant at the 10% level and the black shapes 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 paid-employment at horizon 1 are very similar than those of the detrending series. These charts also display the correlation of forecast errors at larger horizons, which gives an idea of medium term co-movements. In that sense, there is dominant pattern is one which show evidence of positive correlation for the medium term forecast errors when the relation employers-paid-employment is analyzed (except for Greece, France, Italy and The Netherlands) and these correlation coefficients tend to become larger when the forecast horizon increases, and then stabilize.

However evidence about the relationship between own-account workers and paid-employment is mixed. On the one hand, a small group of countries show a statistically significant negative correlation for the long run forecast horizon (Belgium and Luxembourg[10]), whereas Germany, Italy and the UK, show positive correlations, at least at shorter horizons. Therefore we can find two groups of countries. On the one hand those countries which destroy own-account jobs when paid employment increases –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[11]– and those ones in which a positive demand shock increases both paid-employees and own-account workers.[12]

Finally, the observed relationship between self-employment and output are conditioned by the own-account workers evolution. The sign and pattern 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.

[8] The lag lengths and inclusion of linear and quadratic trends are based on the Akaike information criterion. On the other hand, and given that all series considered exhibit a single unit root, we impose it estimating the VAR model.

[9] Diamonds, Squares and triangles denote the relationship for self-employed workers, employers and own-account workers, respectively.

[10] The fact that data from Belgium and Luxembourg includes agricultural self-employed workers could be behind this result.

[11] An alternative explanation can be given by a relatively high number of transitions to employer.

[12] 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/scattering processes or the role of labour market institutions.

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. 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 the previous section. 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 be able to establish the integration properties of each variable under study. To this end, we report in table B1 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, and w* 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.

Paid-employment and self-employment series 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

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

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:

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

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 βx_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,

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

$$J_{trace} = -T \sum_{i=r+1}^{n} \ln\left(1 - \hat{\lambda}_i\right) \qquad (6)$$

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 B2 shows the results of Johansen's Maximal Eigenvalue and Trace tests for a second order vector autoregression. We find, that except for Denmark employers and paid-employment are cointegrated, given that the null hypothesis $H_0: rank(\pi)=0$ is rejected. On the other hand, paid-employment and own-account workers are cointegrated only for four countries: Denmark, the Netherlands, Portugal and the UK. This different pattern occurs in countries characterised by lower employment protection legislation. Probably, becoming entrepreneur in those countries is easier given that becoming entrepreneur has lower opportunity costs than in the rest of countries included in our sample.

5. Causality

If we interpret the presence of cross-correlation between paid-employment growth and the self-employment (or its components) cycle, we should conclude that we found evidence that employers transmits their cycles to paid-employment cycles as dominant pattern, and on the existence of two groups of countries with opposite co-movements when the interplay between the paid-employment and own-account workers is analysed.

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.[13] 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_t 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.

With regard to the instantaneous causality (see table B3), the dominant pattern is one in which the employers` cycle cause and are caused by paid-employment movements (Denmark, Germany, Italy, Spain and the UK) whereas Ireland, Greece and Luxembourg employers' cycles are caused by the paid-employees movements. In addition for Belgium, Germany, Italy, Portugal and the UK, employers' movements cause paid-employment movements. On the other hand, only six countries (Belgium, Germany, Greece, Ireland, Italy, Germany and the UK), show instantaneous or Granger-causality with regard own-account workers, and only four of them (Belgium, Germany Greece and the UK), presents a causality relationship with regard to self-employment.

6. CONCLUSIONS AND IMPLICATIONS

This paper has analysed the co-movement and causality between the two main groups of employees by status: self-employed workers and paid-employees.

[13] Formally y_t is said to be instantaneously non-causal for x_t if and only if $x_{t+1|\Omega} = x_{t+1|\Omega \cup y_{t+1}}$

Our findings can be summarized as follows: the paper reports firstly, a positive relationship between paid-employment and employers, at least in the long term, and quite generalized in the short-run. This result is robust across methods and quite general across countries. Secondly, the relationship between own-account workers and paid-employment differs across countries. Thirdly, the relationship between self-employment and paid-employment is dominated by the own-account workers.

Our results are robust given that for the same country we find the same relationship irrespective of the estimation method: However, different countries show a different relationship between self-employment and paid-employment.

Furthermore, our results point to the need to do further research in order to explore the country-specific factors which can be behind the opposite co-movements of the own-account workers' component. We can conclude that in those countries where own-account workers show a negative relation to paid-employment the Lucas' effect becomes dominant, whereas the recession-push effect and/or the effect of transitions from own-account workers to employers is otherwise dominant.

Therefore, some structural and/or institutional factors, such as the weight of certain sectors in the economic activity or the intensity of certain phenomena such as the outsourcing might be behind these apparently contradictory results. In addition to labour market characteristics, the intensity and persistence of the unemployment problem and the use of the entrepreneurship promotion policy as an instrument of an active labour market policy or even the intensity of transitions from own-account work to employer in expansions should be considered as some of the key elements in order to understand and interpret this counter-cyclical pattern shown by own-account workers in some countries. In any case no conclusions concerning these explanations can be drawn based on the current analysis. These possible explanations should be the subject of future research.

Finally, the access to self-employment of unemployed people with low skills, the high wages or the excessive employment protection legislation (e.g. long-term contracts or dismissal costs) can become negative elements for the entrepreneurship capacity to contribute to the job creation process. Therefore, it seems that entrepreneurship policy must be more precise if its main objective is to contribute to job creation. Fostering transitions from own-account work to employer might be the better way to achieve this goal. In anycase, solid microeconometric evidence linking employers and paid-employees data is necessary for a better understanding of these relationships.

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APPENDIX A

Data were downloaded from the Labour Force Survey 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 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, we present the Johansen's reduced rank regression approach. Fourth, and finally we report the causality test.

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 (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 B1 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 series would be *I(1)*.

Table B1. Unit root tests Ng-Perron

Country	Variable	$\overline{MZ}_{\alpha}^{GLS}$	$\overline{MZ}_{t}^{GLS}$	$\overline{MSB}^{GLS}$	$\overline{MPT}^{GLS}$	Lags
Belgium	*S*	-5.232	-1.527	0.292	4.905	0
	E	-1.237	-0.590	0.477	14.096	0
83-07	*O*	-2.339	-1.002	0.428	9.941	0
	W	1.057	0.618	0.585	28.334	1
Denmark	*S*	-2.482	-0.714	0.288	8.016	0
	E	-11.228*	-2.345*	0.209	2.274	0
84-07	*O*	-1.501	-0.500	-0.333	9.915	0
	W	0.517	0.263	0.510	21.262	0
France	*S*	-1.701	-0.534	0.314	9.307	0
	E	0.265	0.105	0.394	14.922	0
83-07	*O*	-6.909	-1.732	0.251	3.967	0
	W	-4.234	-1.147	0.271	6.144	2
Germany	*S*	0.097	0.064	0.661	28.722	1
	E	-0.196	-0.153	0.779	34.894	0
83-07	*O*	0.168	0.104	0.622	26.574	1
	W	-0.449	-0.267	-0.594	21.888	0
Greece	*S*	-4.612	-1.284	0.279	5.717	2
	E	1.164	0.994	0.854	53.907	0
83-07	*O*	-0.189	-0.112	0.594	23.144	0
	W	-1.956	-0.691	0.353	9.559	2
Italy	*S*	-2.425	-0.857	0.353	8.774	0
	E	-1.922	-0.922	0.480	12.058	0
83-07	*O*	-3.646	-1.348	0.370	6.719	0
	W	0.232	0.093	0.403	15.190	1
Ireland	*S*	0.426	0.246	0.579	25.049	2
	E	0.833	0.726	0.871	52.453	0
83-07	*O*	0.408	0.205	0.502	20.470	2
	W	-6.269	-1.572	0.251	4.506	2
Luxembourg	*S*	-7.471	-1.776	0.238	3.818	1
	E	-4.041	-1.407	0.348	6.077	1
83-07	*O*	-6.550	-1.809	0.276	3.742	0
	W	0.870	0.531	0.610	29.355	1
Netherlands	*S*	-3.833	-1.124	0.293	6.490	3
	E	0.086	0.060	0.697	31.026	0
87-07	*O*	-0.907	-0.358	0.395	12.444	0
	W	-1.133	-0.512	0.452	13.594	2

Portugal	*S*	-0.696	-0.523	0.751	29.058	0
	E	-2.188	-0.979	0.447	10.633	1
86-07	*O*	-2.364	-1.073	0.454	10.270	0
	W	-3.009	-0.987	0.328	7.632	1
Spain	*S*	1.317	0.855	0.649	34.787	2
	E	-0.447	-0.218	0.487	16.893	2
86-07	*O*	0.358	0.153	0.428	16.539	0
	W	-4.158	-1.197	0.288	6.142	0
UK	*S*	-0.613	-0.289	0.471	15.771	1
	E	-3.197	-1.223	0.383	7.604	0
83-07	*O*	0.121	0.069	0.574	23.388	1
	W	-0.616	-0.268	0.435	14.430	1
Critical values	*1%*	*-13.80*	*-2.58*	*0.17*	*1.78*	
	5%	*-8.10*	*-1.98*	*0.23*	*3.17*	

Notes: *, † denotes significance at the 5% level, and 10% level respectively. The critical values are taken from Ng and Perron (2001, Table 1).

TESTING FOR COINTEGRATION

The results obtained from applying the Johansen reduced rank regression approach to our model are given in table B2. The two hypothesis tested, from no cointegration $r=0$ (alternatively $n\text{-}r=2$) to the presence of one cointegration vector ($r=1$) are presented in the last four columns. The eigenvalues associated with the combinations of the *I(1)* levels of x_t are in column 5. Next come the λ_{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 8). The λ_{trace} statistics test the null that $r=q$, where $q=0,1$ against the unrestrictive alternative that $r=2$.

Table B2. Johansen Cointegration test: Self employment-Paid-employment

GDP	Var.	$H_o : r$	$n-r$	λ_{trace} test	λ_{trace} (.95)	λ_{trace} test	λ_{trace} (.95)
Belgium	*S*	0	2	7,92	14,26	8,17	15,49
		1	1	0,25	3,84	0,25	3,84
	E	0	2	7,18	14,26	7,29	15,49
		1	1	0,11	3,84	0,11	3,84
	O	0	2	3,59	14,26	3,74	15,49
		1	1	0,15	3,84	0,15	3,84
Denmark	*S*	0	2	20,33*	15,49	20,33*	14,26
		1	1	0,00	3,84	0,00	3,84
	E	0	2	27,28*	25,87	17,57†	19,39
		1	1	9,72	12,52	9,72	12,52
	O	0	2	12,87	15,49	12,86*	14,26
		1	1	0,02	3,84	0,02	3,84
France	*S*	0	2	14,78†	15,49	13,72†	14,26
		1	1	1,06	3,84	1,06	3,84
	E	0	2	8,20	15,49	7,40	14,26
		1	1	0,80	3,84	0,80	3,84
	O	0	2	11,28	15,49	11,11	14,26
		1	1	0,17	3,84	0,17	3,84
Germany	*S*	0	2	23,85†	25,87	17,03	19,39
		1	1	6,82	12,52	6,82	12,52
	E	0	2	34,03*	25,87	28,27*	19,39
		1	1	5,76	12,52	5,76	12,52
	O	0	2	6,44	15,49	5,64	14,26
		1	1	0,81	3,84	0,81	3,84
Greece	*S*	0	2	27,91*	25,87	17,35	19,39
		1	1	10,56	12,52	10,56	12,52
	E	0	2	24,14†	25,87	19,48*	19,39
		1	1	4,66	12,52	4,66	12,52
	O	0	2	7,01	15,49	6,28	14,26
		1	1	0,73	3,84	0,73	3,84
Italy	*S*	0	2	12,26	14,26	12,35	15,49
		1	1	0,09	3,84	0,09	3,84
	E	0	2	19,08†	19,39	21,48	25,87
		1	1	2,40	12,52	2,40	12,52
	O	0	2	3,18	14,26	3,46	15,49
		1	1	0,29	3,84	0,29	3,84

Ireland	*S*	0	2	6,76	15,49	6,53	14,26
		1	1	0,23	3,84	0,23	3,84
	E	0	2	23,17*	15,49	20,94*	14,26
		1	1	2,23	3,84	2,23	3,84
	O	0	2	22,47	25,87	16,75	19,39
		1	1	5,72	12,52	5,72	12,52
Luxembourg	*S*	0	2	5,58	14,26	5,68	15,49
		1	1	0,10	3,84	0,10	3,84
	E	0	2	17,40†	19,39	19,77	25,87
		1	1	2,38	12,52	2,38	12,52
	O	0	2	5,02	14,26	5,06	15,49
		1	1	0,04	3,84	0,04	3,84
Netherlands	*S*	0	2	13,80†	15,49	13,28†	14,26
		1	1	0,52	3,84	0,52	3,84
	E	0	2	19,90*	15,49	15,77*	14,26
		1	1	4,13	3,84	4,13	3,84
	O	0	2	24,27*	25,87	20,36†	19,39
		1	1	4,01	12,52	4,01	12,52
Portugal	*S*	0	2	33,63*	25,87	20,57*	19,39
		1	1	13,06	12,52	13,06	12,52
	E	0	2	37,51*	25,87	25,23*	19,39
		1	1	12,28	12,52	12,28	12,52
	O	0	2	30,96**	25,87	19,83**	19,39
		1	1	11,10	12,52	11,10	12,52
Spain	*S*	0	2	9,25	15,49	9,24	14,26
		1	1	0,01	3,84	0,01	3,84
	E	0	2	16,77*	15,49	13,97†	14,26
		1	1	2,80	3,84	2,80	3,84
	O	0	2	6,21	15,49	5,72	14,26
		1	1	0,49	3,84	0,49	3,84
UK	*S*	0	2	20,49	25,87	14,15	25,87
		1	1	6,33	12,52	6,33	12,52
	E	0	2	29,21*	25,87	20,69	19,39
		1	1	8,51	12,52	8,51	12,52
	O	0	2	14,65†	15.49	14,48*	14,26
		1	1	0,17	3.84	0,17	3.84

Notes: *, † denotes significance at the 5% level, and 10% level respectively. Mckinnon critical values for both the Maximum-eigenvalue and Trace test statistics

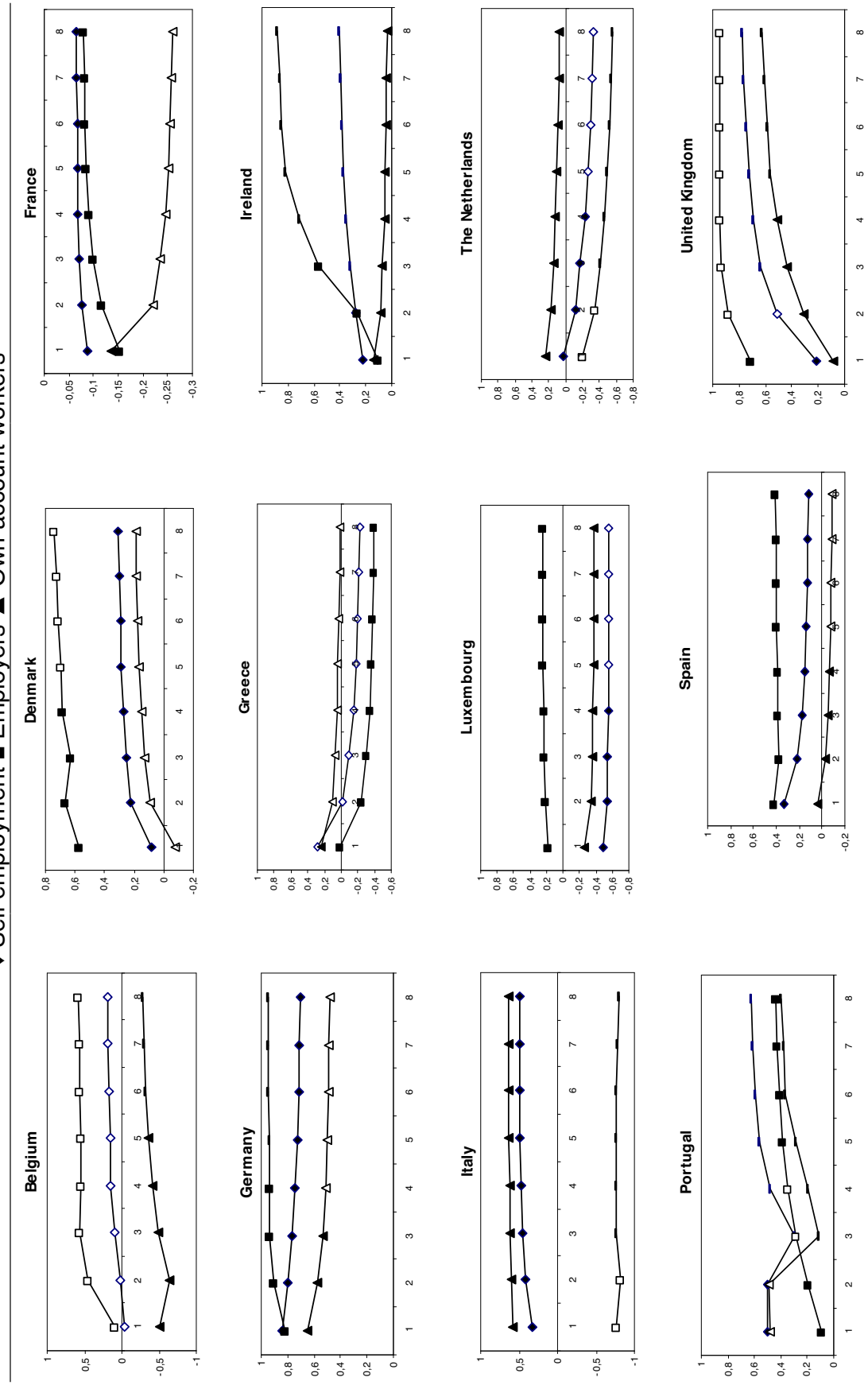
Table B3. Causality between Self-employment and Paid-employment

Causality			Granger		Instantaneous
Country	Variable	Filter	$\rightarrow W$	$\leftarrow W$	$\leftrightarrow W$
Belgium	S	*First difference*	0.044*	0.434	0.741
		Hodrick Prescott	0.198	0.442	0.933
	E	*First difference*	0.061†	0.303	0.283
		Hodrick Prescott	0.030*	0.285	0.418
	O	*First difference*	0.026*	0.729	0.055†
		Hodrick Prescott	0.116	0.626	0.147
Denmark	S	*First difference*	0.391	0.559	0.198
		Hodrick Prescott	0.552	0.565	0.375
	E	*First difference*	0.358	0.933	0.098†
		Hodrick Prescott	0.412	0.405	0.048*
	O	*First difference*	0.228	0.889	0.942
		Hodrick Prescott	0.973	0.428	0.444
France	S	*First difference*	0.566	0.852	0.771
		Hodrick Prescott	0.328	0.609	0.564
	E	*First difference*	0.545	0.988	0.533
		Hodrick Prescott	0.318	0.801	0.379
	O	*First difference*	0.783	0.786	0.994
		Hodrick Prescott	0.597	0.651	0.575
Germany	S	*First difference*	0.177	0.230	0.003*
		Hodrick Prescott	0.096†	0.107	0.002*
	E	*First difference*	0.077†	0.187	0.003*
		Hodrick Prescott	0.015*	0.099†	0.002*
	O	*First difference*	0.998	0.656	0.010*
		Hodrick Prescott	0.944	0.804	0.006*
Greece	S	*First difference*	0.097†	0.571	0.072†
		Hodrick Prescott	0.011*	0.345	0.046*
	E	*First difference*	0.731	0.124	0.672
		Hodrick Prescott	0.428	0.097†	0.727
	O	*First difference*	0.285	0.867	0.346
		Hodrick Prescott	0.071†	0.573	0.389
Italy	S	*First difference*	0,512	0,799	0,252
		Hodrick Prescott	0,280	0,523	0,290
	E	*First difference*	0,528	0,468	0,007*
		Hodrick Prescott	0,034*	0,084†	0,008*
	O	*First difference*	0,487	0,858	0,012*
		Hodrick Prescott	0,091†	0,311	0,019*

Ireland	S	*First difference*	0.876	0.076†	0.424
		Hodrick Prescott	0.968	0.020*	0.464
	E	*First difference*	0.778	0.263	0.756
		Hodrick Prescott	0.912	0.048*	0.386
	O	*First difference*	0.675	0.413	0.982
		Hodrick Prescott	0.061†	0.950	0.479
Luxembourg	S	*First difference*	0.951	0.936	0.027*
		Hodrick Prescott	0.908	0.807	0.033*
	E	*First difference*	0.550	0.081†	0.546
		Hodrick Prescott	0.652	0.034*	0.860
	O	*First difference*	0.394	0.216	0.258
		Hodrick Prescott	0.641	0.110	0.363
Netherlands	S	*First difference*	0.518	0.451	0.608
		Hodrick Prescott	0.762	0.170	0.937
	E	*First difference*	0.197	0.507	0.582
		Hodrick Prescott	0.535	0.107	0.166
	O	*First difference*	0.944	0.669	0.227
		Hodrick Prescott	0.961	0.985	0.312
Portugal	S	*First difference*	0.733	0.276	0.850
		Hodrick Prescott	0.065†	0.045*	0.729
	E	*First difference*	0.259	0.093†	0.232
		Hodrick Prescott	0.004*	0.003*	0.457
	O	*First difference*	0.740	0.799	0.945
		Hodrick Prescott	0.887	0.775	0.753
Spain	S	*First difference*	0.489	0.849	0.274
		Hodrick Prescott	0.338	0.747	0.829
	E	*First difference*	0.221	0.867	0.100†
		Hodrick Prescott	0.551	0.448	0.097†
	O	*First difference*	0.630	0.789	0.919
		Hodrick Prescott	0.325	0.708	0.465
UK	S	*First difference*	0.010*	0.416	0.264
		Hodrick Prescott	0.140	0.831	0.033*
	E	*First difference*	0.096†	0.042*	0.032*
		Hodrick Prescott	0.061†	0.022*	0.024*
	O	*First difference*	0.012*	0.851	0.630
		Hodrick Prescott	0.012*	0.741	0.715

Notes: *, † denotes significance at the 5% level, and 10% level respectively.

FIGURES B1 : CORRELATION COEFFICIENTS OF THE K-PERIOD AHEAD SELF-EMPLOYMENT AND PAID-EMPLOYMENT FORECAST ERROR [14]



[14] The white squares/circles/triangles indicate that the estimate is significant at the 10% level and the black indicate that the estimate is significant at the 5% level. A broken line indicates that the estimate is not significant at the 10% level