Potential Growth and Business Cycle in the Spanish Economy: Implications for Fiscal Policy[*]

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Abstract

An accurately estimation of the cyclical position of an economy is a necessary condition for the success of fiscal stabilisation policies. In this paper we show that the estimation of the output gap by means of decomposing a production function produces similar results to univariate and multivariate methods, increasing their robustness and allowing us to conclude that most of the information on the economic cycle is included in the cyclical component of the unemployment rate. The results also indicate that there is reduced uncertainty about the periods when the Spanish economy has clearly been in a deep recession or in a sharp expansion. These periods have been limited and of relatively short duration. Fiscal policy should pay particular attention to these episodes, when discretionary stabilisation policies make most sense.

Keywords: potential growth, business cycle, speed-limit policies.
JEL Classification: C32, E32.

1. Introduction

The design of fiscal policy aimed at stabilising the Spanish economy is currently determined by the General Budgetary Stability Act (LGEP), which establishes that public accounts must display a surplus when the economy is growing above its potential and a deficit if the opposite is the case. The tone of fiscal policy is therefore adapted to the business cycle in order to lessen its effect. This fiscal policy rule, which guides the actions of

tax authorities, thus enables a counter-cyclical fiscal policy to be designed, without giving up the necessary flexibility, allowing adjustments to be made when the economy is affected by unexpected disturbances.

The operation of this fiscal policy is determined by the assertion of the cyclical position of the economy. However, the cyclical situation cannot always be evaluated immediately, as it is necessary to have information about potential output which, as an unobservable variable, must be estimated. The LGEP currently establishes a growth rate of 3 per cent, as an approximation of the potential GDP growth rate, above which policy makers must present a surplus in their public accounts. Establishing a growth rate which differentiates between situations which require a deficit or a surplus obviously simplifies the application of this rule, despite it being necessary to allow this rate to vary over time, as the underlying economic conditions that determine potential output change. For example, the Spanish economy has, in recent years, benefited from extremely significant employment growth that has increased the potential growth rate, as it is due to permanent increases in the supply of labour such as, for example, those related to immigration or to the increase in the level of participation of women.

The potential GDP growth rate and, therefore, the output gap estimate, may change over time. The use of these two concepts for economic policy therefore depends on three factors. Firstly, that the output gap is closely linked to various macroeconomic imbalances, such as inflation, the foreign trade deficit or the unemployment rate. Secondly, that it is possible to identify the factors that determine the potential output of the economy. Lastly, that the degree of uncertainty with which the potential GDP growth rate and the output gap are estimated is known and not too high.

The aim of this paper is to compare the results of the most relevant methodologies for estimating the output gap and the potential GDP growth rate of the Spanish economy, in order to analyse their robustness and to identify the implications for economic policy. For this purpose, this paper not only compares univariate and multivariate methods such as those analysed by Doménech and Gómez (2005 and 2006), but also focuses on the breakdown that may be carried out, taking into account the technological capacities of the economy, which are reflected in the aggregate production function.

The structure of the paper is as follows. In the second section, we show the evidence on a set of cyclical indicators and variables which contain direct and useful information on the cyclical position of an economy, thereby facilitating the identification of the cyclical component of GDP in the following sections. In the third section, univariate filters were applied to extract the trend component of the main macroeconomic series and we propose the Hodrick-Prescott filter. In the following section, multivariate methods are analysed, enabling the information contained in different variables to be compatible among them.

In the fifth section, potential output is estimated using production function methodology. This method is also applied by the European Commission to evaluate the stability programmes of EU countries, which makes examining its properties and results in detail essential. In the sixth section, we discuss the implications for economic policy of the results obtained in previous sections. Lastly, the main conclusions of the paper are presented in the final section.

2.   Indicators of the cyclical position of the Spanish economy

A very useful way of beginning the analysis of the cyclical situation of any economy is to use a set of indicators containing relevant information on the intensity of the expansions and recessions to which economic activity is subject. These indicators do not initially require any kind of prior transformation, other than the calculation of their growth rates in some cases or the removal of their most erratic components and patterns which are periodically repeated (seasonality or irregular components).

The first variable that should be analysed is undoubtedly the GDP growth rate in real terms, as it is the main indicator of activity in any economy. Another variable which reflects the overall situation of the Spanish economy is the Economic Sentiment Indicator (ESI), produced by the European Commission. This indicator relates to the whole economy but, unlike GDP growth, it is not quantitative but qualitative (it is produced from the affirmative and negative answers given to certain questions by representative individuals) and is already related to the growth of the economy, meaning that obtaining its variation rate is unnecessary. Other variables which are also useful are partial indicators which include the intensity in the use of production factors such as, for example, capacity utilisation in industry, which is also qualitative, and the unemployment rate, an excellent indicator of the degree of imbalance in the employment market, which is logically negatively correlated to the cycle.

The main problem with the unemployment rate when determining the cyclical position of an economy is that it may be subject to changes in its structural component, traditionally known as the NAIRU. This problem also affects other variables, such as the aggregate investment rate (in other words, the weight of Gross Fixed Capital Formation against GDP), the current account surplus, also as a percentage of GDP, revenues from taxes on corporate profits or the inflation rate. These variables are very useful because they usually exaggerate the movements of the economic cycle itself. Investment thus tends to grow by more than GDP during expansions and less during recessions, which means the investment rate is pro-cyclical. A similar situation occurs with corporate taxes, as their tax bases have a positive elasticity against GDP which is above unity. On the other hand, the current account is negatively correlated to the economic cycle, as its behaviour is dominated
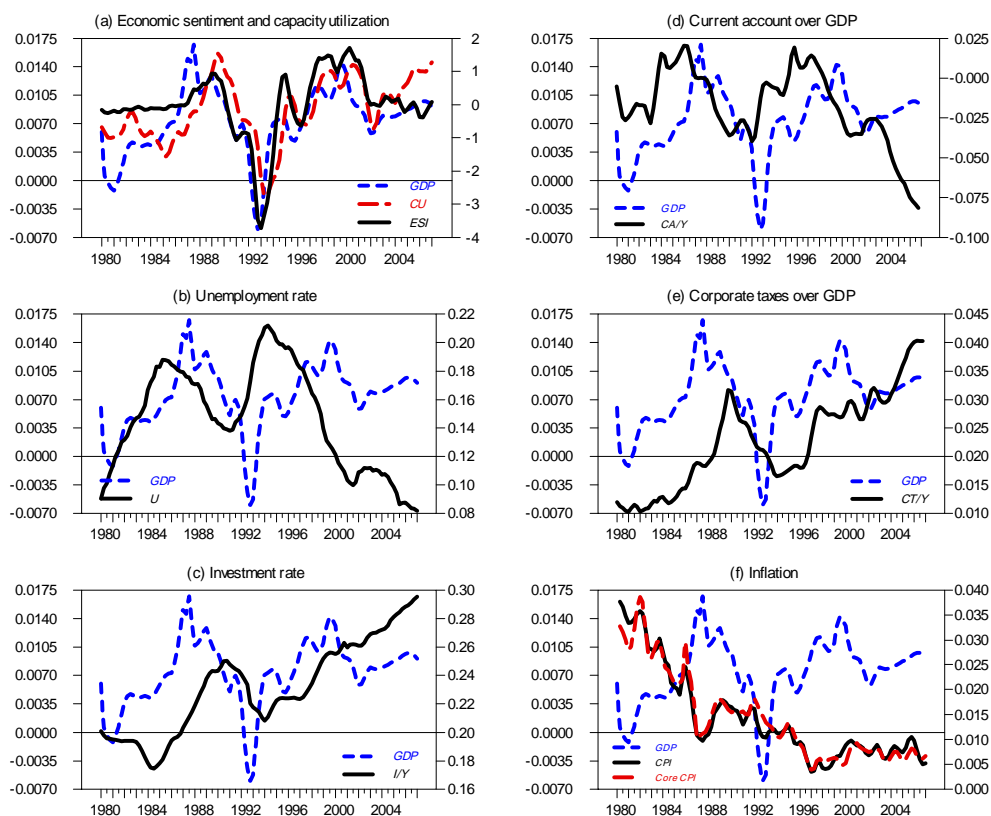
Figure 1: *Quarterly GDP growth (left axis) and various macroeconomic indicators (right axis), 1980-2006.*

by the evolution of imports which, like investment, increase by more than GDP during expansions and much less during recessions. In the case of the aggregate inflation rate, if the economy is dominated by demand shocks, inflation must be higher during expansions and lower during recessions.

As can be seen in Figure 1, where the annual GDP growth is shown, the Spanish economy has been enjoying a prolonged expansion since 1994, with an above-average growth rate in most years. In fact, the lowest GDP growth rate was recorded in 2002, and was above 2.5 per cent. A similar pattern is seen in the Economic Sentiment Indicator (*ESI* in panel (a)) as its correlation with GDP between 1980 and 2006 was equal to 0.72. Nevertheless, it can be seen that having peaked in 2001, the Economic Sentiment Indicator has been below the sample average. With regard to the capacity utilization in industry (*CU*), given that it has a high correlation with GDP growth (0.78), although with an average

lag of three quarters, it is not surprising that it has a similar profile. In recent years this indicator has reflected a pressure on installed capital stock that is well above the historical average, after suffering a short-lived decline in 2002.

The unemployment rate (U in panel (b)) is also below its historical average, but displays an almost constant downward trend, which again leads one to consider the existence of structural factors which have given rise to a reduction in the NAIRU. Among the factors behind this decrease in the structural unemployment rate, some studies (for example, Bentolila and Jimeno, 2006, or Bentolila, Dolado and Jimeno, 2007) have highlighted the reduction in margins, the downward adjustment of interest rates, the reduction in social security contributions and, most recently, the phenomenon of immigration.

The recent evolution of the investment rate (I/Y in panel (c)), the current account surplus in relation to GDP (CA/Y in panel (d)) and corporate income taxes against GDP (CT/Y in panel (e)) seems consistent with the hypothesis that the economy is currently in an expansion. In all three cases, a continued upward trend can be seen from the mid 1990s which was only slightly interrupted around 2002. This pause was less intense than that observed in preceding indicators, but it should not be forgotten that in recent years they may have been affected by elements which might have had an upward influence on its long-term level. Specifically, two of these are Spain's integration in the European Monetary Union (and the subsequent reduction in interest rates) and fiscal consolidation.

Lastly, the interpretation of the evolution of inflation (*CPI* in panel (f)) as a cyclical indicator is quite controversial. If demand disturbances predominate in the economy (for example, a change in public expenditure) the correlation with activity must be positive. However, if supply disturbances predominate (for example, an adjustment in oil prices) the correlation must be negative. In the period 1980-2006, the correlation between inflation and GDP growth was negative (-0.51), which suggests the effect of supply disturbances was predominant. Nevertheless, the correlation between the acceleration of prices ($\Delta^2 \ln P$) and GDP growth is positive (0.15), which indicates that the persistence of inflation is important when interpreting the information that the inflation rate contains on the economic cycle.

In short, the descriptive analysis above leads us to deduce that the Spanish economy has been in an expansion phase of the economic cycle in recent years, although the presence of structural changes, which have certainly affected the long-term levels of some variables, makes it more difficult to draw conclusions. It is therefore necessary to carry out a more detailed and precise analysis which takes these aspects into account.

3.   Univariate methods of estimation of the output gap

In this section we use various statistical procedures to extract the trend component from a

particular series, using only information from its past, present and (in some cases) future. These methods enable any variable to be broken down into a permanent component and another transitory component, which includes the fluctuations in the economic cycle. The objections usually made to these methods are varied. Firstly, in order to identify the permanent component of a variable, a particular stochastic process must be imposed a priori. Secondly, as economic theory is not used in the process of identifying these components, it is therefore not very clear what is being identified in each component. Lastly, the results obtained with these methods are not accompanied by the information necessary to evaluate the uncertainty of the estimations, although, as will be seen later, it is possible to solve this limitation and present the results together with a confidence interval.[1]

The literature in this field has proposed a considerable number of univariate filtering techniques, although only three have been selected in this paper, as they are the most commonly used: the Hodrick and Prescott filter (HP, 1997), the Baxter and King filter (BK, 1999) and the Cogley filter (C, 2002).

The HP filter uses weighted symmetric moving averages from the original series in order to extract the most permanent components. The series to be broken down must therefore have already previously excluded the seasonal component and the irregular component. This procedure involves the arbitrary choice of a parameter (λ) which determines the degree of smoothing of the permanent component or, what amounts to the same thing, the length of the cycles.[2] Furthermore, as the estimation of the trend at any moment requires past, present and future information, there is a problem with this decomposition at the end of the sample, as the amount of future information is smaller as we move towards the end of the sample. As a result, estimations are more imprecise and may be significantly altered by the arrival of new information. In order to minimise this drawback, we follow the recommendations by Kaiser and Maravall (1999), applying the filter to prolonged series with univariate forecasts.

The Baxter and King filter (1999) is also a symmetric filter, but enables the cyclical component for a certain range of frequencies to be extracted (normally those which last for more than two quarters and less than 8 years). As in the case of the HP filter, it is necessary to have a prediction at the end of the sample in order to avoid the problem described above.

Asymmetric filters, such as that proposed by Cogley (2002) for inflation, do not suffer from this problem at the end of the sample, as they only use information from the present and the past to obtain the trend of a variable. This filter also requires the arbitrary

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[1] A detailed description of these aspects can be found, among others, in Canova (1998).

[2] Taking into account that the series are quarterly, $\lambda = 1600$ is used, as recommended by the literature in this field, for cycles with five and seven years of duration. One of the first HP filter applications for analysing the cyclical regularities of the Spanish economy was carried out by Dolado, Sebastián and Vallés (1993).

choice of the parameter which determines the degree of persistence of the disturbances shown by the variable (in the following decompositions it has been set equal to $g_0 = 0.18$), or what amounts to the same thing, the smoothing of the trend finally estimated.

These filters have been applied to the series used in the previous section, extending them with the Spanish Government forecasts for the period 2007-2010 included in the Stability Programme Update or with predictions based on ARIMA models, when necessary.

Figure 2 shows the GDP growth rate together with the potential growth rates estimated by these three univariate filters and the confidence interval at 80 per cent of the potential growth estimated with the BK filter, very similar to that of the HP filter.[3] GDP growth lies outside the estimated confidence interval only in periods in which the expansions and recessions are very intense. The HP and BK filters provide estimations that are very similar to the potential GDP growth rate, which in recent years has increased slightly, reaching 3.4 per cent. The estimated potential growth with the Cogley filter is more volatile, almost always within the estimated confidence interval, at around 3.2 in 2006 and, although it is not shown on the diagram, its correlation with the concurrent estimation of the potential GDP growth rate with both filters is very high (0.986 in the case of the HP filter and 0.982 with the BK filter).

Figure 3 shows the cyclical component obtained with the HP and BK filters. As can be seen, the differences are negligible. For both methods the periods of maximum expansion or recession are statistically significant, which indicates that they were, in general, adequately estimated with the information available at that time.

In Figure 4 we show the cyclical component of GDP estimated by the BK, together with utilization capacity (with a correlation equal to 0.603), the cyclical components of the unemployment rate in logarithms (-0.767), the investment rate (0.742) and the current account surplus (-0.563). In every case these correlations with the output gap are statistically significant, showing that these variables have a high level of information content on the cyclical situation of the Spanish economy, which makes them quite suitable for their use in multivariate procedures for the estimation of the output gap.[4] The results obtained by the

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[3] The confidence interval has been constructed using the standard deviation of the difference between the concurrent or initial estimation ($\Delta \overline{\ln y}_{t/t}$) and the final estimation ($\Delta \overline{\ln y}_{t/t+j}$) of the potential growth rate. This difference reflects the relative importance of the revisions which occur as new information is available. It therefore shows, in a very intuitive way, the degree of uncertainty with which these univariate filters carry out the decomposition between cycle and trend. In order to obtain the concurrent or initial estimation, recursive predictions have been obtained for the 12 quarters following the last available GDP figure, based on recursive estimations of an ARIMA model, starting in 1970(1). The standard deviation of these revisions with the HP filter between 1980(1) and 2006(4) is 0.00693, which drops to 0.00597 with the BK filter. In the case of the Cogley filter, given that it is an asymmetric filter which only uses present and past information, these revisions are equal to zero ($\Delta \overline{\ln y}_{t/t} = \Delta \overline{\ln y}_{t/t+j}$) if no statistical revision in the estimation of the GDP is made.

[4] The correlation between the output gap and the cyclical component of corporate income taxes over GDP is equal to 0.375 between 1980(1) and 2006(6), while the correlation between the cyclical component of inflation
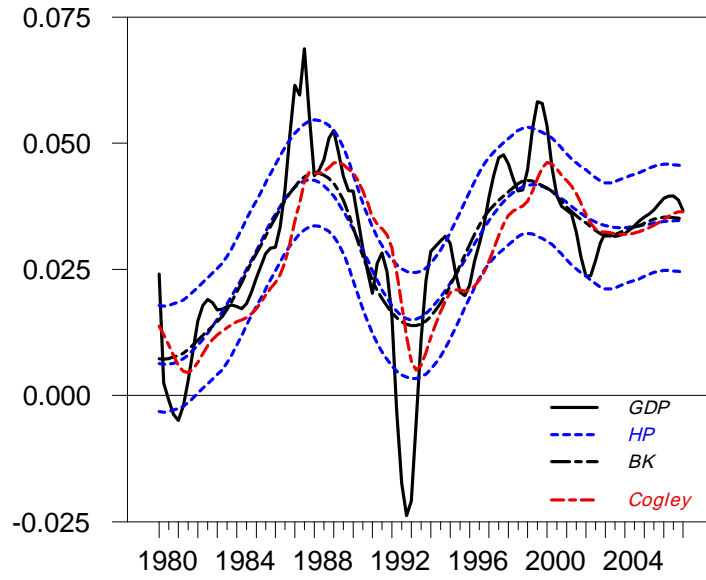
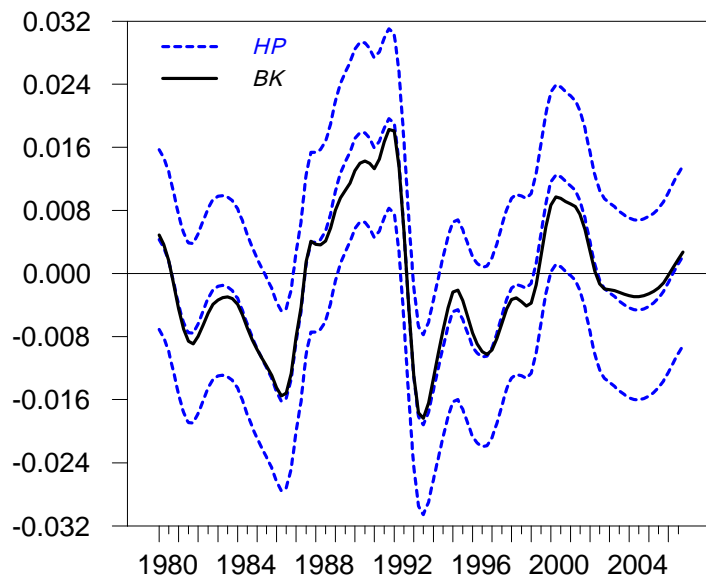**Figure 2:** *GDP growth and rate of growth of its trend component.*

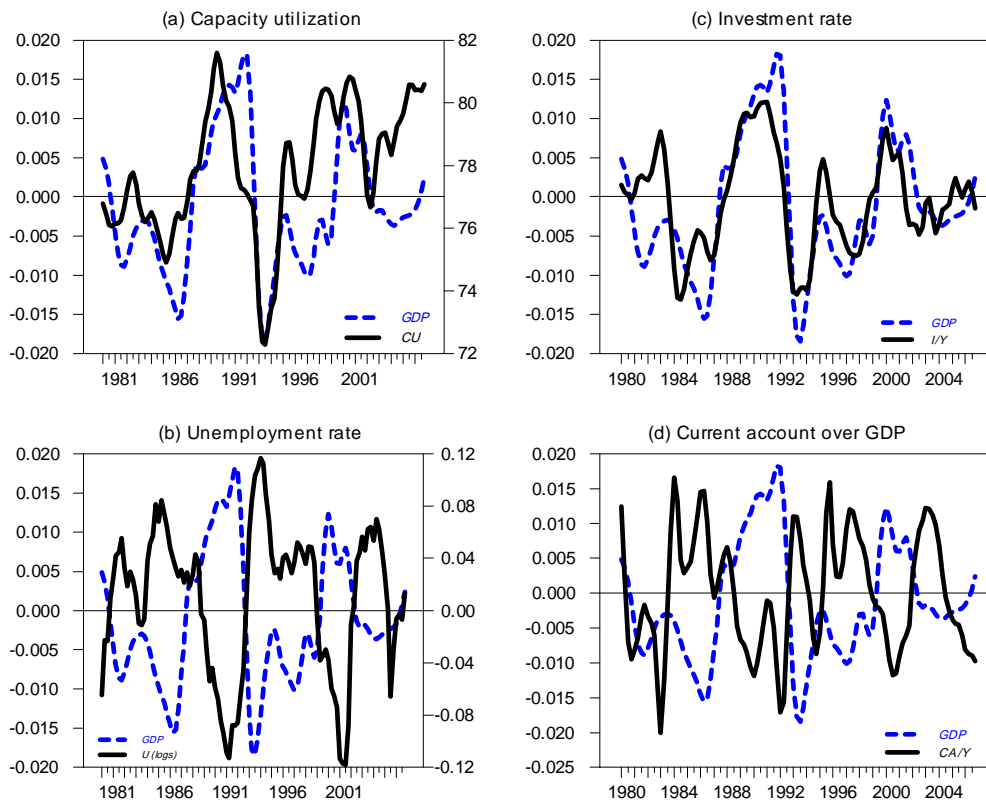**Figure 3:** *Output gap: HP and BK filters.*

Figure 4: *Cyclical components obtained with the BK filter.*

univariate filters appear to be in line with those obtained by these indicators, even in re-cent years: a slight recession appears to be estimated between 2002 and 2004 whereas the economy enjoyed a slight expansion at the end of the sample period analysed.

4. Multivariate methods for the estimation of the output gap

There are three basic differences between the methods used in this section to estimate the output gap and those which have been used in the preceding section. Firstly, more than one variable is used to identify the business cycle. Secondly, economic theory is used to link these variables to each other, allowing a relationship between the permanent and

and the output gap is 0.172. The output gap is positive and statistically significant in estimations in which the acceleration of prices is additionally regressed on its lags.

temporary components estimated with particular economic concepts. The restrictions suggested by economic theory are usually only necessary in the long term, while in the short term the data determine the correlations between the variables. Lastly, all the estimated cyclical components of each variable are related to each other.

This paper considers three different methodologies. The first, proposed by Doménech and Gómez (2005 and 2006), uses the linear model for unobservable components in order to estimate the structural and cyclical components of GDP, the unemployment rate and the investment rate. The second uses the non-linear methodology suggested by Hamilton (1989), which allows for regime shifts, in order to identify states characterised by high (expansion) and low (recession) growth, using GDP and the capacity utilization.[5] The third method uses the inefficiency gap proposed by Galí, Gertler and López-Salido (2007), which takes into account inefficient fluctuations in the economy due to price and wage rigidities.

4.1   The estimation of the potential output and the NAIRU as latent variables

The method proposed by Doménech and Gómez (2005 and 2006) consists of using a model for unobservable components which uses the information contained by the unemployment and investment rates on the cyclical position of the economy. For this purpose, two equations are used to estimate the output gap using the Kalman filter, which link the output gap to the investment rate and the unemployment rate. The last equation is a representation of Okun's Law. Using these equations it is thus possible to obtain an estimation of the output gap with a method that dispenses with the large number of assumptions it is necessary to make using a production function, as we show in the next section, but without using a purely statistical method, as it takes into account some economic relationships between the main variables of interest.

This method can be seen as an alternative specification to a multivariate version of the HP filter, in which, rather than imposing a restriction on the ratio between the variances of the cyclical components and the acceleration of the trend components (in the case of quarterly data, this ratio is usually equal to 1600), these variances are estimated.

Figure 5 shows the estimations obtained with this procedure for the potential GDP growth rate (panel (a)), the cyclical component of GDP (panel (b)), the unemployment rate and the investment rate (panel (c)), as well as the structural unemployment rate (panel (d)). Panel (a) shows how growth in GDP since 2004 has been above the estimated potential growth rate (although the difference is not statistically significant), which stood at around 3.4% at the end of the sample.[6] Notice how the confidence interval in this case

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[5]   The authors particularly acknowledge the work done by Gabriel Pérez-Quirós in the application of this method.

[6]   As in the case of the HP filter, the confidence interval of 80 per cent has been calculated using the typical
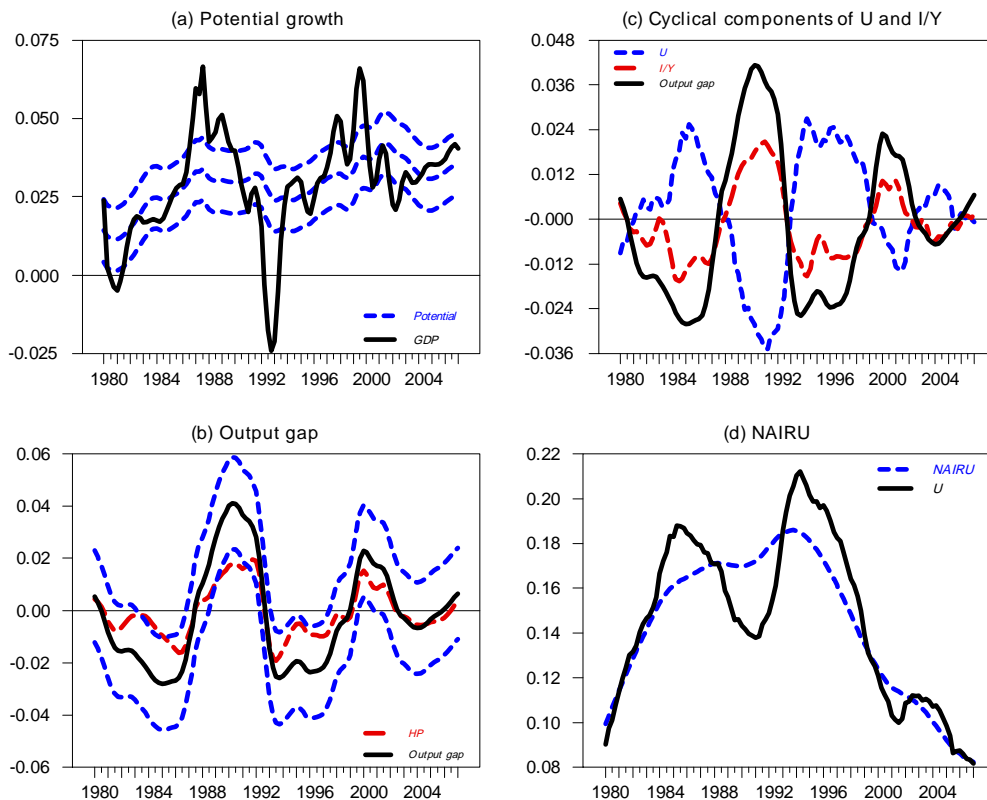
Figure 5: *Results of the unobserved componentes model.*

is much lower than with univariate methods. In other words, by including the additional information contained in other variables, the output gap is estimated with less uncertainty.

As can be seen in panel (b), according to these estimations the Spanish economy in the last decade has experienced less severe cyclical fluctuations in GDP than in previous episodes. In order to facilitate the comparison the output gap estimated with the HP filter has been shown, which, with the usual smoothing parameter for quarterly data (1600), is smoother than that estimated with this multivariate procedure. Nevertheless, the periods of expansion and recession fully coincide with both methods. In fact, the correlation between both estimations of the output gap is very high (equal to 0.92) for the whole of the

deviation between 1980 and 2004 of the difference between the concurrent and final estimation of the potential growth rate.

sample period analysed. The cyclical component of the unemployment rate shows a very similar evolution, making the importance of Okun's Law clear. Lastly, in panel (d) it can be seen that in the latest quarters, the current unemployment rate coincided with its structural rate, estimated in the first quarter of 2007 at 8.2 per cent, after seasonal adjustment.

4.2 Estimation of the probability of recessions

The methodology which is used in this section entails a change with regard to the previous section, as it moves from quantitative analysis to partially qualitative analysis. The aim is therefore not so much to estimate the size of the output gap at a particular moment in time as to estimate the probability of the economy going into a recession or expansion, attempting to anticipate the so-called turning points, in other words, periods at which the economy begins a new trend.

For this purpose, a survey-based indicator is used which, as was seen in the second section, is closely linked to activity: industrial capacity utilization. The use of survey-based indicators has a great tradition in the analysis of the economic situation. However, analysing these series in standard, fundamentally linear models has resulted in all kinds of false alarms, generating a great deal of mistrust with regard to the predictive power of these series. However, in many cases, the predictive power of a series does not depend so much on the series itself as on the filter which is used to extract the information. Various authors (for example, Bengoechea, et al., 2006) have thus proven the usefulness of these survey series as predictors, not at series level, but for its turning points.

Predicting turning points is not a trivial task. Since the first work undertaken by Burns and Mitchell in 1928, the sequence of recessions and expansions has been considered to be a characteristic fact of all economies. Various papers have shown that a large part of the variance of macroeconomic variables can be explained by these non-linearities in the series. Predicting turning points is thus one of the key aspects in the analysis of the business cycle, as the different states of the economy do not change very often. The economy has a tendency to remain in the state it is currently in and detecting a regime shift in time therefore helps to predict activity in subsequent periods with greater accuracy.

The most popular method in the literature in this field with regard to the estimation of the probability of economic recessions is based on Markov chains. It is thus assumed that there is a particular growth rate expected of the economy if it is in an expansion phase and a lower expected growth rate if the period relates to a recession. Furthermore, it is assumed that the states of expansion and recession occur inertially. In other words, in an expansion, the economy will tend to continue in that state and the same applies for a recession.

While a univariate model for the Spanish GDP does not provide satisfactory results in the period analysed, the joint use of capacity utilization and the GDP growth rate en-

Table 1: Estimated coefficients for each state

	$\Delta \ln PIB$	CU	Prob
Expansion	3.88	80.0	0.96
	(0.35)	(0.27)	(0.12)
Recession	1.91	76.3	0.95
	(0.36)	(0.24)	(0.12)

Notes: CU is the capacity utilization. The last column indicates the probability of remaining in each state. Standard deviations are shown in brackets.

ables these expansion and recession phases of activity to be identified more accurately, even if it is not necessary for both series to share the state of the economic cycle, a restriction accepted by the data given the high correlation already shown in Figure 1.

Table 1 shows the results from estimating this bivariate model. As can be seen, average estimated GDP growth in expansion phases is 3.9%, significantly above the 1.9% rate obtained for recession phases. This latter growth rate is statistically higher than zero, which implies that the definition of recession in this model is not the traditional one, linked to decreases in GDP, but takes into account that the potential growth of the economy is positive. Furthermore, the average level of capacity utilization in expansion phases is 80%, also significantly higher than the 76.3% figure obtained in recessions. Lastly, it should be mentioned that the economy has a considerable degree of inertia, as the probability of moving from a recession phase to an expansion phase or vice versa is very low (5% and 4%, respectively).

These coefficients are used to calculate the probabilities of being in recession, which are shown in Figure 6. As can be seen, the estimated probability of the economy being in recession is virtually one in the periods in which the growth rate is below potential, such as between 1991 and 1994 or throughout 2002. These estimations are therefore fairly well in line with the results obtained in the previous sections.

4.3 Markups and inefficiency gaps

Another alternative approach to asses the cyclical position of an economy has been proposed by Galí, Gertler and López-Salido (2007, GGLP hereafter). According to these authors, price and wage rigidities as well as other types of market frictions are responsible for inefficient fluctuations in which the economy moves away from or approaches an efficient (flexible) level of activity, causing inefficient employment allocation. The inefficiency gap proposed by GGLP corresponds to the vertical distance between the perfectly competitive labour supply and labour demand schedules, evaluated at the current level of
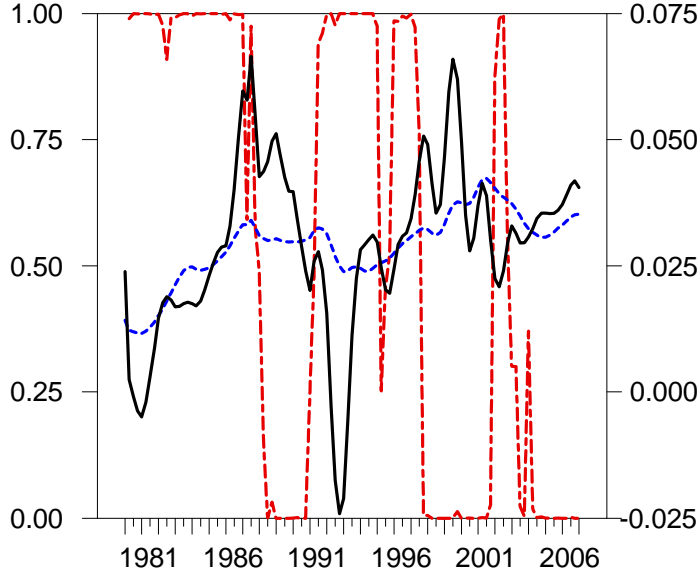
Figure 6: *Recession probability (left) and growth (right).*

employment (measured in hours) and it is defined as the difference between the marginal rate of substitution (*mrs*) and the marginal product of labour (*mpn*), where both variables are in logs:

$$gap_t = mrs_t - mpn_t \tag{1}$$

Adding and subtracting the real wage in this equation we have that

$$gap_t = - \{[mpn_t - (w_t - p_t)] - [mrs_t - (w_t - p_t)]\} \tag{2}$$

that is, the *gap* can be expressed as the sum between the price markup ($\mu_t^p \equiv p_t - (w_t - mpn_t)$)) and the wage markup ($\mu_t^w \equiv (w_t - p_t) - mrs_t$):

$$gap_t = -(\mu_t^p + \mu_t^w). \tag{3}$$

In order to apply this approach to the Spanish economy we have to make some assumptions about technology and preferences. More specifically, as in GGLP we assume that (up to an additive constant) the marginal labour productivity is equal to the average product of labour:
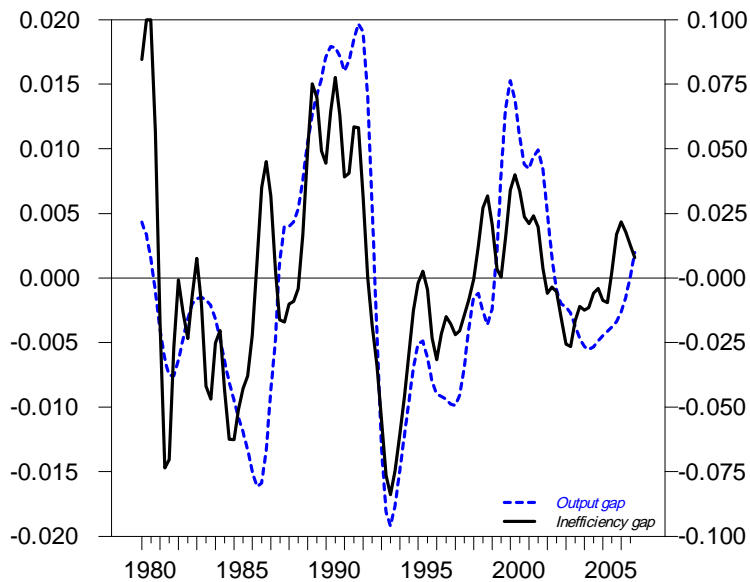
$$mpn_t = \ln Y_t - \ln L_t \tag{4}$$

Figure 7: *Inefficiency gap and output gap in Spain, 1980-2006.*

where Y is the real GDP and L the total number of hours. Additionally, we assume that (up to an additive constant) the marginal rate of substitution is given by:

$$mrs_t = \sigma \ln \left(\frac{C_t^p + C_t^g}{N_t^{16-64}} \right) + \varphi \ln \left(\frac{L_t}{N_t^{16-64}} \right) - \bar{\bar{\zeta}}_t \tag{5}$$

where C^p is private consumption, C^g is public consumption, N^{16-64} the working-age population, $\bar{\bar{\zeta}}$ reflects low-frequency changes in preferences, σ is the relative risk aversion coefficient and φ measures the curvature of the disutility of labour.[7]

In Figure 7 we have represented the inefficiency gap and the HP output gap for the Spanish economy, using quarterly data from 1980 to 2006, for $\sigma = \varphi = 1$. As we can see, the correlation between both variables is relatively high (0.69), although the inefficiency gap is more erratic in some expansions and recessions. A more detailed examination of the components of the inefficiency gap shows that the correlation of the output gap and the wage markup is much higher (-0.75) in absolute values than for the price markup

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[7]   As in Galí, Gertler and López-Salido (2007) $\bar{\bar{\zeta}}$ is estimated as the trend component obtained by fitting a third-order polynomial to the observable component of the wage markup $(w_t - p_t) - \sigma \ln \left(\frac{C_t^p + C_t^g}{N_t^{16-64}} \right) - \varphi \ln \left(\frac{L_t}{N_t^{16-64}} \right)$.
The empirical results are very similar if instead of assuming perfect substitution between private and public consumption we assume that the marginal rate of substitutions depends only on private consumption.

(0.01). As the results of GGLP for the United States, there is a strong co-movement between the inefficiency gap and the inverse wage mark-up, indicating that the countercyclical fluctuations in the latter are the main determinants of this gap.

5.   The production function approach

The estimation of the trend component presented in the preceding sections has the disadvantage that it does not include the information contained in various macroeconomic aggregates in relation to the technological capacities of the economy and the use of production factors. Decomposition by means of a production function is therefore appealing due to being a procedure which aims to incorporate these two elements explaining the evolution of the level of activity. This is precisely the approach used by most international institutions such as, for example, the OECD (see Giorno et al, 1995) and, more recently, the European Commission (see Denis et al, 2006) to estimate the cyclical and trend components of GDP.

In this section we propose a decomposition which is very similar to that used by the European Commission, with some small differences which are described below.

1.   *Estimation of total factor productivity based on a Cobb-Douglas production function*, which in logarithmic terms can be written as follows:

$$\ln Y_t = \ln A_t + \alpha \ln K_t + (1 - \alpha) \ln L_t \tag{6}$$

where Y represents the real GDP at market prices, L the total number of hours worked, K the capital stock and A the total factor productivity. As the European Commission, it has been assumed that the parameter value used to estimate is 0.37, very similar to the average of the share of capital income for the Spanish economy over recent decades.

2.   *Decomposition of total factor productivity (TFP)* in a trend component and another cyclical component using the HP filter with a smoothing parameter $\lambda = 10$:

$$\ln A_t = \overline{\ln A}_{hp,t} + \ln A^c_{hp,t} \tag{7}$$

Figure 8 shows the TFP growth rate, as well as its trend. At the beginning of the 1980s, the TFP grew at an average rate of 2 per cent, which gradually decreased until it stabilised in the mid-nineties at around 0.5 per cent, with a slight acceleration at the end of the sample.[8]

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[8]   A value of $\lambda = 10$ is within the range recommended by Baxter and King (1999) or Maravall and del Río (2001) for annual data, given that it is more in line with the results provided by a filter with a value $\lambda = 1600$ for quarterly data. On the other hand, in all decompositions of the annual variables, the European Commission uses

3.   *The structural unemployment rate* $(\overline{u}_t)$ *or NAIRU,* which is used to obtain the trend component of the total number of hours of work, is estimated as an unobservable component in the following Phillips curve:

$$\Delta^2 \ln W_t \;=\; \beta_1 + \beta_2 \Delta^2 \ln \left(\frac{Y_t}{L_t}\right) + \beta_3 \Delta^2 \ln TT_t + \beta_4 \Delta^2 \ln P_t^c + \beta_5 \Delta^2 \ln P_{t-1}^c +$$
$$\beta_{u0} \left(u_t - \overline{u}_t\right) + \beta_{u1} \left(u_{t-1} - \overline{u}_{t-1}\right) + \varepsilon_t^w \tag{8}$$

where W in the nominal wage, TT the terms of trade, P^c the consumer price deflator and ε_{wt} is i.i.d. as $N(0, \sigma_{\varepsilon w}^2)$ and the *NAIRU* is assumed to behave according to the following model:

$$\overline{u}_t \;=\; \gamma_{ut} + \overline{u}_{t-1} \tag{9}$$
$$\gamma_{ut} \;=\; \gamma_{ut-1} + \omega_{ut} \tag{10}$$

where ω_{ut} is i.i.d. as $N(0, \sigma_{\omega u}^2)$.[9] Figure 9 shows the unemployment rate and the estimated NAIRU. According to these estimations the increase in the structural unemployment rate took place fundamentally in the first half of the 1980s, remaining relatively constant until the end of the crisis at the beginning of the 1990s, when it began to decrease in a similar manner to the current unemployment rate, standing at 8.5 per cent in 2006. The European Commission uses a very similar estimation, although with some differences which should be mentioned. Firstly, the estimated Phillips curve includes the acceleration of the share of salaries in GDP (*ws*) as an explanatory variable. This acceleration can be broken down as follows:

$$\Delta^2 \ln ws_t = \Delta^2 \ln W_t - \Delta^2 \ln \left(\frac{Y_t}{L_t}\right) - \Delta^2 \ln P_t^c \tag{11}$$

so that it includes the dependent variable as a regressor, although imposing a restriction on its coefficient, which is equal to that of the acceleration of productivity and of prices, with a negative sign. Secondly, the NAIRU estimated by the European Commission is characterised by being, on average, below the observed unemployment rate; in other words, it gives rise to a cyclical component of the unemployment rate which has a positive average for the whole sample equal to 1.35 percentage points.

a smoothing parameter $\lambda = 100$. In order to avoid the problems associated to applying the HP filter at the end of the sample, all the variables to which the filter is applied have been extrapolated from 2010 onwards (the last year of the Stability Programme) using ARIMA models.

[9]   Estrada, Hernando and López-Salido (2002) analysed another alternative method for the estimation of the NAIRU.
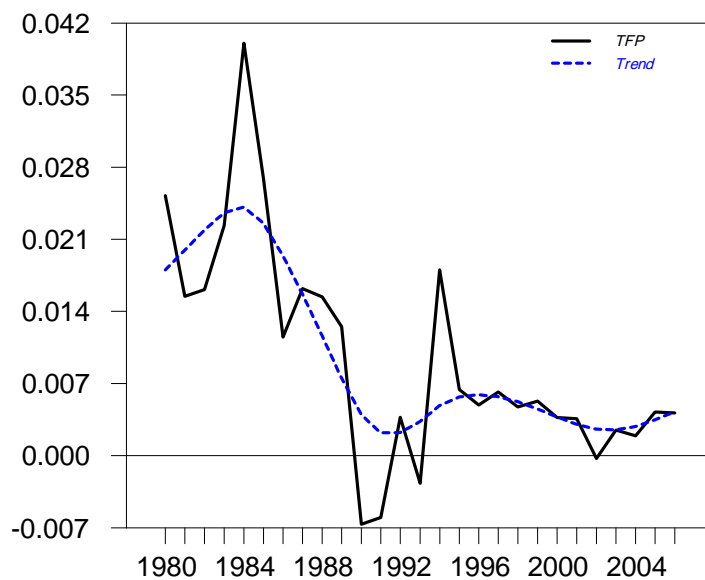
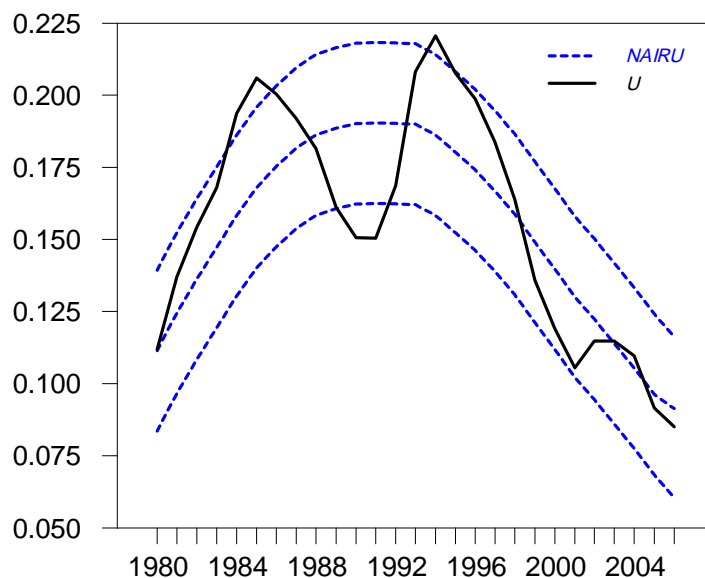**Figure 8:** *Rate of growth of TFP ($\Delta \ln A_t$) and its trend.*

Figure 9: *Unemployment rate and the NAIRU, with its confidence interval (80 per cent).*
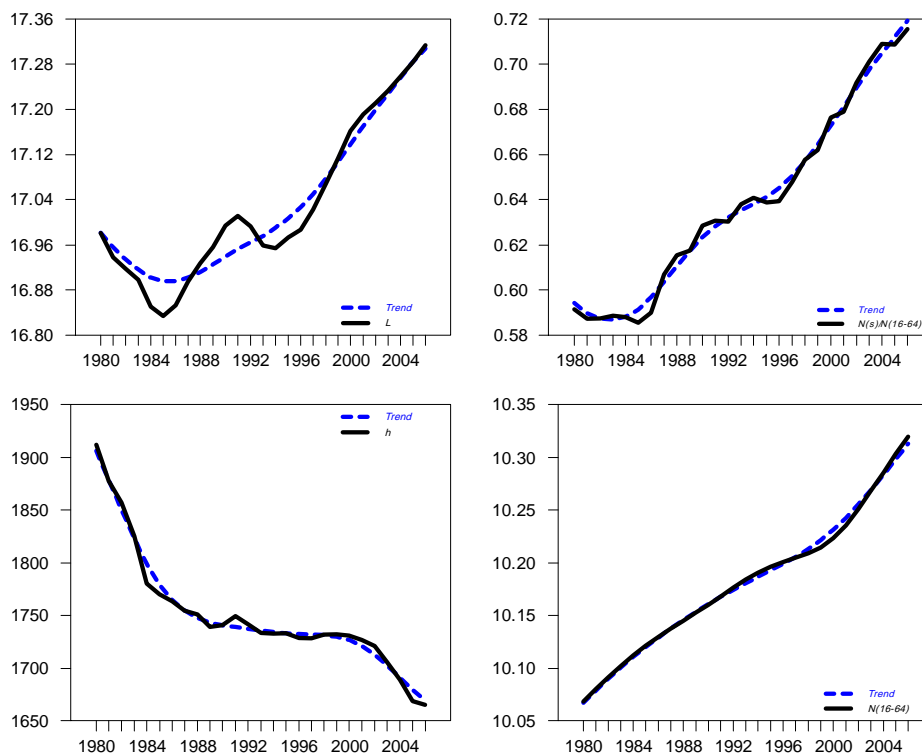
Figure 10: *Total number of hours (L), hours per worker (h), activity rate (N^s/N^{16-64}) and working-age population (N^{16-64}).*

This difference means that the finally estimated output gap has a negative average equal to -0.42 percentage points.

4. Once the NAIRU has been computed, *the estimation of the trend component of the number of hours worked* (L) is carried out, taking into account that this variable can be broken down as the product of the trend components of hours per worker (*h*), the employment rate ($1 - u$) and the activity rate (in other words, the ratio between active workers, N^s, and the working age population, N^{16-64}):

$$\overline{L}_t = \overline{h}_t(1 - \overline{u}_t)\frac{\overline{N}_t^s}{\overline{N}_t^{16-64}}\overline{N}_t^{16-64} \tag{12}$$

As in the case of total factor productivity, the trend components of hours per worker, the activity rate and the population aged between 16 and 64 are obtained by applying the HP filter with a smoothing parameter $\lambda = 10$. Figure 10 shows the evolution of the

total number of hours, hours per worker, the activity rate and the working age population, as well as their trend components. All the variables display an upward trend, except for hours per worker, thereby illustrating the dynamism of the employment market in Spain, particularly from the mid-1990s onwards. Between 1980 and 2006 the equivalent number of hours worked per worker went from 1900 to just above 1650. The extent to which this behaviour reflects the increase in the tax burden on labour incomes, as suggested by Prescott (2004), or a change in the preferences for leisure is open to debate. Another element which should be mentioned when analysing Figure 10 is that, unlike what happens with the number of hours per worker, the participation rate or the labour supply, which have limited volatility in their cyclical component, the total number of hours worked varies far more markedly with regard to its trend, which indicates the importance of the cyclical component of unemployment $(u_t - \overline{u}_t)$ when explaining the volatility of the labour input in the production function described above. In fact, the typical deviation of cyclical unemployment is 1.94%; not too far from the cyclical component of the total number of hours (2.46%), and the correlation between both variables is equal to -0.97 for the period 1965-2006.

5. Lastly, the trend component of GDP is estimated as follows:

$$\overline{\ln Y}_{fp,t} = \overline{\ln A_t} + \alpha \ln K_t + (1 - \alpha) \ln \left(\overline{h}_t (1 - \overline{u}_t) \frac{\overline{N}_t^s}{\overline{N}_t^{16-64}} \overline{N}_t^{16-64} \right) \tag{13}$$

so that, based on this estimation, the *output gap* (y_{fp}^c) is obtained as follows:

$$y_{fp,t}^c = \ln Y_t - \overline{\ln Y}_{fp,t} \tag{14}$$

Figure 11 shows the output gap estimated with the production function and with the HP filter ($\lambda = 50$), as well as the cyclical component of the unemployment rate, defined as the difference between the current unemployment rate and the NAIRU estimated with equations (8) to (10). As can be seen, the two estimations of the output gap provide virtually identical results. In fact, the correlation between these two variables is equal to 0.99. Another interesting result is that a large part of the cyclical behaviour of the output gap estimated with the production function is characterised by cyclical unemployment. In this case the correlation between both variables is equal to -0.96.

Another aspect which should be mentioned is that the volatility of the output gap estimated with the production function is very similar to that of the cyclical component estimated with the multivariate model for unobservable components described previously, which reinforces the robustness of the results obtained with these methods.
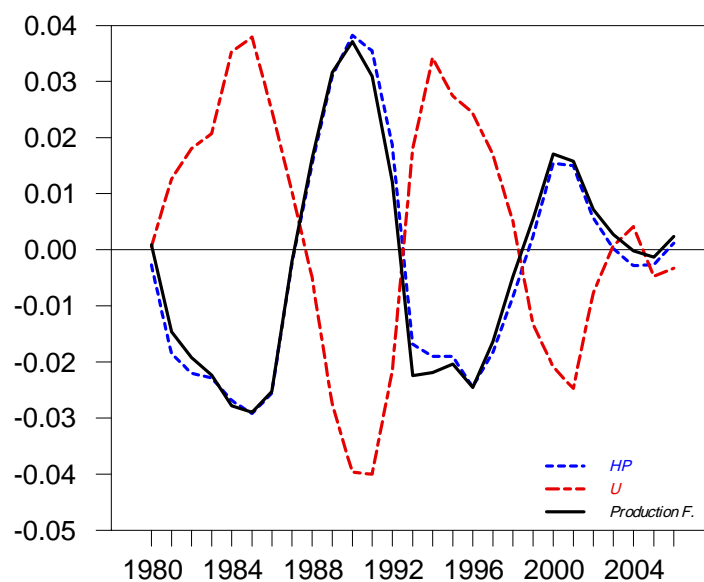
Figure 11: *Output gap estimated with the production function approach and with the HP filter ($\lambda = 50$), and the cyclical component of the unemployment rate.*

6. Economic policy implications

The output gap is a variable that economists give a great and important role to when evaluating economic policy. Its appeal stems from its capacity to synthesize the exact position of the cycle in which the economy is.

Its usefulness when guiding the actions of policy makers is questioned by the unobservable nature of this variable and by the wide range of methods which are used to estimate it. The above sections have presented the results of the estimation of the output gap in the Spanish economy which are obtained by using the usual methods in the literature. It is important to emphasize that, despite the diversity of methods used, the results obtained are in fact very similar, which helps to minimise possible criticism. Often, when disparate results for the same economy are obtained, the reasons can be found in the divergence of basic data and/or necessary predictions. When the various methods are applied to a common database, the discrepancies obtained are reduced, thereby making the output gap an important key variable when diagnosing an economy and indicating the necessary direction of the economic policies to be implemented.

Possible errors in the measurement of the output gap and its impact when correctly approaching economic stabilising policies is another of the major criticisms pointed out by the literature in this field. The advantages of designing economic policies which stabilise

changes in the output gap (known as *speed limit policies*) are well known and are precisely conditioned by the measurement error in the estimation of the output gap, as indicated by Walsh (2003).

This consideration gives special importance to the estimations of confidence intervals undertaken in the previous sections and, on the basis of these results, some conclusions can be drawn for Spanish stabilising economic policies. In Figure 3 it can be seen how, in the period observed, two periods are detected in which the output gap is significantly lower than zero. In addition, at the peak of the expansion cycles, at the end of the 1980s and 1990s, statistically significant observations of the output gap are obtained. Almost identical considerations can be made by observing, in Figure 9, the periods in which the unemployment rate is situated outside the estimated confidence intervals for the NAIRU.

Budgetary stability policy in Spain has recently been redesigned in order to reinforce its stabilising nature with the establishment of a rule which gives the fiscal policy a counter-cyclical nature. The so-called automatic stabilisers already act in this way, so that a fiscal policy designed to enable these stabilisers to operate freely is acting along the right lines. There is an interesting debate when evaluating the appropriateness of the fiscal authorities doing more than merely allowing the stabilisers to work (a passive policy) or promoting discretionary counter-cyclical measures (an active policy), as discussed by Sebastián, González-Calbet and Pérez-Quirós (2004). Compliance with fiscal rules, as has been designed in Spain following the modification of the Budgetary Stability Acts, allows either of the two strategies to be undertaken or, put another way, leaves the choice of whether or not to use of an active policy up to the authorities, through discretionary actions.

The output gap in the Spanish economy has been significantly different from zero in very few periods of its recent history. This result leads us to recommend that fiscal policies should be particularly active only at times when the economy registers a growth rate significantly different from that estimated for its trend component, as shown in Figure 2. In other words, in periods in which the first difference of the output gap is highest in absolute terms.[10] As has been seen in the previous sections, these times, which are relatively scarce, are fairly well estimated with the information available at any particular time.

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[10]   Taking into account that $y_t^c = \ln Y_t - \overline{\ln Y}_t$, the first difference of the output gap is equal to

$$\Delta y_t^c = \Delta \ln Y_t - \Delta \overline{\ln Y}_t.$$

For this reason, the so-called *speed limit policies* act on the deviations of the growth rate in relation to that of potential GDP.

This recommendation could be also extended to other periods when the membership of a monetary union is considered. In the framework of a monetary union, when the size of a particular country such as Spain is not crucial for monetary policy, countries may encounter interest rates or exchange rates that do not contribute to their macroeconomic stability. This is an additional argument in favour of increased fiscal policy activism, in cases where offsetting actions are required. Between 2003 and 2005, the policy of the ECB was relatively lax for the interests of the Spanish economy, favouring the persistence of positive inflation differentials, leading to many voices demanding Spanish fiscal policy to be tightened. The Spanish economy, at the end of the first half of 2007, has been characterised by an acceleration of GDP that has resulted in an output gap which has gone from being slightly negative to slightly positive, although not significantly different from zero. Furthermore, monetary policy has been hardened since 2006. From a strict stabilisation perspective, the exercise of neutral fiscal policy for this period could therefore be recommended, thereby leaving the automatic stabilisers to act freely.

7. Conclusions

An accurately estimation of the cyclical position of an economy is a necessary condition for the success of fiscal stabilisation policies. In fact, the fiscal rule which is currently applicable to the Spanish economy gives potential output a predominant role.

In this paper, the most relevant methodologies have been applied in order to calculate the potential output and the output gap in the case of the Spanish economy. Attention has been paid to the direct indicators of the cyclical position and different estimation techniques have then been applied, whether these are univariate filters and multivariate methods which make use of economic theory or production function methods, which is the methodology adopted by the European Commission to evaluate the fiscal policies of member countries using a common approach.

A recurring criticism when questioning the analytical value of these decompositions, points out the high level of uncertainty which surrounds their estimation. For this reason, this paper, in addition to providing the estimations of the different methods, also proposes the estimation of confidence intervals. It has thus been verified that when applying multivariate methods, the uncertainty associated to the estimation of the output gap can be reduced. In addition, the estimation of the production function developed herein displays similar volatility to that under the multivariate methods, reinforcing the robustness of these methods.

The application of the methods proposed in this paper to a common database provides very similar results, which allow us to conclude that the results are relatively robust. When the results obtained with two of the most popular methods are analysed, such as

the production function approach and HP filter, the results are seen to be practically identical and that their information on the business cycle is virtually explained by the cyclical component of unemployment.

The evolution of the cyclical position of the Spanish economy since 1980 obtained in this paper does not differ from that offered by previous papers, but the effort made when evaluating the degree of uncertainty of the various estimations allows us to conclude that the periods in which the economy was clearly in deep recession or intense expansions are limited and of relatively short duration. Fiscal policy should pay particular attention to these episodes, as they are when discretionary stabilisation policies make most sense.

8.   Appendix. Data and statistical sources

As has been seen throughout the main text, the database of this document includes both quarterly (sections 2, 3 and 4) and annual (section 5) macroeconomic variables. Furthermore, as has already been mentioned, when quarterly series are used their cyclical/trend signal is usually taken into account, excluding their most erratic components.

In general, when it has been necessary to link variables due to base year or methodological changes, the reference has always been the annual series, as they are considered to be more statistically reliable. In order to generate consistent quarterly variables the Denton procedure has thus been applied to the linked annual series, with the quarterly series prior to the base year or methodological change for each series. Only subsequently have the corresponding filters been applied in order to eliminate the short-term irregular component.

The details of the production of each of the variables are thus as follows:

1.   GDP in real terms (Source: INE (National Statistics Institute)). This variable has been available on an annual basis since 1964. Since 1995 it has been obtained from the GDP volume index with base year 2000, which is produced as part of the National Accounts. Prior to that date it was linked to the GDP variation rates in real terms of the National Accounts base years 1995 and 1986. Real GDP has been available on a quarterly basis since 1980. Since 1995 it has coincided with the series adjusted for seasonality and calendar effects of the quarterly GDP volume index of the base year 2000 and prior to that date the quarterly series of real GDP adjusted for seasonality and calendar effects with base year 1995 was used as an interpolation indicator.

2.   Economic Sentiment Indicator (Source: European Commission).This quarterly variable has been taken from the Eurostat database in its seasonally-adjusted version since 1987 and is linked to the industry confidence series produced by the Ministry of Industry, Trade and Tourism (adjusted for seasonality) up to 1980.

3. Industrial capacity utilisation (Source: European Commission). As in the previous case, this quarterly series has been taken from the Eurostat database in its seasonally-adjusted version since 1987 and is linked to the same series from the MOISEES database (1990) up to 1980, interpolated on a quarterly basis to the real added value of the industrial branches, adjusted for seasonality and calendar effects, of the National Accounts with base year 1995.

4. Unemployment rate (Source: INE). Obtaining the unemployment rate is somewhat more complicated, as since 1964 the Labour Force Survey (EPA) has undergone many methodological and sampling changes in order to adapt it to the social reality and to make it internationally comparable. Two variables were thus linked in the different base years of the EPA: the number of employed and unemployed people, the unemployment rate subsequently being obtained as the ratio between the number of unemployed people and the sum of this number and those in work (active population). The links make extensive use of all the work undertaken by the INE to solve any breaks in the series. Specifically, the EPA survey of the first quarter of 2005 and the link of the unemployment associated with the change in its operational definition in 2002 should be mentioned. Lastly, from 1976 to 1964, the García-Perea and Gómez links (1994) were used.

5. Investment rate (Source: INE). Constructed in both nominal and real terms, as the ratio between gross fixed capital formation and GDP. Gross fixed capital formation is obtained from the same sources as GDP and is constructed in the same way.

6. Net lending(+)/net borrowing(-) of the nation as a percentage of GDP (Source: INE). This variable has been available since 1995 with base year 2000 in the National Accounts. Prior to that date it was linked to the base years 1986 and 1980. It has also been available on a quarterly basis from that same date, but is not adjusted for seasonality and calendar effects. For this reason, the annual series provided by the INE have been interpolated from 1980 using the seasonally adjusted difference between exports and imports of goods and services as an indicator. The denominator of this ratio is nominal GDP, which is generated in the same way as real GDP described above.

7. Corporate income tax over GDP (Source: INE). As in the previous case, since 1999 the direct taxes paid by non-financial companies and financial institutions have been available with base year 2000 of the National Accounts. Prior to that date it was linked to the 1995, 1986 and 1980 base years. It has also been available quarterly since 1999, but, again, without being adjusted for seasonality and calendar effects. An interpolation was therefore carried out for the annual series from 1980 using the corporate income taxes in terms of cash provided by the IGAE (State Public Accounts Depart-

ment) as an indicator. The denominator of this ratio is nominal GDP.

8. Inflation rate (Source: INE). The inflation rate is defined as the year-on-year growth of the CPI. Since 2002 this series has been taken from the INE and prior to that date the linked series published by the bank of Spain were used. It should be mentioned that the seasonality adjustment of this variable uses different ARIMA models before and after 2002, in order to adequately correct the introduction of the decreases from this date onwards.

9. Core inflation rate (Source: INE). The core inflation rate excludes the variation in the prices of energy and non-processed foods from the inflation rate. It is seasonally adjusted as detailed above.

10. Population aged between 16 and 64 (Source: INE). Total population is taken from the different base years of the National Accounts. When data from the National Accounts no longer exist, the growth rates provided by the EPA are used. The information for each age group included in this survey is that which enables the population aged between 16 and 64 to be estimated consistent with the National Accounts data.

11. Total and productive capital stock (Source: produced by the authors). The capital stock is obtained using the permanent inventory method with the series for private, public and residential gross production capital formation. The initial conditions for the application of this method are constructed as in de la Fuente and Doménech (2006), adjusted for PPP, and the rates of depreciation, variable over time, are the same as in Kamps (2006).

12. Total employment (Source: INE). Total employment is measured as the number of people in work in the economy, taken from the different base years of the National Accounts and linked to the variation rates of common years.

13. Hours per employed person (Source: INE, AMECO and the Groningen Institute). The product of the hours per employed person multiplied by the number of people employed constitutes our measurement of labour input. Since 1995 this variable has been taken from the National Accounts with base year 2000. This series is extended to 1970 by using the information contained in the AMECO database of the European Commission and, lastly, up to 1964 use is made of the estimations provided by the Groningen Institute, as part of the standardisation of historical series of National Accounts for European countries.

14. Real terms of Trade (Source: AMECO). Obtained from the ratio between the private consumption deflator and the GDP deflator. It therefore details the evolution of import prices in comparison with domestic prices.

15. Real private and public consumption and real wages (Source: Boscá et al., 2007).

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