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Participación laboral y ciclo económico

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Labor Force Participation and the Business Cycle

Participación Laboral y ciclo económico

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A mis padres

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Preface

This PhD thesis investigates some of the main aspects of the relationship between unemployment and labor force participation rates from an empirical point of view. The origins of this contribution can be traced back, when I decided to change my initial research to the field of Labor Economics.

Several people have been influential during my PhD research. Professors Vargas, Carrasco acted as supervisors during different stages in which I spent some time in the field of Social Economy. Finally I decided to switch from this field. Professors Golpe, Congregado and Carmona encouraged me to continue researching into Applied Economics. I am really in debt with them for all the guidance they have provided me with during all this process. I am also grateful to the Head of the Department of Business Administration and Marketing, Professor Carmona and also to all my colleagues for their support and help.

Finally, I would like to express my special thanks to my parents for all their support and encouragement.

Huelva, November 2015
Enrique Ferradás Moreira

Chapter 1: Introduction and outline

1.1. Introduction

As it is well-known, an individual is considered unemployed when is without work but available for work and seeking work. That is to have a job or to be actively seeking for one is the key for active and inactive population. Thus, inactive population comprises all those who are neither employed nor unemployed. Among the inactive one can distinguish individuals marginally attached to the labor market that is affected by certain reasons for not looking for work. One of these reasons is the so-called discouraged effect. The discouraged workers are workers who are willing to work, are ready to work but have stopped active search for work for certain reasons.

Younger and older workers, housewives and long-term unemployed are marginally attached to the labour force and subjected to the business cycle fluctuations. Discouraged workers and added workers describe the flows to and out of the labour force. Thus, institutional changes –labor market legislation, pension system, and so on– and economic situation can be the origin of changes in job finding opportunities. In this context, the aim of this dissertation is to analyze the discouraged/added worker effect taking into account for asym-

metries in several directions: by gender, by age and allowing that the relationship can be time varying, from a macroeconomic perspective by using aggregate time series for Spain. In addition the persistence of these effects of cyclical unemployment on the labor force participation rates is also analyzed by using an econometric approach, which allows analyze hysteresis and non-linear relationships in a single framework.

The aim of this thesis is then to verify the following hypotheses:

1. To explore whether the added and discouraged worker effects due to job market reasons are associated with cyclical pattern of changes of the activity rates with respect to unemployment rates, but we only can aspire to capture the net effect of these to opposite effects. Thus participation rate can be pro-cyclical or counter-cyclical with respect to unemployment rate, depending on the relative magnitude of both effects.
2. To check if the relationship between unemployment and labor force participation rates can be asymmetric.

3. To extend the previous analysis by analyzing different sources of potential asymmetries. In particular, to check:

i) if the relationship is time-varying. In that case, cyclical downturn can have a larger impact on activity rate decrease/increase than the

economic recovery on activity rate increase/decrease. The process adjustment lasts longer/shorter if the cyclical downturn occurs than if the economic recovery/recession is present.

ii) if the added / discouraged worker effect due to personal reasons most often refers to males or females, persons with weaker attachment to the labour market specially the younger and the older.

1.2. The relationship between unemployment and labor force participation rates: Added and Discouraged hypotheses

The concept of the added and discouraged worker effects refer to groups of secondary workers, who flow in and out of the labor force according to changing conditions on the unemployment rate.

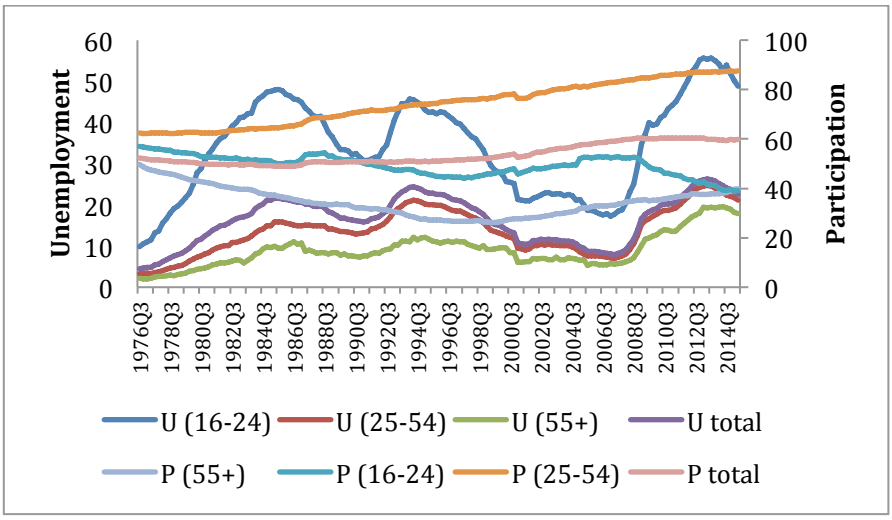
The idea is that they look for work when it is available but stop the search process under unfavorable conditions or start the search process when the economic conditions in the household worsen (see, e.g. Benati 2001, Congregado et al, 2010). The idea is then, that search intensity decreases or increase along unemployment experience, what implies that some workers enter or leave the market looking for a job opportunity or waiting for better job finding opportuni-

ties (Cahuc and Zylberberg, 2004; Altavilla et al. 2005; Congregado et al., 2010; Congregado et al., 2014).

In sum, one could define discouraged workers as those of the inactive population who would have accepted a job once being offered under the prevailing wage conditions but search costs are too large, while added worker hypothesis refers to the labor supply responses of secondary workers, initially inactive, to their partners' or parent's job losses.

1.3. Recent evolution

The Spanish unemployment rate stood at 21.18 percent in the third quarter of 2015, almost five percentage points lower than three years earlier although almost 12 percentage points higher than at the end of 2008. It seems that behind this favorable evolution is not only the result of the entry of the Spanish economy in a new recovery phase but also the effect of the labor force participation rate development. In particular the labor force participation rate is now falling, i.e. it is showing an opposite evolution with regard to the crisis, when the exponential growth of Spanish unemployment was the result of two vectors: an increased supply of labor, reflected by higher labor force participation rates.



In the last four years, a period characterised by austerity, the provisional assessment of the labour market dynamics must be positive in terms of unemployment. The record of the period balance is a fall in unemployment -436.500 unemployed less–but with 104.300 individuals less in employment. These apparently contradictory figures are the result of two opposite movements. The fall in unemployment during de current legislative session reflects the fall in active population during this period. When the Prime Minister Mariano Rajoy arrived at La Moncloa there were 23,4 millions of individuals in the active population, while now (2015 Q3) there are only 22,9.

At the end of 2011, Spain was immersed in a deep recession,

which started in 2007. The unemployment dynamic has been favourable. The Spanish Unemployment has fallen in more than 430.000 individuals. For the first time since 2011, unemployment fell below the 5 million mark.

In particular, the unemployment rate is now at 21,18%. In sum, while the exponential growth in the unemployment rate, experienced during the period 2007-2013, was partially due to the observed rise in the participation rate –specially among some groups of secondary workers such us females or youth, the current fall in the unemployment rate is a direct consequence of the fall in the active population –discouraged effect seems predominate among groups of Spanish workers and specially among migrant workers who have lost their jobs as a result of the crisis have decided to return to their country of origin–. These phenomena could help us to explain the observed fall in the active population a half million lesser than four years ago.

In this framework, this chapter has the aim to explore the relationship between unemployment and LFPR by using alternative econometric frameworks for reconsidering and check the robustness of previous results on the existence of cyclical effects and the persistence of these shocks.

1.4. Unit of analysis

Quarterly data used in this paper are Spanish observations – seasonally adjusted- drawn from the Labour Force Survey (EPA, Spanish National Statistics Institute).

1.5. Econometric framework: an overview

This study takes a macroeconometric approach and applies a wide range of alternative econometric procedures, in order to test the robustness of our empirical results, included the sensitivity of our results to different kind of asymmetries. Our starting point is the search of cointegrating relationships. In particular this analysis uses the Johansen (1988, 1991) procedure to test for the presence of cointegration extended for taking into account nonlinearities by applying a two-regime threshold cointegration model, proposed by Hansen and Seo (2002). 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.

Finally, in order to test the existence of hysteresis in self-employment, we use an unobserved Components approach following the Jaeger and Parkinson's approach (1994) by decomposing rates of entrepreneurship into two unobservable components: a non-stationary "natural rate" component, and a stationary "cyclical" component. These components are estimated in a state space form

by maximum likelihood using the Kalman filter. To the best of our knowledge its application to this relationship is novel.

1.6. Chapter overview

This thesis consists of four self-contained essays structured as follows. It mainly consists of two parts leaving aside this introduction.

Part II includes chapters 2 to 4, three chapters devoted to provide new empirical findings about the cyclical relationship between unemployment and labor force participation. Chapter 2 looks for linear and non-linear relationships between unemployment and labor force participation rate in Spain and the US, using quarterly data from 1976:3 to 2015:2. In this chapter we revisit how participation rates are affected by business cycle fluctuations, while accounting for different sources of asymmetries. In particular, we explore the potential existence of asymmetries into two directions by age groups and checking whether the relationship is time varying. By using Spanish quarterly data over the period 1976-2015, results point to the existence of nonlinear relationships between unemployment and labor force participation for different age groups. In particular, we provide evidence for a nonlinear discouraged worker effect for the oldest and middle-aged groups, while an added worker effect is found for youth when the unemployment rate is below a threshold.

Chapter 3 examines studies the long-run relationship between unemployment and labour force participation rate, from an alternative way, by taking into account possible different sources of asymmetries: structural breaks and the possible existence of asymmetries by gender and age groups, using Spanish data. In the last regime, the current one, our findings support the discouraged for the aggregate labour force participation rate. However, the analysis by gender reports mixed evidence –discouraged for males and added worker effect for females–. Finally when we consider the asymmetries by age, the evidence is mixed again: discouraged for the younger added for the middle age group and invariance for the older.

Chapter 4, re-examines the relationship between the labor force participation rate and the unemployment rate for Spain, looking for Granger causality relationships. The novelty of this study is to explore asymmetries in several ways: by gender, by age and allowing time dependence by using the new tests recently proposed by Hatemi-J (2012). This analysis completes the previous ones, carried out in this dissertation, in order to provide a comprehensive view of the exact nature of this relationship.

The article finds that there is either bidirectional long-run Granger causality running from labor force participation to the unemployment rate for the aggregate and for gender and age groups, except for females and for the middle age group. However if time-

asymmetries are also considered, different causal relationships prevail for different groups and for every regime.

Finally, the contribution of the Part III, deals with the long term. Chapter 5 estimates an unobserved components model to explore the existence of hysteresis in labour participation. In particular, this approach should allow disentangle the effect of unemployment evolution in different business cycle phases on labour force participation –the cyclical effects summarised in the literature in discouraged and added worker effects– and the permanent part, the part that exhibits *resilience* and it is incorporated to the natural component of the participation rate. In addition, and by using an extended version of this model –including non-linearities– we also check the potential existence of different estimates of this relationship in different periods –in expansions and recessions–.

By using this approach, the participation effect of changes in the unemployment rate is analysed. The analysis allows to look not only for cyclical effects –i.e. testing added, discouraged or invariance worker effect– but also for hysteresis.

In sum we use an alternative framework for exploring the dynamic effects of downturns and upturns on labour force participation both in aggregate and by gender, that is the greater/lesser responsiveness labour force participation to downturns/upturns and wheth-

er this shocks show persistence.

The empirical analysis of the labour force participation rate is a hot policy issue at the time of writing, specially in countries like Spain, where not only the deep depression of the economic activity but also the existence of a strong added worker effect –empirical findings of Congregado et al (2014) pointed to this direction among females– are behind the exponential growth experienced by the Spanish unemployment rate. Now, where Spanish economy shows symptoms of recovery and the unemployment rate is starting to fall, the bad news is that it is not the consequence of higher employment but the consequence of a fall in the participation rate –discouraged effect seems to be dominating now the net effect and no hysteresis seems to be present–.

Our results provide robust evidence of hysteresis for the aggregate and for males but not for females, in the linear version. Attending to the cyclical effects our linear unobserved component model also provide evidence of a discouraged effect among males and invariance in the total and females labor force participation rates. However, when the nonlinear model is considered, then we provide evidence of hysteresis not only for males and total but also for females, although in the positive regime for males and for the total. The evidence on the discouraged and invariance hypotheses in this nonlinear model confirms the results obtained in the linear one.

The study concludes with a final chapter, containing some concluding remarks and the future research agenda.

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Parte I

Chapter 2. Exploring asymmetries in the relationship between unemployment, labor force participation

The Spanish unemployment rate stood at 21.18 percent in the third quarter of 2015, almost five percentage points lower than three years earlier although almost 12 percentage points higher than at the end of 2008. It seems that behind this favorable evolution is not only the result of the entry of the Spanish economy in a new recovery phase but also the effect of the labor force participation rate development. In particular the labor force participation rate is now falling, i.e. it is showing an opposite evolution with regard to the crisis, when the exponential growth of Spanish unemployment was the result of two vectors: an increased supply of labor, reflected by higher labor force participation rates. In this article we revisit how participation rates are affected by business cycle fluctuations, while accounting for dif-

ferent sources of asymmetries. In particular, we explore the potential existence of asymmetries into two directions by age groups and checking whether the relationship is time-varying. By using Spanish quarterly data over the period 1976-2015, results point to the existence of nonlinear relationships between unemployment and labor force participation for different age groups. In particular, we provide evidence for a nonlinear discouraged worker effect for the oldest and middle-aged groups, while an added worker effect is found for youth when the unemployment rate is below a threshold.

Keyword: discouraged worker effect, added worker effect, nonlinearity, Spain

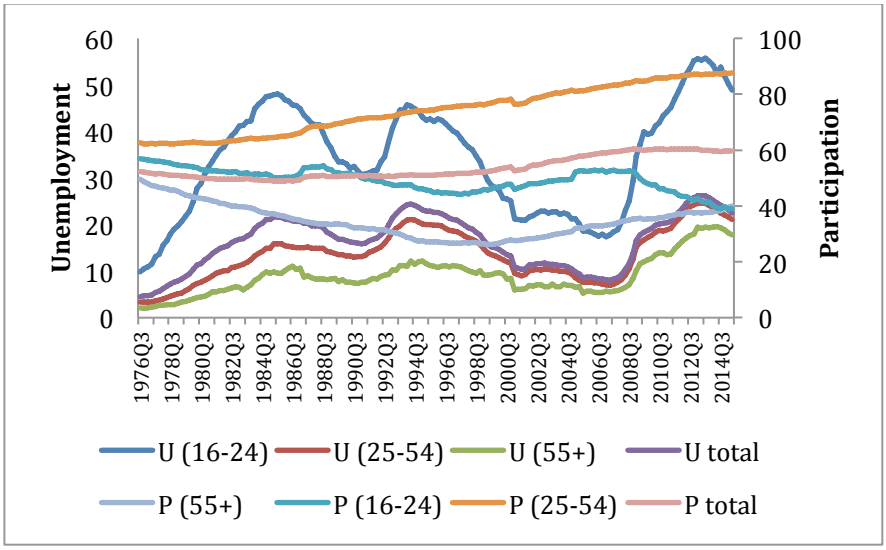
JEL Classification: J22, J64, E24, C32

2.1. Introduction

The Spanish unemployment rate stood at 27.16 percent in the first quarter of 2013. The number of people out of work rose to 6.2 million, the highest number ever in the History of Spain. As it has been well studied some part of this growth was due to the existence of a heavy added worker effect (specially among Spanish females), which offset a weak discouraged effect among males. This evolution of the labor force participation reinforced the deep effect of the fall in the economic activity on the unemployment rate. As is generally known, higher unemployment leads two potential reactions with regard to the decision of participation: on the one hand, people who want a job give up the search due to the lack of job offers (discouraged worker effect). On the other hand, in some households affected by unemployment, some secondary workers, other family members decide to search for a job (added worker effect).

In this context, the aim of this paper is to provide further empirical evidence on the presence of discouraged and added worker effects, in order to understand the importance of these phenomena in the Spanish economy. With this aim, this work, treats to revisit and update the previous works of Congregado, Golpe and Van Stel (2011) and Congregado, Carmona, Golpe and van Stel (2014) which provide evidence for a non-linear relation between unemployment and labor force participation, comprising of a dominant added worker effect for the aggregate participation rate and for the female labour

force participation rate, respectively. Therefore, the present study extends these two previous analyses in two directions. First, Congregado et al. (2011) do not distinguish by age. Second, this work includes data on the recent recovery. In this way the richer variation in the data is much facilitating a more accurate analysis.



As we have analysed in previous chapters, the literature on the cyclical behaviour of the labour force participation provides mixed results. The existence of asymmetries could be behind to these contradictory results. In this way, in this work we are going to hypothesize that: i) the added worker and the discouraged worker effects can have different prevalence depending on the cyclical phase, and then, the relationship can be time-varying; and, ii) regarding age differences one could argue that the discouraged worker effect to be dominant for some interval groups (the two extreme intervals).

Then, we test the discouraged/added worker hypotheses allowing for the possibility of a nonlinear long-run relationship between unemployment and labour force participation that varies by time period and/or by age, using strategies to estimate nonlinear relationships which are in line with recent empirical literature (e.g., Benati, 2001; Altavilla, Garofalo and Vinci, 2005; Congregado et al., 2011, 2014). In particular, our empirical framework initially consists of a linear vector error-correction model (VECM) before employing non-linear econometric methodology. The data are quarterly observations drawn from the Spanish Labour Force Survey. The sample period covers the period 1976:3 to 2015:3.

In sum, the aim of this paper is to provide further empirical evidence on these two opposite effects in order to understand, at least partially, the why and wherefore of the recent evolution of the Spanish labour force participation rate, while attempting to anticipate *its future evolution*. The paper is organized as follows. The next section describes the estimation methodology. The third section presents and discusses the results. Finally, section 4 concludes.

2.2. Econometric Framework[1]

The discouraged-worker effect states that when opportunities of getting a wage-job are relatively low, there will be many discouraged individuals who decide to leave or not enter the labour force. An opposite hypothesis is the so called added-worker which maintains that

[1] This section is based on Congregado et al. (2011, 2014).

when economic conditions worsen, many secondary workers who are not currently in the labour market may decide to start the search for a job. In this way, adverse macroeconomic shocks lead that some secondary workers –students or females in dependence of a main breadwinner–, faced by a household income fall, will decide to participate. Whether, on balance, the labour force participation rate will increase or decrease will depend on the relative strengths of the added-worker and discouraged-worker effects. Then the only way to derive the net effect has to be empirically.

Following the original econometric framework used by Congregado et al. (2011, 2014), the approach consists of analysing the relationship between the labour force participation rate and the employment rate, looking for cointegration relationships. In this way, the benchmark model is a finite-order VAR:

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

where: $x_t = [p_t, e_t]$ is a vector of non-stationary variables containing the labour force participation rate (p_t) and the employment rate (e_t), A_i is a *2x2* matrix of parameters, and ε_t is a *2x1* vector of residuals.2 In order to characterize the long run dynamic adjustments, we

2 Let us define the employment rate (e_t) as the employment to population (aged 16+) ratio, the unemployment rate (u_t) as the unemployment to population (aged 16+) ratio, while the labor participation rate (p_t) consists of the economically active population as a percentage of the population (aged 16+). The relation between

can rewrite the equilibrium VAR model as a vector error correction model (VECM):

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

where: $\Gamma_i = -\left(I - \sum_{i=1}^{k-1} A_i \right)$ and $\Pi = -\left(I - \sum_{i=1}^{k} A_i \right)$. The matrix Π is usually decomposed as $\Pi = \alpha\beta'$, where α and β are *nxr* matrices containing the adjustment coefficients and the cointegrating vector, respectively, *n* is the number of variables, and *r* is the number of cointegrating relationships. The symbol Δ is the first difference operator. In this form, all terms in equation (2) are stationary, that is, integrated of order zero. In our application the system is:

$$\begin{bmatrix} \Delta p_t \\ \Delta e_t \end{bmatrix} = \Gamma(L) \begin{bmatrix} \Delta p_{t-i} \\ \Delta e_{t-i} \end{bmatrix} + \begin{bmatrix} \alpha_p \\ \alpha_e \end{bmatrix} \left(p_{t-1} - \beta e_{t-1} \right) + \begin{bmatrix} u_t^p \\ u_t^e \end{bmatrix} \qquad (3)$$

where α_p and α_e indicate the speed of adjustment of each variable back to its long-run value, the speed of adjustment of this variable back to its steady state.

In the above model, the lagged residuals from the cointegrating vector act as an error correction term. This term, $p_{t-1} - \beta e_{t-1}$, captures the extent of disequilibrium for the system of variables with respect to the long-run relation between all variables in the system. A significant error correction term (i.e. a significant α parameter) im-

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the rates defined above is given by the two following identities: $e_t + u_t = p_t$ and $u_t = p_t - e_t$.

plies long-run causality from the explanatory variable to the dependent variable.

2.3. Results

Model (3) is estimated via maximum likelihood using the procedure developed by Johansen (1988, 1991).3 Our estimation sample period covers the period 1976:3 to 2015:3. We tested that β does not significantly differ from 1, which allows us to fix the value of β at 1. In this way the error-correction term equals $p_{t-1} - e_{t-1}$, i.e. the error correction term is equal to the unemployment rate. This is convenient for interpretation. The estimation results are reported in Table 1.

Table 1

Linear VECM estimates Participation-Employment, by age group

Variables	16-24		25-54		55+	
	Δp_t	Δe_t	Δp_t	Δe_t	Δp_t	Δe_t
c	-0.002*** (0.001)	-0.002** (0.001)	0.002*** (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)
Δp_{t-1}	-0.772*** (0.122)	-0.825*** (0.119)	0.102** (0.062)	-0.471*** (0.161)	-0.005 (0.136)	-0.095 (0.145)
Δp_{t-2}	-0.575*** (0.134)	-0.465*** (0.131)	0.004 (0.054)	0.609*** (0.188)	0.247 (0.157)	0.060 (0.136)
Δp_{t-3}	-0.705*** (0.125)	-0.696*** (0.122)	0.000 (0.070)	-0.382*** (0.135)		
Δp_{t-4}	0.354*** (0.133)	0.685*** (0.130)	-0.117** (0.058)	0.491*** (0.103)	0.241** (0.127)	0.376*** (0.139)

3 Cointegration requires that all variables have the same order of integration. Using the battery of tests proposed by Ng and Perron (2001), p_t and e_t would be I(1). Unit root test results are presented in the Appendix.

Variables	16-24		25-54		55+	
Δe_{t-1}	-0.069 (0.148)	-0.086 (0.144)	0.345*** (0.044)	-0.026 (0.081)	0.080 (0.133)	0.229** (0.120)
Δe_{t-2}	0.264** (0.134)	0.503*** (0.131)	-0.203*** (0.054)	0.281*** (0.082)		
Δe_{t-3}	-0.053*** (0.017)	-0.013 (0.017)	-0.001 (0.004)	0.014** (0.008)	0.027 (0.017)	0.026 (0.017)
Δe_{t-4}	-0.002*** (0.001)	-0.002** (0.001)	0.002*** (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)
α	-0.772*** (0.122)	-0.825*** (0.119)	0.102** (0.062)	-0.471*** (0.161)	-0.005 (0.136)	-0.095 (0.145)

Standard errors are between parentheses.
*, **,*** Significant at 10%, 5% and 1% level, respectively.

Table 1 shows that in the participation rate equation, the error-correction term (α_p) is not significantly different from zero for the oldest specification. By contrast, this term is significantly negative for the specification among the youngest, meaning that an increase in the unemployment rates for this group in one quarter produces downward pressure on the participation rate in the subsequent quarter to restore the long-run equilibrium – evidence of a discouraged worker effect among the youngest individuals. By contrast, for individuals who belongs to the middle-aged interval results provide evidence of a weak added-worker effect, i.e. a positive relationship between unemployment and labor force participation.

Finally, and based on these results, should we reject the existence of a relationship between participation and employment rates for the oldest? The response to this answer should be negative. Indeed, there is no reason for supposing a symmetrical relationship, as a prior. As mentioned earlier, it is possible that the discouraged/added worker effect is time-varying. We then account for nonlinearity by

applying a threshold cointegration model (Balke and Fomby, 1997). The concept of threshold cointegration characterizes a discrete adjustment, in a way in which the cointegration relationship between a set of variables only exists in a certain range, but does not hold if the system gets too far from the equilibrium. Hansen and Seo (2002) provide a vector error-correction model (VECM) in which the interplay between the variables is allowed to differ between situations where the error-correction term is below or above a certain threshold. As an extension of model (3), a two-regime threshold cointegration, or a nonlinear VECM model, takes the form:

$$\begin{bmatrix}\Delta p_t \\ \Delta e_t\end{bmatrix} = \Gamma(L)\begin{bmatrix}\Delta p_{t-1} \\ \Delta e_{t-1}\end{bmatrix} + \begin{bmatrix}\alpha_p \\ \alpha_e\end{bmatrix}\left(p_{t-1} - \beta e_{t-1}\right) + \begin{bmatrix}u_t^p \\ u_t^e\end{bmatrix} \quad with \left(p_{t-1} - \beta e_{t-1}\right) \le \gamma \tag{4}$$

$$\begin{bmatrix}\Delta p_t \\ \Delta e_t\end{bmatrix} = \Gamma'(L)\begin{bmatrix}\Delta p_{t-1} \\ \Delta e_{t-1}\end{bmatrix} + \begin{bmatrix}\alpha_p' \\ \alpha_p'\end{bmatrix}\left(p_{t-1} - \beta e_{t-1}\right) + \begin{bmatrix}v_t^p \\ v_t^e\end{bmatrix} \quad with \left(p_{t-1} - \beta e_{t-1}\right) > \gamma$$

Moreover, Hansen and Seo (2002) propose a set of heteroskedastic-consistent Lagrange multiplier (LM) test statistics for the null hypothesis of linear cointegration (i.e., there is no threshold effect), against the alternative of threshold cointegration (i.e., model 4). The results of the tests for the different age groups are reported in Table 2. Threshold cointegration for the different groups would appear at the 0.2%, 4.2% and 2.2% and 1.4%, 4.2% and 4.2% significance level, for the fixed regressor and for the residual bootstrap, respectively, so that the null hypothesis of linear cointegration would be rejected, in favor of a nonlinear cointegration relationship.

Table 2

Hansen-Seo Tests of Threshold Cointegration

Variables	16-24	25-54	55+
	$\sup LM^0$		
Cointegrating vector	1	1	1
Threshold parameter	0.134	0.104	0.023
Test statistics	32.936	30.254	24.953
Fixed regressor p-value	0.002	0.042	0.022
Residual Bootstrap p-value	0.014	0.042	0.042

The estimated threshold for the interval 16-24 is $\gamma = 0.134$ with the error correction term defined as $p_{t-1} - e_{t-1}$. Hence, the first regime (including 32.24% of the observations) would occur when the employment rate for this age-interval is less than 13.4 percentage points below the participation rate; in other words, when the gap (unemployment rate for this group) is below 13.4%. In turn, the second regime (with 67.76% of the observations) would occur when the gap is above 13.4%. The corresponding two-regime threshold VECM for the age group 16-24 is given below, in table 3.

Table 3 shows that when youth unemployment, expressed as a percentage of the population between the ages 16 to 24, is below 13.4%, increases in unemployment lead to increases in labor force participation, consistent with an added worker effect.

Above the threshold, the error-correction term for the youth specification is not significant, so that above this threshold, we do not find

a relation between unemployment and labor force participation for youth. The results for the effects of unemployment on labor force participation for this age group are illustrated in Figure 2.

Table 3

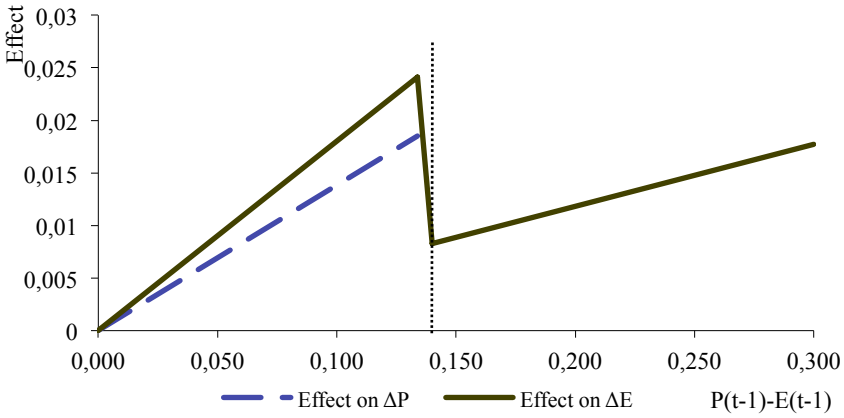
Threshold VECM Estimates for the age group 16-24 (Hansen & Seo Approach)

Regime defined by	$p_{t-1} - e_{t-1} \leq 0.134$		$p_{t-1} - e_{t-1} > 0.134$	
Variable	Δp_t	Δe_t	Δp_t	Δe_t
C	-0.011* (0.007)	-0.017* (0.010)	-0.011** (0.005)	-0.015*** (0.005)
Δp_{t-1}	-1.205*** (0.266)	-1.258*** (0.270)	-0.647*** (0.122)	-0.695*** (0.095)
Δp_{t-2}	-1.012*** (0.223)	-0.945*** (0.276)	-0.371** (0.160)	-0.194 (0.149)
Δp_{t-3}	-0.818*** (0.228)	-0.973*** (0.298)	-0.666*** (0.163)	-0.579*** (0.116)
Δe_{t-1}	0.525* (0.273)	0.716*** (0.280)	0.305** (0.143)	0.764*** (0.114)
Δe_{t-2}	0.194 (0.210)	0.249 (0.257)	-0.216 (0.155)	-0.343*** (0.140)
Δe_{t-3}	0.074 (0.236)	0.434 (0.294)	0.367* (0.204)	0.578*** (0.118)
α	0.138** (0.063)	0.180** (0.096)	0.031 (0.028)	0.059** (0.026)
Observations percentage:	32.24		67.76	

Standard errors are between parentheses.
*, **,*** Significant at 10%, 5% and 1% level, respectively.

Figure 2. Responses of Participation Rates to Error Correction, by age-group (P-E): 16-24

16-24



Middle age group

The estimated threshold for the interval 25-54 is now $\gamma = 0.104$. Thus, the first regime (including 62.50% of the observations) would occur when the unemployment rate for this age group is below 10.4%. In turn, the second regime (with 37.50% of the observations) would occur when the gap is above 10.4%. Table 4 reports the estimates of the two-regime threshold VECM for this age group. As we can observe, from estimates we only provide evidence of a negative relationship between unemployment and participation (discouraged effect) when the unemployment among this middle-aged groupd, expressed as a percentage of the population between the ages 25 to 54, is below 10.4%, i.e. a rise in unemployment lead to a fall in labor force participation, consistent with an discouraged worker effect.

Below the threshold, the error-correction term is not significant, so that we do not find a relation between unemployment and labor force participation for this group. The results for the effects of unemployment on labor force participation for this age group are illustrated in Figure 3.

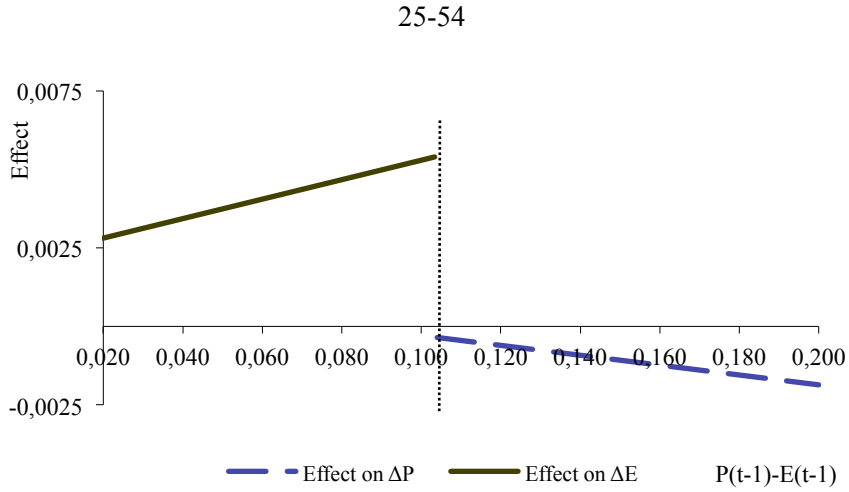
Table 4

Threshold VECM Estimates for the age group 25-54 (Hansen & Seo Approach)

Regime defined by	$p_{t-1} - e_{t-1} \leq 0.104$		$p_{t-1} - e_{t-1} > 0.104$	
Variable	Δp_t	Δe_t	Δp_t	Δe_t
C	0.000 (0.001)	-0.002* (0.001)	0.005*** (0.001)	0.001 (0.003)
Δp_{t-1}	0.102* (0.068)	-0253** (0.119)	-0.255** (0.114)	-0.972*** (0.235)
Δp_{t-2}	-0.012 (0.063)	0.192 (0.124)	-0.266** (0.109)	1.043*** (0.187)
Δp_{t-3}	0.000 (0.106)	-0.174 (0.117)	-0.196** (0.086)	-0.742*** (0.163)
Δe_{t-1}	-0.061 (0.103)	0.444*** (0.132)	-0.167*** (0.058)	0.543*** (0.113)
Δe_{t-2}	0.373*** (0.087)	0.202** (0.093)	0.228*** (0.049)	-0.224** (0.108)
Δe_{t-3}	-0.227* (0.128)	0.131 (0.095)	-0.149*** (0.051)	0.423*** (0.112)
α	0.017 (0.013)	0.027* (0.015)	-0.018*** (0.007)	0.007 (0.017)
Observations percentage:	62.50		37.50	

Standard errors are between parentheses.
*, **,*** Significant at 10%, 5% and 1% level, respectivel

Figure 3. Responses of Participation Rates to Error Correction, by age-group (P-E): 25-54



Oldest age group

Finally, we report the results for the oldest age group. The estimated threshold for population aged 55 to more is $\gamma = 0.024$. Thus, the first regime (including 84.31% of the observations) would occur when the unemployment rate for this age group is below 2.4%. In turn, the second regime (with 15.69% of the observations) would occur when the gap is above 2.4%. Table 5 reports the estimates. Results provide now a weak evidence of a negative relationship between unemployment and participation (discouraged effect) when the unemployment rate for this group is below 2.4%, consistent then with an discouraged worker effect.

Above the threshold, the error-correction term is not significant. The results for the effects of unemployment on labor force participation for this age group are illustrated in Figure 4.

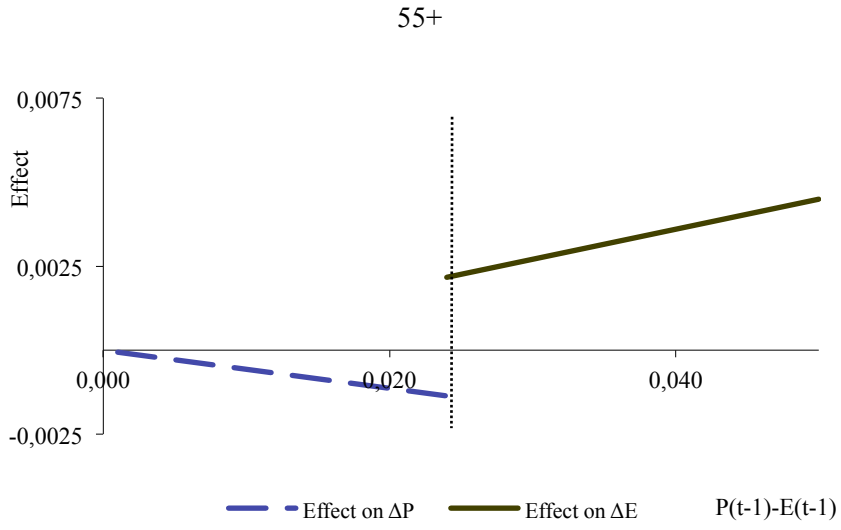
Table 4

Threshold VECM Estimates for the age group 55+ (Hansen & Seo Approach)

Regime defined by	$p_{t-1} - e_{t-1} \leq 0.024$		$p_{t-1} - e_{t-1} > 0.024$	
Variable	Δp_t	Δe_t	Δp_t	Δe_t
C	0.001 (0.001)	-0.001 (0.001)	0.001 (0.001)	-0.003 (0.002)
Δp_{t-1}	0.066 (0.161)	-0.050 (0.159)	-0.714*** (0.284)	-0.600* (0.348)
Δp_{t-2}	0.158 (0.155)	-0.032 (0.143)	-0.040 (0.446)	0.069 (0.451)
Δp_{t-3}				
Δe_{t-1}	0.202 (0.146)	0.327** (0.144)	0.503* (0.267)	0.657* (0.349)
Δe_{t-2}	0.125 (0.128)	0.347*** (0.135)	0.135 (0.307)	-0.139 (0.300)
Δe_{t-3}				
α	-0.057* (0.035)	-0.011 (0.039)	0.033 (0.039)	0.090* (0.054)
Observations percentage:	84.31		15.69	

Standard errors are between parentheses.
*, **,*** Significant at 10%, 5% and 1% level, respectively.

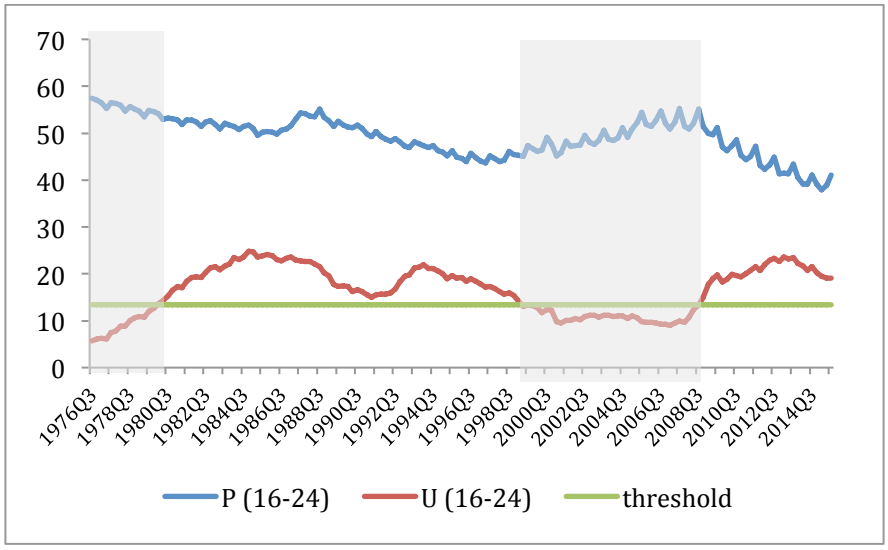
Figure 3. Responses of Participation Rates to Error Correction, by age-group (P-E): 55+

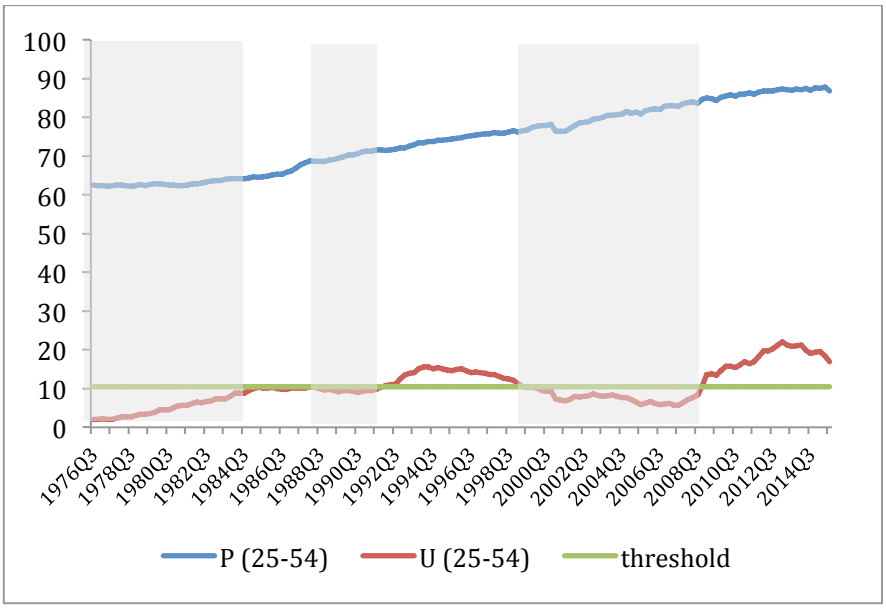


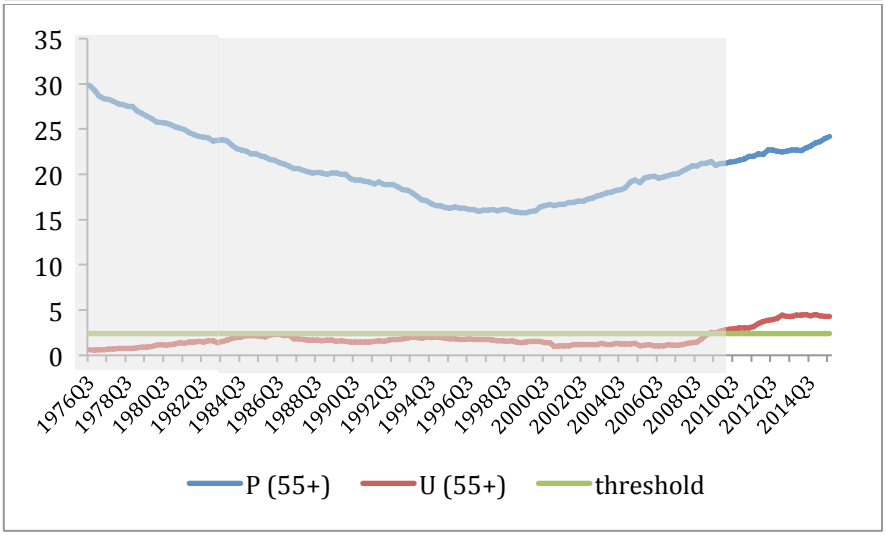
In sum, according to our results, the null hypothesis of linear cointegration is rejected for the different age groups considered, and rejected in favor of a two-regime threshold cointegration model. In addition, taking into account these two sources of asymmetries we can qualify previous empirical evidence. In particular our findings point to: for youth, we provided evidence of a cointegrating relationship (a positive one) only when the unemployment rate (expressed as a percentage of population aged from 16 to 24 years) is below 13.4%. This first regime coincides with the relatively higher unemployment levels during the period, as one can see in Figure 3. This figure shows the 'equivalent' youth unemployment rate threshold (23.45%), based on the official unemployment data. Shadowed areas correspond to the first regime, in which an added worker effect operates for Spanish youth.

For the other two groups shows only a discouraged worker effect, when the unemployment rate is above 10.4% for individuals aged from 25 to 54, and when the oldest unemployment rate is below 2.4% for individuals with 55 years and older.

Figure 4. Labour Market Evolution (16-24, 25-54, 55-+), 1976:Q3-2015:Q2
Regimes and Threshold







2.4. Conclusions

The Spanish unemployment rate stood at 21.18 percent in the third quarter of 2015, almost five percentage points lower than three years earlier although almost 12 percentage points higher than at the end

of 2008. It seems that behind this favourable evolution is not only the result of the entry of the Spanish economy in a new recovery phase but also the effect of the labour force participation rate development. In particular the labor force participation rate is now falling, i.e. it is showing an opposite evolution with regard to the crisis, when the exponential growth of Spanish unemployment was the result of two vectors: an increased supply of labor, reflected by higher labor force participation rates. In this article we revisit how participation rates are affected by business cycle fluctuations, while accounting for different sources of asymmetries. In particular, we explore the potential existence of asymmetries into two directions by age groups and checking whether the relationship is time varying. By using Spanish quarterly data over the period 1976-2015, results point to the existence of nonlinear relationships between unemployment and labor force participation for different age groups. In particular, we provide evidence for a nonlinear discouraged worker effect for the oldest and middle-aged groups, while an added worker effect is found for youth when the unemployment rate is below a threshold.

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Appendix 1: Statistical Tests

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

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 with 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, $\overline{MZ}_{\alpha}^{GLS}$, $\overline{MZ}_{t}^{GLS}$, $\overline{MSB}^{GLS}$, $\overline{MPT}^{GLS}$ and ADF tests. All test statistics formally examine the unit root null hypothesis against the alternative of stationarity. The null hypothesis of non-

stationarity for the series in levels cannot be rejected, regardless of the test statistic. Accordingly, these series would be *I(1)*.

Ng-Perron Unit Root Tests

Table A1: Ng-Perron and Phillips-Perron unit root tests for unemployment rate

	I(1) vs. I(0)					
	PP	Ng-Perron				
Variable	**Test**	$\overline{MZ}_{\alpha}^{GLS}$	$\overline{MZ}_{t}^{GLS}$	$\overline{MSB}^{GLS}$	$\overline{MPT}^{GLS}$	**Lags**
Unemployment rate						
Total	-1.984	-8.668	-2.082	0.240	10.513	2
Male	-1.878	-9.959	-2.229	0.224	9.164	4
Female	-2.053	-3.775	-1.365	0.361	24.009	2
16-24	-2.601	-8.312	-2.037	0.245	10.967	4
24-55	-1.809	-10.243	-2.263	0.221	8.897	2
55+	-1.379	-6.587	-1.768	0.268	13.863	4
Participacion rate						
Total	-2.884	-3.997	-1.386	0.347	22.470	9
Male	-2.225	-4.888	-1.525	0.312	18.441	7
Female	-3.179*	-2.104	-1.002	0.476	41.973	4
16-24	-1.370	-4.544	-1.426	0.314	19.458	2
24-55	-3.231*	-3.324	-1.289	0.388	27.410	4
55+	-0.876	-7.704	-1.760	0.238	12.650	7

Notes:
The critical values for the Ng-Perron test are tabulated in Ng & Perron (2001). The *MAIC* information criteria is used to select the autoregressive truncation lag, *k*, as proposed in Perron and Ng (1996)
***, ** and * denote significance at 1%, 5% and 10% level respectively

I(2) vs. I(1)

	PP	Ng-Perron				
Variable	**Test**	$\overline{MZ}_{\alpha}^{GLS}$	$\overline{MZ}_{t}^{GLS}$	$\overline{MSB}^{GLS}$	$\overline{MPT}^{GLS}$	**Lags**
Unemployment rate						
Total	-4.279***	-21.337***	-3.214***	0.151***	1.334***	1
Male	-4.146***	-18.216***	-2.905***	0.159***	1.755***	1
Female	-6.441***	-17.682***	-2.963***	0.168***	1.424***	4
16-24	-5.157***	-13.418**	-2.491**	0.186**	2.211**	2
24-55	-4.353***	-22.304***	-3.288***	0.147***	1.278***	1
55+	-11.118***	-8.365**	-2.033**	0.243*	2.975**	9
Participacion rate						
Total	-8.673***	-0.607	-0.387	0.637	23.410	8
Male	-10.433***	-0.833	-0.625	0.749	27.929	9
Female	-8.976***	-0.789	-0.418	0.529	17.600	8
16-24	-10.100***	-9.024**	-2.089**	0.232**	2.854**	8
24-55	-10.452***	-0.834	-0.466	0.559	18.621	9
55+	- 6.075***	0.733	1.037	1.415	125.478	9

Notes:
The critical values for the Ng-Perron test are tabulated in Ng & Perron (2001). The *MAIC* information criteria is used to select the autoregressive truncation lag, *k*, as proposed in Perron and Ng (1996)
***, ** and * denote significance at 1%, 5% and 10% level respectively.

Chapter 3. The unemployment invariance hypothesis in Spain

This article studies the long-run relationship between unemployment and labor force participation rate by taking into account possible different sources of asymmetries: structural breaks and the possible existence of asymmetries by gender and age groups, using Spanish data. In the last regime, the current one, our findings support the discouraged for the aggregate labor force participation rate. However, the analysis by gender reports mixed evidence –discouraged for males and added worker effect for females–. Finally when we consider the asymmetries by age, the evidence is mixed again: discouraged for the younger added for the middle age group and invariance for the older.

3.1. Introduction

There is a growing body of literature studying the long-run equilibrium relationship between unemployment rates and labor force participation –see, e.g. Österholm (2010) for Sweeden, Emerson (2011) and Congregado et al. (2010, 2012) for Spain and the United States and Kakinaka and Miyamoto (2012) for Japan, Kleykamp and Wan (2014) for US–. In principle, srisis may lead two opposite effects in relation to labor participation rates: on the one hand, some participants might decide not to participate further, abandoning the search due to the lack of job offers (discouraged effect). On the other hand, in some households heavily affected by unemployment, some secondary workers such as females or the youngster will decide to search for a job (added worker effect). Overall, the literature on the cyclical behavior of the labor force participation at the business-cycle frequency appears as essentially divided between studies finding evidence of a statistical significant cyclical sensitivity –either a negative o positive net effect–, and others finding no evidence of pro- or counter-cyclicality (unemployment invariance hypothesis). A possible explanation of these controversial results could be due to ignoring asymmetries when these exist. For instance the existence of a relationship which varies across regimes –due to the existence of structural changes, or opposed movements between different groups (e.g. by gender or age group) or both. For this reason in this paper we try to test the unemployment invariance hypothesis, allowing for the possibility of structural breaks in the long-run relationship and

taking into account the possible existence of differences in the observed relationship by gender, in line with the recent empirical literature (e.g., Benati, 2001, Congregado et al., 2011, Österholm, 2010, Emerson, 2011). We argue that the evidence of two opposite long run relationships between unemployment and labor participation found recently in the Spanish economy (Congregado et al., 2011, 2012, 2014) –a discouraged worker effect for males and an added worker effect for females- arises due to the failure to account for potential instabilities in the long run relationship between them.

At this point, we want to emphasize that our results qualify the previous ones looking for nonlinearities in the relationship. For this reason, our empirical findings do not necessarily contrast with previous results. In sum this article contributes explores a new line of research by assessing whether or not there are some structural changes in the relationship between labor force participation and unemployment. In sum, this article try to test the invariance/ discouraged/added hypotheses by gender and age group, by means of the analysis of a linear VECM and testing if the relationship is subjected to structural breaks, using seasonally adjusted quarterly data, for Spain (Labor Force Survey, Instituto Nacional de Estadística) during the period 1976:3-2015:2.

The rest of the paper is organized as follows: Section 2 will present an econometric framework for studying the tendency of some groups of workers to move in and out of the labor force over the cycle while section 3 presents the basic results. Finally, section 4 concludes.

3.2. Econometric framework

The common way to check the previous hypotheses empirically, using time series, consists in analysing the relationship between the labour participation rate and the unemployment rate, by means of a linear cointegration approach. The benchmark model is a finite-order VAR of the following form:

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

In the above model, $x_t = [p_t, u_t]$ is a vector of non-stationary variables containing the labor force participation rate (p_t) and the unemployment rate (u_t), A_i is a *2x2* matrix of parameters, and ε_t is an *2x1* vector of residuals. In order to characterize the long run dynamic adjustments, we can rewrite the equilibrium VAR model as a vector error correction model (VECM):

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

where $\Gamma_i = -\left(I - \sum_{i=1}^{k-1} A_i \right)$ and $\Pi = -\left(I - \sum_{i=1}^{k} A_i \right)$. The matrix Π, is usually decomposed as $\Pi = \alpha\beta'$, 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 cointe-

grating relationships. In this form all terms in equation (2) are stationary. In our application the system can be written as:

$$\begin{bmatrix}\Delta p_t \\ \Delta u_t\end{bmatrix} = \Gamma(L)\begin{bmatrix}\Delta p_{t-i} \\ \Delta u_{t-i}\end{bmatrix} + \begin{bmatrix}\alpha_p \\ \alpha_u\end{bmatrix}\left(p_{t-1} - \beta u_{t-1}\right) + \begin{bmatrix}\varepsilon_t^p \\ \varepsilon_t^e\end{bmatrix} \tag{3}$$

where α_p and α_u indicate the speed of adjustment of each variable back to its long-run value. In the above model, the lagged residuals from the cointegrating vector act as an error correction term. This term, $p_{t-1} - \beta u_{t-1}$, captures the extent of disequilibrium for the system of variables with respect to the long-run relation between all variables in the system.

The existence of a cointegration relationship in the model above would lead us to reject the unemployment invariance hypothesis. However, as Österholm (2010) suggests since the two series may not have exact unit roots, we also need to test whether the restrictions β=(1 0)' and β=(0 1)' can be rejected. On the other hand, testing the restrictions on the error-correction terms -α=(α_p,0)' and α=(0,α_u)' – we could know whether the unemployment rate adjusts to the labor participation rate or vice versa.

However, nothing guarantees the stability of our estimates. Accounting for parameter shifts is crucial in cointegration analysis, we propose to use the Kejriwal and Perron (2010) testing procedure that not only enables detection of parameter instability but also allows consistent estimation of the number of breaks. Once structural breaks are found, we apply the Österholm's approach for each regime.

In sum, this equation will serve as the basis of our empirical estimates. Our parameter of interest β will be estimated analysing the long-run relationship. Once having checked that these two variables are non-stationary –unit roots test–, we will estimate the linear cointegration relation. However, since we are considering a long period of time (1976:3-2015:2), it is possible that the relationship between the two variables changes over time, i.e., it is possible that estimation of linear cointegration relations yields spurious inference results due to the presence of one or more structural breaks in the relation. Then, we consider the possibility that a linear cointegrated regression model with multiples structural changes would provide a better empirical description of this relationship. Our methodology is based on instability tests recently proposed in Kejriwal and Perron (2010) developed to allow for multiple breaks under the null hypothesis of cointegration.

3.3. Results

As a preliminary step in our analysis, we examine the time series properties of the series by testing for a unit root. We have used a modified version of the Dickey-Fuller and Phillips-Perron tests proposed by Ng and Perron (2001), which try to solve the main problems present in these conventional tests for unit roots[1]. The null hy-

[1] See Ng and Perron (1995).

pothesis of nonstationarity in levels is also clearly non-rejected at the usual significance levels. Therefore, according to the results of these tests, u_t and p_t would be I(1).

Table 1: Ng-Perron and Phillips-Perron unit root tests for unemployment rate

I(1) vs. I(0)

	PP	Ng-Perron				
Variable	**Test**	$\overline{MZ}_{\alpha}^{GLS}$	$\overline{MZ}_{t}^{GLS}$	$\overline{MSB}^{GLS}$	$\overline{MPT}^{GLS}$	**Lags**
Unemployment rate						
Total	-1.984	-8.668	-2.082	0.240	10.513	2
Male	-1.878	-9.959	-2.229	0.224	9.164	4
Female	-2.053	-3.775	-1.365	0.361	24.009	2
16-24	-2.601	-8.312	-2.037	0.245	10.967	4
24-55	-1.809	-10.243	-2.263	0.221	8.897	2
55+	-1.379	-6.587	-1.768	0.268	13.863	4
Participation rate						
Total	-2.884	-3.997	-1.386	0.347	22.470	9
Male	-2.225	-4.888	-1.525	0.312	18.441	7
Female	-3.179*	-2.104	-1.002	0.476	41.973	4
16-24	-1.370	-4.544	-1.426	0.314	19.458	2
24-55	-3.231*	-3.324	-1.289	0.388	27.410	4

55+	-0.876	-7.704	-1.760	0.238	12.650	7

Notes:

The critical values for the Ng-Perron test are tabulated in Ng & Perron (2001). The *MAIC* information criteria is used to select the autoregressive truncation lag, k, as proposed in Perron and Ng (1996)

***, ** and * denote significance at 1%, 5% and 10% level respectively

I(2) vs. I(1)

	PP	Ng-Perron				
Variable	**Test**	$\overline{MZ}_{\alpha}^{GLS}$	$\overline{MZ}_{t}^{GLS}$	$\overline{MSB}^{GLS}$	$\overline{MPT}^{GLS}$	**Lags**
Unemployment rate						
Total	-4.279***	-21.337***	-3.214***	0.151***	1.334***	1
Male	-4.146***	-18.216***	-2.905***	0.159***	1.755***	1
Female	-6.441***	-17.682***	-2.963***	0.168***	1.424***	4
16-24	-5.157***	-13.418**	-2.491**	0.186**	2.211**	2
24-55	-4.353***	-22.304***	-3.288***	0.147***	1.278***	1
55+	-11.118***	-8.365**	-2.033**	0.243*	2.975**	9
Participation rate						
Total	-8.673***	-0.607	-0.387	0.637	23.410	8
Male	-10.433***	-0.833	-0.625	0.749	27.929	9
Female	-8.976***	-0.789	-0.418	0.529	17.600	8
16-24	-10.100***	-9.024**	-2.089**	0.232**	2.854**	8
24-55	-10.452***	-0.834	-0.466	0.559	18.621	9

55+	- 6.075***	0.733	1.037	1.415	125.478	9

Notes:

The critical values for the Ng-Perron test are tabulated in Ng & Perron (2001). The *MAIC* information criteria is used to select the autoregressive truncation lag, *k*, as proposed in Perron and Ng (1996)

***, ** and * denote significance at 1%, 5% and 10% level respectively

As we argued before, it is important to account for structural breaks in the cointegration relationship. Our data covers almost four decades, during which time the relationship have probably changed. Therefore, we apply the tests for structural change that have been proposed in Kejriwal and Perron (2010). We use 15% trimming so that the maximum numbers of breaks allowed under the alternative hypothesis is 5.[2] Both the intercept and the slope are allowed to change.

Table 2. Kejriwal-Perron test forecasting multiple structural breaks in cointegrated regression models

Trimming			Gender		Age	
	Total	**Males**	**Females**	**16-24**	**25-54**	**55+**
Sup F(1)	130.839***	6.358	5.267	5.154	5.195	10.038
Sup F(2)	3.653	4.386	3.545	3.798	3.703	4.075
Sup F(3)	4.015	5.596	4.202	4.242	3.402	4.189
Sup F(4)	4.584	4.530	4.536	3.760	2.956	3.121
Sup F(5)	2.673	2.858	2.623	2.827	2.466	3.084

[2] Assuming in line with previous studies an average periodicity of the Spanish cyclical unemployment rate about 7 years. For this reason, we use a trimming of 15%. Then, each segment should contain at least 26 observations, i.e, 6 ½ years.

UD max	130.839	6.358	5.267	5.154	5.199	10.038
Seq	1	0	0	0	0	0
BIC	4	5	4	3	5	4
LWZ	4	3	4	3	5	4
Numbers of breaks	4	3	4	3	5	4
Break dates	1986:2 1992:4 2001:3 2007:1	1985:2 1990:4 2002:2	1986:2 1992:1 2001:2 2006:4	1986:1 1991:3 2001:2	1984:2 1989:4 1995:2 2001:2 2006:4	1983:4 1989:2 1994:4 2004:1

Note: *,**, and *** denote significance at the 10%, 5% and 1% levels, respectively. Theoretical values are taken from Kejriwal and Perron (2010).

Table 2 presents the results of stability tests as well as the number of breaks selected by the sequential procedure (*Seq*) and the information criteria *BIC* and *LWZ*. For the total aggregate LFPR the sequential procedure selects one break, but for the five groups considered (two by gender and three by age), the sequential procedure selects no break - i.e. it does not suggest any instability. However, the two information criteria –BIC and LWZ- suggest from three to five breaks for the aggregate rate, for males and females and for the three intervals of age. Overall, the results of the Kejriwal-Perron tests suggest as current regimes from 2007:1 until now for the aggregate rate 2002:2 for males and from 2006:4 for females. By age, the initial start dates of the current regimes are 2001:2, 2006:4, and 2004:1, for the younger, intermediate and older age groups, respectively. In order to compare the coefficients obtained from a model with different regimes with those reported from a model without any structural break, we proceed to estimate the cointegration equation

(3) for the sub-samples using the Johansen procedure. The results are reported in table 3.

Table 3. Johansen Cointegration Test

	Varia-ble	H_0:r	n - r	λ_{trace} test	λ_{trace}	λ_{max} test	λ_{max}	Lags
Full sample	TOTAL	0	2	10.322	15.495	9.928	14.265	2
		1	1	0.394	3.841	0.394	3.841	
	1976:3 - 1986:2	0	2	17.073**		12.781*		2
		1	1	4.293**		4.293		
	1986:3 - 1992:4	0	2	23.813***		21.972***		5
		1	1	1.841		1.841		
	1993:1 - 2001:3	0	2	11.257		11.253		1
		1	1	0.004		0.004		
	2001:4 – 2007:1	0	2	23.189***		16.644**		5
		1	1	6.544**		6.544**		
	2007:2 – 2015:2	0	2	22.844***		15.415**		1
		1	1	7.429**		7.429**		
Males	TOTAL	0	2	29.324***		20.855***		2
		1	1	8.469***		8.469***		
	1976:3 - 1985:2	0	2	30.163***		17.466**		7
		1	1	12.696***		12.697***		
	1985:3 - 1990:4	0	2	24.847***		24.117***		1
		1	1	0.730		0.730		

	1991:1 - 2002:2	0	2	34.960 ***		21.484 ***		6
		1	1	13.477 ***		13.477 ***		
	2002:3 – 2015:2	0	2	20.526 ***		16.264 **		3
		1	1	4.262**		4.262**		
Females	TOTAL	0	2	6.799		6.745		2
		1	1	0.055		0.055		
	1976:3 - 1986:2	0	2	11.810		9.153		1
		1	1	2.657		2.657		
	1986:3 - 1992:1	0	2	8.243		6.643		1
		1	1	1.601		1.601		
	1992:2 - 2001:2	0	2	16.256 **		15.733 **		5
		1	1	0.524		0.524		
	2001:3 – 2006:4	0	2	16.567 **		16.446		6
		1	1	0.121		0.121		
	2007:1 – 2015:2	0	2	38.329 ***		24.461 ***		1
		1	1	13.867 ***		13.867 ***		
16-24	TOTAL	0	2	19.322 **		17.978 **		5
		1	1	1.344		1.344		
	1976:3 - 1986:1	0	2	11.526		8.010		1
		1	1	3.516*		3.516*		
	1986:2 - 1991:3	0	2	11.011		6.017		1
		1	1	4.994**		4.994**		
	1991:4 - 2001:2	0	2	15.460 *		13.700 *		5

		1	1	1.760		1.760		
	2001:3 – 2015:2	0	2	21.469***		16.605**		1
		1	1	4.864**		4.864**		
25-54	TOTAL	0	2	8.861		8.861		2
		1	1	0.000		0.000		
	1976:3 - 1984:2	0	2	10.736		8.878		1
		1	1	1.857		1.857		
	1984:3 - 1989:4	0	2	12.158		11.968		1
		1	1	0.189		0.189		
	1990:1 - 1995:2	0	2	31.384***		27.831***		5
		1	1	3.553*		3.553*		
	1995:3 - 2001:2	0	2	18.034**		17.292**		4
		1	1	0.742		0.742		
	2001:3 – 2006:4	0	2	7.114		7.038		1
		1	1	0.076		0.076		
	2007:1 – 2015:2	0	2	15.418*		8.699		2
		1	1	6.718***		6.718***		
55+	TOTAL	0	2	8.511		8.495		7
		1	1	0.015		0.015		
	1976:3 - 1983:4	0	2	9.003		6.810		1
		1	1	2.194		2.194		
	1984:1 - 1989:2	0	2	19.204**		15.440**		1
		1	1	3.764*		3.764*		
	1989:3 - 1994:4	0	2	15.482*		15.344**		3
		1	1	0.139		0.139		

	1995:1 – 2004:1	0	2	9.095		9.063		1
		1	1	0.033		0.033		
	2004:2 – 2015:2	0	2	6.264		6.112		1
		1	1	0.152		0.152		

Evidence points to mixed evidence about the existence of cointegrating relationships for the different groups and regimes. The next step should be to identify the type of relationship in order to look for the –the rejection/acceptance of the different hypotheses. To this end we estimate the cointegrating vector. Results are reported in table 4.

Table 4. Estimated cointegration vector

	TOTAL	**Male**	**Female**	**16-24**	**25-54**	**55+**
Full	1976:3 – 2015:2	1976:3 – 2015:2	1976:3 – 2015:2	1976:3 – 2015:2	1976:3 – 2015:2	1976:3 – 2015:2
P		1		1		
U		0.630***(D) (0.117)		-0.736***(A) (0.229)		
constant		-77.789		-0.234		
1st	1976:3 – 1986:2	1976:3 – 1985:2	1976:3 - 1986:2	1976:3 – 1986:1	1976:3 – 1984:2	1976:3 – 1983:4
P	1	1				
U	0.092*** (D)	0.406*** (D)				

	(0.019)	(0.013)				
constant	-51.352	-78.768				
2nd	1986:3 – 1992:4	1985:3 – 1990:4	1986:3 – 1992:1	1986:2 – 1991:3	1984:3 – 1989:4	1984:1 – 1989:2
P	1	1				1
U	-0.003 (I) (0.093)	-0.267***(A) (0.005)				-0.346* (A) (0.206)
constant	-50.414	-65.247				-0.183
3rd	1993:1 – 2001:3	1991:1 – 2002:2	1992:2 – 2001:2	1991:4 – 2001:2	1990:1 – 1995:2	1989:3 – 1994:4
P		1	1	1	1	1
U		1.452*** (D) (0.282)	0.101 (I) (0.078)	-0.795** (D) (0.323)	-0.717*** (A) (0.080)	0.783*** (D) (0.162)
constant		-86.599	-40.991	-0.172	-0.601	-0.259
4th	2001:4 – 2007:1	2002:3 – 2015:2	2001:3 – 2006:4	2001:3 – 2015:2	1995:3 - 2001:2	1995:1 - 2004:1
P	1	1	1	1	1	
U	0.196 (I) (0.333)	0.254***(D) (0.034)	0.609*(D) (0.376)	0.434***(D) (0.046)	-0.028 (I) (0.123)	
constant	-58.425	-71.703	-53.536	-0.620	-0.756	
5th	2007:2 – 2015:2		2007:1 – 2015:2		2001:3 - 2006:4	2004:2 - 2015:2
P	1		1			
U	1.185***(D)		-			

	(0.296)		0.375***(A) (0.018)			
constant	-82.947		-44.946			
6th					2007:1 - 2015:2	
P					1	
U					-0.354***(A) (0.040)	
constant					-0.794	

Note: *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. Estimates are not reported when the Johansen (1988, 1991) cointegration test rejects the cointegration relationship. Johansen's tests results available upon request. A, D and I, denotes evidence of Added worker effect, Discouraged effect and Invariance unemployment hypotheses, respectively.

Provided estimates suggest a more complex view about this relationship, not only by gender or age but also when a time varying relationship is allowed. In particular results show that it is important to take into account the potential existence of nonlinearities in the relationship as well as other sources of asymmetry. In the last regime, for every group, our findings support the unemployment invariance hypothesis for the oldest, a discouraged effect for the aggregate, males and the younger and evidence of an added worker effect for female labour force participation rates and for people included in the intermediate interval by age.

Finally, and by using the framework proposed by Österholm (2010) we are interested in testing the restrictions reported in the first column in table 5. Focusing on the last regime, the unemployment invariance hypothesis is confirmed by age, except for the younger, whereas there are long term relationships for the rest. For the aggregate labour force participation rate and for males and younger seems that participation is not weakly exogenous at conventional levels. For males, in the current regime, we reject the four restrictions. Therefore the discouraged worker effect is confirmed for males in Spain from 2002:3.

Table 5. Test of restriction in cointegrated VAR (P-Values)

	Regime	**Males**	**Females**	**16-24**	**25-54**	**55+**
Full sample	1976:3 – 2015:2	1976:3 – 2015:2	1976:3 – 2015:2	1976:3 – 2015:2	1976:3 – 2015:2	1976:3 – 2015:2
β=(1,0)		**0.001**		**0.006**		
β=(0,1)		**0.004**		0.183		
$\alpha=(\alpha_P,0)$		**0.030**		**0.000**		
$\alpha=(0,\alpha_U)$		**0.001**		0.542		
1st regime	1976:3 – 1986:2	1976:3 – 1985:2	1976:3 - 1986:2	1976:3 – 1986:1	1976:3 – 1984:2	1976:3 – 1983:4
β=(1,0)	0.277	**0.031**				
β=(0,1)	**0.075**	**0.029**				

$\alpha=(\alpha_P,0)$	0.137	**0.066**				
$\alpha=(0,\alpha_U)$	**0.007**	0.542				
2nd regime	1986:3 – 1992:4	1985:3 – 1990:4	1986:3 – 1992:1	1986:2 – 1991:3	1984:3 – 1989:4	1984:1 – 1989:2
β=(1,0)	0.981	**0.000**				0.135
β=(0,1)	**0.009**	**0.000**				**0.002**
$\alpha=(\alpha_P,0)$	0.269	0.309				**0.015**
$\alpha=(0,\alpha_U)$	**0.001**	**0.001**				**0.080**
3rd regime	1993:1 – 2001:3	1991:1 – 2002:2	1992:2 – 2001:2	1991:4 – 2001:2	1990:1 – 1995:2	1989:3 – 1994:4
β=(1,0)		**0.011**	0.131	0.140	**0.000**	**0.000**
β=(0,1)		0.479	**0.000**	0.530	**0.000**	**0.008**
$\alpha=(\alpha_P,0)$		**0.006**	**0.010**	**0.038**	**0.000**	**0.001**
$\alpha=(0,\alpha_U)$		0.363	0.845	0.212	0.948	**0.012**
4th regime	2001:4 – 2007:1	2002:3 – 2015:2	2001:3 – 2006:4	2001:3 – 2015:2	1995:3 - 2001:2	1995:1 - 2004:1
β=(1,0)	0.713	**0.001**	0.109	**0.002**	0.900	
β=(0,1)	**0.024**	**0.007**	**0.000**	**0.022**	**0.058**	
$\alpha=(\alpha_P,0)$	**0.051**	0.557	**0.000**	0.600	**0.000**	
$\alpha=(0,\alpha_U)$	**0.002**	**0.001**	**0.073**	**0.001**	**0.010**	
5th regime	2007:2 – 2015:2		2007:1 – 2015:2		2001:3 - 2006:4	2004:2 - 2015:2
β=(1,0)	**0.075**		**0.009**			
β=(0,1)	0.927		**0.031**			
$\alpha=(\alpha_P,0)$	0.188		**0.050**			
$\alpha=(0,\alpha_U)$	**0.005**		**0.002**			
6th regime					2007:1 -	

					2015:2	
$\beta=(1,0)$					0.396	
$\beta=(0,1)$					0.537	
$\alpha=(\alpha_P,0)$					0.159	
$\alpha=(0,\alpha_U)$					0.391	

Note: In bold p-values lower than 10% of the likelihood ratio test for the restrictions.

3.4. Conclusions

In the last regime, the current one, our findings support the discouraged for the aggregate labour force participation rate. However, the analysis by gender reports mixed evidence –discouraged for males and added worker effect for females–. Finally when we consider the asymmetries by age, the evidence is mixed again: discouraged for the younger added for the middle age group and invariance for the older.

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Chapter 4. Asymmetries in the Granger causality relationship between unemployment and labor force participation rate

This article re-examines the relationship between the labor force participation rate and the unemployment rate for Spain, looking for Granger causality relationships. The novelty of this study is to explore asymmetries in several ways: by gender, by age and allowing time dependence by using the new tests recently proposed by Hatemi-J (2012). This analysis completes the previous ones, carried out in this dissertation, in order to provide a comprehensive view of the exact nature of this relationship.

The article finds that there is either bidirectional long-run Granger causality running from labor force participation to the unemployment rate for aggregate and for gender and age groups, except for females and for the middle age group. However if time-asymmetries is also considered, different causal relationships prevail for different

groups and for every regime.

***JEL classification*:** L26, C32; C33.

***Keywords*:** Unemployment; Labor Force Participation; Granger Causality, asymmetric causality.

4.1. Introduction

The debate over the exact form of the relationship between labor force participation (LFP, hereafter) and unemployment rate (u) is a highly hot political issue in Spain at the time of writing, given the role played by the LFP rate not only in the exponential growth experienced by unemployment rates during the last recession but also as a key factor behind to the recent fall in the unemployment rate which some scholars interprets as the starting point of new recovery phase.

Following the early contribution of Mincer (1966) about the effect of unemployment on labour force participation decisions, many empirical works have treated to clarify the causal nexus between labor force participation and unemployment. However and independently

of the adopted approach, mixed evidence has been the origin of a traditional controversy in Labor Economics.

In this dissertation we provided a number of empirical findings about different aspects of this relationship, in order to look for robustness, but maybe the most important one has not been analyzed yet. For completing and providing a comprehensive empirical analysis on this relationship the issue to be solved is the question of 'what causes what?'

Therefore, this chapter complete our study about the relationship between unemployment and participation rates in the Spanish economy, analyzing the Granger causality between these two variables taking into account the potential existence of asymmetries in this causal relationship, in several ways: by gender, by age and taking into account the potential existence of a time-varying relationship.

To this end, we apply two alternative approaches. Firstly, we explore the existence of linear relationships by gender and age, by applying the Toda and Yamamoto (1995) test. Secondly, we look for asymmetric causality relationships by using the Hatemi-J (2012) method.

From a policy point of view the direction of causality is important. For instance if a negative causal impact from unemployment to LFP

is found, the discouraged effect predominates. Conversely, if the causal impact of unemployment on LFP is found to be positive, higher unemployment rates can result in increasing LFP (added worker effects). A bi-directional causality infers that the higher unemployment the higher LFP and vice versa.

Several studies have examined this issue, but mainly due to the use of different methodologies and type of data previous findings are mixed. In particular, literature has usually neglected to test for asymmetry. The question is important because in different regimes, cyclical shocks can lead different impacts in the sense that one of the two opposite effects (added versus discouraged hypothesis) can prevail, even leading a null net effect.

In sum, the aim of this study is to clarify the direction of the relationship from an alternative perspective, by using some linear and non-linear tests for Granger-causality. With this aim the work makes two main contributions to the literature.

Firstly, we have explored new sources of asymmetries in the relationship exploring the causal nexus by employing age-specific data on LFP and by gender, by using the Toda Yamamoto test.

Secondly, we explore the asymmetry analyzing whether the causal relationship is time varying. In particular, by using the test provided by Hatemi-J (2012) in order to investigate the causal relationship be-

tween unemployment and labor force participation.

The estimation results based on the Toda-Yamamoto test reveal that there is a bidirectional causality relationship for the whole. However, when we explore this relationship by gender or by age group, we must reconsider this result given that this bidirectional causality is only valid for some groups: in particular for males and for the younger and older groups. In any case, when we also consider potential time asymmetries estimates provides a more complex picture about this nexus.

The structure of the article is as follows. Section 2 contains a discussion of alternative conceptual perspectives on the causal relationship, and a selective review of previous studies that have explored this causality between the labor force participation rate and the unemployment rate. A discussion of the econometric methodology and results are contained in Section 3 and 4. The fifth section concludes with some avenues for further research.

4.2. Hypotheses

In previous literature we can distinguish among four hypotheses on the relationship. In fact, the most explored causality relationship analyses the response of the labor force participation to fluctuations in unemployment.

In particular, much of the previous empirical literature has been focused on the discussion of the prevalence or not of the discouragement hypothesis –i.e. the fall in participation when unemployment raises, workers drop out when the labor market deteriorates (Dernburg and Strand, 1966) versus the added worker effect –the entry in the labor force of new entrants in special secondary workers as females and for the younger (Lundberg, 1985).

Since the relationship is subjected to these two opposite effects, we only can aspire to capture a net effect which sign depends on the relative strength of the two effects. Then, providing evidence in favor of either effect or even no provide evidence on this relationship if the balance of these two effects offsetting influences on participation is thus an empirical question.[1]

Wasmer (2009) investigates the causal links between participation and unemployment in four countries, France, Germany, Italy and the US, and finds that the effects differ between the US and Europe. In European countries, unemployment shocks have a short run effect on participation and participation shocks have a short run effect on unemployment. By contrast, their findings support the idea that short run changes in unemployment and participation in the US are unemployment shocks and participation shocks themselves. Parker and

[1] As examples of macroeconometric analyses on the relationship between the labor force participation rate and unemployment rate one can consider, at least, the pioner work of Elmeskov and Pichelmann (1993), Darby et al. (2001), and Benati et al. (2001).

Skoufiasi (2004) find evidence of a significant added worker effect for women in Mexico. Finally, Mishra and Smyth (2010), analyze the causality relationship between female labor force participation and fertility rates for 28 OECD countries combining, panel cointegration and Granger causality testing.

The first one is characterized by a set of empirical works, which does not provide evidence on causal relationships between the two variables in any direction. The hypothesis, in this case, is that given that added and discouraged worker effects are both equally possible, the finding of no causality in the relationship between unemployment and labor force participation rates can be due to the fact that we only can observe a net effect.

A second hypothesis is that the direction of the causality is from unemployment to labor force participation. Thus, business cycle transmits (propagates) to the labor market not only in terms of the demand buy acting also on labor supply. Then, a negative shock in real output causes a positive or negative effect on LFP depending on whether the added or the discouraged effect prevails. From an alternative perspective active labor market policies aimed at reducing unemployment should cause variations in the LFP.

The third hypothesis explores the unidirectional causality running from labor force participation to unemployment, implying that participation decisions leads to rises and falls in unemployment rates.

From this perspective, an observed fall in the unemployment rate can be the result of a strong discouraged effect instead of a symptom of recovery. Consequently a reduction of the labor force participation would imply a positive impact on unemployment.

Finally the fourth hypothesis finds a bi-directional causality or feedback between both variables indicating that a high unemployment rate results in a higher (lower)
Labor force participation rate and vice versa. Many studies support this two-way causal relationship.

In table 1, we outline a selective review of previous empirical literature on the causality between participation and unemployment with the scope, econometric methods and findings. As the reader can check, none of these works has taken into account the potential existence of time varying relationships. In order to fill this gap, we apply the test recently proposed by Hatemi-J (2012).

Table 1: Previous findings

Authors	Variables	Period	Asymmetries considered	Scope	Econometric method	Results
Mishra & Smith (2010)	p-u	Unbalanced panel	By gender By age	28 OECD countries	Panel Granger causality test	$p \Leftrightarrow u$ $p \Leftarrow u$ $p \nLeftrightarrow u$ $p \Rightarrow u$
Wasmer (2009)	p-u	1956-2002	No	US, France, Italy, Ger-	Bivariate VAR	$p \Leftrightarrow u$ Eu-

				many		rope
Fuchs & Weber (2013)	p-u	1970:01 2011:09	Gender and age	Germany	Unobserved component model for detrending	$p \Leftarrow u$ US $p \Leftarrow u$ $p \nLeftrightarrow u$ $p \Longrightarrow u$
Parker & Skoufias (2004)	p-u		No	México		$p \Leftarrow u$
Benati et (2001)	p-u		Gender and age	US	VAR	$p \Leftarrow u$
Con-gregado et al. (2011)	p-e	1976:3 2009:3	Time varying	Spain	Threshold cointegra-tion Hansen Seo	$p \Leftarrow u$
Con-gregado et al (2014)	p-e	1976:3 2012:4	Time varying Gender		Threshold cointegra-tion Hansen Seo	For fe-fe-males $p \Leftarrow u$ for males $p \Longrightarrow u$

p and u denotes, labor force participation and unemployment rates, respectively. VAR represents the vector autoregressive model, VEC is the vector error correction model and ECM is the error correction model. The denotations for causality are as follows: $p \Leftrightarrow u$ implies both p and u cause each other (bidirectional causality); $p \Longrightarrow u$ implies p causes u only; $p \Leftarrow u$ implies u causes p; $p \nLeftrightarrow u$ implies there is no causality between participation and unemployment.

4.3. Looking for Granger causality in alternative frameworks

4.3.1. *Toda-Yamamoto test*

One of the most popular ways for examining the causality effects, in Economics, is by means of the Granger causality approach.

In particular, this approach is based on the estimation of VAR models.

In order to deal with some problems related to the lack of suitable properties, Toda and Yamamoto (1995) developed a methodology, which avoids the problems stemming from cointegration relationship and non-stationarity of the time series. I n addition, following this strategy some recent developments has added value to this approach. In particular, Granger and Yoon (2002) explored the possibility of allowing asymmetric structures in the study of causality relationships. This model extended and performed recently by Hatemi-J (2012) who provides a more flexible framework, which allow explore more complex causality relationships.

In this article, we explore the relationship between the unemployment and participation rates, by using the Toda-Yamamoto causality approach, i.e. a causality test *à la Granger* based on augmented-VAR models in levels and extra lags, an approach which provides more efficient and robust results than the standard VAR model.[2] However, the main advantage of this test –the Toda Yamamoto test– is that it can be applied irrespective of the order of integration or whether the time series are or not cointegrated (Booth and Ciner, 2005).

[2] It can be the cause of bias, in particular, with finite samples –see, Johansen and Juselius, (1990); Zapata and Rambaldi (1997), Maddala and Kim (1998); Pesaran et al., (2001) and Clarke and Mirza (2006)–.

Let us start for describing the benchmark model for applying this test. In particular and for our exercise, a bivariate model including the P_t and U_t flows variables under analysis, can be writte as follows:

$$P_t = \alpha_1 + \sum_{i=1}^{h+d_{max}} \beta_{1i} P_{t-i} + \sum_{j=1}^{l+d_{max}} \gamma_{1j} U_{t-j} + \varepsilon_{1t}$$

$$U_t = \alpha_2 + \sum_{i=1}^{h+d_{max}} \beta_{2i} U_{t-i} + \sum_{j=1}^{l+d_{max}} \gamma_{2j} P_{t-j} + \varepsilon_{2t}$$

where h and l define the lag structure for the *VAR* model, according to the Akaike Information Criterion (AIC); k is defined as the sum of $(p + d_{max})$, where d_{max} –extra lagged explanatory variables– is the maximum order of integration for the variables included in the model; ε_{1t} and ε_{2t}, the residual terms, are Gaussian error which follow white noise processes. Hence, the test uses the estimates of this $VAR\ (k)$ model for computing a modified Wald test (MWALD), which statistic is asymptotically distributed as a chi-squared with *k* degrees of freedom.

For testing the Granger causality between these two variables note that, for the first equation, if $\sum_{j=1}^{l} \gamma_{1j} \neq 0$ implies that U_t Granger causes P_t. Analagously, and for the second equation, in the case of $\sum_{j=1}^{l} \gamma_{2j} \neq 0$ P_t Granger causes U_t. Finally, a simultaneous

rejection of both hypotheses implies that there exists bi-directional causality in the relationship under study.

4.3.2. Looking for asymmetric causality relationships.

One of the most common causes for rejecting the existence of causality in a linear framework could be 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 nonlinear test developed by Hatemi-J (2012), in order to know out whether the cumulative positive and negative shocks can cause different impacts on the causal relationship between the unemployment and participation rates. Following this strategy, we start specifying the two time series by means of a random walk model:

$$P_t = P_{t-1} + \varepsilon_{1t} = P_0 + \sum_{i=1}^{t} \varepsilon_{1i}$$

and

$$U_t = U_{t-1} + \varepsilon_{2t} = U_0 + \sum_{i=1}^{t} \varepsilon_{2i}$$

where $t = 1, 2, \ldots T$; P_0 and U_0 denote the initial values, and the variables ε_{1i} and ε_{2i} are white noise disturbance terms. The shocks –positive and negative- are defined as: $\varepsilon_{1i}^{+} = \max\ (\varepsilon_{1i}, 0);\ \varepsilon_{2i}^{+} = \max\ (\varepsilon_{2i}, 0); \varepsilon_{1i}^{-} = \min\ (\varepsilon_{1i}, 0); \varepsilon_{2i}^{-} = \min\ (\varepsilon_{2i}, 0)$

Grouping these terms as, $\varepsilon_{1i} = \varepsilon_{1i}^{+} + \varepsilon_{1i}^{-}$ and $\varepsilon_{2i} = \varepsilon_{2i}^{+} + \varepsilon_{2i}^{-}$, we can rewrite the system as:

$$P_t = P_{t-1} + \varepsilon_{1t} = P_0 + \sum_{i=1}^{t} \varepsilon_{1i}^{+} + \sum_{i=1}^{t} \varepsilon_{1i}^{-}$$

$$U_t = U_{t-1} + \varepsilon_{2t} = U_0 + \sum_{i=1}^{t} \varepsilon_{2i}^{+} + \sum_{i=1}^{t} \varepsilon_{2i}^{-}$$

Therefore, positive and negative shocks can be wrote as:

$P_t^{+} = \sum_{i=1}^{t} \varepsilon_{1i}^{+}$; $P_t^{-} = \sum_{i=1}^{t} \varepsilon_{1i}^{-}$; $U_t^{+} = \sum_{i=1}^{t} \varepsilon_{2i}^{+}$; $U_t^{-} = \sum_{i=1}^{t} \varepsilon_{2i}^{-}$.

Assuming that $y_t^{+} = (P_t^{+}, U_t^{+})$, $y_t^{-} = (P_t^{-}, U_t^{-})$, $y_t^{\pm} = (P_t^{+}, U_{1t}^{-})$, and $y_t^{\mp} = (P_t^{-}, U_{1t}^{+})$, the causal relationship between the variables can be tested using a vector autoregressive model for a lag order $r = (1, \dots, p)$.

In order to estimate the Wald test, we must run the VAR (p) model. To this end let us start by expressing the model in compact form:

$Y = DZ + \delta$, where

$Y \coloneqq (y_1^{+}, \dots, y_T^{+})\ (n\ x\ T)\ matrix,$

$D \coloneqq \left(v, A_1 \dots, A_p\right)\ (n\ x\ (1 + np))\ matrix,$

$$Z_t \coloneqq \begin{pmatrix} 1 \\ y_t^+ \\ y^+{}_{t-1} \\ \vdots \\ y_{t-p+1}^+ \end{pmatrix} ((1+np)\ x\ 1)\ matrix, for\ t = 1, \dots, T,$$

$$Z \coloneqq (Z_0 \dots, Z_{T-1})\ ((1+np)\ x\ T)\ matrix, and$$

$$\delta \coloneqq (u_1^+, \dots, u_T^+)\ (n\ x\ T)\ matrix$$

The Wald statistic is $(C\beta)'\ [C((Z'Z)^{-1} \otimes S_U)C']^{-1}\ (C\beta)$, where $\beta = vec(D)$, being *vec(·)* the column-stacking operator; $\otimes$ is the Kronecker product and C is a $p\ x\ n(1+np)$indicator matrix with elements ones for restricted parameters and zeros for the rest of the parameters; $S_U = \frac{\widehat{\delta}_U' \widehat{\delta}_U}{T-q}$, where q is the numbers of parameters in each equation of the VAR model. Under the assumption of normality, the Wald statistic follows an asymptotic χ^2 distribution with the same degrees of freedom than the number of restrictions to be tested (in our case, equal to p). The null hypothesis of non-Granger causality, $H_0: C\beta = 0$, is rejected at the α level of significance (1%, 5% or 10%) according to the bootstrap critical values generated by GAUSS software.

4.4. Empirical Results

In accordance with the econometric strategy outlined above, in this section we discuss the results of the analysis of the Granger cau-

sality relationships not only by using a linear framework but also allowing non-linear behavior between the two variables. In the next subsections the results of all these approaches are reported distinguishing by the direction of the causality, that is, depending on the theoretical hypotheses previously discussed. The estimation results are reported in the Appendix.

The first step in our empirical analysis is conducting unit roots tests. Table 1 reports the results of the unit root tests. The null is tested, by using alternative unit roots tests. In particular, the Ng-Perron and Phillips-Perron is applied to the two variables for the aggregate and for the different groups by gender and by age.

4.4.1. The influence of labor force participation on the unemployment rate

Based on the results of Toda-Yamamoto test –table 2– the null hypothesis that participation shocks do not Granger cause shocks in unemployment can be rejected only for females and for the group of middle aged. However, when we consider the results of asymmetric causality tests (Tables 3-6) of this causal relationship with matching shocks the null hypothesis of no Granger causality can be rejected only for the two extremes groups of age. However, when we observe this relationship for combinations that consists of opposite shocks –mixed effects–, the results support the idea that positive shocks in participation do not cause a negative shock in unemployment except for males and for the middle age group. Conversely, a negative

shock in participation causes a positive impact on the unemployment rate but only for males, for the younger and the older.

4.4.2. The effect of the labor market developments on labor force participation: Added and worker effects.

Let us to discuss now what tell us our results about the influence of the labour market developments –in terms of the unemployment evolution– on the labor force participation rate, as the added worker effect and the discouraged hypotheses states. In both cases, we should expect a rejection of the null hypothesis at least for some groups of secondary workers or for some periods related with the business cycle phase. In particular, the results of the Toda-Yamamoto test point to the existence of causality that goes from unemployment to participation not only for the whole but also for some groups of workers. In particular, this result seems to be robust by age, although this causality relationship only holds for males. However, it is possible to enrich this initial view when the existence of time-varying relationships is considered. Especially interesting is the asymmetric behaviors showed by males and females and for the different age groups over the business cycle. Thus, results seems to suggest the existence of an added worker effect for the oldest and a discouraged one for males and for the younger, but only in recessions, while in expansions females and the middle aged group reacts decreasing the participation. These results confirm previous findings.

4.4.3. Bi-directional Granger causality: feedback hypothesis

By using the results of the Toda-Yamamoto –table 3– test one can conclude that there is evidence of bidirectional causality in the results not only for the whole, but also for males and for the two extremes age intervals. However, multivariate tests for normality (Doornik and Hansen, 2008) conclude that the data is not normally distributed and time varying volatility prevails. For this reason it is essential to use the bootstrap simulation method as Hatemi-J (2012) suggests. In this way, when we explore these same relationships allowing time varying asymmetries –tables 4 to 6– the feedback hypothesis can not be rejected only for the group of individuals older than 55, for combination that consist of *positive shocks* ($p^+ \nRightarrow u^+$) ($u^+ \nRightarrow p^+$), for the youngest for combinations of negative shocks, and for the oldest, the youngest and males for mixed shocks, i.e. combinations that consists of opposite shocks.

Then, the evidence on bidirectional relationships provide support to the feedback hypothesis, and reinforces the importance of taking into account the potential existence of asymmetries, not only by gender and age groups but also time varying asymmetries in order to qualify the initial results derived from the use of aggregates. In this way we provide a more complete and better overview of this relationship.

4.5. Conclusions

This article has tested the Granger causality relationships between participation and unemployment looking for asymmetries in several ways: by gender, age and allowing a time varying relationship.

When we analyze the Granger causality running from labor force participation to unemployment that is the role of LFPR as a leading indicator of the unemployment rate when LFPR show a positive evolution leads increases in the unemployment rates for both the aggregate and the group of the older. Conversely, this same shock leads unemployment rates reductions for males, females and for individuals belonging to the middle age group. Finally the predictive power of the fall in the participation rate on the unemployment rate is weak for leading unemployment reduction (only for the younger), while negative shocks on the LFPR causes positive impacts on the unemployment rates for males, younger and older.

In crisis, if Granger causality runs from unemployment to LFPR, and this effect is negative, this is also evidence for the discouraged effect. This effect is found only for males and younger when time asymmetries are considered. When the Granger causality runs from unemployment to LFPR and the relationship is positive, this would be evidence for the added worker effect, it can be only considered in for the older.

In sum, our results seem to support the existence of both the discouragement and the added worker effect and a reverse causality running from participation to unemployment, but these causality relationships are different by gender, for different age groups and time varying, i.e. different in expansions and recessions. One implication for practitioners, forecasters and policy-makers is that they should bear in mind the complexity of the relationship between the labor participation and unemployment in order to evaluate and/or forecasting the effects of shocks in these two variables. In this sense fluctuations in labor force participation can alleviate or stress unemployment problems, as recent data show.

4.6. References

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Annex:

Table 1: Ng-Perron and Phillips-Perron unit root tests for unemployment rate and participation rate

I(1) vs. I(0)

	PP	Ng-Perron				
Variable	**Test**	$\overline{MZ}_{\alpha}^{GLS}$	$\overline{MZ}_{t}^{GLS}$	$\overline{MSB}^{GLS}$	$\overline{MPT}^{GLS}$	**Lags**
Unemployment rate						
Total	-1.984	-8.668	-2.082	0.240	10.513	2
Male	-1.878	-9.959	-2.229	0.224	9.164	4
Female	-2.053	-3.775	-1.365	0.361	24.009	2
16-24	-2.601	-8.312	-2.037	0.245	10.967	4
24-55	-1.809	-10.243	-2.263	0.221	8.897	2
55+	-1.379	-6.587	-1.768	0.268	13.863	4
Participacion rate						
Total	-2.884	-3.997	-1.386	0.347	22.470	9
Male	-2.225	-4.888	-1.525	0.312	18.441	7
Female	-3.179*	-2.104	-1.002	0.476	41.973	4
16-24	-1.370	-4.544	-1.426	0.314	19.458	2
24-55	-3.231*	-3.324	-1.289	0.388	27.410	4
55+	-0.876	-7.704	-1.760	0.238	12.650	7

Notes:
The critical values for the Ng-Perron test are tabulated in Ng & Perron (2001). The *MAIC* information criteria is used to select the autoregressive truncation lag, *k*, as proposed in Perron and Ng (1996)
***, ** and * denote significance at 1%, 5% and 10% level respectively

I(2) vs. I(1)

	PP	Ng-Perron				
Variable	**Test**	$\overline{MZ}_{\alpha}^{GLS}$	$\overline{MZ}_{t}^{GLS}$	$\overline{MSB}^{GLS}$	$\overline{MPT}^{GLS}$	**Lags**
Unemploy-ment rate						
Total	-4.279***	-21.337***	-3.214***	0.151***	1.334***	1

Male	4.146***	-18.216***	-2.905***	0.159***	1.755***	1
Female	6.441***	-17.682***	-2.963***	0.168***	1.424***	4
16-24	5.157***	13.418**	-2.491**	0.186**	2.211**	2
24-55	4.353***	-22.304***	-3.288***	0.147***	1.278***	1
55+	-11.118***	-8.365**	-2.033**	0.243*	2.975**	9
Participacion rate						
Total	8.673***	-0.607	-0.387	0.637	23.410	8
Male	-10.433***	-0.833	-0.625	0.749	27.929	9
Female	8.976***	-0.789	-0.418	0.529	17.600	8
16-24	-10.100***	-9.024**	-2.089**	0.232**	2.854**	8
24-55	-10.452***	-0.834	-0.466	0.559	18.621	9
55+	-6.075***	0.733	1.037	1.415	125.478	9

Notes:
The critical values for the Ng-Perron test are tabulated in Ng & Perron (2001). The MAIC information criteria is used to select the autoregressive truncation lag, k, as proposed in Perron and Ng (1996)
***, ** and * denote significance at 1%, 5% and 10% level, respectively.

Table 2. Global effects: Toda-Yamamoto test

$\boldsymbol{p \nRightarrow u}$		$\boldsymbol{u \nRightarrow p}$	
Test	Bootstrap critical values	Test	Bootstrap critical values

	statistic	1%	5%	10%	statistic	1%	5%	10%
Whole	12.326**	12.684	8.700	6.532	10.067**	15.515	8.575	6.704
Men	21.669***	17.053	11.703	9.393	16.070***	15.643	11.069	9.505
Wom-en	5.520	15.781	8.736	6.638	5.747	16.591	8.806	6.447
16-24	14.201**	18.156	12.810	10.641	14.762**	18.147	13.179	11.160
25-54	1.545	16.834	9.246	7.318	9.274**	16.273	8.983	6.859
55+	16.929**	22.513	16.248	13.560	25.310***	21.842	17.287	15.195

For all tables ***, ***, *, imply rejection of the null hypothesis at 1%, 5% and 10% level of significance, respectively.

Tables 4-7: Time-varying asymmetric Granger causality test

Table 4. Positive effects

	$p^+ \nRightarrow u^+$				$u^+ \nRightarrow p^+$			
	Test statistic	Bootstrap critical values			Test statistic	Bootstrap critical values		
		1%	5%	10%		1%	5%	10%
Whole	5.821*	11.306	6.408	4.780	1.108	9.572	6.906	5.044
Men	6.296	21.370	15.988	14.016	9.890	23.544	17.251	14.637
Women	3.838	13.749	8.192	6.584	1.166	12.959	9.193	7.053
16-24	3.843	18.216	12.157	9.658	4.455	18.211	13.646	10.372
25-54	2.109	11.597	7.753	6.606	4.937	12.534	8.454	6.399
55+	16.371**	17.970	13.090	11.256	12.047*	19.885	13.870	11.321

Table 5. Negative effects

	$p^- \nRightarrow u^-$				$u^- \nRightarrow p^-$			
	Test statistic	Bootstrap critical values			Test statistic	Bootstrap critical values		
		1%	5%	10%		1%	5%	10%
Whole	0.366	22.222	10.655	6.750	11.910**	31.900	9.818	6.476
Men	7.476	14.618	10.521	8.551	5.886	16.752	10.780	8.582
Women	3.078	31.138	9.093	6.175	17.315**	43.160	12.721	7.915
16-24	9.101*	15.289	10.023	8.140	9.572*	15.237	10.508	8.328
25-54	0.007	27.30	7.652	4.48	31.788**	29.73	7.906	4.92

		5		6	*	9		7
55+	3.174	12.692	8.724	6.683	1.440	13.220	8.629	6.732

Table 6. Mixed effects (I)

	$p^+ \nRightarrow u^-$				$u^+ \nRightarrow p^-$			
	Test statistic	Bootstrap critical values			Test statistic	Bootstrap critical values		
		1%	5%	10%		1%	5%	10%
Whole	3.806	15.136	8.910	6.690	0.074	11.787	7.078	4.717
Men	14.169**	15.071	10.189	8.238	10.260*	18.990	12.457	9.776
Women	7.257*	19.951	9.723	6.379	0.753	17.309	8.634	6.817
16-24	6.357	20.837	11.255	8.760	19.896***	16.629	11.122	9.413
25-54	19.926***	17.713	11.360	9.554	0.109	14.809	6.950	4.865
55+	4.583	20.879	12.697	10.338	2.358	11.962	7.883	6.539

Table 7. Mixed effects (II)

	$p^- \nRightarrow u^+$				$u^- \nRightarrow p^+$			
	Test statistic	Bootstrap critical values			Test statistic	Bootstrap critical values		
		1%	5%	10%		1%	5%	10%
Whole	2.557	13.967	7.183	5.358	2.514	15.150	8.961	6.418
Men	28.448***	15.721	10.626	8.315	1.916	14.020	9.848	8.023
Women	0.058	12.086	7.001	5.023	1.513	20.445	9.330	6.478

16-24	22.931***	13.369	8.047	6.460	10.981**	18.959	10.358	8.366
25-54	0.277	14.808	8.105	5.615	1.899	14.407	8.423	6.430
55+	16.368***	11.593	7.974	6.383	17.359***	15.390	8.811	6.533

Parte II

Chapter 5. Exploring the Dynamics of labor force participation with a nonlinear unobserved component model

This chapter provides estimates from an unobserved components model, initially suggested by Jaeger and Parkinson (1994, 1998) in order to check the existence of hysteresis in labour participation. In particular, this approach should allow disentangle the effect of unemployment evolution in different business cycle phases on labour force participation –the cyclical effects summarised in the literature in discouraged and added worker effects– and the permanent part, the part that exhibits *resilience* and it is incorporated to the natural component of the participation rate. In addition, and by using an extended version of this model –including non-linearities– we also check the potential existence of different estimates of this relationship in different periods –in expansions and recessions–.

By using this approach, the participation effect of changes in the unemployment rate is analysed. The analysis allows to look not only

for cyclical effects –i.e. testing added, discouraged or invariance worker effect– but also for hysteresis.

In sum we use an alternative framework for exploring the dynamic effects of downturns and upturns on labour force participation both in aggregate and by gender, that is the greater/lesser responsiveness labour force participation to downturns/upturns and whether this shocks show persistence.

The empirical analysis of the labour force participation rate is a hot policy issue at the time of writing, specially in countries like Spain, where not only the deep depression of the economic activity but also the existence of a strong added worker effect –empirical findings of Congregado et al (2014) pointed to this direction among females– are behind the exponential growth experienced by the Spanish unemployment rate. Now, where Spanish economy shows symptoms of recovery and the unemployment rate is starting to fall, the bad news is that it is not the consequence of higher employment but the consequence of a fall in the participation rate –discouraged effect seems to be dominating now the net effect and no hysteresis seems to be present–.

Our results provide robust evidence of hysteresis for the aggregate and for males but not for females, in the linear version. Attending to the cyclical effects our linear unobserved component model also

provide evidence of a discouraged effect among males and invariance in the total and females labor force participation rates. However, when the nonlinear model is considered, then we provide evidence of hysteresis not only for males and total but also for females, although in the positive regime for males and for the total. The evidence on the discouraged and invariance hypotheses in this nonlinear model confirms the results obtained in the linear one.

5.1. Introduction

In the last four years, a period characterised by austerity, the provisional assessment of the labour market dynamics must be positive in terms of unemployment. The record of the period balance is a fall in unemployment -436.500 unemployed less–but with 104.300 individuals less in employment. These apparently contradictory figures are the result of two opposite movements. The fall in unemployment during de current legislative session reflects the fall in active population during this period. When the Prime Minister Mariano Rajoy arrived at La Moncloa there were 23,4 millions of individuals in the active population, while now (2015 Q3) there are only 22,9.

At the end of 2011, Spain was immersed in a deep recession, which started in 2007. The unemployment dynamic has been favourable. The Spanish Unemployment has fallen in more than 430.000 individuals. For the first time since 2011, unemployment fell below the 5 million mark.

In particular, the unemployment rate is now at 21,18%. In sum, while the exponential growth in the unemployment rate, experienced during the period 2007-2013, was partially due to the observed rise in the participation rate –specially among some groups of secondary workers such us females or youth, the current fall in the unemployment rate is a direct consequence of the fall in the active population –discouraged effect seems predominate among groups of Spanish workers and specially among migrant workers who have lost their jobs as a result of the crisis have decided to return to their country of origin–. These phenomena could help us to explain the observed fall in the active population a half million lesser than four years ago.

In this framework, this chapter has the aim to explore the relationship between unemployment and LFPR by using an alternative econometric framework for reconsidering and check the robustness of previous results on the existence of cyclical effects and the persistence of these shocks.

To this end, this work estimates an unobserved components model to explore the dynamics of labor participation in a country like Spain where the effect of the crisis on the unemployment rate has been specially deep effect on the unemployment rate. We ask whether labor participation rate exhibits hysteresis, defined as a dynamic structure in which business cycle fluctuations have persistent effects on the natural rate. In other words the key question is whether labor participation evolves as a trend-stationary or as a non-stationary time-series process. If participation rate is trend-stationary, shocks can be regarded as transitory: the rate reverts to its underlying, long-run ("natural") rate. So if the rate is trend- stationary, shocks on labor participation will have only temporary effects. If on the other hand the rate is non-stationary, shocks will have permanent effects.

In a time-series, hysteresis is checked in various ways. The most popular approach equates hysteresis with the existence of a unit root in a variable (see, Røed 1997, for a survey). An alternative approach proposed by Jaeger and Parkinson (1990, 1994) posits a more demanding criterion: hysteresis exists if cyclical changes affect the natural rate of a variable, even as the natural rate follows a unit root process. In which case, temporary shocks have permanent effects while the business cycle does not evolve independently of the natural rate; it then follows that a unit root is a necessary but not a sufficient condition for hysteresis. Following this idea, one could find in the literature the use of different unobserved components models for

checking (and capturing) this hysteresis effect (see, Fuchs and Weber, 2013, as example of this kind of strategies by using a trend-cycle decomposition method). In this chapter, we adopt Jaeger and Parkinson's (1990, 1994) definition of hysteresis in order to explore whether labor participation exhibits cycles with potentially durable long-run effects.

To test for hysteresis, we follow Jaeger and Parkinson (1990, 1994) and decompose labor participation into (two unobservable) components: a non-stationary component, the natural rate, and a stationary component, the cyclical one. Although we can find a number of works of this type in the literature on unemployment (see Assarson and Janson, 1998; Karamé, 1999; Salemi, 1999; Di Sanzo and Pérez, 2005; Logeay and Tober, 2005), on entrepreneurship (Congregado et al., 2011), and on Tourism (Merida and Golpe, 2015) to the best of our knowledge its application to labor participation is novel.

The aim is to explore whether the Spanish participation rate exhibits hysteresis. We do so using quarterly time-series data on participation and unemployment rates for Spain during the last decades. Spain is a suitable case of analysis since the high volatility observed in the dynamic macroeconomic of the Spanish Economy –a deep depression with an exponential growth in the unemployment rate and the existence of two opposite trends in the labor force participation rate during the last recession (a first regime in which added worker effects

marked the evolution of the labor participation and a second one in which discouraged effect predominate) and the existence of asymmetries by gender and age. We argue that if labor participation exhibits hysteresis, any increase/decrease in participation brought about these cyclical effects are incorporated into all future levels of labor participation. Furthermore, business cycles would have important effects on the participation, by impacting on the future trajectory of the Spanish unemployment rate.

The rest of this chapter has the following structure. The next section discusses theory and empirical evidence about the dynamics of labor participation over the business cycle including the existence of hysteresis. The third section describes the data and the estimation methodology. The final section concludes and reports some avenues for future research.

5.2. Previous literature

To look for hysteresis processes, that is the fact that transitory shocks become permanents has been a well-explored hypothesis, both from a theoretical and empirical perspective, in different fields of research such as the search of hysteresis in the unemployment time series. This body of literature started with the seminal work of Blanchard y Summers (1986, 1988), has been applied to a broad range of fields such as the entrepreneurship (Congregado, Golpe and Parker, 2012), in Energy Economics (see Golpe, Congregado y

Carmona, 2012), or tourism economics (Mérida, Golpe and Carmona, 2015) among oherts, in an essay to check if cyclical shocks reverts in permanents or not.

In any case, there is no doubt in that it is the analysis of hysteresis in unemployment has been the most explored topic, given the interest of detecting whether raises in unemployment during recessions show resilience of where conversely, its effects are merely transitory tending to disappear in the long-term. In sum, the empirical analysis of hysteresis is equivalent to knowing if in a time series any cyclical shocks become part of the natural component –i.e. of the trend component–.

In Labour Economics, the analysis of the hysteresis in unemployment has been the most intensively explore done, in both theoretical and empirical perspectives.1 However, a relative scarce literature on self-employment and labor force participation (Fuchs and Weber, 2013) can also be found.

In general and independently of the existence of differences in methodologies, scopes and results, there is a certain consensus on the existence of a strong dependence of the non rejection of this hypothesis in labor markets with high employment protection legisla-

[1] The way to look for hysteresis has been a controversial matter. For a detailed discussion of this questions see the works of Jaeger & Parkinson (1994), Pérez & di Sanzo (2012) or Congregado, Golpe & Parker, (2012), among others.

tion (Bassanini and Duval, 2009; Nickell et al., 2005, Blanchard and Wolfers, 2000).

In any case economists has also analysed the hysteresis phenomenon in other fields of labor economics. For instance the analysis of persistence in entrepreneurship/self-employment –see Congregado, Parker & Golpe, 2012, for the US and Spain or Parker, Congregado y Golpe, 2011, for 23 OECD countries, or Millán, Congregado & Román (2014) for the EU-15– or the labor force participation rate (Fuchs & Weber, 2013).

However, the evolution of the labor force participation rate over the business cycles is a hot policy issue, especially in economies where unemployment rates have experienced exponential growths as a result of the fall in the economic activity. In these cases the dynamic of the unemployment rates has not been only the result of the employment destruction but also the parallel phenomena of added worker effects in the labor force participation, since a number of secondary workers such as youth and females decided to enter in the active population. (see, Congregado, Golpe, van Stel, 2010; Congregado, Carmona, Golpe, van Stel, 2012, as examples of this kind of literature).

In this sense, knowing if the positive shocks showed by the LFPR during the last crisis are permanent or transitory is a very important

question not only for forecasts future unemployment rates trends but also for understanding if these negative shocks will show a mean reversion –mitigating the unemployment problem– or whether conversely they will show persistence causing that the employment intensity of growth, in terms of reduction in the unemployment rate becomes low. If this were the case, the new employment intensity of growth must be higher or the intensity of growth or experience impressive growth rates in order to achieve some targets in the unemployment rates. This question is crucial in countries like Spain characterised by high unemployment rates and a relative persistence. The empirical analysis of this relationship is the goal of this chapter.

As we mentioned before, the issue of labour force participation hysteresis has received limited attention with regard to other types of issues, although the long-term effects of some shocks to labor participation rates could potentially be large. For instance, LFPR have changed markedly over decades due to structural changes –irreversible– in the decisions of participation by females, compulsory education or changes in the retirement decision of older workers. All these changes result in new long-term trends consistent with the idea of persistence. By using this argument, one could argue that there is the possibility that adverse/favorable macroeconomic shocks may turn temporary participation declines/rises into persistent. Conversely, one can also argue, that recessions have scarring effects on the job prospects (and wages) for the cohorts that enter the labour

market in such periods (see Raaum and Roed, 2006), that is the issue of whether crises have persistent effects on the participation of the overall labour force or of particular gender/age groups.

Based on individual survey data, Coile and Levine (2007, 2009) Von Wachter (2007) or Hallberg (2008), Tatsiramos (2010) find that retirement decisions respond to economic conditions – a result supported by– and that this cyclical sensitivity is amplified by available public retirement provisions. A number of case studies have also documented durable participation declines in the aftermath of past recessions (see, e.g. Nickell and Van Ours, 2000, Fortin and Fortin, 1999).

5.3. Data and Methodology

5.3.1. Data

Let us define the employment rate (et) as the employment to population (aged 16+) ratio, the unemployment rate (ut) as the unemployment to population (aged 16+) ratio, while the labour participation rate (pt) consists of the economically active population as a percentage of the population (age +16). The relation between the rates de-

fined above is given by the two following identities: $e_t + u_t = p_t$ and $u_t = p_t - e_t$.

Our empirical analysis uses quarterly data on seasonally adjusted quarterly observations drawn from the Labor Force Survey (EPA, Spanish National Statistics Institute). The sample starts in 1976(III) and conclude in 2015(II).

5.3.2. Econometric Methodology

Several studies equate hysteresis in a time series with a unit root process.2 Others argue that hysteresis arises when changes to the cyclical component of a time series, p_t^C, induce permanent changes in the "natural rate" of the series, p_t^N. This is different to a unit root process. To comprehend the different estimation strategies these approaches call for, decompose the series pt into the sum of its two (unobservable) components: the non-stationary natural rate component, p_t^N, and the stationary cyclical component, p_t^C:

$$p_t = p_t^N + p_t^C \qquad (1)$$

[2] See Blanchard and Summers (1986). Layard et al. (1991) popularized the term "pure" hysteresis for describing the presence of a unit root in time series.

Now define the natural rate component as a random walk plus a term capturing a possible hysteresis effect:

$$p_t^N = p_{t-1}^N + \beta p_{t-1}^C + \varepsilon_t^N \qquad (2)$$

where the β coefficient measures, in percentage points, how much the natural rate increases if the economy experiences a cyclical labor force participation rate increase of 1 percent. Evidently a unit root in the participation rate pt is a necessary but not sufficient condition for the existence of hysteresis since a unit root could be generated by an accumulation of shocks to the natural rate p_t^N while at the same time $\beta = 0$ (Røed, 1997). In contrast, there is hysteresis if $\beta > 0$.

The specification of the model is completed by writing the cyclical component of the participation rate as a stationary second-order autoregressive process:

$$p_t^C = \varphi_1 p_{t-1}^C + \varphi_2 p_{t-2}^C + \alpha \Delta u_{t-1} + \varepsilon_t^C \qquad (3)$$

augmented with a term, $\alpha \Delta u_{t-1}$, which relates cyclical self-employment to lagged output growth, where u_{t-1} is lagged real un-employment rate. This enables the relationship between the business cycle and labor force participation to be analyzed. The random shocks ε_t^N and ε_t^C are assumed to be mean-zero draws from the normal distribution with variance-covariance matrix Ω; the state-space form of the model can be written as

$$p_t = \begin{pmatrix} 1 & 1 & 0 \end{pmatrix} \begin{pmatrix} p_t^N \\ p_t^C \\ p_{t-1}^C \end{pmatrix} \tag{4}$$

$$\begin{pmatrix} p_t^N \\ p_t^C \\ p_{t-1}^C \end{pmatrix} = \begin{pmatrix} 1 & \beta & 0 \\ 0 & \varphi_1 & \varphi_2 \\ 0 & 1 & 0 \end{pmatrix} \begin{pmatrix} p_{t-1}^N \\ p_{t-1}^C \\ p_{t-2}^C \end{pmatrix} + \begin{pmatrix} 0 \\ \alpha \\ 0 \end{pmatrix} \Delta u_{t-1} + \begin{pmatrix} \varepsilon_t^N \\ \varepsilon_t^C \\ 0 \end{pmatrix} \tag{5}$$

$$\Omega = \begin{pmatrix} \sigma_N^2 & 0 & 0 \\ 0 & \sigma_C^2 & 0 \\ 0 & 0 & 0 \end{pmatrix} \tag{6}$$

To summarize, hysteresis is inferred if the coefficient β is significantly different from zero, whereas pro- or anti-cyclical variation is inferred depending on whether the coefficient α is positive or negative, respectively. The coefficients of the model (4) – (6) are estimated by maximum likelihood using a Kalman filter.

A non-linear version of this model (4) through (6) can also be estimated, to take account of the possibility that participation rates respond asymmetrically to the business cycle.

When we talk about "positive" or "negative" shocks, we do so relative to some threshold level of unemployment growth, τ (where τ is not necessarily zero). To explore whether asymmetries exist, we es-

timate a non-linear version of the unobserved components model. Specifically, we replace the state-space equation (5) with the Threshold Auto Regressive (TAR) specification

$$\begin{pmatrix} p_t^N \\ p_t^C \\ p_{t-1}^C \end{pmatrix} = \begin{pmatrix} 1 & \beta & 0 \\ 0 & \varphi_1 & \varphi_2 \\ 0 & 1 & 0 \end{pmatrix} \begin{pmatrix} p_{t-1}^N \\ p_{t-1}^C \\ p_{t-2}^C \end{pmatrix} + \tag{7}$$

$$+ \begin{pmatrix} 0 \\ \alpha^+ \\ 0 \end{pmatrix} I_t^+ \Delta u_{t-1}^+ + \begin{pmatrix} 0 \\ \alpha^- \\ 0 \end{pmatrix} I_t^- \Delta u_{t-1}^- + \begin{pmatrix} \varepsilon_t^N \\ \varepsilon_t^C \\ 0 \end{pmatrix}$$

where I_t^+ and I_t^- are the Heaviside indicator functions such that:

$$I_t^+ = \begin{cases} 1 \, if \; \Delta u_{t-1} \geq \tau \\ 0 \, if \; \Delta u_{t-1} < \tau \end{cases}$$

$$I_t^- = \begin{cases} 1 \, if \; \Delta u_{t-1} < \tau \\ 0 \, if \; \Delta u_{t-1} \geq \tau \end{cases}$$

This model can be estimated via maximum likelihood using the Kalman filter, where $\alpha+$ and $\alpha-$ are among the parameters to be estimated, and τ is obtained by grid search to minimize the residual sum of squares of the autoregressions. In this context a test for asymmetry becomes a test for linearity, i.e. a test for a single regime against the alternative of two regimes. The null hypothesis we are interested in is $H_0 : \alpha^+ = \alpha^-$.

5.4. Results

The results obtained in this paper can be divided in three main sections. Firstly, the necessary condition for persistence is assessed by means of unit root tests. The second part of the results derives from the application of the unobserved components model proposed by Jaeger and Parkinson (1990, 1994). Lastly the potential asymmetry is tested through the nonlinear version of the aforementioned model as has been explained.

5.4.1. Unit root tests

To begin with the empirical procedure we shall start by testing for the existence of a unit root in the tourism series as a necessary condition for the presence of persistence. In order to conduct this task we make use of the approaches developed by Phillips and Perron (1988) and Ng and Perron (2001).

Table 1 contains the results obtained from both the Phillips-Perron (PP) test and the Ng-Perron test, which consists of four different test statistics based on the GLS detrended data and a modified Akaike Information Criteria to select the lag length for the regression. Just like in the PP test, the null hypothesis of a unit root in the series is tested against the alternative of stationarity. As can be observed, both approaches suggest that the null hypothesis of non-stationarity can be rejected, which leads to consider the presence of a unit root in the series of unemployment rates (total, males and females).

Table 1: Ng-Perron and Phillips-Perron unit root tests for unemployment

rate

Variable		Parameter	**I(2) vs. I(1)**	**I(1) vs. I(0)**
Unemployment rate	Ng-Perron	$\overline{MZ}_{\alpha}^{GLS}$	-21.337	-6.667***
		$\overline{MZ}_{t}^{GLS}$	-3.214	-2.082***
		$\overline{MSB}^{GLS}$	0.151	0.240***
		$\overline{MPT}^{GLS}$	1.334	10.531***
	PP test	PP statistic	-8.673	-1.984
		Prob.	0.000	0.605
Males Unemployment rate	Ng-Perron	$\overline{MZ}_{\alpha}^{GLS}$	-18.216	-9.959***
		$\overline{MZ}_{t}^{GLS}$	-2.905	-2.229***
		$\overline{MSB}^{GLS}$	0.160	0.224***
		$\overline{MPT}^{GLS}$	1.755	9.164***
	PP test	PP statistic	-4.146	-1.878
		Prob.	0.000	0.661
Females Unemploy-ment rate	Ng-Perron	$\overline{MZ}_{\alpha}^{GLS}$	-17.628	-3.775***
		$\overline{MZ}_{t}^{GLS}$	-2.963	-1.365***
		$\overline{MSB}^{GLS}$	0.168	0.362***
		$\overline{MPT}^{GLS}$	1.424	24.009***
	PP test	PP statistic	-6.441	-2.053
		Prob.	0.000	0.567

Critical values	I(2) vs. I(1)					I(1) vs. I(0)				
	Ng-Perron test				PP test	Ng-Perron test				PP test
	$\overline{MZ}_{\alpha}^{GLS}$	$\overline{MZ}_{t}^{GLS}$	$\overline{MSB}^{GLS}$	$\overline{MPT}^{GLS}$	$\tilde{t}_{\alpha}$	$\overline{MZ}_{\alpha}^{GLS}$	$\overline{MZ}_{t}^{GLS}$	$\overline{MSB}^{GLS}$	$\overline{MPT}^{GLS}$	$\tilde{t}_{\alpha}$
1%	-13.800	-2.580	0.174	1.780	-3.480	-23.800	-3.420	0.143	4.030	-4.028
5%	-8.100	-1.980	0.233	3.170	-2.883	-17.300	-2.910	0.168	5.480	-3.444
10%	-5.700	-1.620	0.275	4.450	-2.578	-14.200	-2.620	0.185	6.670	-3.147

Notes: The critical values for the Ng-Perron test are tabulated in Ng & Perron (2001). The *MAIC* information criteria is used to select the autoregressive truncation lag, *k*, as proposed in Perron and Ng (1996)

*** Rejects null hypothesis at 1% significance level.

** Rejects null hypothesis at 5% significance level.

* Rejects null hypothesis at 10% significance level.

5.4.2. Linear unobserved component model

The results from the application of the Jaeger and Parkinson (1990, 1994) procedure are reflected on Table 2. The lack of significance of the parameter β indicates that the hypothesis of hysteresis cannot be confirmed -in a linear way-. Plus, the parameter δ, which can be interpreted as an indicator of the invariance hypothesis, is also non-significant.

Hence, it seems appropriate to check the nonlinear version of this model in order to assess the potential existence of persistence in the unemployment rate -and also to evaluate the invariance hypothesis- under an asymmetric behaviour.

Table 2. Linear unobserved component model

	Total	Males	Females
	Natural rate equation		
β	0.065**	0.032***	0.823
	(0.033)	(0.010)	(0.831)
σ_N	0.218***	0.020***	0.025***
	(0.072)	(0.004)	(0.005)
	Cyclical rate equation		
ϕ_1	1.796***	1.851***	1.393***
	(0.066)	(0.050)	(0.276)
ϕ_2	-0.807***	-0.857***	-0.485**
	(0.060)	(0.047)	(0.192)
σ_C	0.305***	0.022****	0.012*
	(0.057)	(0.003)	(0.006)
	Identification equation		
α	0.340***	-0.031	0.473***
	(0.129)	(0.099)	(0.090)
δ	-0.015	-0.316***	1.785
	(0.011)	(0.090)	(4.531)
σ_D	0.370***	0.269***	0.810***
	(0.063)	(0.035)	(0.134)

Notes: Standard errors in parentheses.
***,**,* Rejects null hypothesis at 1,5 and 10% significance level respectively

5.4.3. Nonlinear version

Since the application of the linear unobserved components model has not provided satisfactory results, we shall proceed to assess the hypothesis of persistence while relaxing the symmetric assumption of the model above. The process of identifying whether there is an asymmetric behaviour in the number of nights spent can be approached by finding a potential threshold such that $H_0 : \beta^+ \neq \beta^-$; i.e. there exist two different regimes separated by that threshold. The

bootstrap technique explained in Pérez and Di Sanzo (2011) has been applied to obtain the p-value for that contrast. Since p-value= 0.000, the null hypothesis can be rejected at a 1% level thus implying the existence of two different regimes in the behaviour of the variable (total, men and women).

Table 3 shows the results obtained from the nonlinear estimation. The persistence parameter in the total sample is significant at the 5% level for the first regime and at the 1% level for the second one, the former being lower than the latter. This implies that the hypothesis of persistence cannot be rejected when considering an asymmetric behaviour. The unemployment invariance hypothesis is confirmed for the aggregate labour forcé participation rate and for females. For males, the discouraged worker effect is confirmed.

Table 3 Nonlinear unobserved component model

	Total	**Males**	**Females**
	Natural rate equation		
β^+	0.127*	0.059**	0.525***
	(0.037)	(0.031)	(0.123)
β^-	0.017	0.051	0.361***
	(0.031)	(0.069)	(0.099)
σ_N	0.096***	0.126***	0.000
	(0.020)	(0.037)	(0.001)
	Cyclical rate equation		
ϕ_1	1.656***	1.698***	0.927***
	(0.140)	(0.108)	(0.136)
ϕ_2	-0.686***	-0.721***	-0.215***
	(0.116)	(0.091)	(0.063)
σ_C	0.043	0.045	0.084***
	(0.029)	(0.033)	(0.019)

Identification equation						
α	0.192*		-0.074		0.488***	
	(0.115)		(0.095)		(0.098)	
δ	-0.452		-0.447**		-0.201	
	(0.330)		(0.187)		(0.333)	
σ_D	0.344***		0.260***		0.815***	
	(0.071)		(0.038)		(0.143)	
Threshold	0.027		-0.031		-0.003	
% of observations	43.8	56.2	68.6	31.4	58.8	41.2
Delay lag	3		3		2	

Notes: Standard errors in parentheses.
***,**,* denote significance at 1,5 and 10% level respectively

5.5. Conclusions

This paper estimated unobserved components models for the Spanish labor force participation rate, by means of a definition of hysteresis based on the assumed interdependent evolution of its two unobserved components: a non-stationary natural rate and a stationary cyclical component, thereby distinguishing hysteresis from natural rate shocks. The results provide robust evidence of hysteresis for the aggregate and for males but not for females, in the linear version. Attending to the cyclical effects our linear unobserved component model also provide evidence of a discouraged effect among males and invariance in the total and females labour force participation rates.

However, when the nonlinear model is considered, then we provide evidence of hysteresis not only for males and total but also for females, although in the positive regime for males and for the total.

The evidence on the discouraged and invariance hypotheses in this nonlinear model confirms the results obtained in the linear one.

In sum, it seems that economic and/or policy shocks on unemployment in Spain have permanent effects on labor force participation rates at least in some regimes
In addition our results also shed new light on the issue of business cycle effects on labor force participation rate.

Further research is needed to determine whether it is different institutional conditions which explain the diverse findings in previous literature. Future work might fruitfully apply the methodology used in this article to a broader range of countries.

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Table 1

Unit Root Tests

Table 1: Ng-Perron and Phillips-Perron unit root tests for unemployment rate

I(1) vs. I(0)

	PP	Ng-Perron				
Variable	**Test**	$\overline{MZ}_{\alpha}^{GLS}$	$\overline{MZ}_{t}^{GLS}$	$\overline{MSB}^{GLS}$	$\overline{MPT}^{GLS}$	**Lags**
Unemployment rate						
Total	-1.984	-8.668	-2.082	0.240	10.513	2
Male	-1.878	-9.959	-2.229	0.224	9.164	4
Female	-2.053	-3.775	-1.365	0.361	24.009	2
Participacion rate						
Total	-2.884	-3.997	-1.386	0.347	22.470	9
Male	-2.225	-4.888	-1.525	0.312	18.441	7
Female	-3.179*	-2.104	-1.002	0.476	41.973	4

Notes:
The critical values for the Ng-Perron test are tabulated in Ng & Perron (2001). The *MAIC* information criteria is used to select the autoregressive truncation lag, k, as proposed in Perron and Ng (1996)
***, ** and * denote significance at 1%, 5% and 10% level respectively

I(2) vs. I(1)

	PP	Ng-Perron				
Variable	**Test**	$\overline{MZ}_{\alpha}^{GLS}$	$\overline{MZ}_{t}^{GLS}$	$\overline{MSB}^{GLS}$	$\overline{MPT}^{GLS}$	**Lags**
Unemployment rate						
Total	-4.279***	-21.337***	-3.214***	0.151***	1.334***	1
Male	-4.146***	-18.216***	-2.905***	0.159***	1.755***	1
Female	-6.441***	-17.682***	-2.963***	0.168***	1.424***	4
Participacion rate						
Total	-8.673***	-0.607	-0.387	0.637	23.410	8
Male	-10.433***	-0.833	-0.625	0.749	27.929	9

Female	-8.976***	-0.789	-0.418	0.529	17.600	8

Notes:
The critical values for the Ng-Perron test are tabulated in Ng & Perron (2001). The *MAIC* information criteria is used to select the autoregressive truncation lag, *k*, as proposed in Perron and Ng (1996)
***, ** and * denote significance at 1%, 5% and 10% level respectively

Conclusions

The Spanish unemployment rate stood at 21.18 percent in the third quarter of 2015, almost five percentage points lower than three years earlier although almost 12 percentage points higher than at the end of 2008. It seems that behind this favorable evolution is not only the result of the entry of the Spanish economy in a new recovery phase but also the effect of the labor force participation rate development. In particular the labor force participation rate is now falling, i.e. it is showing an opposite evolution with regard to the crisis, when the exponential growth of Spanish unemployment was the result of two vectors: an increased supply of labor, reflected by higher labor force participation rates.

In this article we revisited how participation rates are affected by business cycle fluctuations, while accounting for different sources of asymmetries.

In particular, we explored the potential existence of asymmetries into two directions by age groups and checking whether the relationship is time varying. By using Spanish quarterly data over the period 1976-2015, results point to the existence of nonlinear relationships

between unemployment and labor force participation for different age groups.

In particular, we provide evidence for a nonlinear discouraged worker effect for the oldest and middle-aged groups, while an added worker effect is found for youth when the unemployment rate is below a threshold.

This article studied the long-run relationship between unemployment and labor force participation rate by taking into account possible different sources of asymmetries: structural breaks and the possible existence of asymmetries by gender and age groups, using Spanish data. In the last regime, the current one, our findings support the discouraged for the aggregate labor force participation rate.

However, the analysis by gender, reports mixed evidence –discouraged for males and added worker effect for females–. Finally when we consider the asymmetries by age, the evidence is mixed again: discouraged for the younger added for the middle age group and invariance for the older.

This dissertation also tested the Granger causality relationships between labor force participation (LFPR) and unemployment looking for asymmetries in several ways: by gender, age and allowing a time varying relationship.

When we analyze the Granger causality running from labor force participation to unemployment that is the role of LFPR as a leading indicator of the unemployment rate when LFPR show a positive evolution leads increases in the unemployment rates for both the aggregate and the group of the older. Conversely, this same shock leads unemployment rates reductions for males, females and for individuals belonging to the middle age group. Finally the predictive power of the fall in the participation rate on the unemployment rate is weak for leading unemployment reduction (only for the younger), while negative shocks on the LFPR causes positive impacts on the unemployment rates for males, younger and older. In crisis, if Granger causality runs from unemployment to LFPR, and this effect is negative, this is also evidence for the discouraged effect. This effect is found only for males and younger when time asymmetries are considered. When the Granger causality runs from unemployment to LFPR and the relationship is positive, this would be evidence for the added worker effect, it can be only considered in for the older.

In sum, our results seem to support the existence of both the discouragement and the added worker effect and a reverse causality running from participation to unemployment, but these causality relationships are different by gender, for different age groups and time varying, i.e. different in expansions and recessions. One implication for practitioners, forecasters and policy-makers is that they should bear in mind the complexity of the relationship between the labor

participation and unemployment in order to evaluate and/or forecasting the effects of shocks in these two variables. In this sense fluctuations in labor force participation can alleviate or stress unemployment problems, as recent data show.

Finally this dissertation discuss about the potential hysteresis in LFPR, based on the assumed interdependent evolution of its two unobserved components: a non-stationary natural rate and a stationary cyclical component, thereby distinguishing hysteresis from natural rate shocks. The results provide robust evidence of hysteresis for the aggregate and for males but not for females, in the linear version. Attending to the cyclical effects our linear unobserved component model also provide evidence of a discouraged effect among males and invariance in the total and females labor force participation rates.

However, when the nonlinear model is considered, then we provide evidence of hysteresis not only for males and total but also for females, although in the positive regime for males and for the total. The evidence on the discouraged and invariance hypotheses in this nonlinear model confirms the results obtained in the linear one.

In sum, it seems that economic and/or policy shocks on unemployment in Spain have permanent effects on labor force participation rates at least in some regimes.

Further research is needed to determine whether it is different institutional conditions, which explain the diverse findings in previous literature. Future work might fruitfully apply the methodology used in this article to a broader range of countries.

Resumen en ingles

Summarise

This thesis consists of four self-contained essays structured as follows. It mainly consists of two parts leaving aside this introduction.

Part II includes chapters 2 to 4, three chapters devoted to provide new empirical findings about the cyclical relationship between unemployment and labor force participation. Chapter 2 looks for linear and non-linear relationships between unemployment and labor force participation rate in Spain and the US, using quarterly data from 1976:3 to 2015:2. In this chapter we revisit how participation rates are affected by business cycle fluctuations, while accounting for different sources of asymmetries. In particular, we explore the potential existence of asymmetries into two directions by age groups and checking whether the relationship is time varying. By using Spanish quarterly data over the period 1976-2015, results point to the existence of nonlinear relationships between unemployment and labor

force participation for different age groups. In particular, we provide evidence for a nonlinear discouraged worker effect for the oldest and middle-aged groups, while an added worker effect is found for youth when the unemployment rate is below a threshold.

Chapter 3 examines studies the long-run relationship between unemployment and labour force participation rate, from an alternative way, by taking into account possible different sources of asymmetries: structural breaks and the possible existence of asymmetries by gender and age groups, using Spanish data. In the last regime, the current one, our findings support the discouraged for the aggregate labour force participation rate. However, the analysis by gender reports mixed evidence –discouraged for males and added worker effect for females–. Finally when we consider the asymmetries by age, the evidence is mixed again: discouraged for the younger added for the middle age group and invariance for the older.

Chapter 4, re-examines the relationship between the labor force participation rate and the unemployment rate for Spain, looking for Granger causality relationships. The novelty of this study is to explore asymmetries in several ways: by gender, by age and allowing time dependence by using the new tests recently proposed by Hatemi-J (2012). This analysis completes the previous ones, carried out in this dissertation, in order to provide a comprehensive view of the exact nature of this relationship.

The article finds that there is either bidirectional long-run Granger causality running from labor force participation to the unemployment rate for the aggregate and for gender and age groups, except for females and for the middle age group. However if time-asymmetries are also considered, different causal relationships prevail for different groups and for every regime.

Finally, the contribution of the Part III, deals with the long term.

Chapter 5 estimates an unobserved components model to explore the existence of hysteresis in labour participation. In particular, this approach should allow disentangle the effect of unemployment evolution in different business cycle phases on labour force participation –the cyclical effects summarised in the literature in discouraged and added worker effects– and the permanent part, the part that exhibits *resilience* and it is incorporated to the natural component of the participation rate. In addition, and by using an extended version of this model –including non-linearities– we also check the potential existence of different estimates of this relationship in different periods –in expansions and recessions–.

By using this approach, the participation effect of changes in the unemployment rate is analysed. The analysis allows to look not only for cyclical effects –i.e. testing added, discouraged or invariance

worker effect– but also for hysteresis.

In sum we use an alternative framework for exploring the dynamic effects of downturns and upturns on labour force participation both in aggregate and by gender, that is the greater/lesser responsiveness labour force participation to downturns/upturns and whether this shocks show persistence.

The empirical analysis of the labour force participation rate is a hot policy issue at the time of writing, specially in countries like Spain, where not only the deep depression of the economic activity but also the existence of a strong added worker effect –empirical findings of Congregado et al (2014) pointed to this direction among females– are behind the exponential growth experienced by the Spanish unemployment rate. Now, where Spanish economy shows symptoms of recovery and the unemployment rate is starting to fall, the bad news is that it is not the consequence of higher employment but the consequence of a fall in the participation rate –discouraged effect seems to be dominating now the net effect and no hysteresis seems to be present–.

Our results provide robust evidence of hysteresis for the aggregate and for males but not for females, in the linear version. Attending to the cyclical effects our linear unobserved component model also provide evidence of a discouraged effect among males and invari-

ance in the total and females labor force participation rates. However, when the nonlinear model is considered, then we provide evidence of hysteresis not only for males and total but also for females, although in the positive regime for males and for the total. The evidence on the discouraged and invariance hypotheses in this nonlinear model confirms the results obtained in the linear one.

The study concludes with a final chapter, containing some concluding remarks and the future research agenda.

Resumen en español

Resumen

Esta tesis se compone de cuatro ensayos auto-contenidos dedicados al análisis de la relación entre el autoempleo y la tasa de participación estructurados como sigue.

La primera parte incluye los capítulos 2 a 4, tres capítulos dedicados a proporcionar nueva evidencia empírica sobre la relación cíclica entre el desempleo y la tasa de participación laboral. El capítulo 2 busca relaciones lineales y no lineales entre el desempleo y la tasa de participación en España haciendo uso de datos trimestrales desde 1976:3 a 2015:2. En particular se reconsidera el cómo están afectadas la tasas de participación laboral por la evolución del desempleo cuando se tienen en cuenta diferentes fuentes de asimetría. En concreto se exploran varias Fuentes de asimetría: por grupos de edad y en términos de si la relación es diferente en diferentes momentos de tiempo.

Utilizando datos de la economía española, los resultados apuntan a la existencia de una relación no lineal entre el desempleo y la tasa de participación para diferentes grupos de edad. En concreto lo resultados avalan un efecto desánimo para los grupos de edad intermedia y superior mientras que evidencia de efecto trabajador añadido es encontrada para jóvenes, cunado la tasas de desempleo no alcanza un determinado umbral.

El capítulo 3 examina la relación desde una perspectiva ligeramente distinta, desde el largo plazo, tendiendo en cuneta si existen asimetrías provocadas no sólo por estas diferencias de edad y género sino también por la existencia de cambios estructurales. En el último régimen, el actual, los hallazgos avalan el efecto desánimo para la tasa de participación agregada y efectos mixtos para ambos sexos – desánimo para hombres y trabajador añadido para las mujeres. Las asimetrías por edad también son avaladas por nuestro resultados.

El capítulo 4 reconsidera la relación para completar el análisis buscando relaciones de causalidad a la Granger. La novedad del análisis proviene de la exploración de estos test de causalidad en presencia de asimetrías: género, edad y no linealidad. Haciendo uso de los nuevos test propuestos por Hatemi-J (2012).
El análisis completa a los anteriores en aras a ofrecer una visión completa de la naturaleza exacta de la relación. Encontramos evidencia de una relación de causalidad unidireccional desde la partici-

pación al desempleo para el agregado y por género y grupos de edad, excepto para las mujeres y el grupo de individuos de edad intermedia. Sin embargo, al considerar simetrías temporales los resultados son mixtos dependiendo de la asimetrías considerada y del régimen o período objeto de análisis.
Finalmente, la segunda parte se dedica al análisis de los efectos en el largo plazo, y en particular si los shocks transitorios se convierten o no en permanentes.

El capítulo 5 estima un modelo de componentes inobservables para explorar la existencia de histéresis en la participación laboral. En particular, esta aproximación permite descomponer el efecto de la evolución del desempleo en las diferentes fases cíclicas sobre el componente cíclico de la participación laboral y sobre el componente tendencial.

Utilizando esta aproximación, exploramos los efectos dinámicos del desempleo en la participación laboral en el corto y en el largo plazo. Los resultados proporcionan evidencia robusta de histéresis para el agregado y para los hombres pero no para las mujeres en la versión lineal. En el modelo no lineal existe histéresis para hombres y mujeres.