The ‘recession-push’ hypothesis reconsidered

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Abstract
The relationship between unemployment and self-employment has been studied extensively. Due to its complex, multifaceted nature, various scholars have found a large array of different results, so that the exact nature of the relation is still not clear. An important element of the relation is captured by the recession-push hypothesis which states that in times of high unemployment individuals are pushed into self-employment for lack of alternative sources of income such as paid employment. We make two contributions. First, we argue that official unemployment rates may not capture the ‘true’ rate of unemployment as it does not include ‘hidden’ unemployed who are out of the labour force. Therefore, we propose a new method where the ‘recession-push’ effect relates not only to the (official) unemployed but also to the inactive population. Second, we argue that the magnitude of the recession-push effect is non-linear in the business cycle, i.e. the effect is disproportionally stronger when economic circumstances are worse. We provide empirical support for our hypotheses using quarterly data for Spain over the period 1976-2004.

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1. Introduction

The correlation between macroeconomic variables (such as unemployment or GDP rates) and self-employment has been a traditional source of controversy among economists, caused by an ambiguous prediction provided by the theory (Thurik, Carree, Van Stel, and Audretsch, 2008). On the one hand, 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.[1] 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. On the other hand, the 'prosperity-pull' hypothesis represents an opposite interpretation of this relationship: at times of high unemployment firms face a lower market demand. This reduces self-employment incomes and possibly also the availability of capital, while the risk of bankruptcy increases. Thus, individuals are "pulled" out of self-employment. At the same time, self-employment may become riskier because if the venture fails, it is less likely that the self-employed worker can find a job in paid-employment. As a result, a negative relationship between self-employment and unemployment is suggested.

Empirical evidence should be a natural way to solve a controversy of these characteristics. However, evidence 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]

We argue that there are four important disadvantages of testing the recession-push hypothesis using unemployment rates. First, it is difficult to distinguish between who is really unemployed and who is out of the labour force. This separation should ideally be made according to who wants a job and who does not. However, official statistics have great difficulty accurately measuring this separation as only individuals fulfilling some

[1] Binks and Jennings (1986) propose a secondary and complementary effect. As firms close down in recessions the availability and affordability of second-hand capital equipment increases, reducing barriers to entry.

[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, 1994a), 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.

criteria of actively searching for a job are entered as unemployed.[5] Hence, many 'hidden' unemployed are not included in the official unemployment statistics, causing a bias of which the magnitude cannot be traced.

A second and related drawback of previous studies is the explicit or implicit assumption of a one-to-one relationship between unemployment and self-employment. This is a questionable assumption as participation rates vary in a way that need not be stationary. The extent of underestimating the number of unemployed may be higher in recession periods, i.e. in times where unemployment rates are already high. In other words, in recession periods relatively many unemployed may 'escape' to the status of inactivity by leaving the labor force. This makes it even harder to make a correct assessment of the relation between unemployment and self-employment.

Third, empirical estimates of the self-employment/unemployment relationship invariably confound the above two effects, capturing a "net" effect of the recession-push and the prosperity-pull effects. In addition, reversed causality is also at play in the sense that a higher number of self-employed individuals may bring down unemployment by means of entrepreneurial activities (Thurik *et al.*, 2008).

Fourth and finally, results in some previous studies are conditioned by the investigation of linear relationships, not controlling for non-linearity. If it is the case that in different phases of the business cycle different types of effects prevails, results from linear models could be hiding either of the two effects.

Given that the available empirical evidence proved unable to solve this controversy, we should explore new empirical approaches or take into account some additional explanatory mechanisms in order to understand and interpret the why and wherefore of the lack of uniformity shown by the empirical evidence. In this sense we explore the recession-push hypothesis from a different perspective: omitting deliberately the use of unemployment rates to avoid the related measurement problems, but, alternatively, analyzing the relationship between paid-employment and self-employment while allowing the employment rate to have an impact as well. As the complement of employment in the adult population is the sum of the (official) unemployed and the inactive population, we basically investigate the interactions between paid-employment, self-employment, and unemployment in a broader sense (including the 'hidden' unemployed). To do this we will employ a vector error correction model (VECM).

In addition, we will investigate both linear and non-linear (cointegration) relationships. In particular, we allow the strength of the 'recession-push' effect to vary according to the employment rate. It is conceivable that the pressure to start their own business is stronger for individuals in a situation of low employment compared to a situation of high employment, as it is harder for individuals to find paid-employment in times of recession. The basic idea behind our approach is the following. The traditional approach for testing the existence of a recession-push (refugee) effects consists of

[5] In the Spanish case, this problem is particularly serious. In 2002, the operational definition of unemployment was changed in Spain, in order to advance towards the European harmonization (COM 1987/2000). As a result, the main problem to reconstruct the unemployment series according to the new definition was given by the new active job search definition. The solution was to recalculate unemployment rates through a probit regression.

analyzing the relationship between unemployment and self-employment rates, using linear cointegration techniques. Contrary to earlier studies we will test whether or not the relationship is time-dependent (in particular dependent on the business cycle). If the statistical test indicates that the relation is not time-dependent, linear cointegration techniques are sufficient. Otherwise, non-linear techniques should be used.

To carry out this task, we extend earlier analyses in two ways: i) analyzing the relationship between self-employment and paid-employment rates in a VECM linear model, where the error correction term can be interpreted as the employment rate, and given the relationship between the employment and unemployment rates, interpreting the self-employment adjustment process when a shock occurs; ii) testing the possible existence of a nonlinear relationship, as a way to verify if the long-term relationship is time-varying.

In sum, this paper aims at investigating the interactions between paid-employment, self-employment and unemployment (in broad sense) in the framework of a VECM model, using Spanish quarterly data during the period 1976:3-2004:4. Our approach allows us to solve methodological and measurement problems associated with the use of unemployment rates for testing the recession-push hypothesis. In addition, in an attempt to explore the robustness of the results obtained by means of the traditional approach, i.e. analysis of a linear VECM, we will test if the relationships under investigation are time-dependent, by means of a threshold cointegration model.

The paper is organized as follows: The empirical methodology is outlined in section 2, the empirical tests are performed in section 3, while the main conclusions are summarized in Section 4.

2. Econometric methodology

As mentioned above, before employing non-linear econometric methodology we estimate a linear VECM using the maximum likelihood technique. The data used in the empirical analysis are quarterly observations drawn from the Labour Force Survey (LFS) produced by the Spanish National Institute of Statistics (INE). The sample period ranges from 1976:3 to 2004:4, where self-employment is defined, adopting the ICSE-1993 criteria[6], as the sum of employers, own-account workers and members of producer's cooperatives.

2.1. Benchmark linear model

The benchmark linear model is a finite-order VAR of the following form:

$$x_t = c + \sum_{i=1}^{k} A_i x_{t-i} + \varepsilon_t \qquad (1)$$

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[6] The International Classification by Status in Employment (ICSE-93) consists of the following groups: employees; employers; own-account workers; members of producers' cooperatives; contributing family workers; and workers not classifiable by status.

In the above model, $x_t = [w_t, s_t]'$ is a vector of non-stationary variables containing the paid-employment rate (w_t) and the self-employment rate (s_t), A_i is a *2x2* matrix of parameters, and ε_t is an *2x1* vector of residuals.[7] Cointegration requires that all the variables have the same order of integration. Before estimating a linear cointegration model we have tested for the order of integration of the paid-employment and the self-employment series. To this end, we have used the modified version of the Dickey-Fuller and Phillips-Perron tests proposed by Ng and Perron (2001). According to these results, s_t and w_t would be I(1). See Appendix A, Table A1, for more details.

In order to characterize the long run dynamic adjustments, we can rewrite the equilibrium VAR model as a vector error correction model (VECM). The VAR(*k*) model can be rewritten in its VECM representation by substracting x_{t-1} from the left and right hand sides:

$$\begin{aligned}\Delta x_t &= c + (A_1 - I)x_{t-1} + \ldots + A_k x_{t-k} + \varepsilon_t = \\ &= c + (A_1 - I)x_{t-1} - (A_1 - I)x_{t-2} + (A_1 - I)x_{t-2} + A_2 x_{t-2} + \ldots + A_k x_{t-k} + \varepsilon_t = \\ &= c + \underbrace{(A_1 - I)x_{t-1} - (A_1 - I)x_{t-2}}_{(A_1 - I)\Delta x_{t-1}} + (A_1 - I)x_{t-2} + A_2 x_{t-2} + \ldots + A_k x_{t-k} + \varepsilon_t = \text{=c+} \\ &= c + (A_1 - I)\Delta x_{t-1} + (A_1 + A_2 - I)\Delta x_{t-2} + \ldots + A_k x_{t-k} + \varepsilon_t\end{aligned}$$

Hence, .

$$\Delta x_t = c + \sum_{i=1}^{k-1} \Gamma_i \Delta x_{t-i} + \Pi x_{t-k} + \varepsilon_t \qquad (2)$$

where $\Gamma_i = -\left(I - \sum_{i=1}^{k-1} A_i\right)$ and $\Pi = -\left(I - \sum_{i=1}^{k} A_i\right)$.

Another decomposition of (1) is given by:

$$\Delta x_t = c + \sum_{i=1}^{k-1} \Gamma_i^* \Delta x_{t-i} + \Pi x_{t-1} + \varepsilon_t \qquad (2')$$

where $\Gamma_i^* = -\left(\sum_{i=1}^{k-1} A_{i+1}\right)$ and $\Pi = -\left(I - \sum_{i=1}^{k} A_i\right)$.

The matrix Π is usually decomposed as:

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[7] Let us define the employment rate (e_t) as the employment to population (aged 16+) ratio, the paid-employment rate (w_t) as the paid-employment to population (aged 16+) ratio, the self-employment rate (s_t) as the self-employment to population (aged 16+) ratio, the unemployment rate (u_t) as the unemployment to population (aged 16+) ratio, while the labour participation rate (p_t) consists of the economically active population (aged 16+) as a percentage of the total population of that same age group. The relation between the rates defined above is given by the two following identities: $w_t + s_t = e_t$ and $u_t + e_t = p_t$.

$$\Pi = \alpha\beta^{'} \qquad (3)$$

where α and β are nxr matrices containing the adjustment coefficients and the cointegrating vector, respectively, n is the number of variables, r is the number of cointegrating relationships (one, in our case). The symbol Δ in equation (2) is the first difference operator. In this form all terms in equation (2) are stationary, that is, integrated of order zero, denoted *I(0)*.

The lagged residuals from the cointegrating vector $\beta^{'}x_{t-1}$, act as an error correction term. This term captures the extent of disequilibrium for the system of variables with respect to the long-run relation between all variables in the system. The α parameters on the error correction terms in each individual equation indicate the speed of adjustment of this variable back to its long-run value. A significant error correction term (i.e. a significant α parameter) implies long-run causality from the explanatory variables to the dependent variable under consideration.

In our application the system can be written as:

$$\begin{bmatrix} \Delta w_t \\ \Delta s_t \end{bmatrix} = \Gamma(L)\begin{bmatrix} \Delta w_{t-i} \\ \Delta s_{t-i} \end{bmatrix} + \begin{bmatrix} \alpha_1 \\ \alpha_2 \end{bmatrix}(w_{t-1} - \beta s_{t-1}) + \begin{bmatrix} \varepsilon_t^w \\ \varepsilon_t^s \end{bmatrix} \qquad (4)$$

where α_1 and α_2 indicate the speed of adjustment of each variable back to its long-run value.

We estimated this model using the maximum likelihood procedure developed by Johansen (1988, 1991). Importantly, we tested that β does not significantly differ from -1 (see Appendix C), hence when estimating the VECM, we fix the value of β to -1. In this way the error-correction term equals $w_{t-1} + s_{t-1}$, i.e. the error correction term is equal to the employment rate. This is convenient for interpretation. The estimation results (linear VECM) are reported in Table 1, while results obtained from applying the Johansen reduced rank regression approach are reported in Table A3.[8]

The results suggest that the hypothesis of non-cointegration (*r=0*) can be rejected at the 5% level. Both in the wage-employment equation and in the self-employment equation the error-correction terms are not significant. As the α 's are not statistically different from zero, both rates are said to be long-run weakly exogenous with respect to the long-run equilibrium.

However, the non-significance of the α parameters could be due to the presence of nonlinearity in the relation –i.e. the relation could be time-dependent. In particular the relation could vary according to different stages of the business cycle. We will account for nonlinearity by applying a two-regime threshold cointegration model, proposed by Hansen and Seo (2002).

[8] Johansen's approach is based on MLE of the VECM, by step-wise concentrating the parameters out, i.e. maximizing the likelihood function over a subset of parameters, treating the other parameters as known, and giving the number r of cointegrating vectors, with the matrix β is the last to be concentrated out.

Table 1. Linear VECM Estimates - Paid-employment-Self-employment

	Δw_t	Δs_t
c	0.0021 (0.0030)	0.0006 (0.0017)
Δw_{t-1}	0.6178** (0.0916)	-0.0272 (0.0436)
Δw_{t-2}	-0.0026 (0.0680)	0.0612 (0.0423)
Δs_{t-1}	0.6820** (0.1568)	0.1154 (0.0771)
Δs_{t-2}	-0.3146 (0.1809)	-0.0490 (0.0762)
α	-0.0038 (0.0073)	-0.0026 (0.0035)

Standard errors are between parentheses.
* Significant at the 5-percent level
** Significant at the 1-percent level

3. Modelling Non-linearity

We then account for non-linearity by applying a threshold cointegration method. The concept of threshold cointegration characterizes a discrete adjustment, in a way in which the system will reach the long-run equilibrium only when it exceeds or does not reach a critical threshold.

Hansen and Seo (2002) provide a vector error-correction model (VECM) in which a cointegration relationship exists between two variables and a threshold effect as an error correction term. As an extension of model (4), a two-regime threshold cointegration model takes the form

$$\begin{bmatrix}\Delta s_t \\ \Delta w_t\end{bmatrix} = \Gamma(L)\begin{bmatrix}\Delta s_{t-1} \\ \Delta w_{t-1}\end{bmatrix} + \begin{bmatrix}\alpha_{11} \\ \alpha_{21}\end{bmatrix}(w_{t-1} - \beta s_{t-1}) + \begin{bmatrix}\varepsilon_t^s \\ \varepsilon_t^w\end{bmatrix} \text{with } (w_{t-1} - \beta s_{t-1}) \leq \gamma$$
$$\begin{bmatrix}\Delta s_t \\ \Delta w_t\end{bmatrix} = \Gamma'(L)\begin{bmatrix}\Delta s_{t-1} \\ \Delta w_{t-1}\end{bmatrix} + \begin{bmatrix}\alpha_{11}' \\ \alpha_{21}'\end{bmatrix}(w_{t-1} - \beta s_{t-1}) + \begin{bmatrix}v_t^s \\ v_t^w\end{bmatrix} \text{with } (w_{t-1} - \beta s_{t-1}) > \gamma \quad (5).$$

Hansen and Seo (2002) proposed a heteroskedastic-consistent LM test where the null hypothesis of linear cointegration (i.e., there is no threshold effect) is tested against the alternative of threshold cointegration. The test assumes a fixed value of β (-1, in our case). Application of the test for our model reveals that the null hypothesis of linear cointegration is indeed rejected in favour of threshold cointegration. We refer to Appendix A for details (see Table A4).

The estimated threshold is $\hat{\gamma} = 38.82$, with the error correction term defined as $w_t + s_t = e_t$ (i.e., the employment rate). Hence, the first regime would occur when the employment rate is below 38.82%. This is the relatively unusual regime, including 13% of the observations (namely, 1984:4 to 1986:3; 1987:1; and 1993:4 to 1994:4). By contrast, the usual regime (with 87% of the observations) would occur when the employment rate is above 38.82%.

The estimated two-regime threshold VAR is reported in Table 2, where significant error-correction effects appear in the first regime (the estimated α parameters are significant) but not in the second regime.

Table 2. Threshold VECM Estimates (Hansen & Seo approach)

Regime 1	$\hat{\beta} = -1$	$w_{t-1} + s_{t-1} \leq 0.3882$
	Δw_t	Δs_t
c	0.2094* (0.0932)	-0.1477* (0.0739)
Δw_{t-1}	0.2067 (0.1450)	-0.3328 (0.2083)
Δw_{t-2}	0.3250* (0.1494)	0.3017 (0.2791)
Δs_{t-1}	1.1497** (0.3549)	1.0470 (0.8736)
Δs_{t-2}	0.0973 (0.4970)	-0.1584 (0.4074)
α	-0.5388* (0.2412)	0.3865* (0.1870)

Standard errors are between parentheses.
Observations percentage: 12.61%.
* Significant at the 5-percent level
** Significant at the 1-percent level

Table 2, continued

Regime 2	$\hat{\beta} = -1$	$w_{t-1} + s_{t-1} > 0.3882$
	Δw_t	Δs_t
c	-0.0004	0.0000
	(0.0038)	(0.0013)
Δw_{t-1}	0.6302**	0.0017
	(0.1003)	(0.0397)
Δw_{t-2}	-0.0124	0.0433
	(0.0732)	(0.0392)
Δs_{t-1}	0.7331**	0.0743
	(0.1747)	(0.0755)
Δs_{t-2}	-0.2837	-0.1073
	(0.1923)	(0.0725)
α	0.0017	-0.0014
	(0.0089)	(0.0031)

Standard errors are between parentheses.
Observations percentage: 87.39%
*Significant at the 5-percent level
**Significant at the 1-percent level

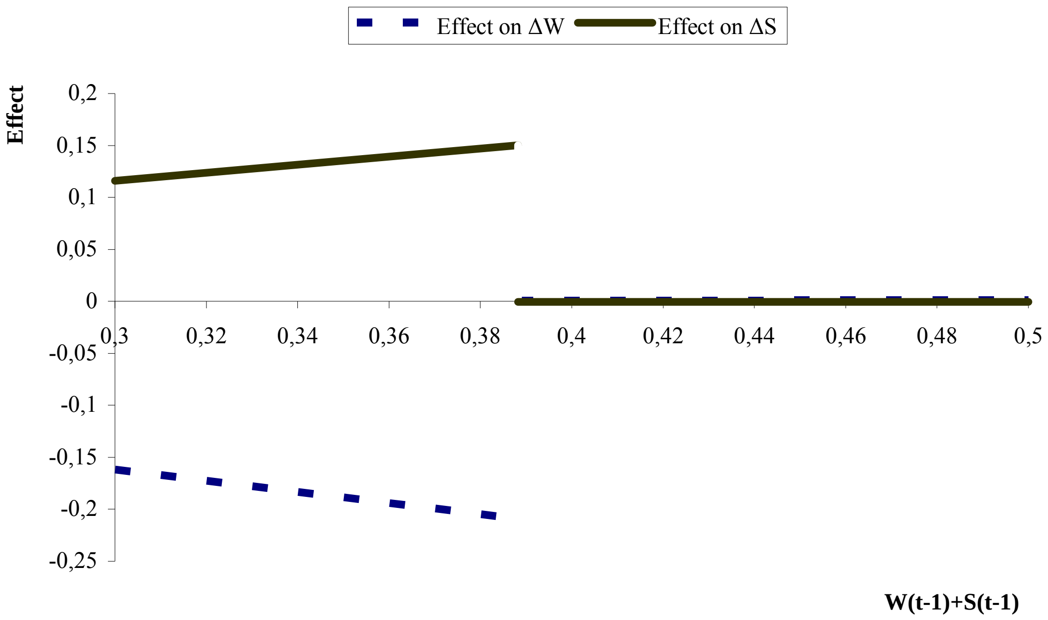
For the self-employment rate equation, the adjustment coefficient (α) is significantly different from zero when the employment rate is below 38.82%, meaning that a value of the gap below 38.82% in one quarter produces upward pressure on the self-employment rate in the subsequent quarter to restore the long-run equilibrium. By contrast, when the employment rate is above 38.82%, the error-correction term in the self-employment rate equation is not significant. As α is not statistically different from zero, the self-employment rate is said to be long-run weakly exogenous with respect to the long-run equilibrium in this second regime.

The economic interpretation of the above findings is as follows. When the employment rate is very low, or, put differently, the unemployment rate in broad sense (i.e. including the inactive) is very high, this phenomenon in itself causes upward pressure on the self-employment rate. Alternative income options are less numerous hence more people start their own businesses. Importantly though, we do not observe this phenomenon when the employment rate is above the estimated threshold value. These results suggest that the recession-push hypotheses is only valid when economic circumstances are poor, i.e. when employment rates are (very) low.

As regards the paid-employment rate equation, the adjustment coefficient (α) is significantly different from zero when the employment rate is below 38.82%, and the effect is negative. We interpret this as a signal that in times of economic recession it is hard to find a job in paid-employment. Hence, the mere phenomenon of low employment causes even more individuals to lose their wage jobs and some of them may be inclined to start their own business, witness the positive α in the self-employment equation in regime 1.

Besides some degree of path-dependency in the wage-employment equation, we note one other interesting result from the table. In both regimes there is a significant positive (causal) effect of the self-employment rate on the paid employment rate, which seems to be quite substantial. This might imply that –at the aggregate level– self-employed individuals create jobs by their entrepreneurial activities. This finding of an 'entrepreneurial' effect for Spain is consistent with findings at the international level reported by Thurik *et al.* (2008).

Figure 1. Response of self-employment and paid-employment rates to error correction (w+s).



Data Source: Spanish Labour Force Survey. Instituto Nacional de Estadística

Figure 1 plots the error-correction effect, i.e., the estimated response of (changes in) the paid- employment rate (Δw_t) and the self-employment rate (Δs_t) to the discrepancy between them (i.e. to the employment rate) in the previous period, holding the other variables constant. As we can see, for a "high" employment rate (i.e. above the threshold, greater than 38.82%), the response of both series (paid-employment rate and self-employment rate) would be nearly zero. However, for a "low" employment rate (i.e. lower than 38.82%), the effect on paid-employment is negative while the effect on self-employment is positive. The latter finding is consistent with the recession-push hypothesis, which can be seen to be only valid for low employment rates.[9]

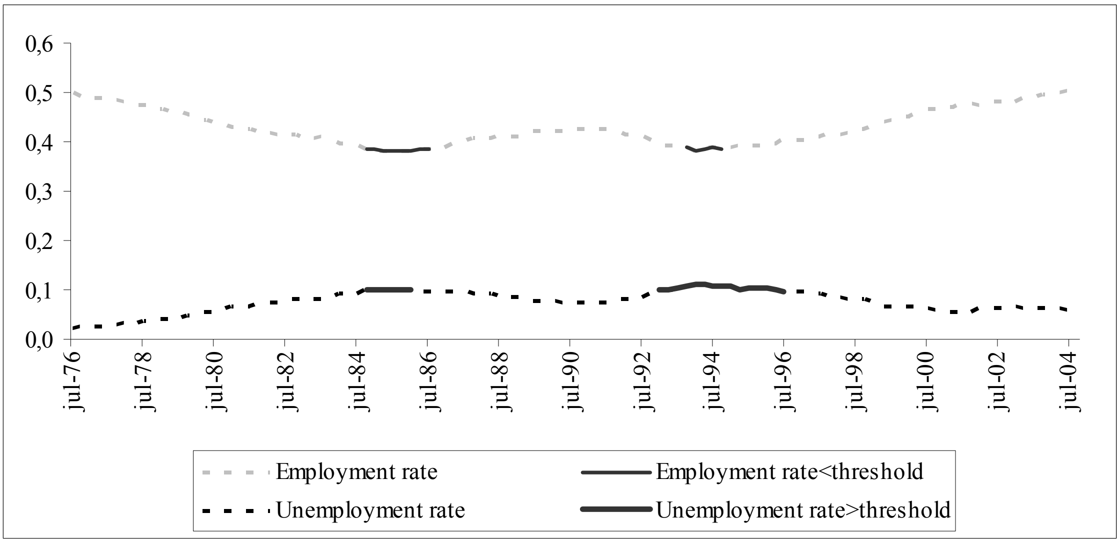
In sum, according to our results, the null hypothesis of linear cointegration is rejected in favour of a two-regime threshold cointegration model. Consequently, a system of two

[9] It is more the positive and negative *intercepts* (i.e. magnitudes) of the effects in regime 1 that are important than the very small positive (negative) *slopes* for the effects on self-employment (paid employment). The positive slope for the self-employment effect is even counter-intuitive as a higher employment rate would make the 'recession-push' to find self-employment less pressing, hence you would expect the magnitude of this effect to be decreasing in employment, instead of increasing. Note that the slope is anything but steep, though.

regimes would seem to characterize the discontinuous adjustment of the self-employment rate towards a long-run equilibrium, with the threshold parameter –the employment rate– estimated at 38.82 percentage points. Therefore, we have a cointegrating relationship only when the employment rate is below 38.82%. This first regime, or the relatively unusual regime in the Spanish economy (with 12.61% of the observations), is coincident with many of the higher unemployment levels during the period, as we can see in Figure 2. This figure shows the unemployment rate (u_t), defined as the unemployment to population (aged 16+) ratio, based on the official unemployment data, defining the unemployment threshold as the difference between the active population to population (aged 16+) ratio and the employment ratio. Although in general high unemployment rates correspond to low employment rates and vice versa (which one would expect), the figure illustrates that the classification of regimes might nevertheless be quite different depending on whether the threshold is computed in terms of employment or in terms of unemployment.[10]

Hence, when the gap is below the estimated threshold parameter (that is when the unemployment rates reach its highest levels), an increase in self-employment rate ought to occur in order to restore the long-run equilibrium between self-employment and wage-employment rates, that is, we would expect a net refugee effect, supporting although qualifying the argument that the recession-push hypothesis states.

Figure 2. Spanish Labour Market indicators. 1976:2-2004:4



Data Source: Spanish Labour Force Survey. Instituto Nacional de Estadística.

[10] We computed the unemployment threshold as follows. Given that our threshold has been defined as an employment rate (38.82%), we have checked that this value corresponds to period 1987/I. In this quarter, the "pseudo" unemployment rate (defined as the difference between active people and employment plus people not included in our self-employment definition), is 9.76%. Using this unemployment rate value, 22 quarters have unemployment rates above this value. Specifically, it concerns periods 1984:4-1986:1 and 1987:1 and 1993:1-1996:3. On the other hand 14 quarters are below the *employment* threshold (1984:4-1986:3 and 1987:1 and 1993:4-1994:4), 12 of which correspond to quarters with values above the *unemployment* threshold. However, considering the 22 periods for which unemployment exceeds the unemployment threshold, only 12 of them correspond to periods where employment is below its specific threshold. This illustrates that it matters a lot whether to compute the threshold in terms of employment or in terms of unemployment.

4. Conclusions

The relationship between unemployment and self-employment has been studied extensively. Due to its complex, multifaceted nature, various scholars have found a large array of different results, so that the exact nature of the relation is still not clear. An important element of the relation is captured by the recession-push hypothesis which states that in times of high unemployment individuals are pushed into self-employment for lack of alternative sources of income such as paid employment. We make two contributions to this literature. First, we argue that official unemployment rates may not capture the 'true' rate of unemployment as it does not include 'hidden' unemployed who are out of the labour force. Therefore, we propose a new method where the 'recession-push' effect relates not only to the (official) unemployed but also to the inactive population. Second, we argue that the magnitude of the recession-push effect is non-linear in the business cycle, i.e. the effect is disproportionally stronger when economic circumstances are worse. We account for this possibility by introducing a two-regime threshold cointegration model. Estimating our model with quarterly data for Spain over the period 1976-2004, we find that the recession-push hypothesis is only valid when the employment rate (the number of employed individuals as a percentage of the total population of 16 years and older) is lower than 39%.

Our paper contributes to a better understanding of the relation between self-employment and unemployment. We have shown that the relation varies with the business cycle, operationalised as the employment rate. Our results raise the question why unemployed individuals are more inclined to start their own business when employment levels are low, compared to situations of high employment. An obvious factor to start a business in times of recession would be the lower job offer arrival rate, resulting in too high search costs for finding a paid job. However, we may also think of a second possible reason. If one imagines a situation where members of the labour force (employed and unemployed individuals) support not only children but also adult (inactive) members of the population (e.g. elderly), then, in times of low employment, the average number of people to be supported (e.g. inactive family members) by an unemployed individual is higher compared to a situation of a flourishing economy (i.e. high employment). This is because the ratio of inactive versus active members of the population is likely to be higher when employment is lower. Hence, on average an unemployment benefit would have to be divided between more people. This might increase pressure for the unemployed to find a (higher) income through self-employment, particularly because the unemployment benefit is only received for a fixed period of time, after which one receives a benefit that is typically lower. This pressure may be felt especially hard when the employment rate is (extremely) low.

Given the current international credit crunch, the regime of low employment, although found only for 13% of the observations during the period 1976-2004, might become more relevant than ever before, hence an important avenue for future research is to investigate the decision processes at the micro level that lead individuals to start businesses in times of recession.

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Appendix A: Statistical tests

In this appendix we present results from several statistical tests which guided us throughout our empirical analysis. First, we show results from unit root tests to see whether or not the variables from our model are stationary or not. Second, we report the diagnosis on the lag length. Third, we present the Johansen's reduced rank regression approach. Fourth and finally, we report the tests of threshold cointegration proposed by Hansen and Seo (2002).

Unit root tests for paid-employment rate and self-employment rate

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 A1 reports the results of Ng-Perron tests, $\overline{M}Z_{\alpha}^{GLS}$, $\overline{M}Z_{t}^{GLS}$, $\overline{M}SB^{GLS}$, $\overline{M}PT^{GLS}$ 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 A1. Unit root tests Ng-Perron

Variable	$\overline{M}Z_{\alpha}^{GLS}$	$\overline{M}Z_{t}^{GLS}$	$\overline{M}SB^{GLS}$	$\overline{M}PT^{GLS}$	*Lags*	*ADF*	*Lags*
Paid-employment rate	-5.965***	-1.552*	0.260*	4.650*	6	-0.219*	6
Self-employment rate	0.884*	1.231*	1.392*	125.74*	8	-2.116*	8

Note:
*Rejects null hypothesis at 1% significance level.
** Rejects null hypothesis at 5% significance level.
** Rejects null hypothesis at 10% significance level.

The critical values are tabulated in Ng & Perron (2001).

Critical values	$\overline{M}Z_{\alpha}^{GLS}$	$\overline{M}Z_{t}^{GLS}$	$\overline{M}SB^{GLS}$	$\overline{M}PT^{GLS}$	ADF
1%	-13.80	-2.58	0.17	1.78	-3.49
5%	-8.10	-1.98	0.23	3.17	-2.89
10%	-5.70	-1.62	0.27	4.45	-2.58

Testing for the lag length

Cointegration analysis requires the model to have a common lag length. To select the lag length of the VAR we have used the Akaike information criterion (AIC), the Schwarz information criterion (SC), and the Hannan-Quinn (HQ) criterion. Although the SC and HQ criteria suggest that *k=2*, the choice of *k* based on the Akaike information criterion suggests that *k=3* is to be preferred. Hence, since the VECM variables are in first-differences, our estimates (see Tables 1 and 2 in the text) incorporate two lags.

Table A2 Results for choosing the lag length of the VAR model based on the AIC, SC and HQ criteria.

Lag	AIC	SC	HQ
0	-13.53957	-13.44193	-13.49996
1	-19.29674	-19.10145	-19.21752
2	-19.50893	-19.21601*	-19.39010*
3	-19.51149*	-19.12092	-19.35305

Testing for cointegration

The results obtained from applying the Johansen reduced rank regression approach to our model are given in table A3. 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 the two first columns. 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. Hence, following the tests for cointegration rank suggest the rejection of the null hypothesis of no cointegration.

Table A3 Johansen Cointegration test

$H_o : r$	$n-r$	λ	$\lambda_{\max}$ test	$\lambda_{\max}$ (0,95)	λ_{trace} test	λ_{trace} (0,95)	Lags
0	2	0.1452	17.4125*	14.2646	17.5023*	15.4947	2
1	1	0.0008	0.0896	3.8415	0.0896	3.8415	

*Asterisk denotes rejection at the 5% significance level.

Testing for nonlinearity

Hansen and Seo (2002) proposed a heteroskedastic-consistent LM test, namely, sup LM^0 (for a fixed β; $\beta = -1$ in our case) for the null hypothesis of linear cointegration (i.e., there is no threshold effect) against the alternative of threshold cointegration. For the test, the p-value is calculated using a parametric bootstrap method (with 5000 simulations replications), as proposed by Hansen and Seo (2002)[11]. Therefore, according to Table A4, threshold cointegration appears at the 0.8% significance level for the sup LM^0 test, i.e., when β is fixed[12], so that the null hypothesis of linear cointegration would be is strongly rejected.

Table A4 Hansen-Seo tests of threshold cointegration

	$\sup LM^0$
Cointegrating vector	$\beta = -1$
Threshold parameter	0.388241
Test statistic value	28.3281
Fixed regressor p-value	0.000
Residual Bootstrap p-value	0.008

Appendix B: Derivation of model and error correction term interpretation

This appendix shows for our application that the residual in the VECM can be interpreted as the employment rate.

Our benchmark model is given by the following expression, (rates expressed in levels):

$$w_t = \mu + \beta s_t + \varepsilon_t ,$$

the estimates of which are presented in Table B1.

In order to contribute to a correct interpretation of the error correction term, observe that, the error correction mechanism is derived from the relationship in first differences:

$$\begin{cases} \Delta s_t = \gamma_0^s + \gamma_1^s \Delta s_{t-1} + \gamma_2^s \Delta w_{t-1} + \alpha^s \varepsilon_{t-1} \\ \Delta w_t = \gamma_0^w + \gamma_1^w \Delta s_{t-1} + \gamma_2^w \Delta w_{t-1} + \alpha^w \varepsilon_{t-1} \end{cases}$$

---

[11] The test is denoted by $\sup LM^0 = \sup_{\gamma_L \le \gamma \le \gamma_U} LM(\beta_0, \gamma)$, where β_0 is the known value of β (in our case $\beta = -1$). The sup LM^0 is a heteroskedastic-consistent LM test statistic for the null hypothesis of linear cointegration against the alternative of threshold cointegration. We have used the bootstrap method developed by Hansen and Seo (2002) to calculate asymptotical critical and p-values.

[12] It can be shown that the long-term parameter between both series is close to -1 (see Table C2 in Appendix C). Therefore we have used the threshold cointegration test sup LM^0, for a fixed β equal to -1, in order to facilitate interpretations. Note that the ECM term $(\mathrm{w}_{t-1} - \beta \mathrm{s}_{t-1})$ is now $(w_{t-1} - (-1)s_{t-1}) = e_t$, i.e., the employment rate.

If $\beta = -1$, then
$w_t = \mu + (-1)\, s_t + \varepsilon_t \Rightarrow \varepsilon_t = w_t - \mu + s_t$

Hence

$$\begin{cases} \Delta s_t = \gamma_0^s + \gamma_1^s \Delta s_{t-1} + \gamma_2^s \Delta w_{t-1} + \alpha^s \left(w_t - \mu + s_t\right)_{t-1} \\ \Delta w_t = \gamma_0^w + \gamma_1^w \Delta s_{t-1} + \gamma_2^w \Delta w_{t-1} + \alpha^w \left(w_t - \mu + s_t\right)_{t-1} \end{cases}$$

$$\begin{cases} \Delta s_t = \gamma_0^s - \mu\alpha^s + \gamma_1^s \Delta s_{t-1} + \gamma_2^s \Delta w_{t-1} + \alpha^s \left(w_t + s_t\right)_{t-1} \\ \Delta w_t = \gamma_0^w - \mu\alpha^w + \gamma_1^w \Delta s_{t-1} + \gamma_2^w \Delta w_{t-1} + \alpha^w \left(w_t + s_t\right)_{t-1} \end{cases}$$

As $e_t = w_t + s_t$

$$\begin{cases} \Delta s_t = c_0^s + \gamma_1^s \Delta s_{t-1} + \gamma_2^s \Delta w_{t-1} + \alpha^s e_{t-1} \\ \Delta w_t = c_0^w + \gamma_1^w \Delta s_{t-1} + \gamma_2^w \Delta w_{t-1} + \alpha^w e_{t-1} \end{cases}$$

where

$$\begin{cases} c_0^s = \gamma_0^s - \mu\alpha^s \\ c_0^w = \gamma_0^w - \mu\alpha^w \end{cases}$$

Appendix C: Testing for the value of β.

Table C2 reports a Wald test where we test the null hypothesis of $\beta = -1$, which is a basic assumption for fixing the beta value in order to facilitate the threshold interpretation. Using the Wald test, we can not reject the null hypothesis.

Table C1: OLS results for the relation between wage-employment and self-employment

Linear regression	
$w_t = \mu + \beta s_t + \varepsilon_t$	
μ	β
0.411* (0.024)	-0,834* (0.214)
Standard errors are between parentheses. * Significant at the 1-percent level	

Table C2. Wald test $H_0 : \beta = -1$

Test statistic	p-value
F-statistic	0.440
Chi-square	0.439