
“Countercyclical Labor Productivity: The Spanish Anomaly”

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Abstract

The cyclical pattern of labor productivity has been a subject of discussion in the economic literature for long time with important theoretical implications. Many authors point out the role of labor market institutions as determinants of the cyclical pattern. For these authors, the loss of procyclicality experimented in the United States since the mid-1980s could be explained by decrease of rigidities in labor market.

Following the literature, this paper explores the role of labor regulation by analyzing the case of Spain, which has gone in a few years from a strongly procyclical pattern to a countercyclical one.

Our results suggest that the high rigidity in wages and the great flexibility in labor, related to the temporary workers after the 1984 legislative reform, is the main cause of the countercyclical pattern of the Spanish labor productivity. Our findings are in line with previous papers highlighting the crucial influence of labor market institutions over the cyclical pattern

JEL classification: E32, J30, K31, O47.

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1. INTRODUCTION

As pointed out by Biddle (2014), at the beginning of the last century labor productivity (LP) was widely considered as countercyclical. Mitchell (1913) had already described the forces behind this behavior as follow:

- 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 effort to avoid dismissal.
- In prosperous times, workers have more workloads, which "tires" them by reducing their average hourly productivity.

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

The empirical works of Hultgren (1960) or Kuh (1963) verified the pro-cyclical behavior of labor productivity in the 1960's. Solow (1964), in an attempt to reconcile his model with the new empirical evidence, interpreted that firms retain workers during recessions. Oi (1962) also observed the smaller adjustment of employment in recessive shocks. He explained this firms' behavior by including in his 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 increasing in technology and inputs reduction.

Some authors have pointed out the vanishing of procyclicality United States (US) labor productivity since the mid-1980s. The explanations for this change came from the increasing flexibility of labor market, opening a way to explain the cyclical pattern via the labor institutions. In this sense, Gali and van Rens (2009) stand out the surge of flexibility due to the decrease of the unions' power to explain the reduction of procyclicality 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 the labor institutions are the main cause of the cyclical pattern of LP. He disputes the explanations from the RBC models as well as the fulfilment of the Okun Law⁴. Daly et al (2011) discuss how institutional or other features of labor markets might affect Okun coefficient. Garamonnt (2016), on the other hand, tries to reconcile the procyclicality of productivity with the neoclassical model through the variable "effort", being able to offer a theoretical explanation to the pro-cyclical variation. Rujiwattanapong (2016) finds that unemployment benefits cause half the fall of the positive correlation since 1985. For Berger (2012), the decline of pro-cyclical LP as well as the "jobless recoveries" after recessions are due to the fact that firms grows in inefficiency during expansions, while during contractions they restructure their manpower in order to become more efficient.

Fernald and Wang (2016) add an explanation based on the softer response of employment to cycle and to the pro-cyclical factor utilization (physical capital, labor and human capital). They contend that LP in the neoclassical formulation depends on human capital (countercyclical),

⁴ The Okun Law implies that 2/3 of the deviations on Gross Domestic Product (GDP) trend correspond to deviations in working hours, in addition to the existence of a negative correlation between product and unemployment.

physical capital deepening (countercyclical) and Multi Factor Productivity (MFP). Although in the long term MFP reflects technological change, in the short term, it also includes factors utilization. They find that MFP results countercyclical when factor utilization is taken into account. They argue that one of the possible causes of reduction of variability in the use of factors is the change of the economic structure towards a greater weight of sectors where the utilization adjustment is less important (from industry to services).

Other authors focus the attention on the effects of different cross-country labor institutions. Siebert (1997) discusses the failure of the European labor market in terms of higher unemployment than the American one because of the higher distortions in reserve wages. The point is that workers and firms supply and demand jobs according to the expected benefits for 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 for workers as benefits and, therefore these costs reduce the firms' reserve salary without increasing the perceived profit by workers creating a mechanism to lead 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 sectorial 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 to achieve efficient equilibrium in the Nash sense. In the same way, Nickell (1997) emphasizes that when wage bargaining rests on unions, they tend to increase wages and unemployment. He also criticizes the distorting role of unemployment protection, contending that "*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 to note that union coverage in Spain is very high (79.1% by 2013⁵).

Regarding the Spanish literature on these issues, some explanations come from the physical capital factor. Thereby Maroto-Sanchez and Cuadrado-Roura (2012) advocate an explanation based on physical capital variations per unit of work. Rojo (2002) 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 (i. e., large proportion of temporary workers). In this sense, Cabrales, Dolado and Mora (2013) report a small business investment on temporary workers training (less accumulation of human capital in these workers and therefore lower relative productivity), that are those that support most of the adjustment. Dolado, Sebastián and Valles (1993) already stressed the volatility of employment as the cause of counter-cyclicality. Hospido and Moreno (2015) finds a negative correlation between the proportion of temporary workers and MFP in the period 1996-2012. However, they show a negative correlation between 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 for the labor factor adjustment mainly on temporary workers, thus the few survivors are more productive on average than the permanent workers. Recently, Jimeno (2016) explains the high volatility of labor related to GDP due to both the rigidity of bargaining negotiation process and the flexibility of temporary employment.

⁵ 2013 is the latest data available on the website of the International Labor Organization (ILO), where Spanish trade union coverage is 79.1% of wage earners. Out of 42 countries, only Austria, Belgium, Denmark, France, Finland, Iceland, the Netherlands, Sweden and Uruguay have more union coverage. Nevertheless, it has decreased compared to previous years. In 2009 it covered 82.5% of wage earners being surpassed by Austria, Belgium, France, Greece, the Netherlands, Romania, Slovenia and Sweden.

This paper, focused on the Spanish economy, aims to offer empirical evidence on the determining influence of labor market institutions as the main cause of the cyclical pattern of labor productivity. The paper is structured as follows: Section 2 describes the sources of data and estimates used as well as the general methodology. Section 3 analyzes the situation offering a hypothetical explanation that is tested according to empirical data. Finally, 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 57 years (1960-2016). EUROSTAT offers data with homogeneous methodology that follow the most accepted international standards.

For the quarterly data (1996-2013), our source is the National Accounts database offered online for the Spanish National Statistics Institute (INE, for its initials in Spanish), being 2010 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 the 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 main firm's motivation to decide quantity of labor. This approach will be justified later on.

The elasticity of contribution to the output of productive factors has been estimated, as is commonly accepted, considering a perfectly competitive market with physical capital and labor remunerations equivalent to its marginal productivity. The problem of the strong oscillations of freelance worker's incomes has been solved by considering same remuneration as average wage earners. This follows the international standard methodology of the Productivity Guide of the Organization for Economic Co-operation and Development (2001) and it is identified with the Adjusted Wage Share used by EUROSTAT. Formulas 1 and 2 explicit the calculation and they result on an annual average of capital-GDP elasticity of 0.35 ($\alpha=0.35$).

$$w^* = \frac{w}{\text{Wage Earners}} \text{ Ocupieds} \quad [1]$$

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

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

Capital input is referred 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 is obtained from the annual data provided by the Bank Bilbao Vizcaya Argentaria Foundation (FBBVA, for its initials in Spanish) and the Valencian Institute of Economic Research (IVIE, for its initials in Spanish) expressed in current and constant annual values of 2005, from which we will

extract the 2005 base deflator, changing the base to get 2010 constant values. Quarterly values are estimated after calculate depreciation (δ) by the formula

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

where K denotes productive net physical 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):

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

The resulting values have been adjusted by annual utilization coefficient of productive capacity offered supplied by the Bank of Spain. By using average values, we have computed quarterly values. Capital utilization is a procyclical coefficient that has to be taking into account. Other way, it would lead to an increase of capital contribution by reducing the residual (MFP). This has been shown 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 rate of unemployment, as the Spanish one, seems to produce underutilization of human capital as evidenced by BBVA Research (2010). We do not make any 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. The average productivity per occupied worker can be obtained as a product of hourly productivity and average working time. Likewise, the variation of per capita product in logarithmic form is defined as the summation of variations of the MFP, deepening physical capital, average working time and occupation rate as shows below.

$$\Delta \ln \frac{Y}{N} = \Delta MFP + \alpha \Delta \ln \frac{K}{Hs} + \Delta \frac{L}{N} \quad [5]$$

where Y denotes GDP, N is population, L stands for labor, K is capital, Hs is hours worked and MFP denotes Multi Factor Productivity.

2.2. Growth Model

We follow the Organization for Economic Co-operation and Development (2001)'s methodology, which is the most accepted international standard. This methodology use the neoclassical model based on the Kaldor (1957)'s stylized traits and the fulfillment of the Inada (1963)'s conditions about 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).

The MFP is calculated as residual using the formula

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

Note that capital services do not include housing and it has been adjusted for utilization. This implies that physical capital deepening will be reduced in the recession by the decrease of the coefficient of utilization that is procyclical. As a result, the MFP may vary from other estimations that do not take into account these evidences.

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 eliminated the unit root but it has the defect of exaggerating the weight of high frequency components. Modern 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 (trend) and of very high frequency (seasonal and irregular component). However there is not a fixed periodicity⁶ for every component and there is not a mathematical definition of 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 to remove the trend (low frequency component) by means of a parameter (λ) that penalizes its acceleration. HP is used on series previously deseasonalized for removing part of the high frequency perturbations when using quarterly or monthly data.

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

The use of the HP filter has some drawbacks: the filtering is done in two successive phases, the trend obtained is a smoothed trend, not an actual trend. In addition, the ex-ante choice of the parameter (λ) is arbitrary. The standard values are considered to be 14400 for monthly, 1600 for quarterly and 100 for annual. However the automatic use of these parameters can lead to misleading estimates since such standard values were devised for the cyclical properties of the US economy from 1950 to 1979. In fact, the value 1600 was calculated under the assumptions of approximate 1/8% quarterly growth of the economy and that the cyclical component could imply a variation of 5% (Hodrick and Prescott 1997). This allowed to fix the parameter by solving the following equation that gives the value 1600

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

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 make 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 just look for an equivalent parameter to cross-country comparison but assuming 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 by means of the formula

⁶ Spain is not an exception. The Spanish Economic Association shows the different durations of economic cycles in its website http://www.asesec.org/comite_fechado.php

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

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

$$y_t = \hat{B}(L) X_t = \sum_{j=-n}^n \hat{B}_j X_{t+j} = \hat{B}_0 X_t + \sum_{j=1}^n \hat{B}_j (X_{t-j} + X_{t+j}) \quad [10]$$

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

Our solution is the using of a HP filter with a $\lambda=10$ as closer to the results of a BK (2, 8) for annual series.

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

Following the usual practice, the relative volatilities of one variable over another is calculated by the quotient of their typical deviations.

3. ANALYTICAL FRAMEWORK AND EMPIRICAL RESULTS

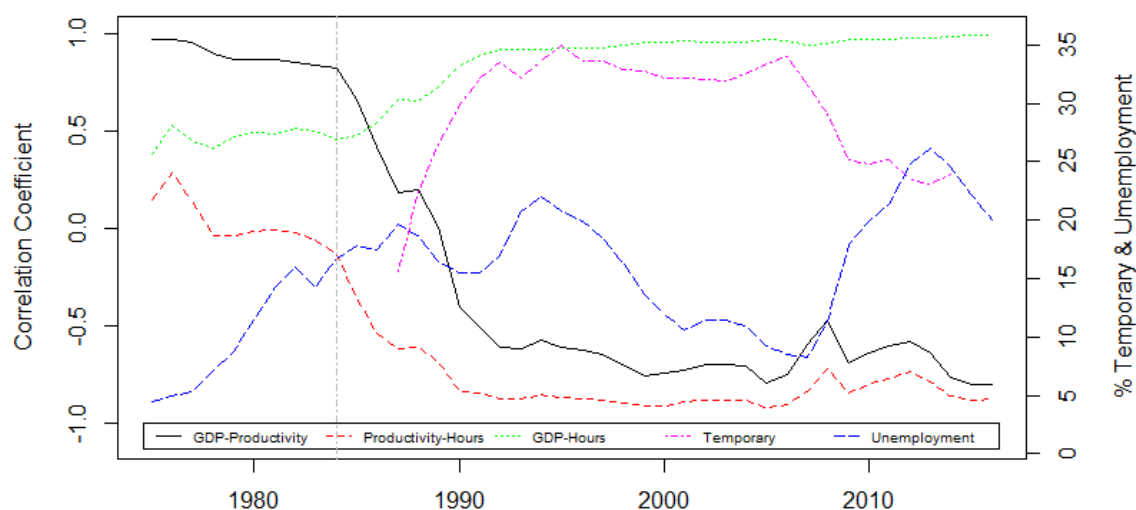
As physical capital is fixed in the short run, the only way for firms to adjust producing factors in response to negative demand shocks, is changing labor inputs. The choice between making the adjustment on working time, employees, salary or effort will depend on the flexibility allowed by labor market 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 are considered in a broad sense as anything that prevents the automatic allocation of supply and demand. Rigidities allow 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.

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

Figure 1 displays the shift from a strongly procyclicality⁷ to a countercyclical pattern since 1984⁸. Also are noteworthy the sharp increase in unemployment since 1975 and the increase in temporary employment since data available⁹.

Figure 1: Historical evolution of the cyclical pattern



Note: Rolling correlations with 15 lags

Data source: EUROSTAT

Table 1 shows the increase of correlation between GDP and hours from procyclical period (1960-1983) to counter-cyclical one (1992-2016). In addition, relative labor volatility has also increased relative to GDP. A value greater than 1 since 1992 indicates that working hours increase (decrease) more than the increase (decrease) of GDP. Also temporary employment suffer dramatic fluctuations depending on economic cycle.

⁷ Following Dolado, Sebastián and Vallés (1993), we will consider as strongly procyclical a coefficient greater than 4 sample errors and weakly coefficients greater than 2 sample errors.

	1960-2016	1960-1983	1992-2016
Weakly procyclical (countercyclical)	>0.26	>0.41	>0.40
Strongly procyclical (countercyclical)	>0.53	>0.82	>0.80

⁸ Until 1984 the mean correlation coefficient was +0.89, becoming -0.73 from 1992. The period from 1984 to 1992 seems to be a transitional period.

⁹ Data about type of contracts (temporary or indefinite) are produced by INE from its Active Population Survey (EPA, for its initials in Spanish) on a quarterly basis. It was not until the last quarter of 1987 that this survey start collecting number of contract by typology. In spite of, INE offer contractual flow monthly data from December 1984 to January 2016. Data shows that 92.91% of new contracts are temporary since December 1984.

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

	GDP - Prod.	GDP - Hrs.	Prod. - Hrs.	Relative volatility (Hrs/GDP)
1960-1983	0.892 (0.0000)	0.311 (0.1377)	-0.152 (0.4771)	0.457
1992-2016	-0.728 (0.0000)	0.977 (0.0000)	-0.857 (0.0000)	1.332
1960-2016	0.047 (0.7287)	0.803 (0.0000)	-0.558 (0.0000)	1.204

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

Data source: EUROSTAT

3.2. Wages: rigidity in pricing

To evaluate wage flexibility, it is a common practice in the literature to examine the response of wages to variations of their main determinants: unemployment and productivity. Like Aixala and Pelet (2014), we use the Engle-Granger residual-based tests to determine existence of a cointegration relationship (Engle and Granger, 1989), the absence of cointegration indicating the lack of competitive response in wages determination.

The variables productivity, wages and unemployment are random processes with drift and trend¹⁰. An Augmented Dickey Fuller (ADF) test of the series shows sufficient evidence of first order integration while Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test allows to reject the stationarity. Integration disappears with the first difference showing they are first order integrated. Table 2 shows the estimation results applying the Fully Modified OLS (FOLS) estimation method for a single cointegrating vector¹¹.

¹⁰ The literature usually considers that unemployment has no tendency and apply the ADF test with constant and without trend. However, for the period (1960-2016) seems to have a tendency, although we assume that this is not possible in the long term. The ADF test with only constant shows a *p*-value of 0.4 verifying the existence of unit root. For more information see Appendix 2.

¹¹Phillips and Hansen (1990) propose an estimator which employs a semi-parametric correction to eliminate the problems caused by the long run correlation between the cointegrating equation and stochastic regressors innovations. The resulting FMOLS estimator is asymptotically unbiased and has fully efficient mixture normal asymptotics allowing for standard Wald tests using asymptotic Chi-square statistical inference.

Table 2: FOLS estimation results (1960-2016)

(Dependent Variable: Real Salary)

	(1)	(2)	(3)
Constant	1.1453*** (0.1357)	-1.1224*** (0.0823)	-1.2034*** (0.1068)
Unemployment	0.5326*** (0.0572)		-0.0362 (0.0257)
Productivity		1.1180*** (0.0265)	1.1709*** (0.0509)
Adjusted R ²	0.8276	0.9902	0.9902
Engle-Granger tau-statistic	-2.7902 [0.1851]	-3.0235 [0.1213]	-2.9984 [0.2659]
Engle-Granger z-statistic	-12.7080 [0.1915]	-17.1750* [0.0694]	-17.4304 [0.1719]

Notes:

Variables in log

***, ** and * indicate signification at 1%, 5% and 10%, respectively

In the ordinary brackets below the parameter estimates, the corresponding t-statistics are shown.

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

In spite of the fact that first model seems to show relationship between unemployment and wages, it disappears when differentiating, pointing out it is spurious. In the third model unemployment is not significant. The second model shows a productivity elasticity greater than unity indicating higher wage increases than hourly productivity. Regarding the cointegration tests, the Engle-Granger tau-statistic (t-statistic) and the normalized autocorrelation coefficient (the z-statistic) both do not reject the null hypothesis of no cointegration (unit root in the residuals) at the 1% and 5% level. Only for the second model the tau-statistic rejects at a 10% significance level. On balance, the evidence clearly suggests that the variables under study are not cointegrated. Therefore we conclude that salaries are rigid and they do not depend on competitive market conditions. 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 to the unemployment increasing. It is what they call *"the vicious circle of real wages increase and unemployment"*. This is not new, there is a large consensus in the specialized literature about the high rigidity of wages in Spain.

3.3. The 1984 reform: flexibility in quantity

Figure 1 shows a radical variation in the cyclical pattern of labor productivity starting from the year 1984. It leads to ask which institutional modification may have motivated such a change. The unemployment increased rapidly during previous years while showing wage rigidity. Unemployment increasing forced the Government to relax the labor market in any way. And the way chosen was the creation of a dual labor market by the 1984's reform¹². The 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,

¹² Law approved by Act 1989/1984 which entered into force on November 10, 1984.

hoping in this way to stop the increase of unemployment¹³. The essential point is the creation of differentiated regimes of dismissal compensation for temporary and fixed workers. Later reforms such as 1994's tried to limit the use of the employment contract but as explained by Gómez, Contreras y García (2008, page 20) "*temporary contracting had been incorporated in a structural way to the business habits*"¹⁴.

The great duality of the Spanish labor market is a feature shared with other countries such as Chile, Poland and the Netherlands. However all of them present pro-cyclicality labor productivity. Therefore the mere duality of labor market is not by itself a valid explanation for the Spanish counter-cyclical pattern, but a conjunction of wage rigidity and employment flexibility. However, the high rigidity in wages, does not leave another way of adjustment to firms that the quantity of labor, which is enhanced by a regulation that favors the adjustment on the typology at work with lower costs of transaction: the temporary work.

3.4. A model of labor demand

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

We propose a modification of the Oi (1962)'s model as shown in equation (11). We postulate that the initial worker productivity (M_t) is increased (ΔM_t) by firm-specific training. Labor productivity must compensate for the costs that are determined by the wage (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).

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

The firm takes the costs of recruitment and training as fixed, amortizing them during time the worker remain in the company to 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 T) and temporary (denoted by the subscript I). The basic difference is the salary-days to pay in case of dismissal that have a direct effect on dismissal compensation (IWT).

¹³ The explanatory statement of the Law cannot be clearer when it says "... it is not justified by the temporary nature of the needs ... but by the importance of such modality can have in the generation of new jobs ...".

¹⁴ Translation from the original in 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.*"

There have been several regulatory reforms affecting the 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 double the days-payment per year of permanency for permanent workers in case of dismissal. Another determinant of the dismissal compensation is the time of permanence in the company. Taking data on permanence by type of contract from INE, we estimate¹⁵ that permanent workers remain five times more on average than temporary ones. This means ten times more dismissal cost of a permanent worker. We are conscious that this proportion is nor realistic neither accurate, but we use it to illustrate the much higher cost incurred by a firm when firing permanent workers than when dismissing temporary ones.

Cabrales, Dolado and Mora (2013) have verified that almost no firm invests in training on temporary workers. This absence of investment is consistent in our model with a lower productivity of temporary workers. The inverse correlation between percentage of temporary work 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:

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

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

The theoretical conclusions of our model imply that, in expansions, firms may be interested in investing on 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 they are more productive on average because of the investment in training that is a sunk cost they 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 consists on keeping a "hard core" of permanent workers and using temporary workers as a way of adjustment. By reducing workers during recessions, with less specific training, the average human capital increases, resulting in an improvement in average labor productivity.

¹⁵ We collect data on "Wage earners by time that 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 in 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 more than 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 to the days of 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. The 23% of the temporary stays remain less than 3 months in the company and 80% does not survive the three years in the same. While more than 60% of the permanent workers remain for more than 6 years (modal value) in the company.

3.5. Empirical evidence: testing our model

Now it is time to check if data back the conclusions of our labor model, which assumes different behavior for expansionary and contractionary periods. We use quarterly data from 1996 to 2008 as the expansion and from 2008 to 2013 as the contraction. In the expansion (1996:1 to 2008:3), GDP increased a 53% and working hours did in 49%. During the following contraction (2008:3 to 2013:3) GDP decayed an 8.6% and working hours registered a 17% reduction. Therefore, the high volatility of employment in relation to GDP seems to be associated with recessions.

Equation (14) decomposes the changes in the aggregate hours (H) by labor typologies in variation of people (L) and variation on their average annual working time (J). Because detailed data are not available, we assume that the working time of the different employees is the same. There are three kind of occupation: non-employees (NA), permanent employees (AI) and temporary ones (AT)¹⁶.

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

Data shows that, during expansionary period, non-employees only contributed 2% to the increase in total hours, temporary workers added a 24% and the remainder 74% was due to permanent-employees. In terms of people, permanent workers augmented by a 79%, while temporary ones experienced a 44% increase.

In contrast, during recessions, temporary workers contributed in 47% to the reduction of hours, falling by a 32% the number of these workers. While only 11% of permanent workers were fired, being responsible for 42% of the decrease in hours. The only occupies that have increased their working time during the recession are the non-employees, showing a high degree of flexibility. They were reduced by 13%, leading to an 11% decrease in hours.

The empirical evidence is consistent with the dynamic our labor model predicts. Temporary workers and non-employees are those who suffer most of the adjustment during contractions, being the main way to adjust costs to face recessions.

However, a question remain: what allow to increase productivity during contractions to compensate higher dismissal of working hours? The answer is offered in the following subsection.

3.6. MFP and Capital Deepening

The higher reduction of working ours than production during contractionary episodes is compensated with increasing labor productivity. This increasing can only be due to human capital, capital deepening and MTF.

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

¹⁶ See Appendix 3 for more data.

$$\Delta(y - l) = \Delta MFP + \Delta \alpha [k_o + c_o - l_o] + \alpha_o [\Delta k + \Delta c - \Delta l] \quad [15]$$

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

The last two summands of our equation constitute the contribution of capital that we call physical capital deepening. The variation of the MFP, as has already been said, is obtained as a residual.

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

	Capital without adjustment		Capital adjusted by utilization ¹⁷
	$\alpha=0.35$	α variable	$\alpha=0.35$
MFP (1996-2008)	-0.22%	-1.45%	-0.37%
Capital deep. (1996-2008)	0.35%	1.58%	0.50%
MFP (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

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 expansion.

Additionally, it can be seen that, adjusting capital for productive capital utilization coefficient (pro-cyclical), physical capital contribution is reduced while MFP contribution increases.

If we take into account the elasticity of the physical capital contribution (α), which has increased in the expansion and contraction by 3% and 6% respectively, the contribution of physical capital is further increased by decreasing the MFP 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 strong decrease in occupation: a 3.78% annual reduction in hourly terms during the recession, being 18.9% during the whole period.

Therefore, our findings suggest that the contribution of capital is the sole cause of the increase of productivity during the expansion and it is the main cause of higher improvement during recessions. In this same way, Fernández de Guevara (2012), using micro data from a panel of companies, shows how Spanish growth was based on the accumulation of factors during the expansionary period and, in the recession, labor productivity increased by the adjustment of employment but decreasing MFP. Therefore, the increase in capital per unit of labor, even adjusted by coefficient of utilization, is what allows smaller falls of the production than labor

¹⁷ 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 results with adjusted K and α variable have been omitted from the table.

factor producing a factorial substitution effect by reducing the proportion of labor in the production equation.

3.7. After 2013

Three years have passed since the last recession episode concluded. We wonder if the Spanish labor productivity will continue being counter-cyclical or not. Data from last quarter of 2013 to same quarter of 2016 shows that GDP has increased 7.9% (2.6% per year), working hours 5.7% (1.9% per year) and labor productivity 2.1% (0.7% per year). The dramatic downfall of labor productivity evolution when economy has started to grow again, seems to confirm that the counter-cyclical pattern will continue.

Apparently, the legislative reforms as the 2012's one did not have any effect on firm's labor strategy. The reform tried to approach labor market to companies' reality by decentralizing bargaining and making the dismissals policy closer to business needs. It seems that it has not had effect on the pattern. Lahera (2017) reports that effectiveness of the normative reform has been reduced in practice by the jurisprudential interpretation.

As in the previous expansive period (1996-2008), we assist to an increase in the rate of temporary workers, from 23.66% in last quarter of 2013 to a 26.47% in the last quarter of 2016.

Maybe it is too soon to determining the continuity of the countercyclical pattern, but the data seem to suggest the dynamics we have described will hold for some time.

4. CONCLUDING REMARKS

This paper, following the relevant economic literature, has empirically explored the idea that labor market institutions are determinant of the cyclical pattern of labor productivity. To that end, we have analyzed the evolution of the Spanish labor productivity that has experienced a dramatic change in its cyclical pattern in few years.

As in every empirical analysis, the results must be regarded with caution since they are based on the experience of a particular country over a certain period and a given econometric methodology. We have shown that the change of cyclical pattern (from strongly procyclical to contracyclical) is originated abruptly in 1984, coinciding with a legislative reform that allowed a flexible way of adjusting labor through temporary work. In addition, we have detected a lack of competitive response of salaries, being the quantity of labor the only way of adjustment.

We have found that high volatility of employment related to GDP during recessions, is compensated by a large increase in labor productivity. Increases in productivity during contractions are due to a factorial substitution effect in favor of capital per unit of labor. Moreover, reduction of temporary workers, who accumulate less investment in human capital as result of firms' dismissal cost strategy, can have a positive influence over average labor productivity. In contrasts, labor productivity evolution is quite poor during expansions.

All in all, our findings leads to the conclusion that the 1984 legislative reform has produced a change in the cyclical pattern proving the influence of labor market institutions on the cyclical pattern of labor productivity.

The results presented in this paper should be of value to policymakers because of its implications on the effectiveness of the 1984 legislative reform. Moreover, our findings may also provide useful data for economic theoreticians since they can find inspiration by the patterns revealed in this paper.

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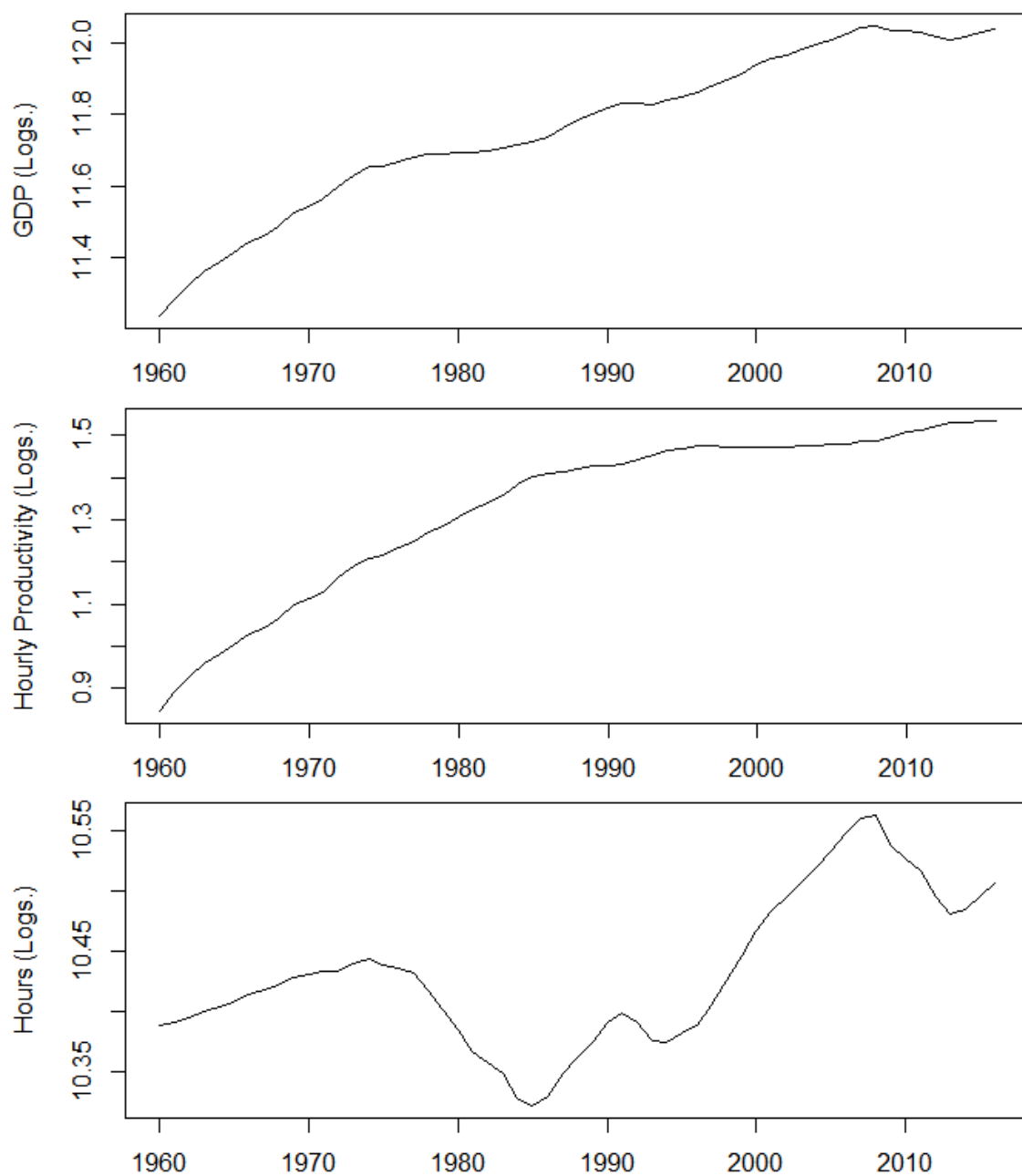
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APPENDIX 1: FILTER ELECTION FOR CYCLE EXTRACTION

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



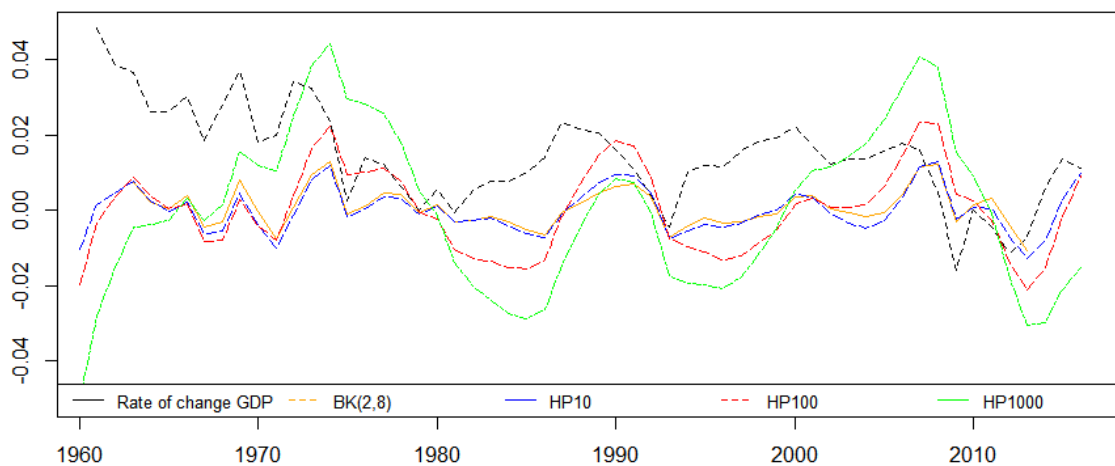
Applying different filters (Baxter-King and Hodrick-Prescott) we contrast stationarity.

p -Value	Augmented Dickey-Fuller: $H_0 = I(1)$	KPSS: $H_0 = I(0)$
GDP	> 0.7306	0.01
Log GDP	> 0.29	0.01
Cycle Log GDP HP10	0.00	0.1
Cycle LGDP HP100	< 0.005	0.1
Cycle LGDP BK (2, 8)	< 0.007	0.1
Ciclo L.Prod.Hora HP10	0.01	0.1

After filter application, Dickey-Fuller test reject the null hypothesis of unit root and accepting KPSS test accept the null hypothesis of stationarity.

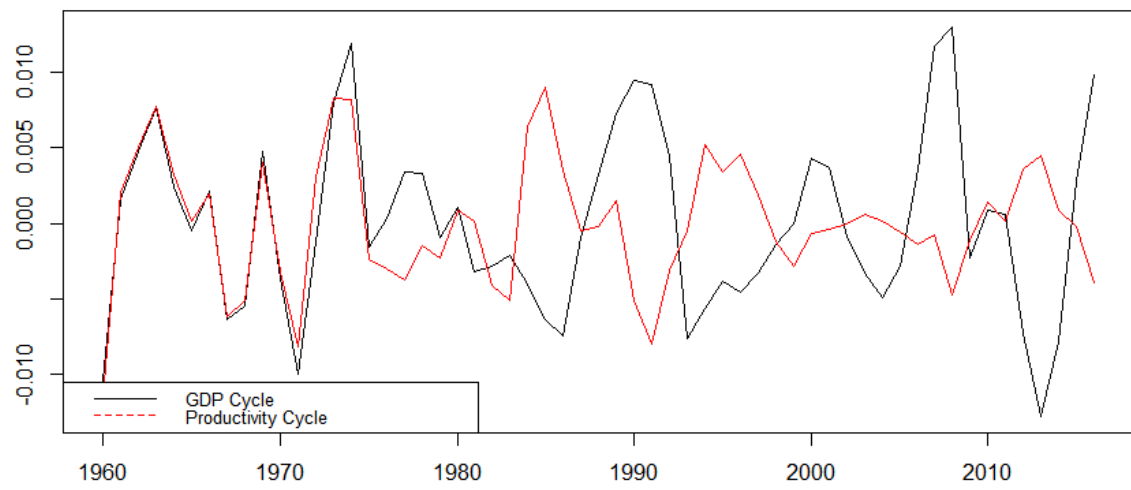
There is no exact mathematical definition of what the economic cycle is. We adopt Burns and Mitchell definition that supposes a cycle duration between 6 and 32 quarters, or its equivalent for annual series: 2 to 8 years.

GDP Cycle (log) with HP and BK



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.

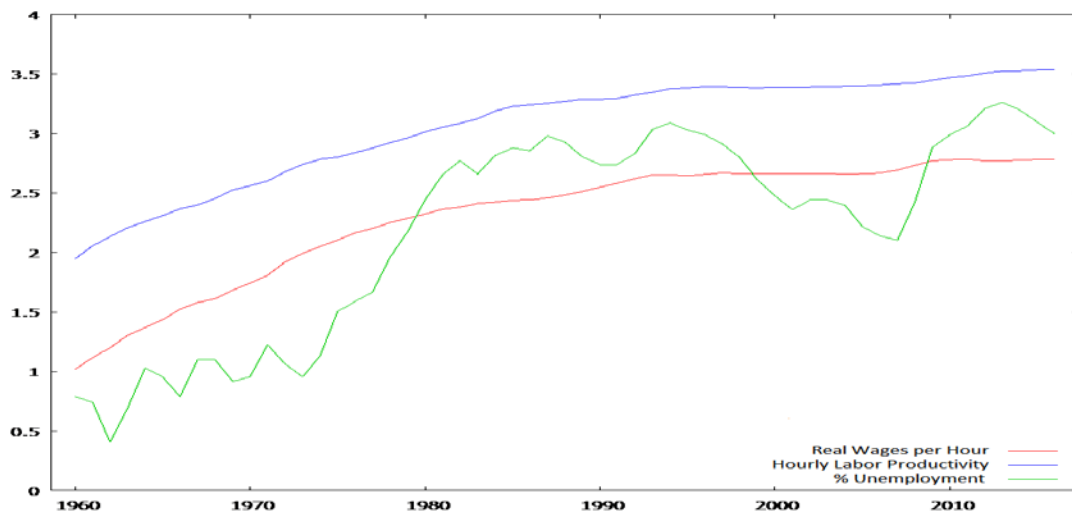
GDP & Productivity Cycle



APPENDIX 2: COINTEGRATION AND UNIT ROOTS

To prove the lack of relation between unemployment rate and evolution of real wages in the Spanish labor market, we use the Engle and Granger (1987)'s 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 evolution of variables (log. scale)

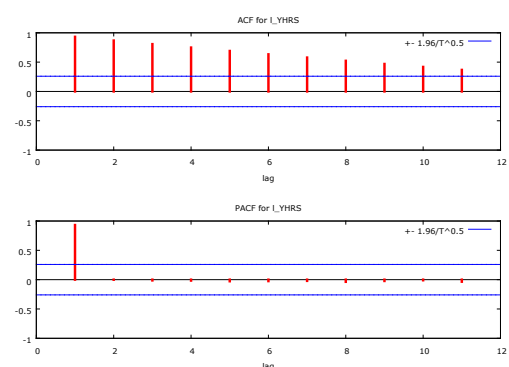
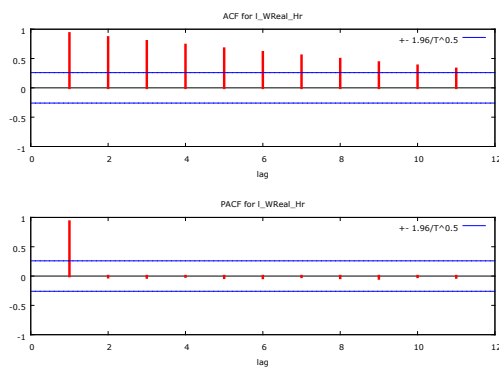


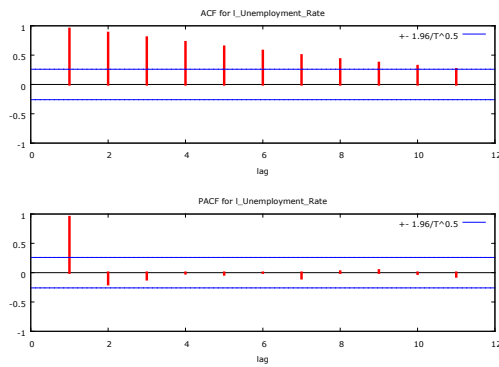
Data source: Eurostat

In the previous graph it seems obvious a cointegration relationship between productivity and wages, but possibly there is not a cointegrated relationship between wages and unemployment.

Autocorrelation Functions (ACF) and Partial

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

You can see that there are large number of 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

	Real Wages	Unemployment	Productivity	Wages (derivate)	Unemployment (derivate)	Productivity (derivate)
Augmented Dickey-Fuller ¹⁸	0.33	0.4	0.59	0.011	0.0000	0.001
KPSS	<0.01	<0.01	<0.01	<0.01	>0.1	<0.01

From the preceding tests, the first-order integration of the three variables is confirmed. The lack of confirmation of the stationarity of the derivative of unemployment by the KPSS test is not important, being more relevant the rejection of the unit root hypothesis by the ADF test. Therefore, we conclude that the three variables are I (1).

¹⁸ Following the literature and the structure of the processes, the test has been carried out with constant for unemployment and with constant and tendency for productivity and wages. The ADF test has taken into account 11 delays for the level and differentiated variables.

APPENDIX 3: EVOLUTION OF WORKING HOURS

Table A: Increasing Working Hours

	Δ Hours Non-Employees		Δ Hours Permanent Employees		Δ Hours Temporary Employees	
	Δ L	Δ Workingtime	Δ L	Δ Workingtime	Δ L	Δ Workingtime
1996:1-2008:1 (3,230,220,380)	55,184,290	4,624,468	2,414,380,879	-17,234,378	782,080,680	-8,815,559
	59,808,759		2,397,146,501		773,265,121	
2008:3-2013:3 (-1,579,791,875)	-191,079,099	17,445,017	-579,085,435	-78,539,274	-715,910,767	-32,622,318
	-173,634,081		-657,624,709		-748,533,085	

Table B: Contribution of Employed Persons

	Non-Employees	Permanent	Temporary
1996:1-2008:1	1.44%	74.44%	24.11%
2008:3-2013:3	10.94%	39.83%	49.24%

Table C: Contribution of Hours Variation

	Non-Employees	Permanent	Temporary
1996:1-2008:1	1.85%	74.21%	23.94%
2008:3-2013:3	10.99%	41.63%	47.38%

Table D: Rate of Variation of the Period (People)

	Non-Employees	Permanent	Temporary
1996:1-2008:1	4.03%	79.18%	50.14%
2008:3-2013:3	-13.33%	-10.73%	-31.93%

Table A decomposes the variation of the working hours according to the formula 17 between variation of the workingtime and variation of people. The sum of both variations in bold. Tables B and C show the percentage of variation that is due to each type of work in each period, both the total number of employees and the number of hours worked. Lastly, table D shows the rates of variation of each type of worker in the period.

Source: own elaboration based on the data provided by the National Institute of Statistics (INE).



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