Cuadernos de Economía (2020) 43, 105-118

Asociación Cuadernos de economía

Cuadernos de economía

www.cude.es

ARTÍCULO

Countercyclical labor productivity: the case of Spain

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JEL CODES
D220; D240; E240; E320; J240; J320; O470

KEYWORDS:
Business cycle; Labor productivity; Labor regulation; Total factor productivity; Countercyclicality

Abstract: This paper explores the role of labor regulation over the cyclical pattern of labor productivity by analyzing the case of Spain, which has gone in a few years from a strongly pro-cyclical pattern to a counter-cyclical one. A description of the mechanism underlying the counter-cyclical behavior of Spanish labor productivity has thus far not been formulated. In this paper, we offer an explanation based on Oi's 1962 model that seems to fit with the empirical evidence for Spanish labor productivity.
Our results suggest that the high rigidity in wages and the great flexibility in labor, related to temporary workers following the 1984 legislative reform, is the main cause of the countercyclical pattern of Spanish labor productivity. Our findings are in line with previous papers highlighting the crucial influence of labor market institutions over the cyclical pattern.
In addition, our analysis shows that the strong increase in labor productivity during contractions lack the appropriate fundamentals for the long term, given that the increase Spanish labor productivity is on average very weak in the long term.

CÓDIGOS JEL
D220; D240; E240; E320; J240; J320; O470

PALABRAS CLAVE:
Ciclo económico; Productividad laboral; Regulación laboral; Productividad total de los factores; Contraciclidad

Resumen: Este artículo explora el papel de la regulación laboral sobre el patrón cíclico de la productividad laboral analizando el caso español, que ha pasado en pocos años un patrón procíclico a otro contracíclico. La descripción del mecanismo que subyace en semejante fenómeno se describe en este artículo a partir del modelo de Oi de 1962, que parece corresponderse con la evidencia empírica.
Nuestros resultados sugieren que la alta rigidez de los salarios unida a la gran flexibilidad en el empleo tras la reforma de 1984, es la causa principal del patrón contracíclico de la productividad laboral española. Esta conclusión está alineada con numerosa literatura económica que destaca el papel crucial de las instituciones laborales sobre el patrón cíclico.
Además de ello, nuestro análisis muestra como los elevados incrementos de la productividad laboral durante los periodos contractivos carecen de fundamentos sólidos, siendo la evolución de la productividad muy limitada en el largo plazo.

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https://doi.org/10.32826/cude.v42i122.194

1. Introduction

That Spanish labor productivity is counter-cyclical is something assumed in the literature; however, the mechanism that produces the counter-cyclical pattern has not been sufficiently addressed. We find that there is a relationship between the counter-cyclical pattern and the duality of the labor market that emerged after the legislative reform of 1984, which allowed companies to adjust the labor factor through temporary employment at a low cost. Although more recent literature uses more sophisticated models, it seems that this mechanism conforms to the Oi's model of 1962.

In addition, the study of the cyclical pattern of labor productivity reveals the foundations of the evolution of productivity, the main source of economic growth in the long term. Therefore, we believe that this article can be of interest not only from an academic point of view but also from the point of view of economic policy.

The study of the cyclical pattern of labor productivity has been and continues to be the object of academic attention, as pointed out by Biddle (2014), and at the beginning of the last century, labor productivity (LP) was widely considered countercyclical. Mitchell (1913) had already described the forces behind this behavior as follows:

- Less productive employees are dismissed during recessions, increasing average productivity (human capital is countercyclical).
- High unemployment during recessions motivates workers to be more productive by improving efforts to avoid dismissal.
- In prosperous times, workers have greater workloads, which "tires" them by reducing their average hourly productivity.

This approach seemed to be corroborated by the increase in labor productivity during the Great Depression of the 1930s. Moreover, the Solow-Swam neoclassical model introduced in the 1950s, based on factors' accumulation where capital is fixed in the short run while labor is flexible, assumes a countercyclical behavior of labor productivity (Solow, 1956; Swam, 1956).

The empirical works of Hulgren (1960) and Kuh (1963) verified the procyclical behavior of labor productivity in the 1960s. Solow (1964), in an attempt to reconcile his model with new empirical evidence, found that firms retain workers during recessions. Oi (1962) also observed the smaller adjustment of employment in recessive shocks. He explained this behavior by including in a firm's labor demand model the costs of recruiting and training new employees (sunk cost). The procyclical pattern of labor productivity supported the new Real Business Cycle (RBC) models based on the association between increases in technology and inputs reduction.

The cyclicality of LP is related to the response of labor input to production variations. Firms adapt labor to production level according to the degree of flexibility that labor institutions allow. Some authors have pointed out that the vanishing of procyclicality in United States (US) labor productivity since the mid-1980s stems from the increased flexibility in the labor market, opening a way to explain the cyclical pattern via labor institutions. In this sense, Gali and van Rens (2009) ascribe the surge in flexibility to the decrease in the unions' power to explain the reduction of pro-cyclicality and the increase in the volatility of employment and wages with respect to output in the US since 1984. In the same way, Gordon (2011) postulates that labor institutions are the main cause of the cyclical pattern of LP. According to Gordon, while European labor institutions are concerned with maintaining of employment, North America, due to the decrease in union power in the 1980s, has moved to an almost unitary elasticity of hours' response to GDP fluctuations and a near-zero response of labor productivity, producing a vanishing in the procyclical behavior of LP. This new evidence seems to dispute explanations from the RBC models, based on the relationship between product and technological shocks, as well as the fulfillment of the Okun Law[1]. In this sense, Daly et al (2011) analyze the three components of the Okun coefficient: hours-per-worker, number of workers and LP. They find that to face shocks, firms sometimes opt for reducing working hours and sometimes for reducing staffing levels, producing different effects over the cyclical pattern of LP. In addition, they point out the role of the factor utilization margin. At this point, one cause of the decrease in pro-cyclicality during the 1980s is the loss in response to utilization to unemployment fluctuations. For Berger (2011), on the other hand, the decline of the American pro-cyclical LP as well as the "jobless recoveries" following recessions are due to the fact that firms grow in inefficiency in expansions, while in contractions they restructure their manpower in order to become more efficient. After the 1980s, the decline of union power has lowered firing costs, allowing firms to adjust employment that has reduced the procyclical pattern since then.

The effects of sticky wages on labor input have long been studied. Siebert (1997) discusses the failure of the European labor market in terms of higher unemployment than in America in terms of the higher distortions in reserve wages. The point is that workers and firms supply and demand jobs according to the expected benefits to each other in perfect equilibrium. But this balance can be distorted by taxes and social contributions. These imply a cost to the firm that is not directly perceived by workers as benefits, and therefore these costs reduce the firms' reserve salary without increasing the perceived profit by workers, thus creating a mechanism that leads to unemployment. Christoffel and Linzert (2005) point out that the European model is more like a right-to-manage negotiation because of the extensive coverage of sectoral agreements that block wage formation. In this sense, firms would only choose the level of employment at any given salary. The monopolization of bargaining power in the hands of firms or workers (unions) can fix wages that preclude the market mechanism from achieving efficient equilibrium in the Nash sense. In the same way, Nickell (1997) emphasizes that when wage bargaining

[1] Okun (1962) finds a relationship between unemployment and GNP for the American economy in the 1950s. According to Okun, a 1% decrease in unemployment is related to a 3.2% increase GNP, due to increases of 1.8% in man-hours and 1.4% in hourly productivity. This has been considered an empirical approximation for some time.

rests on unions, they tend to increase wages and unemployment. He also criticizes the distorting role of unemployment protection: *"Long-term benefits generate long-term unemployment"* (Nickell 1997, page 67). He shows that between 1989 and 1994, Spain was the European country with the longest duration of unemployment aid. It is also worth noting that union coverage in Spain is very high (79.1% in 2013[2]).

Not only wages but other labor market factors can impact the flow of labor input. Grandmont (2016) takes into account efficient labor, the product of hours and effort, as the labor input in the productive process. Efficient wages theory assumes that workers' effort depends on wages. As wages are procyclical, so is effort, and this boosts procyclical labor productivity. This mechanism rests on labor institutions that allow the flexibility of companies to choose efficient wages. Rujiwattanapong (2015) finds that the increase in unemployment insurance (UI) duration has caused half the decline in the positive correlation of labor productivity and production since 1985 in the US, from 0.70 to 0.30. As workers are covered by long-term UI, they expend less effort in finding a job and become more selective in terms of job offers. This lower employment increases labor productivity during contractions decreasing procyclicality.

Fernald and Wang (2016) add an explanation based on the softer response of employment to cycle and to pro-cyclical factor utilization (physical capital, labor, and human capital). They contend that LP in the neoclassical formulation depends on human capital (countercyclical), physical capital deepening (countercyclical) and Total Factor Productivity (TFP). Although in the long term, TFP reflects technological change, in the short term, it also includes factors utilization. They find that the TFP result is countercyclical when factor utilization is taken into account. They argue that one of the possible causes of the reduction in variability in the use of factors is the change in the economic structure towards a greater weight of sectors where the utilization adjustment is less important (from industry to services).

In terms of the Spanish literature on these issues, some explanations stem from the physical capital factor. Thus, Maroto-Sanchez and Cuadrado-Roura (2012) advocate an explanation based on physical capital variations per unit of work as the main force behind the cyclical pattern of LP. Rojo (2002) has already highlighted the greatest growth of labor productivity in the contractive phases of the 1990s, in contrast to the expansion stages, due to the role of capital per unit of labor. Other authors focus on the high duality of the Spanish labor market (a large proportion of temporary workers). In this sense, Cabrales, Dolado and Mora (2013) report a small business investment in training temporary workers (less accumulation of human capital in these workers and therefore lower relative productivity) that supports most of the adjustment. Dolado, Sebastián and Valles (1993) already stressed the volatility of employment as the cause of countercyclicality. Hospido and Moreno (2015) find a negative correlation between the proportion of temporary workers and TFP in the period between 1996 and 2012. However, they show a negative correlation in the proportion of temporary work during the period of expansion (1995-2008) but also a positive correlation in the contraction (2008-2012), which can be explained in terms of labor factor adjustment mainly by temporary workers; thus, the few survivors are more productive on average than the permanent workers. Recently, Jimeno (2016) has explained the high volatility of labor related to GDP due to both the rigidity of the bargaining negotiation process and the flexibility of temporary employment.

All in all, the literature offers a variety of explanations, many of them based on the degree of flexibility for labor adjustment. As LP is a quotient between production and labor input, we need to understand the response of labor input to changes in production level. Firms adapt to production level according to their preferences and to possibilities that labor institutions allow.

This paper, focused on Spanish labor productivity, aims to show the determining influence of labor market institutions as the main cause of the cyclical pattern of labor productivity. Spain presents an interesting case study because it is the only country that has changed from a strongly pro-cyclical LP to a clearly countercyclical one in only few years.

The paper is structured as follows: Section 2 describes the sources of data and estimates used as well as the general methodology. In Section 3, we date the change in pattern, offering a preliminary hypothesis. As counter-cyclicality means that LP grows more during contractions, we focus on the last periods of expansion (1996-2008) and contraction (2008-2013) to support our hypothesis. Lastly, some concluding remarks are offered in Section 4.

2. Data and methodology

2.1. Data and estimates

Annual data are taken from the European Bureau of Statistics (EUROSTAT) to investigate the behavior of the variables over the last 59 years (1960-2018). EUROSTAT offers data with a homogeneous methodology that follow the most accepted international standards.

For the seasonally adjusted quarterly data (1996-2013), our source is the National Accounts database offered online by the Spanish National Statistical Institute (INE, its Spanish initials), with 2010 as the base year. This data follows the European System of Accounts 2010 (SEC 2010), Rule No. 549/2013 of the European Parliament and the European Council of 21 May.

To obtain real wages, we use the GDP deflator instead of the Consumer Price Index. We opt for this approach by assuming that workers and firms are price-takers and labor is decided by firms without any workers' influence. In this way, real wages are a proxy of labor cost that is the

[2] 2016 is the latest data available at the International Labor Organization (ILO) website, where Spanish trade union coverage is 73.10% of wage earners. Out of 42 countries, only a few such as Austria, Belgium, the Netherlands, Iceland or Uruguay, have greater union coverage. Nevertheless, this has decreased compared to previous years. In 2013, union coverage in Spain was 81.10% of wage earners, a figure surpassed by only 8 countries: Austria, Belgium, Denmark, Finland, Iceland, the Netherlands, Sweden, and Uruguay (www.ilo.org).

main firms' motivation to decide the quantity of labor. This approach will be justified later on.

The non-parametric elasticity of contribution to the output of productive factors has been estimated, as is commonly accepted, considering a perfectly competitive market with labor and capital remuneration (GOS: Gross Operating Surplus) equivalent to its marginal productivity (formula 2). We consider all people who work (occupieds), both salaried and self-employed. To approach a hypothetical average remuneration of occupieds (W*), we consider all occupieds with the same salary as salaried (formula 1). This follows the international standard methodology of the Productivity Guide of the Organization for Economic Co-operation and Development (OECD, 2001) and is identified with the Adjusted Wage Share used by EUROSTAT. Formulas 1 and 2 outline the calculations and results on an annual average of capital-GDP elasticity of 0.35 (α=0.35).

$$w^{*} = \frac{w}{WageEarners} Ocupieds \quad [1]$$

$$\propto = 1 - \frac{w^{*}}{w + GOS} \quad [2]$$

where *w* denotes real wages, α is the capital-GDP elasticity, and *GOS* is the Gross Operating Surplus.

Capital input refer to the concept of capital services (i. e., the hypothetical rental value that the market, in perfect competition, would pay for the use of capital goods at market price). As this variable is not directly observable, we proxy capital services by the net productive capital stock (measure of capacity), obtained after deducting the stock of housing and adjusting for capacity utilization offered by the Bank of Spain. Productive capital will be obtained from the annual data provided by the Bank Bilbao Vizcaya Argentaria Foundation (FBBVA, its Spanish initials) and the Valencian Institute of Economic Research (IVIE, its Spanish initials) expressed in current and constant annual values for 2005, from which we will extract the 2005 base deflator, changing the base to obtain 2010 constant values. Quarterly values are estimated after calculating depreciation (δ) using the formula

$$\delta_t = 1 - \frac{K_t - I_{t-1}}{K_{t-1}} \quad [3]$$

where *K* denotes productive net capital stock and *I* is investment (Gross Fixed Capital Formation excluding houses).

We identify the average productive net capital stock with the end of the second quarter. We have used the permanent inventory method (equation 4) to estimate the quarterly values taking into account depreciation rate as well as gross fixed capital formation (*I*):

$$K_t = K_{t-1}\left(1-\delta\right)^{\frac{1}{4}} + I_{t-1} \quad [4]$$

The resulting values have been adjusted using the annual utilization coefficient of productive capacity offered supplied by the Bank of Spain. Using average values, we have computed quarterly values. Capital utilization is a procyclical coefficient that must be taken into account. Other way, would increase capital contribution, reducing the residual (TFP). This has been demonstrated analytically and empirically by Fernald and Wang (2016).

Human capital is considered homogeneous over time. In the short time span under analysis, it must not have varied enough to be relevant. In addition, a huge unemployment rate, such as the Spanish one, seems to produce underutilization of human capital, as evidenced by BBVA Research (2010). We make no estimation of the effort per employee (variable not observed), considering it is homogeneous over time.

When talking about labor productivity, we refer to hourly productivity, which has the advantage of not being influenced by changes in yearly working time or part-time contracts.

2.2. Growth Model

We follow the Organization for Economic Co-operation and Development's (2001) methodology, which is the most accepted international standard. This methodology uses the neoclassical model based on Kaldor's (1957) stylized traits and the fulfillment of Inada's (1963) conditions regarding the shape of a production function that guarantee the stability of an economic growth path in a neoclassical growth model. It will take the form of a Cobb-Douglass function with Hicks-neutral technology (output-augmenting).

$$Y = A K^{\propto} L^{1-\propto} \quad [5]$$

where Y denotes GDP, L stands for labor, K is capital, and A is the technology that we relate to TFP. Thus, LP in logs results in the contribution of TFP and capital deepening

$$Ln\frac{Y}{L} = TFP + \propto \ln\frac{K}{L}$$

Variation in TFP is calculated as the residual using the formula

$$\Delta TFP = \Delta ln\frac{Y}{L} - \alpha \Delta ln\frac{K}{L} \quad [6]$$

Note that capital services do not include housing and this has been adjusted for utilization. This implies that capital deepening will be reduced in the recession by the decrease in the coefficient of utilization that is pro-cyclical. As a result, the TFP may vary from other estimations that do not take this evidence into account.

2.3. Correlation analysis and cycle extraction

To calculate the correlation between the macroeconomic time-series under study, we need to remove the trend. A traditional solution is to find the rate of logarithmic variation, which eliminates the unit root but has the defect of exaggerating the weight of high-frequency components. The recent literature uses filters that are approaches to a bandpass filter for finite series.

These filters extract the cycle by removing disturbances of very low frequency (tendency) and of very high frequency (seasonal and irregular component). However, there is no fixed periodicity[3] for every component and no mathematical definition of a cycle. We follow the definition of Burns and Mitchell (1946), according to which a cycle typically lasts between 6 and 32 quarters (2 to 8 years for annual series).

One of the most popular filters is the Hodrick-Prescott filter (HP). This filter only allows one to remove tend (low-frequency component) by means of a parameter (λ) that penalizes its acceleration. HP is used on series previously season adjusted for removing part of the high-frequency perturbations when using quarterly or monthly data.

$$Min\sum_{t=1}^{T}C_t^2+\lambda\sum_{t=1}^{T}\left[\left(g_t-g_{t-1}\right)-\left(g_{t-1}-g_{t-2}\right)\right]^2 \qquad [7]$$

The use of the HP filter has some drawbacks: the filtering is done in two successive phases, and the trend obtained is a smoothed trend, not a real trend. In addition, the ex-ante choice of the parameter (λ) is arbitrary. The standard values are considered to be 14400 monthly, 1600 quarterly and 100 annually. However, the automatic use of these parameters can lead to erroneous estimates, as the standard values were devised for the cyclical properties of the US economy from 1950 to 1979. In fact, the explanation of the 1600 parameter is offered by Hodrick and Prescott (1997, page 4) "*Our prior view is that a 5 percent cyclical component is moderately large, as is a one-eighth of 1 percent change in the growth rate in a quarter*.". Thus, in solving formula 8, we obtain the value 1600.

$$\sqrt{\lambda}=\frac{5}{1/8} \qquad [8]$$

It has been found that the standard parameter (1600 for quarterly series) yields good results for the US economy by comparing its results with the historical series of production but it may not be adequate for economies whose cyclical component presents important differences in periodicity.

Marcet and Ravn (2003) offer two methods to find comparisons between countries, finding that the parameter equivalent to the standard for the Spanish economy in the period 1970 to 1998 would be between 5385 and 6369. Following Marcet and Ravn (2003), Segura Rodríguez and Vazquez Carvajal (2011) calculate a parameter 2250 as the optimum for the quarterly series of Costa Rica. These systems only look for an equivalent parameter for cross-country comparison but assume the standard parameters for the US economy as right. On the other hand, Marvall and Rio (2007) propose to interpret the smoothing parameter, which does not have a direct economic interpretation, in terms of frequency using the formula

$$\tau=\frac{2\pi}{acos\left(1-\frac{1}{2\sqrt{\lambda}}\right)} \qquad [9]$$

In this case, the application of the standard parameter (λ = 1600) for quarterly series would be equivalent to a cycle of periodicity of less than 39.7 quarters, which should correspond to λ = 129,119 for monthly series and λ = 6.65 for annual series. To obtain a periodicity of 32 exact quarters, corresponding to the definition of Burns and Mitchell, the parameter would be λ = 678 for quarterly series.

Another filter is the one devised by Baxter and King (1999), who create a linear filter of moving average (BK filter), which eliminates the components of low frequency and of very high frequency producing a stationary cycle. The main advantage of this filter lies in the possibility of directly specifying the frequency band in the functional form

$$y_t=\hat{B}(L)X_t=\sum_{j=-n}^{n}\hat{B}_jX_{t+j}=\hat{B}_0X_t+\sum_{j=1}^{n}\hat{B}_j\left(X_{t-j}+X_{t+j}\right) \qquad [10]$$

As a disadvantage, the BK filter truncates the tails and has worse statistical properties (normality) than the HP filter.

Our solution is to use an HP filter with a λ=10 as closer to the results of a BK (2, 8) for annual series because we adopt Mitchel's (1913) definition.

The correlation is the quotient between covariances and typical deviations, allowing standardization of results in easily interpretable values between -1 and 1.

The relative volatilities of one variable over another will be calculated, following the accepted methodology, by the quotient of their typical deviations.

3. Analytical framework and empirical results

Our previous hypothesis is that capital is fixed in the short run, and thus, the only way for firms to adjust costs of production factors in response to negative demand shocks is by adjusting labor inputs. The choice between making the adjustment on working time, employees, salary or effort depends on the flexibility allowed by labor market institutions.

The Nash efficiency model involves a simultaneous and automatic adjustment of hours and wages. Such precise behavior contrasts with empirical evidence. Pissarides (1985) incorporates distortions to the model in the form of rigidities. Rigidities, broadly considered, are everything that prevents the automatic allocation of supply and demand. Rigidities allow one to explain the long-term dismissal costs strategy to face a fall in production level by keeping jobs with low productivity, thus adversely affecting productivity and making the company compensate for the costs of dismissal and the effect of maintaining unproductive jobs with a reduction in wages.

In this section, we date the change in pattern and offer a theoretical framework that is consistent with the dates of the last expansionary (1996-2008) and contractive (2008-2013) periods. Keep in mind that counter-cyclicality means that LP grows more during contractions. Thus, we need to compare the behavior between contractive and expansive periods.

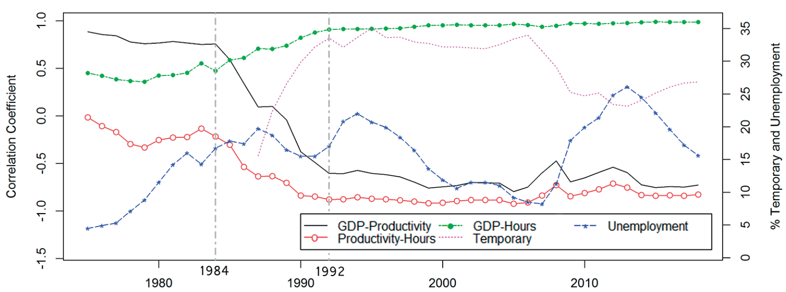
3.1. Evolution of the cyclical pattern and date of the change

The solid line in graph 1 represents a 15-years window rolling correlation between the cyclical components of

[3] Spain is no exception. The Spanish Economic Association shows the different durations of economic cycles at its website: http://www.asesec.org/comite_fechado.php

GDP and LP. It shows a dramatic downfall of the correlation after 1984 that stabilizes after 1992. We consider the period 1984-1992 as a transitional one.

Figure 1: Historical evolution of the cyclical pattern (1975-2018)



Note: 15-year (trailing) rolling correlation

Data source: EUROSTAT

The correlation between LP and Hours also decreases after 1984. In the same way, table 1 shows how LP and Hours have passed from a non-significant correlation to a significant negative correlation of -0.844 after 1984. This indicates a possible relation between labor input (hours worked) and LP after 1984. The high negative coefficient and significance could be interpreted as a strong relation or, as we will see later on, a substitution factor between labor and capital.

Table 1: Correlations and volatilities of cyclical components in logs.

	GDP-LP	GDP-Hrs.	LP-Hrs.	Relative Volatility (Hrs./GDP)
1960-1983	0.801	0.400	-0.229	0.616
	(0.0000)	(0.0531)	(0.2811)	
1984-2018	-0.660	0.960	-0.844	1.402
	(0.0000)	(0.0000)	(0.0000)	
1984-1992	-0.840	0.967	-0.951	1.747
	(0.0046)	(0.0000)	(0.0001)	
1992-2018	-0.642	0.973	-0.800	1.279
	(0.0003)	(0.0000)	(0.0000)	
1960-2018	0.031	0.815	-0.554	1.200
	(0.8166)	(0.0000)	(0.0000)	

Note: *p*-values in parenthesis. Relative volatility is equal to the quotient of typical deviations.

Data source: EUROSTAT

The correlation between GDP and LP has gone from +0.801 before 1984 to -0.660 for the 1984-2018 period. In addition, the correlation between GDP and Hours has increased after 1984 indicating a strong relation after 1984 that was not significant earlier. Therefore, GDP seems to grow mainly based on labor accumulation rather than on LP.

In addition, the relative volatility of labor compared to GDP has also increased after 1984. A value greater than 1 since 1992 indicates that working hours' increase (decrease) more than the GDP increases (decreases). Thus, there is an aggrandized response of labor to output fluctuations. Also, noteworthy is the sharp increase in unemployment since 1975 and the increase in temporary employment since data became available.[4] In addition, temporary employment suffers dramatic fluctuations depending on the economic cycle.

At this point, it appears there is a great change in the cyclical pattern of LP that we can date to 1984, and this change can be allied with changes in labor market behavior. We try to reveal this connection below.

3.2. Wages: rigidity in pricing

To evaluate wage flexibility, it is common in the literature to examine the response of wages to variations of their competitive main determinants: unemployment and productivity. Like Aixala and Pelet (2014), we use the Engle-Granger residual-based test to determine the existence of a cointegration relationship (Engle and Granger, 1989). If the variables are same order cointegrated and the residuals of the linear combination of variables are not stationary, we can conclude that the variables are not synchronized and that therefore there is no competitive response in wage determination.

The variables productivity, wages, and unemployment are random processes with drift and trend.[5] An Augmented Dickey-Fuller (ADF) test of the series shows sufficient evidence of first-order integration, while the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test allows for rejecting the stationarity. See Appendix 2 for more information.

Table 2: FMOLS estimation results (1980-2018)

(Dependent Variable: Real Wages)

	(1)	(2)	(3)
Intercept	10.0970***	2.3736***	2.5028***
	(2164.9180)	(10.6462)	(19.5919)
Unemployment	0.0933		0.0416***
	(135.8161)		(5.2856)
Labor Productivity		0.7364***	0.7144***
		(120.2713)	(183.7985)
Adjusted R^2	0.0666	0.8814	0.9111
Engle-Granger ADF z-statistic	-1.8438	-23.8160***	-23.2742**
	[0.9391]	[0.0077]	[0.0326]
Engle-Granger ADF tau-statistic	-1.0238	-3.5798**	-3.5709
	[0.8972]	[0.0427]	[0.1099]

Notes: *, ** and *** indicate significance at 10%, 5% and 1% levels, respectively.

[4] Data about the type of contracts (temporary or indefinite) are produced by National Bureau of Statistics (INE, its Spanish acronym) from its Active Population Survey (EPA, its Spanish initials) on a quarterly basis. It was not until the last quarter of 1987 that this survey began collecting the number of contracts according to typology. Nonetheless, INE offers contractual flow monthly data from December 1984.

[5] The literature usually considers that unemployment has no tendency and applies the ADF test with constant and without trend.

In the ordinary brackets below the parameter estimates, the corresponding F-statistic of Wald tests (which are modified by semiparametric corrections for serial correlation and second order endogeneity bias) are shown.

The Engle-Granger the tau and z statistics are the residual-based test for cointegration. In the square brackets, the associated probability values are given.

Table 2 shows the estimation results of a Fully Modified Ordinary Last Squares (FMOLS) model proposed by Phillips and Hansen (1990) over variables in the logarithmic base. ADF allows one not to reject first-order integration of residuals in models 1 and 3 at 5%.

For the third model, Engle-Granger and Philips-Oularis tests reject cointegration of the variables at the 1%.

The second model has a high adjusted R^2 (88%) and a significant coefficient of 0.73 for productivity. The Engle-Granger test does not allow rejecting cointegration. The Wald test gives a probability of 0.000 to the null hypothesis for every coefficient equal to zero.

It appears that there is a relationship between LP and wages with a 0.74 elasticity, indicating that only about 74% of the productivity increase (decrease) transfers to wages. This finding is according to literature.

However, for the first model, unemployment is not significant and the adjusted R^2 is very low. Engle-Granger test do not reject the null hypothesis of non-cointegration. The Wald test does not reject the null hypothesis of unemployment coefficient equal to zero, and therefore, unemployment is irrelevant to explain wages. Therefore, the evidence clearly suggests that unemployment is not cointegrated with wages. We conclude that salaries are rigid and do not depend on competitive market conditions, and there is no reaction of wages to unemployment shocks. In the same way, Domenech, García, and Ulloa (2016) consider the increase in real wages at the beginning of the contraction initiated in 2008 as the main driver of increasing unemployment. It is what they call *"the vicious circle of real wages increase and unemployment."* This is not new, as there is a large consensus in the economic literature about the rigidity of wages in Spain.

3.3. The 1984 reform: flexibility in quantity

Figure 1 shows a radical change in the cyclical pattern of labor productivity beginning in 1984. This leads us to ask which institutional modification may have motivated such a change. Unemployment increased rapidly during the previous years while showing wage rigidity. That increase forced the government to relax the labor market in any way it could, and chose to create a dual labor market by means of the 1984's reform.[6] That reform broke the principle of causality in temporary contracting, allowing the use of temporary contracts in permanent posts by nature. New contracting forms were created, such as the Contract for Employment Promotion, which allowed contracts of 6 months' duration to be chained up to 3 years. Thus, the reform offered a "cheap" formula for adjusting labor factor, hoping in this way to stop the increase in unemployment.[7] The essential point is the creation of different regimes of dismissal compensation for temporary and permanent workers. Later reforms, such as those in 1994, tried to limit the use of the temporary contract, but as explained by Gómez, Contreras and Garcia (2008, page 20) "*temporary contracting had been incorporated in a structural way to the business habits.*"[8]

However, the great duality of the Spanish labor market is a feature shared with other countries such as Chile, Poland, and the Netherlands, all of them present pro-cyclicality labor productivity. Therefore, the mere duality of the labor market is not by itself a valid explanation for the Spanish countercyclical pattern, but a conjunction of wage rigidity and employment flexibility. The high rigidity in wages leaves no other means of adjustment for firms that control the quantity of labor, which is enhanced by a regulation that favors the adjustment on the typology at work with the lower cost of transaction: temporary work.

3.4. Oi's labor demand model

Given the lack of salary response to a competitive market and, the high unemployment rate, we assume that there are unemployed individuals who would be willing to work for lower wages than those set by collective bargaining. This implies that the quantity of labor is determined only by the demand side. During contractions, firms adjust costs. Given the rigidity of physical capital in the short term, firms adjust the labor factor by taking into account marginal productivity and adjustment costs.

We propose a modification of Oi's (1962) model, as shown in equation (11). We postulate that the initial worker productivity (M) is increased (ΔM) by firm-specific training. Labor productivity must compensate for the costs that are determined by wages (*W*), the cost of recruitment (*H*), the cost of training (*F*) and the dismissal compensation (*IWT*). The dismissal compensation is determined by the number of salary-days to pay per year of permanence in the firm (*I*), the years of permanence in the firm (*T*) and the salary itself (*W*).

[6] Law approved by Act 1989/1984, which entered into force on November 10, 1984.

[7] The explanatory statement of the Law cannot be clearer when it states that "... it is not justified by the temporary nature of the needs ... but by the importance such modality can have in the generation of new jobs ...".

[8] Translation from the original Spanish: "*La contratación temporal se ha incorporado de manera estructural en los hábitos empresariales, sea uno u otro el tipo de contrato temporal en cada etapa.*"

$$M+\Delta M=W+\frac{H+F}{\sum_{t=0}^{T}(1+r)^{-t}}+IWT \quad [11]$$

The firm takes the costs of recruitment and training as fixed, amortizing them during the time the worker remains in the company to a future discount factor (*r*). Recruitment costs are considered a homogeneous sunk cost for all types of workers. Training is both a sunk cost and an investment in increasing worker productivity. We consider two types of workers: permanent (denoted by the subscript *I*) and temporary (denoted by the subscript *T*). The basic difference is the salary-days to pay in case of dismissal that have a direct effect on dismissal compensation (IWT).

There have been several regulatory reforms affecting dismissal compensation during the period under study. We assume an average of 33 salary-days for permanent and 16 for temporary workers as the most general. Therefore, an approximation is to consider doubling the day-payments per year of permanency for permanent workers in case of dismissal. Another determinant of the dismissal compensation is length of permanence in the company. Taking data on permanence by type of contract from INE, we estimate[9] that permanent workers remain five times more on average than temporary ones, which means ten times more dismissal costs per permanent worker. We are conscious that this proportion is neither realistic nor accurate, but we use it to illustrate the much higher cost incurred by a firm when dismissing permanent workers than when dismissing temporary ones.

Cabrales, Dolado, and Mora (2013) have verified that almost no firm invests in training temporary workers. This absence of investment is consistent in our model with the lower productivity of temporary workers. An inverse correlation between the percentage of temporary workers and productivity has been detected by Hospido and Moreno (2015). If we consider a null training investment in temporary workers, we obtain the following two different functions of labor demand depending on the kind of workers:

$$M=W+\frac{H}{\sum_{t=0}^{T}(1+r)^{-t}}+I_T W T_T \quad [12]$$

$$(M+\Delta M)=W+\frac{H+F}{\sum_{t=0}^{T}(1+r)^{-t}}+I_I W T_I \quad [13]$$

[9] We collect data on “Wage earners by the time they have been working in the current employment, sex and type of contract or labor relation” from INE’s official website www.ine.es. The information offered is disaggregated into 6 groups for temporary and permanent workers: less than 3 months, 3 to 5 months, 6 to 11 months, 1 to 2 years, 2 to 3 years, 3 to 6 years and over 6 years. The number of average days of each group has been calculated, except for the last one, which has been set at 6 years. The percentage of workers of each type in each group has also been computed. The average of the multiplication of both variables gives an approximation of the days of the permanence of each type of worker, resulting in 88 days for the temporary and 432 days for the indefinite. We therefore consider a permanence of the indefinite approximately 5 times higher. 23% of temporary workers remain less than 3 months in the company and 80% do not survive three years in the same firm, while over 60% of the permanent workers remain for more than 6 years (modal value) in the company.

The theoretical conclusions of our model imply that, during expansions, firms may be interested in investing in training permanent workers to increase productivity, given the rigidity in wages. In contrast, during recessions, firms may not be interested in losing permanent workers, as these are more productive on average because of the investment in training that is a sunk costs firms do not want to lose. In addition, the adjustment costs in terms of dismissal compensation are greater for permanent employees. As a result, a rational strategy for firms may consist in keeping a “hard core” of permanent workers and using temporary workers as a means of adjustment; by reducing workers in contractions, with less specific training the average human capital increases, resulting in an improvement in average labor productivity.

3.5. Empirical evidence

During the expansion between the first quarter of 1996 and the third quarter of 2008, GDP increased by 53% and working hours by 49%. During the following contraction (third quarter of 2008 to the same quarter of 2013), GDP decreased by 8.6% and working hours registered a 17% reduction. Therefore, the volatility of employment in relation to GDP seems to be higher during contractions.

Equation (14) decomposes the changes in the aggregate hours (H) by labor typologies in the variation of people (L) and the variation on their average quarterly working time (J). Because detailed data are not available, we assume that the working time of various employees (temporary and permanent) is the same. Therefore, there are three kinds of occupieds: non-employees (NA), permanent employees (AI) and temporary ones (AT)[10].

$$\Delta H=\Delta L_{NA}*J_{NA}+L_{NA}*\Delta J_{NA}+\Delta L_{AI}*J_{AI}+L_{AI}*\Delta J_{AI} +\Delta L_{AT}*J_{AT}+L_{AT}*\Delta J_{AT} \quad [14]$$

The data show that, during the expansionary period, non-employees contributed only 2.01% to the increase in total hours, temporary workers added 22.06%, and the remaining 75.93% was from permanent employees. In terms of individuals, permanent workers increased 76.95% and temporary ones 43.69%.

In contrast, during contraction, temporary workers contributed 47.91% to the reduction of hours, reducing by 31.75% the number of these workers, while only 10.50% of permanent workers were fired, being responsible for 42.02% of the decrease in hours. The only occupieds to have increased their working time during contraction are non-employees with a high degree of flexibility. These were reduced by 12.49%, leading to a 10.07% decrease in hours.

The empirical evidence seems to fit well with the implications of the modified Oi model we described in subsection 3.4. Temporary workers and non-employees are those who suffer most from the adjustment during contractions, being the primary means of adjusting costs to face recessions.

However, one question remains: how can productivity be increased during contractions to compensate for decreased working hours? The answer is offered in the following subsection.

[10] See Appendix 3 for more data.

3.6. TFP and Capital Deepening

Higher reduction in working hours than production during contractionary episodes is compensated by increasing labor productivity. In the classical Solow-Swam model, this increase can only come from human capital, capital deepening and TFP.

In our sample, hourly productivity has increased by 1.6% (0.13% per year) during the expansion (1996-2008) and 10% (1.99% per year) during the contraction (2008-2013). Using expression (15), we decompose the contribution of the productive factors whose results are shown in Table 3.

$$\Delta\left(y-l\right)=\Delta TFP+\Delta\alpha * ln\left(\frac{K*C}{L}\right)+\alpha_o\left[\Delta k+\Delta c-\Delta l\right] \qquad [15]$$

where lowercase letters indicate base logarithm, Δ indicates the first difference, C denotes the coefficient of utilization, and subscript o represents the value at the beginning of the period.

The last two sums of our equation constitute the contribution of capital that we call physical capital deepening. The variation of the TFP, as already noted, is obtained as a residual.

Table 3: Annual change rates of components of variation in hourly productivity

	Capital without adjustment		Capital adjusted by utilization[11]
	α=0.35	α variable	α=0.35
TFP (1996-2008)	-0.22%	-1.45%	-0.37%
Capital deep. (1996-2008)	0.35%	1.58%	0.50%
TFP (2008-2013)	0.14%	-6.64%	0.73%
Capital deep. (2008-2013)	1.85%	8.63%	1.26%

Data source: INE, Central Bank of Spain, BBVA-IVIE

The results in Table 3 imply that productivity growth is due mainly to the contribution of physical capital (especially during recessions), with a very low contribution of multifactorial productivity, being even negative in the expansion.

Additionally, it can be seen that in adjusting capital for the productive capital utilization coefficient (procyclical), the capital contribution is reduced while TFP contribution increases.

If we take into account the elasticity of the physical capital contribution (α) as a variable, which has increased in the expansion and contraction by 3% and 6% respectively, the contribution of capital is further increased by decreasing the TFP residual.

Note that the increase in the contribution of capital per unit of labor during the recession is not due to an increase in physical capital stock (it increases 1.52% per year, quite low if compared to 4.59% in the expansion period). Rather, it is due to a strong decrease in occupation: a 3.78% annual reduction in hourly terms during the recession, being 18.9% during the entire period.

Therefore, our findings suggest that the contribution of capital is the sole cause of the increase in productivity during the expansion and the main cause of higher improvement during contractions. In this same way, Fernández de Guevara (2012), using microdata from a panel of companies, shows how Spanish growth was based on the accumulation of factors during the expansionary period and, in the recession, how labor productivity increased by the adjustment of employment but decreasing TFP. Therefore, the increase in capital per unit of labor, even adjusted by the coefficient of utilization, is what allows smaller declines in production than the labor factor producing a factorial substitution effect by reducing the proportion of labor in the production equation.

3.7. After 2013

Six years have passed since the last contractive period concluded. We must wait until the next contractive period to be sure that the same countercyclical pattern will continue; however, we can describe what has happened since the last contraction to anticipate some insights.

Seasonally adjusted data from the third quarter of 2013 to the last quarter of 2018 shows that GDP has increased 15.68% (2.81% per year), working hours 13.51% (2.44% per year) and hourly labor productivity 1.91% (0.36% per year). The dramatic decline in labor productivity when the economy has begun to grow again seems to confirm that the countercyclical pattern continues.

The 2012 legislative reform[12] seeks to increase the flexibility of the Spanish labor market, oriented to reduce both unemployment and temporality. To do this, it approaches the cost of dismissal for temporary and indefinite employees, prioritizes the company bargaining against unionized ones, and tries to open alternatives to dismissal, such as flexibility of wages and reduction of working hours.[13]However, the reform has not been enough to reduce temporality. As in the previous expansive period (1996-2008), we witness to an increase in the temporary work rate: from 24.05% in the third quarter of 2013 to 26.86% in the last quarter of 2018. During that period, the number of permanent employees increased by 12.19% (1,307,600 workers)

[11] It does not make sense to take into account α variable and K adjusted since α would already collect the capital utilization coefficient. Therefore, the table does not show results with adjusted K and α variable.

[12] Royal Decree-Law 3/2012 of 10 February, on urgent means to reform the labor market.

[13] The explanatory statement of the law describes the fundamental objectives pursued. We transcribe some of its illustrative phrases: *"In a system that generates adequate incentives, employers can cope with the oscillations of demand by resorting to mechanisms other than dismissal, which preserve the company's human capital, such as temporary reductions in wages or working hours."*, *"Chapter IV includes a set of measures to favor the efficiency of the labor market and to reduce labor duality."* , *"The speed and intensity of the destruction of employment in Spain is mainly due to the rigidity of the Spanish labor market, as has been indicated on many occasions by both international organizations and the European Union."*

and temporary employees by 30.08% (1,022,200 workers). Lahera (2017) reports that the effectiveness of the normative reform to increase flexibility has been reduced in practice by the jurisprudential interpretation.

However, in a different direction, a recent law[14] increasing the minimum salary by 22% to 12,600 euros per year could introduce some rigidity in sectors with very low labor productivity.

Perhaps it is too soon to determine the continuity of the countercyclical pattern, but data suggest that the dynamics we have described will continue for some time.

4. Concluding remarks

This article suggests that the countercyclicality of labor productivity is related to a labor market adjustment mechanism that uses temporary work as the primary means of adjusting input costs. The factor substitution effect during contractions increases capital per unit of work, with the contribution of capital being the primary cause of labor productivity improvements with a very low contribution of the TFP. Moreover, the reduction in temporary workers, who accumulate less investment in human capital as a result of firms' dismissal cost strategy, can have a positive influence on labor productivity. This overshadows the large increases in productivity during contractions. In fact, labor productivity evolution is quite poor during expansions. On average, hourly productivity from the first quarter of 1996 to the last quarter of 2018 grew at an average rate of 0.59%, which places its evolution behind other countries, as various international organizations have observed.

Relevant economic literature has explored the idea that labor market institutions determine the cyclical pattern of labor productivity. Following their lead, we have analyzed the evolution of Spanish labor productivity, which has experienced a dramatic change in its cyclical pattern in only a few years. However, the mechanism underlying the cyclical behavior of Spanish labor productivity has not previously been explained. We have found that Oi's model can be useful in describing the mechanism that produces the countercyclical pattern of LP. We have shown that the change in cyclical pattern originated abruptly in 1984, coincide with a legislative reform that allowed a flexible way of adjusting labor through temporary work. We have detected a lack of competitive response to salaries, being quantity of workers the only way of adjustment.

The results presented in this paper should be of value to policymakers, given the implications and consequences of the 1984 legislative reform and the fundamentals of Spanish growth. Moreover, our findings may also provide useful data for economic theoreticians, as they can be inspired by the mechanism revealed in this paper.

Acknowledgements

The authors are very grateful to two anonymous referees for useful comments and suggestions on a previous draft of this article.

[14] Royal Decree-Law 1462/2018 of 21 December.

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Appendix 1:
Filter election for cycle extraction

GDP and productivity series are not stationary as they include trend.

FIGURE 2: GDP (LOG BASE)

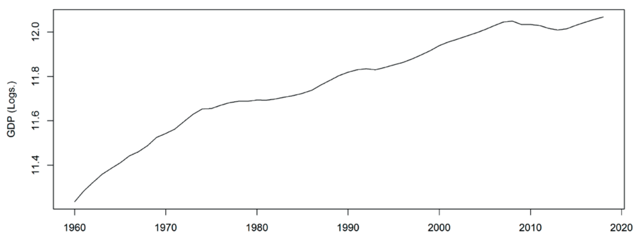


FIGURE 3: HOURS WORKED (LOG BASE)

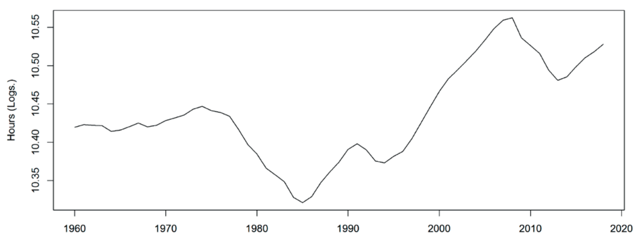
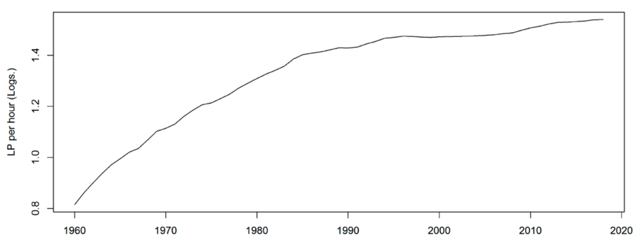


FIGURE 4: HOURLY PRODUCTIVITY (LOG BASE)



Applying different filters (Baxter-King and Hodrick-Prescott) we contrast stationarity.

	ADF: Ho=I(1)	KPSS: Ho=I(0)
GDP	0.986	< 0.01
	[1.87882]	
Log GDP	0.9931	< 0.01
	[2.16019]	
LP	0.961	< 0.01
	[1.41016]	
Log LP	0.8736	< 0.01
	[0.736569]	
GDP derivate	0.007704	0.013
	[-2.70302]	
BK (2,8) GDP (log) cycle	0.002914375	> 0.10
	[-5.17521]	
HP (λ=10) GDP(log) cycle	0.003565458	> 0.10
	[-5.13384]	
HP (λ=100) GDP(log) cycle	0.00260269	> 0.10
	[-4.92957]	
HP (λ=1000) GDP(log) cycle	0.001471	> 0.10
	[-3.17403]	
HP (λ=10) LP(log) cycle	0.007287531	> 0.10
	[-4.70915]	

** Table shows asymptotic p-values. Tau statistic in brackets*

*** LP is hourly labor productivity*

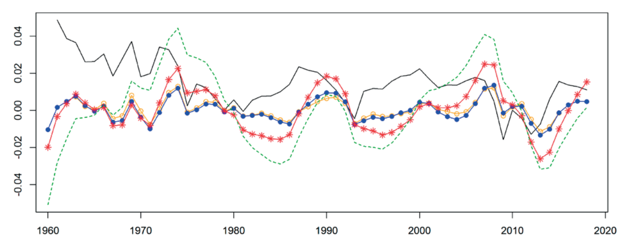
**** Augmented Dickey-Fuller test (ADF) without constant with 10 lags and Akaike Information Criteria (AIC).*

***** KPSS with 3 lags*

After filter application, the Dickey-Fuller test rejects the null hypothesis of unit root and the KPSS test accepts the null hypothesis of stationarity.

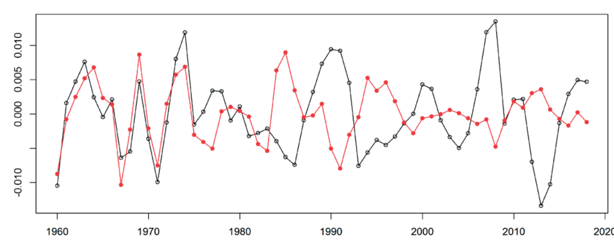
There is no exact mathematical definition of what the economic cycle is. We adopt Burns and Mitchell definition that supposes a cycle duration between 6 and 32 quarters, or its equivalent for annual series: 2 to 8 years.

FIGURE 5: GDP CYCLE (LOGS) WITH THE HP AND BK FILTERS



Taking the BK filter (2,8), whose parameters are equivalent to eliminating frequency disturbances of less than 2 years and more than 8 years, the smoothing parameter of the HP filter that offers a cycle more equivalent to a BK (2, 8) is a parameter 10.

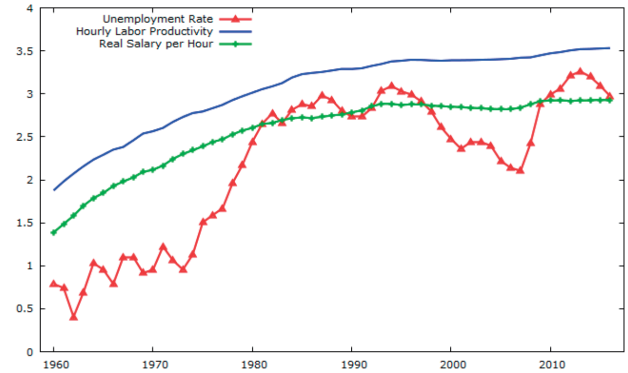
FIGURE 6: GDP AND PRODUCTIVITY CYCLE (LOG BASE) WITH THE HP FILTER (λ=10)



Appendix 2: Cointegration and unit roots

To prove the lack of relation between the unemployment rate and the evolution of real wages in the Spanish labor market, we use the Engle and Granger's (1987) method. This method contrasts the cointegration of the linear combination of integrated variables of the same order to determine if there is a long-term relationship between them.

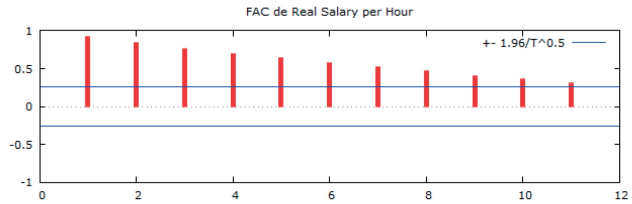
Graph showing the evolution of variables (log. scale)

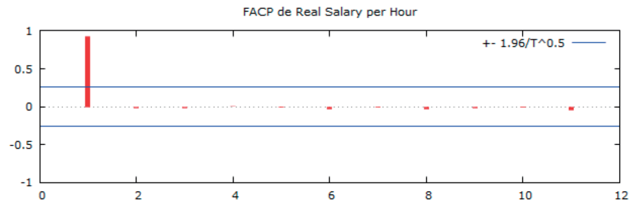


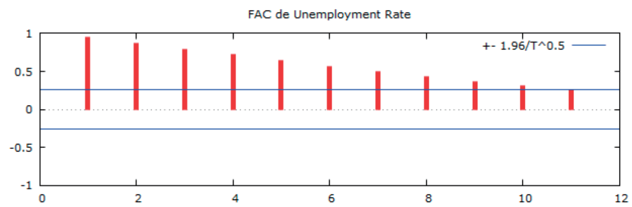
Data source: Eurostat

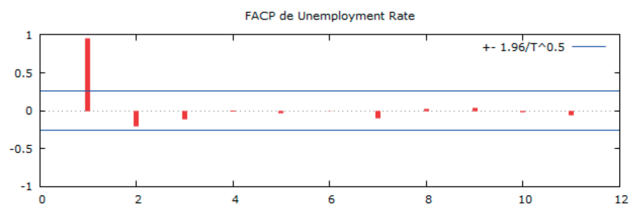
In the previous graph, it seems obvious that a cointegration relationship exists between productivity and wages, but there may be no cointegrating relationship between wages and unemployment.

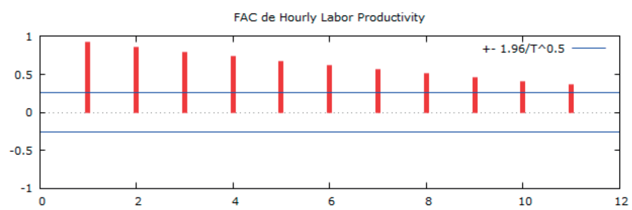
Autocorrelation Functions (ACF) and Partial Autocorrelation Functions (PACF) of variables

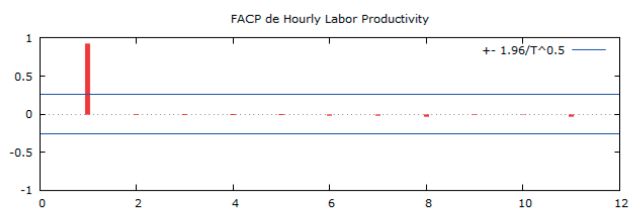












ACF slowly decays + PACF in first delay near unit => Drift = I (1).

One can see that there are numerous delays.

It seems that the variables respond to a random process with drift and trend.

P-Values of the formal tests to verify integration of the variables

	LP	Wage	Unemployment	LP (derivate)	Wage (derivate)	Unemployment (derivate)
Augmented Dickey-Fuller[1]	0.1345	0.1498	0.0786	0.2882	0.06628	0.008186
KPSS	<0.01	<0.01	>0.10	0.087	<0.01	>0.10

[1] Following the literature and the structure of the processes, the test has been carried out with a constant for unemployment and with a constant and tendency for productivity and wages. The ADF test has taken into account 9 lags with Akaike Information Criteria (AIC). KPSS test with 3 lags.

Appendix 3: Working hours evolution

Table A: Variation of hours worked (number of hours) due to variations in the number of people or variation in working time

	Δ Hours Non-Employees		Δ Hours Permanent Employees		Δ Hours Temporary Employees	
	Δ People	Δ Workingtime	Δ People	Δ Workingtime	Δ People	Δ Workingtime
1996:1-2008:3	35,353,201	26,925,399	2,479,885,858	2,464,461	791,268,307	1,023,646
3,336,920,872	**62,278,600**		**2,482,350,319**		**792,291,953**	
2008:3-2013:3	-178,981,581	24,009,881	-510,105,962	-73,606,159	-651,382,051	-23,313,032
-1,413,378,904	**-154,971,700**		**-583,712,121**		**-674,695,083**	
2013:3-2018:4	-13,298,961	-13,938,139	534,198,683	72,976,987	417,562,308	26,800,435
1,024,301,312	**-27,237,100**		**607,175,670**		**444,362,743**	

Table B: Contribution to variation of people (%)

	Non-Employees	Permanent	Temporary
1996:1-2008:3	0.98	76.73	22.29
2008:3-2013:3	10.43	39.70	49.87
2013:3-2018:4	-1.15	55.06	46.09

Table C: Contribution to variation in hours (%)

	Non-Employees	Permanent	Temporary
1996:1-2008:3	2.01	75.93	22.06
2008:3-2013:3	10.07	42.02	47.91
2013:3-2018:4	-2.68	57.85	44.83

Table D: Rate of Variation (% of persons)

	Non-Employees	Permanent	Temporary
1996:1-2008:3	2.58	99.85	62.29
2008:3-2013:3	-12.49	-10.27	-31.58
2013:3-2018:4	-1.04	12.19	30.08

Table A decomposes the variation of the working hours according to formula 17 between the variation of working time and the variation of people. The sum of both variations is in bold. Tables B and C show the contribution of people and hours by the kind of occupied per period. Lastly, table D shows the rates of variation of each type of worker occupied in the period. Source: own elaboration based on the data provided by the Spanish National Institute of Statistics (INE).