Economics Department

Dating and Forecasting the Spanish Business Cycle

HUMBERTO LÓPEZ, EVA ORTEGA
and
ANGEL UBIDE

ECO No. 97/5

EUI WORKING PAPERS

EUROPEAN UNIVERSITY INSTITUTE

EUROPEAN UNIVERSITY INSTITUTE, FLORENCE

ECONOMICS DEPARTMENT

EUI Working Paper ECO No. 97/5

Dating and Forecasting the Spanish Business Cycle

HUMBERTO LÓPEZ, EVA ORTEGA
and
ANGEL UBIDE

BADIA FIESOLANA, SAN DOMENICO (FI)

Printed in Italy in March 1997
European University Institute
Badia Fiesolana
I – 50016 San Domenico (FI)
Italy

Dating and Forecasting the Spanish Business Cycle

Humberto López *
World Bank

Eva Ortega
European University Institute
and
Angel Ubide
International Monetary Fund

Abstract

This paper constructs a composite index of coincident economic indicators (CEI), which tracks the state of the Spanish economy better than real GDP, and provides a rigorous dating of the Spanish business cycle turning points. Four different composite leading indicators of the Spanish business cycle are suggested for forecasting the CEI. We find that the main forces underlying the overall state of the economy are consumer expectations and unemployment, while the production side of the economy contributes less. Our proposed composite leading indicators are able to predict the recovery of the Spanish economy which started at the end of 1994 as well as the slowdown that followed afterwards.

Keywords: Business Cycles, Coincident Indicators, Leading Indicators, Forecasting.

JEL Classification Nos.: E32, E37, C53.

*We have benefitted from the comments of Fabio Canova, Jeffrey Franks, Zenon Kontolemis and participants of the 1996 ASSET Meeting held in Alicante, Spain. All remaining errors are ours. Please send any comment or suggestion to: Eva Ortega Department of Economics, European University Institute, I-50016 San Domenico di Fiesole (FI), Italy. E-mail: ortega@datacomm.iue.it

1 Introduction

The recurrence of peaks and troughs in economic activity is a stylized fact that has attracted the attention of the economics profession for several decades. Investment decisions and government policies require knowledge of the state of the economy in the medium to long run: in particular, whether there will be a slowdown or an expansion in economic activity. Therefore, special attention is given to constructing an accurate estimator of the state of the economy that can be used to forecast the broad-based swings in economic activity known as the business cycle. The series which is typically used as a measure of the state of the economy is the GDP. Burns and Mitchell (1946), Lucas (1977) and Stock and Watson (1989, 1993), among others, argue that the evolution of other macrovariables than GDP reflects the general state of the economy. The idea underlying an index of coincident economic indicators (CEI) is to utilize a combination of several macrovariables to estimate the unobserved common element in the fluctuations of multiple observed aggregate time series. The evolution of the CEI would reflect the evolution of the underlying state of the economy, and could be used as a basis to predict its future performance.

This paper builds an index of coincident monthly economic indicators for the last complete cycle of the Spanish economy and proposes alternative composite leading economic indicators (LEI) to forecast the future evolution of the Spanish economy. These LEI combine the information provided by a selected set of individual leading monthly economic indicators in various ways.

In order to evaluate how good our CEI is as an indicator of the Spanish business cycle, we need to have a tentative dating of peaks and troughs as a reference. To the best of our knowledge, there is no official or generally agreed business cycle chronology for the Spanish economy or an official CEI that can be taken as the reference series to be dated. Therefore, as a first step we follow in section 2 the general practice and consider the real GDP a sufficient summary of the aggregate economy to be used as an initial reference. We have dated turning points in real GDP following simple decision rules standard in the existing literature, as explained in Artis et al.(1995, 1996). According to the dates of turning points we found, the more recent complete cycle of the Spanish economy, including both a peak-to-peak cycle and a trough-to-trough cycle, spans over the period 1980Q1-1993Q2.

However, as argued before, the GDP may miss some relevant information for the measurement of the state of the Spanish economy. In Section 3 we construct a composite index of coincident economic indicators which tracks closely GDP, but includes a variety of other key aspects of the economy. We want to capture both the supply and the demand sides of the goods and services and labor markets. Economic justification and graphical inspection of the series are used as initial selection criteria. We use cointegration analysis to find the common element in the evolution of the selected individual coincident indicators and estimate their common trend. This common trend is taken as the CEI, the estimator

we propose to measure the state of the Spanish economy. We show that it does a better job than the GDP in capturing the turning point for the last recession, and propose the dating of the turning points of the CEI as an improved chronology of the Spanish business cycle.

Once identified the underlying state of the economy, the last step is to forecast the future evolution of the Spanish economy (Section 4). For this purpose, we identify a number of leading economic indicators that provide useful information to forecast the future values of the CEI. We construct alternative composite leading economic indicators (LEI) in three different ways and find them very informative for improving the forecasts of how the Spanish economy is going to evolve in the medium to long run. We evaluate their relative performance in terms of how well they predicted the evolution of the CEI over the whole sample period, and also their ability to predict business cycle turning points.

Section 5 summarizes the main results and presents our conclusions.

2 A Business Cycle Chronology for Spain

As we have mentioned before, there is no official or generally agreed business cycle chronology for the Spanish economy . Hence, in this section we will determine the chronology of the Spanish business cycle on the basis of the evolution of real GDP. This dating will be compared later with the one obtained with our computed CEI.

Figure 1 shows real Spanish quarterly GDP for the maximum period of available data, 1970Q1-1995Q2.

In dating of the Spanish real GDP cycle, we have followed a set of simple rules that are commonly found in the literature. In particular, we follow Artis et al.(1995) to define the following rules: (i) alternancy: peaks (troughs) only follow troughs (peaks), (ii) each regime, either expansion (trough to peak) or recession (peak to trough), has a minimum duration of 3 quarters, (iii) a turning point is the most extreme value, in levels, between two adjacent regimes (expansion or recession), (iv) if there is more than one extreme value within a regime, the most recent is chosen as the turning point of the regime. In order to avoid identifying very short upswings or downswings as recoveries or recessions, two additional rules are commonly applied requiring (v) a minimum duration of cycles (peak-to-peak or trough-to-trough) and (vi) a minimum amplitude (in terms of percentage change in the level of real GDP) of expansions and recessions.

Table 1 displays the dates of the peaks and troughs identified with the above rules. It also summarizes the information of the different phases, peak-to-trough (P-T) or trough-to-peak (T-P), in terms of duration in quarters and amplitude in percentage change of the real GDP level between two turning points. The first column in Table 1 refers to a preliminary dating of the real GDP turning points obtained using rules (i) to (iv). If we define the minimum duration of cycles rule (v) by requiring cycles to last more than

Table 1: Chronology of the Spanish Real GDP cycle

Dating	Duration in quarters	(with min.duration of cycle 6Q)	Amplitude % change	(with min.change per regime of ‖0.5%‖)
Peak/Trough	T-P/P-T	T-P/P-T	T-P/P-T	T-P/P-T
74Q4 / 75Q2	/3	/3	31.5/-0.6	31.5/-0.6
78Q3/79Q2	13/*3*		8.4/*-0.42*	
80Q1/81Q1	*3*/4	19/4	1.9/-0.58	10.01/-0.58
92Q1/93Q2	44/5	44/5	39.5/-1.6	39.5/-1.6

6 quarters, the period 1979Q2-1981Q1 is not classified as a cycle, hence, rule (iv) leads to reject 1978Q3 as a peak in favor of the later one at 1980Q1. We also define a limit to the minimum amplitude of regimes rule (vi) by requiring recessions and recoveries to represent at least a 0.5% change in the level of GDP[1]. This implies that the downswing (peak-to-trough) between 1978Q3 and 1979Q2 is not classified as a recession and the final dating coincides with that obtained before. The selected turning points are highlighted in Table 1 as well as displayed in Figure 1.

Our results are consistent with the finding of Artis et al.(1996) that Spain exhibits very few business cycles when dating the reference series in levels ("classical business cycles"), compared to other OECD and European countries during the period 1961-1993. We have found that the last complete real GDP cycle in Spain, including both a peak-to-peak cycle and a trough-to-trough cycle, spans over the period 1980Q1-1993Q2. With real GDP data up to 1995Q2, our chronology procedure cannot as yet identify an end for the recovery that started at 1993Q2. Instead, by mid 1995 there was a clear perception in the Spanish society and among economic analysts that the recovery was over.

3 A Composite Index of Coincident Indicators

This section constructs an estimator of the state of the economy alternative to the real GDP. The technique followed is to construct a composite index of coincident economic indicators (CEI) by combining several macrovariables to estimate an unobserved series which captures the common element in the fluctuations of multiple aggregate time series, i.e. the state of the economy. The evolution of the CEI provides a sense of the evolution of the state of the economy, and a basis for predicting its future performance.

[1]Note that we are studying the real GDP series in levels i.e. a trending series, hence a drop of 0.5% over a certain period is not such a small change.

Ideally, to capture the underlying evolution of the real economy, the components of the CEI should provide information about the supply and demand sides of goods and services and labor markets. This is particularly important in the case of Spain, where the behavior of the aggregate labor variables (in particular, the persistence of high unemployment levels) has been a serious constraint for the evolution of the whole economy in the last years.

Rather than using many different variables to build the CEI, it is important to select few series that provide complementary information so that we avoid the pressure of too much idiosyncratic noise in the estimator of the general state of the economy. Because the selected variables should be sensitive to changes in the economic conditions, we look for high frequency series (i.e. monthly).

In order to maximize the forecasting ability of the CEI, it is also important that the selection of the CEI components is based on the recent periods since the set of variables containing the most information can change over sufficiently large periods of time[2]. On the other hand, the sample size used should not be too short in order to avoid a high dependence of the CEI on temporary events, and more importantly, in order to exploit the information of how each individual series captured past turning points. For these reasons, we make use of the business cycle chronology derived in Section 2 and choose a period for which data is available for all the selected series. The resulting selected period for our study is 1977M6-1994M10 which includes the last complete cycle of real GDP, i.e. 1980Q1-1993Q2 (including both a peak-to-peak cycle and a trough-to-trough cycle).

With the constraints imposed by the above requirements in terms of number, frequency and time period of the selected variables, we apply economic and statistical criteria to a number of series to select the potentially best indicators for the overall state of the Spanish economy.

We have explored series covering different aspects of the aggregate economy. The final set of individual coincident indicators was selected using two basic criteria. Firstly, the individual indicators should represent complementary aspects of the economy, so that e.g. a particular sector of the economy would not be over or under-represented. Secondly, they should be "coincident", in the sense that they should display a common evolution, e.g. a common trend. We have selected three individual coincident economic indicators for the Spanish economy: industrial production index (IP), department stores retail sales index (RS) and unemployment, to represent production, demand and the labor market[3].

[2]In other words, the general evolution of the economy may be driven by different variables over different periods of time. For example, Stock and Watson (1993) found that the indexes of coincident and leading economic indicators, CEI and LEI respectively, proposed in Stock and Watson (1989) for the US economy failed to predict the 1990 recession mainly because the set of best individual coincident and leading economic indicators had changed.

[3]A more rigorous theoretical justification for the selection of these series, based on an insider-outsider model, can be found in López, Ortega and Ubide (1996).

The production side of the economy is typically represented by the monthly IP. We have chosen to represent the demand side with the department stores retail sales index for several reasons. Firstly, it is one of the few monthly indicators of consumers' demand; secondly, it provides information about the services sector while the IP only refers to industry, and finally, it can capture a very important explanatory variable for business cycle fluctuations namely consumers' unobserved expectations. A simple candidate to represent the labor market content of the underlying state of the economy is the unemployment series. Figure 2 plots each of the three series. All variables are defined in real terms, seasonally adjusted monthly indexes (base 100 the first observation, 1977M6) and in logs. Data description and sources are provided in the Appendix.

Figure 2 reveals that while retail sales and industrial production have followed a similar trend over time, unemployment has grown at a much faster rate than the other two variables (350% change over the whole period compared to 55% and 30% respectively)[4]. Notice, however, that until 1988 unemployment seems to have followed a linear upwards trend, which has been identified in the literature with job destruction in agriculture and labor supply issues such as the stop in the flow of migrants towards other European countries in the mid 70s, the huge increase in female participation rate during the 80s and the arrival of the baby boom generation which reached the working age over the late 70s and 80s (see López, Ortega and Ubide (1996) and references therein).

Unit root analysis of the series reveals that while first differences of retail sales and industrial production are found stationary around a constant, the first difference of unemployment is found stationary around a linear time trend. Hence, we have transformed the unemployment series by detrending the first difference of the log of unemployment and then integrating the detrended series using as a starting condition the first value of the original series. In doing so we extract from the series the component that may be due to the above mentioned factors and construct a series of *virtual* unemployment (see López, Ortega and Ubide (1996) for a detailed explanation and interpretation)[5].

Figure 3 plots *virtual* unemployment together with industrial production, retail sales and GDP[6]. We can see that the *virtual* unemployment shows the usual mirror image with respect to production and consumer demand, an image that the actual unemployment series did not show (Figure 2). In what follows, all the analysis will be done with the *virtual* unemployment series, and for simplicity we will refer to it as unemployment (UN).

[4]We also explored other labor series like the number of labor contracts registered or the number of persons who found a job, but they were either less related to the evolution of the rest of the economy or displayed a similar picture to the unemployment series.

[5]We have transformed the unemployment series in this way because we believe that the deterministic component is not likely to arise again in the future with the same intensity, once modernization in agriculture and normalization in the labor market occurs. Therefore, we think that the *virtual* unemployment series reveal the true "structural" state of unemployment.

[6]Since GDP is only available on a quarterly or yearly basis, the GDP series displayed is a step function in which each value is fixed for a whole quarter.

The joint plot of the three series with GDP shows how the selected indicators share with real GDP a common underlying driving force, the unobserved series we wish to estimate to measure the state of the economy . Until 1985 there is slow GDP growth, matched by slow IP and retail sales growth, and stable (slowly decreasing at the end) unemployment levels. Retail sales even decreases in the initial periods, but we have to take into account that those were the periods of highest inflation and RS is defined in real terms. Then we can observe a period of continuous and steep improvement of all series (the sharp decrease in unemployment appears with a certain delay) until the peak in GDP in 1992Q1, which coincides with the peak in RS, while the peak in IP occurs half a year before and the UN changes trend only some months later. Since then, a slowdown is present in all series. GDP starts its recovery phase after the trough in 1993Q2. However, industrial activity (reflecting investment recovery) had started growing before the end of 1992, unemployment stopped growing only at the beginning of 1994, and the turning point had not been reached yet by the retail sales index at the end of 1994. The different but coordinated behavior of IP, RS and UN in capturing this recent change in the business cycle points out the complementary information they provide about the common underlying state of the economy. Moreover, it can be the case that at certain periods of time the additional information they represent, with respect to GDP, suggests a somehow different state of the economy. In fact, by the end of 1994 real GDP had been growing for a year and IP even for longer (suggesting a similarly optimistic state of the economy), whereas unemployment had stopped growing for a shorter period (suggesting a view of the economy not so optimistic) and retail series had not yet started to increase clearly (even less optimistic).

In order to give formal content to the analysis, we have also tested statistically the common evolution of the three individual coincident indicators -IP, RS and UN- using cointegration analysis. Following Johansen (1991), and Johansen and Juselius (1990), we obtain two cointegrating vectors among our three coincident indicators

$$IP_t = -.467\ UN_t \tag{1}$$

$$RS_t = .99\ IP_t - .31\ UN_t \tag{2}$$

The first cointegrating vector captures the stable long-run negative relationship between economic activity and unemployment (Okun Law). The second one highlights several important facts. Firstly, the coefficient of the IP captures the positive income elasticity of consumption. Secondly, the relatively bigger elasticity to IP than to unemployment suggests that production levels drive consumer demand in Spain, although the expectation of having a stable labor income (the higher the lower the unemployment) has a sizable effect. The last recession is paradigmatic in this sense: despite a rapid recovery on the production side of the economy (as indicated by IP), household consumption did not recover as robustly due to continuing high unemployment and low consumer confidence.

The existence of two stationary relationships between the three non-stationary variables leaves room for only one non-stationary relationship that drives the non-stationarity of all three: a single common trend, which will be our Index of Coincident Economic Indicators.

3.1 The Coincident Indicator Model

The statistical model we propose is a version of the single-index models discussed by Sargent and Sims (1977) in which the single unobserved index is common to the variables. Stock and Watson (1988) develop a probability model for extracting a common component from a set of series as follows. Let X_t be the vector containing the n series that we want to include in our index. We assume that these series are driven by a common underlying component, our composite index CEI_t, and an additional idiosyncratic component that includes the individual behavior of each series plus measurement errors, u_t. Both components are modeled as stochastic linear structures of the type:

$$X_t = \mu + \theta CEI_t + u_t \tag{3}$$

According to the above formulation, CEI_t is defined as a coincident index since it enters contemporaneously in all the equations, although with different weights.

In the construction of indexes of coincident and leading economic indicators for the U.S. economy, Stock and Watson (1989, 1993) do not find cointegration among the variables they select. Hence they specify their coincident indicator model in terms of stationary transformations of the variables (first differences in their case) and estimate with the Kalman filter the unobserved common state of the economy, which is defined as a stationary one. Constructed with the information contained in the covariance matrix of the stationary series, their CEI captures the short-run comovements of the coincident variables, but not a long-run shared growth pattern, limiting the ability of the CEI to predict future states of the economy to short run forecasts.

Instead, we have found three coincident indicators of the Spanish economy that are cointegrated and share a common stochastic trend. In contrast to Stock and Watson (1989, 1993), our CEI captures the joint evolution in the long run of the individual coincident indicators, hence it has the potential to forecast the state of the Spanish economy beyond the short run, provided that the causal relationship remains stable.

The approach we follow is based on Kasa (1992). He defines the common trend as

$$ct_t = (\beta_\perp' \beta_\perp)^{-1} \beta_\perp' X_t \tag{4}$$

where $(\beta_\perp' \beta_\perp)^{-1} \beta_\perp'$ are the 'weights' of each series into the common trend ct_t and $\beta_\perp$ is a 3x1 vector that represents the loading factors (i.e. a scale measuring the relative importance of the trend for each series). Application of this methodology to the cointegration relations of our three coincident indicators yields the estimates displayed in Table 3.

Table 2: Common Trend Estimates

	IP	RS	UN
weights	1.9471	3.2268	-4.1738
loading factors	0.0616	0.102	-0.132

Thus, our index of coincident economic indicators is defined as follows:

$$CEI_t = 1.95\ IP_t + 3.23\ RS_t - 4.17\ UN_t \tag{5}$$

3.2 Evaluation of the CEI

As noted earlier, the components of our proposed index of coincident indicators contain the information about the evolution of the state of the economy found in the GDP. However, they indicate a somehow different picture of the economy than GDP does in certain periods. We would like our CEI to reflect the additional sources of relevant information without losing the information about the state of the economy contained in the GDP.

But we would also like the CEI to summarize the information contained in its individual components in such a way that discrepancies to the picture given by GDP are due to a more realistic description of the Spanish economy. In particular, comparing the individual components to GDP in figure 3 we observed that by the end of 1994 the GDP was indicating a stable recovery, and even more the IP series, whereas unemployment and retail sales indicated a less optimistic view of the economy. Economy analysts, business opinion surveys, and other indicators of confidence at that time coincided in casting some doubts about the intensity and duration of the upward tendency of GDP. As it turned out to be, the Spanish economy entered an expansion period, but not as intense as suggested by the evolution of GDP since mid-1993. A better estimator of the state of the Spanish economy at the end of 1994 would have indicated a slower and less intensive recovery than indicated by the GDP (reflecting the less optimistic picture given by unemployment and retail sales), and hence would have been a more adequate candidate to estimate the state of the economy.

Figure 4 shows the parallel evolution of GDP and the CEI until 1988, when a period of *inflated expectations* driven mainly by the decrease in unemployment partly due to the 1992 Olympic Games and the World Fair, and the exaggerated fall of the CEI after 1992 due to *too pessimistic expectations* and the unstable political climate that followed.

Table 2 contains the relative weight each of the individual indicators has on our proposed estimator of the state of the Spanish economy. The basic message is that the underlying state of the Spanish economy, as estimated with our CEI, is more than twice (one and a half times) as responsive to changes in unemployment (retail sales) than to

changes in industrial production. UN and RS have a higher weight in the common trend than the IP, and hence analyses of the economic situation based only on the evolution of GDP may miss crucial information to understand the economic climate, as the recent recession has shown.

In sum, our CEI satisfies the two properties we were looking for in an improved estimator of the Spanish state of the economy with respect to the GDP. First, it contains the same information provided by the latter and, second, it contains further relevant information in such a way that, in cases of divergence between the CEI and the GDP, it is the former who gives a better picture of the economy. Hence, the CEI is the adequate series to look at if we want to forecast the future evolution of the economy.

3.3 An improved chronology of the Spanish business cycle

Because the estimated CEI provides an improved picture of the state of the Spanish economy with respect to GDP, it is the turning points of the CEI that we suggest as the chronology of the Spanish business cycle.

Table 3 shows the chronology obtained applying the same rules described in Section 2 to our composite index of coincident economic indicators, CEI. In particular, we have applied the rules for dating turning points to the centered 13-month moving average of the CEI. The moving average reduces the risk of misleading information of a peak or a trough coming from an outlier. For comparison, table 3 includes the dating of real GDP turning points for the same period (1977Q2–1994Q4).

Table 3: An Improved Chronology of the Spanish Business Cycle. Turning Points of the CEI

CEI Turning Points	Duration in months	Amplitude % change	Real GDP turning points
Peak/Trough	T-P/P-T	T-P/P-T	Peak/Trough
77M8/79M4	/20	/-20.29	
81M4/83M4	24/24	6.57/-3.47	80Q1/81Q1
91M5/94M9	97/40	91.24/-24.49	92Q1/93Q2

Notice that the CEI has a trough suggesting the end of the last recession in September 1994, more than a year later than what the turning points of GDP indicates.

4 Forecasting the Spanish Business Cycle

How to accurately forecast future upswings and downswings of the economy is an old problem to which economists have provided multiple solutions. Once one has a single series with which to estimate the current state of the economy (the estimated CEI), the forecasting exercise can be conducted essentially in two ways. One is to exploit the information contained in the past evolution of the single CEI series (univariate forecast using e.g. ARIMA methodology) or in the past evolution of the multivariate system from which the CEI has been obtained (multivariate forecast using e.g. VAR models). The other possibility is to use the information provided by series other than the CEI or its underlying multivariate system, whose evolution in a certain period is found to be a good forecast of the state of the economy some periods ahead. Those series are known as *leading economic indicators.*

In this paper we follow the second approach and suggest alternative composite indexes of leading economic indicators for the state of the Spanish economy. Because there is no consensus in the literature about how to construct the ideal leading indicator, we will follow three different procedures.

One approach is to construct one leading series aimed to forecast comprehensively the CEI. This series would possibly include different series which lead the CEI with a different number of periods, in order to incorporate information from different time horizons. In our case, we can implement this approach in two different ways: either finding separate leading indicators for each of the individual coincident indicators which compose the CEI and then combining them with the same weights used in the construction of the CEI (leading indicator LEI1), or directly finding a leading indicator for the CEI (leading indicator LEI2).

An alternative approach is to construct separate leading indicators for the short and long run (leading indicators SLEI3 and LLEI3, respectively), arguing that these separate indicators would predict more accurately the evolution of the desired series at the desired horizons.

4.1 Leading Indicator LEI1

We construct our first leading indicator for the Spanish business cycle following a four step procedure. First, we select a set of series that lead the components of the CEI (industrial production, retail sales and unemployment) and can provide useful information to forecast their future evolution. Second, we use correlation and cointegration analysis to construct three combinations of those leading series which best lead IP, RS and UN, and we will call them LIP, LRS and LUN. Third, we construct a composite leading indicator for our estimate of the state of the Spanish economy (CEI) which combines the three leading indicators previously obtained. Finally, we use the basic property of the leading indicators

and obtain forecasts for the out-of-sample evolution of our CEI using the information contained in the in-sample observations of the leading series.

Searching for good leading economic indicators an important problem arises, as pointed out by Stock and Watson (1993). The best in-sample forecast of the industrial production, retail sales and unemployment can be obtained with the series that have led them in the past but this does not guarantee that they will still be the best leading indicators in the future. Stock and Watson (1993) find that the recession in the US in 1990 could not be predicted by their index of leading economic indicators precisely for this reason. By studying the leading potential of different series during only the last Spanish business cycle, we rule out this danger without having too short a sample size for the statistical analysis to be accurate.

We have considered as potential leading series a similar set as the one suggested in Ortega (1996): official building permits (*licitof*), electricity consumption (*consele*), passenger cars registered (*matric*), industrial production index of equipment goods (*ipibseq*), Madrid stock prices index (*stockp*), employees affected by layoff agreements (*expreg*), stocks of investment goods (*stbsinv*), nominal effective exchange rate of the peseta against developed countries (*xrpdes*). Data description and sources are in the Appendix. Figure 5 plots each of the individual potential leading series with IP, RS and UN.

In the second step, we have constructed a leading indicator for each of the three series whose common trend we associate to the Spanish business cycle. Our aim is to find the combination of leading series which best matches the evolution of IP, RS and UN a number of periods ahead. Each leading indicator is constructed as a linear combination of some leading series where each coefficient reflects the stable relationship with the series they lead (IP, RS or UN) i.e. comes from the statistically significant cointegrating vector they form, and where the leading lag is selected using the following criteria: maximum bivariate correlation (IP, RS or UN with each leading series), maximum R^2 and minimum variance of the residuals from the bivariate regression between IP, RS or UN and each leading series at different leading times. The resulting three leading indicators are:

$$LIP_t = 0.0924\ licitof_{t-12} + 0.047\ stockp_{t-12} \tag{6}$$

$$LRS_t = 0.104\ licitof_{t-12} + 0.0524\ stockp_{t-26} + 0.146\ matric_{t-26} \tag{7}$$

$$LUN_t = -0.248\ licitof_{t-20} + 0.354\ expreg_{t-12} \tag{8}$$

Two main observations can be drawn from the definition of the three leading indicators LIP, LRS and LUN. The first one is the sequence of leading times: according to the relationship found between the individual coincident indicators and their leading series, industrial production seems to move earlier than the other two, and unemployment seems to be clearly the last individual coincident indicator to reflect the movements of the overall state of the Spanish economy. Notice that building permits (*licitof*) is a good leading series for the three coincident indicators of the Spanish economy, but reflects future

unemployment behaviour with a longer leading time (20 months) than future industrial production or future retail sales (a year in both cases). Also, the stock prices index appears to be a good leading indicator of economic activity but its leading time is longer as a predictor of consumer demand (above two years) than of industrial production (only a year leading time). The second observation refers to the still important differential behavior of the labor market, even after having discounted the deterministic elements in the evolution of unemployment (recall that we are using the *virtual* unemployment series). In fact, the number of employees affected by layoff agreements (*expreg*) is a significant leading series for unemployment but not for the other two series, whereas stock prices is not a good leading series for unemployment while it is so for IP and RS.

Figures 6, 7 and 8 plot IP, RS and UN, respectively, against the corresponding number of periods ahead forecast made by their corresponding leading indicator (LIP, LRS and LUN). The last observations of the three leading indicators are out-of-sample forecasts for the individual coincident indicator series. It is striking to see how well our three proposed leading indicators track the evolution of the industrial production, retail sales and unemployment in Spain, especially in the more recent periods.

In the third step of the procedure described above, we make use of the stable relationship found in section 3 between IP, RS and UN (the linear combination of them which defines their common trend, the CEI) to propose our first leading economic indicator. LEI1 is defined replacing each of its three components by their corresponding leading indicator:

$$LEI1_t = 1.95\ LIP_t + 3.23\ LRS_t - 4.17\ LUN_t \qquad (9)$$

Figure 9 plots the 12-month ahead forecast of the CEI made with LEI1 against the actual CEI. With information up to 12 months before, the LEI1 series is able to forecast quite accurately the evolution of our estimated CEI, especially since the middle of the eighties.

Finally, we use the same combination of current values of these series to forecast out-of-sample values of IP, RS and UN, and hence of the CEI. The smallest leading lag being 12 months, with information up to 1994M10 we can obtain the values of the leading indicators LIP, LRS, LUN and LEI1 that forecast the evolution of IP, RS, UN and the CEI up to 1995M10. Those are the last 12 observations of the four leading indicators in figures 6 to 9.

Looking at these forecasts, it is worth noting the following observations: (i) the optimistic growth of the IP gets moderate in 1995, (ii) consumer demand does not clearly recover by the end of 1995 nor continues decreasing, (iii) unemployment decreases sharply at the end of 1994 and, as a result, (iv) the economy enters a clear recovery which is not as substained from the middle of 1995 onwards as it was the first half of the year.

4.2 Leading Indicator LEI2

Next suggest a second leading indicator of our CEI, LEI2. To do so, we have looked for a cointegrating relationship between the CEI and each individual leading series where the leading time is selected using maximum bivariate correlation (CEI and each leading series) and maximum R^2 and minimum variance of residuals from bivariate regression (CEI and each leading series) at different leading lags. The leading indicator obtained is:

$$LEI2_t = 3.233\ licitof_{t-13} \tag{10}$$

Cointegration for the whole sample size seems to be a very hard requirement and only one of the individual leading series satisfy the requirement. Not surprisingly it is *licitof*, the only series that was found a good leading indicator for all three components of the CEI. Figure 10 plots the CEI against and its 13-month ahead forecast made by the LEI2. It can be seen that, since it contains less information than LEI1, LEI2 tracks our estimate of the Spanish business cycle in a less satisfactory manner, especially in the last recession: according to LEI2 it would have been terminated by 1993 whereas our dating of CEI turning points identifies the end of the recession in September of 1994. However, the LEI2 confirms the moderate nature of the recovery after 1994.

4.3 Leading Indicator LEI3

Next we try to exploit the fact that some series tend to lead the CEI or its components with a different leading lag than others. Following Ortega (1996) and Artis et al. (1994), we organize the forecasting information the leading series contain for the Spanish business cycle according to their leading time. We combine the series having a leading time with respect to the CEI of around a year and of more than a year into a shorter (SLEI3) and longer (LLEI3) leading indicator, respectively. SLEI3 and LLEI3 are constructed as weighted averages of the corresponding individual leading indicators, the weights being their respective correlation coefficients with the CEI [7]. The resulting short and long term leading indicators are[8]:

$$SLEI3_t = .8042\ licitof_{t-13} + .8839\ consele_{t-10} + .8636\ matric_{t-12} + .8367\ ipibseq_{t-13} \tag{11}$$

$$LLEI3_t = .9457\ stockp_{t-25} - .8188\ stbsinv_{t-42} \tag{12}$$

[7] These maximum correlation coefficients with the CEI of each leading series (Newey-West consistent standard errors in parentheses) with the corresponding leading time are:
licitof: 0.8042 (0.0815), 13 months; *stockp*: 0.9457 (0.0709), 25 months; *consele*: 0.8839 (0.1035), 10 months; *matric*: 0.8636 (0.0917), 12 months; *stbsinv*: -0.8188 (0.10), 42 months; *xrpdes*: -0.9086 (0.0965), 50 months; *ipibseq*: 0.8367 (0.1078), 13 months; *expreg*: -0.4034 (0.17), 0 months.

[8] We have excluded two series: *expreg*, because it is not a leading series for the CEI according to the correlation coefficients, and *xrpdes* because the suggested leading lag is too large to make economic sense.

SLEI3 results in a one-year leading indicator whereas LLEI3 results as a more than two-year leading indicator for the Spanish business cycle. It can be noticed how the shorter composite leading indicator (SLEI3) has a simple economic interpretation. Once agents have perceived a change in the general economic conditions, e.g. a recovery, consumers activate their demand for durable goods (passenger cars, *matric*, and houses, *licitof*) and firms their production (hence the industrial production of equipment goods, *ipibseq*, increases and also the electricity consumption, *consele*). These reactions require a certain time to take full effect into the economy, and hence their leading time of around a year. Notice, however, that there is a rationale in the sequence of leading times of the four series included in the SLEI3, the shorter one corresponding to the series more closely related to final consumption i.e. *consele*.

LLEI3 is composed of variables less related to final expenditure like the stock prices index (*stockp*) and the stocks of investment goods (*stbsinv*). The first one is by its very nature related to the expectations of future benefits of the firms. *Stbsinv* has a long lead because when a change in the overall economic activity is about to occur, the first variable to react is usually investment, and hence the stocks of investment goods. Then the actual production of those investment and equipment goods (*ipibseq*) reacts, followed by the production of all kinds of final goods and services.

Figure 11 plots the contemporaneous CEI with its forecasts for each period as suggested by SLEI3 and LLEI3 one or more than two years ahead, respectively. The shorter leading lag of SLEI3 permits to obtain out-of-sample forecasts only for 10 more months (until 1995M8) whereas the LLEI3 can use the information up to 1994M10 to forecast the evolution of the CEI up to 1996M11. It is striking how, in spite of the considerable lag of the CEI with respect to the LLEI3, the latter manages to accurately track the former over the whole period, in particular at the end of the sample.

Consistently with the picture given by LEI1 and LEI2, both SLEI3 and LLEI3 forecasted a recovery of the Spanish economy after 1994 and its moderate nature soon afterwards.

4.4 A Comparison of the Leading Indicators

Figures 9 to 11 show how similar the four leading indicators series are and how they track the evolution of our CEI estimate. This similarity is confirmed by the consistent picture they give of the evolution of the overall state of the Spanish economy after 1994. By starting to increase earlier than the CEI with the corresponding leading time, they predicted the beginning of a recovery at the end of 1994. They also gave an indication of the slowdown after the initial recovery. In fact, after a sharp increase, all leading indicators (LEI) enter a slowdown period. Moreover, the last out-of-sample forecasts made by all four leading indicator series suggest that unless major changes were observed in private consumption and unemployment, the period of stability would turn into a new recession

period. In fact, all LEI predict a peak before the end of 1995.

After confirming that all four LEI make consistent predictions of the Spanish business cycle (even if they do not share the leading time with respect to the CEI), we want to be able to compare their forecasting performance. For that purpose we evaluate them along two lines: (i) how well they have predicted the evolution of the CEI within the sample period, and (ii) how well they have captured the CEI turning points.

To answer the first issue we have constructed in table 4 the percentage monthly rates of growth of each LEI and evaluated its difference with that of the CEI using two similar statistics: Root Mean Square Error (RMSE) and Mean Absolute Deviation (MAD). Since we want the leading indicators to indicate a number of periods ahead what the evolution of the economy will be, it is the changes in the CEI that we want them to track rather than the levels.

Table 4: In-sample forecasting the CEI with the Leading Indicators

	Root Mean Squared Error (percentage)	Mean Absolute Deviation (percentage)
LEI1	451.4	111.3
LEI2	8.64	6.89
SLEI3	3.8	3.02
LLEI3	593.8	71.7

Table 4 indicates that the average forecast error of our leading indicators throughout the whole sample size is quite big. It is the SLEI3 (the leading indicator constructed using the shorter leading-time series) the one that achieves better predictions of the Spanish state of the economy, also LEI2 has a fairly good performance. Instead, the LEI1 which includes more similar information to what we have used in the construction of the CEI seems to do a particularly bad in-sample tracking of the changes in the CEI. In particular, because LEI1 and LLEI3 are substantially more volatile than the CEI, their average error in forecasting the mothly growth rate of the CEI is very high. However, from figures 9 to 11 one can see that the discrepancy between the leading indicators and the CEI is much smaller in the later periods, which are the most important from our point of view, since we want the leading indicators to predict the CEI from the end of the sample onwards.

The literature on leading indicators typically focuses on their ability to predict non-linearities such as turning points rather than make linear forecasting of a series, as we have done so far. In order to evaluate how well our four LEI have captured the CEI turning points, we first date the Spanish business cycle turning points according to each of the leading indicator series we have constructed (LEI1, LEI2, SLEI3 and LLEI3). Table 5 reports the dating of the turning points, duration and amplitude of recoveries and

recessions of the Spanish business cycle as predicted by the four LEI the corresponding number of periods ago. The dating of the turning points has been obtained applying the same rules we have used to date real GDP and CEI turning points (see tables 1 and 3). For comparison, the last column displays the dates of the CEI turning points, which are the ones each LEI tries to capture.

Table 5: Dating of the Spanish business cycle turning points according to the Leading Indicator series

LEI1			**LEI2**			**CEI**
Dating	Duration in months	Amplitude % change	Dating	Duration in months	Amplitude % change	CEI Turning Points
Peak/Trough	T-P/P-T	T-P/P-T	Peak/Trough	T-P/P-T	T-P/P-T	Peak/Trough
80M1/81M8	/19	/-66.77	78M12/81M1	/25	/-6.91	77M8/79M4
83M8/85M2	24/18	138.4/-76	83M4/85M3	27/23	12.71/-6.22	81M4/83M4
91M1/94M4	71/39	1165.6/-40.78	91M9/93M4	78/19	31.53/-12.84	91M5/94M9
95M8	16/	42.25/	94M9/	17/	10.15/	
SLEI3			**LLEI3**			**CEI**
Dating	Duration in months	Amplitude % change	Dating	Duration in months	Amplitude % change	CEI Turning Points
Peak/Trough	T-P/P-T	T-P/P-T	Peak/Trough	T-P/P-T	T-P/P-T	Peak/Trough
79M1/81M1	/24	/-2.33	/81M10			77M8/79M4
83M1/85M4	24/27	2.65/-1.39	83M3/84M9	17/18	46.43/-88.44	81M4/83M4
91M5/93M9	73/28	14.32/-3.88	92M2/94M10	89/32	31.53/-12.84	91M5/94M9
95M7	22/	1.10/	95M10/96M8	12/10	36.87/-11.89	

The first four turning points of the Spanish business cycle as we have defined them (i.e. turning points of the CEI) are predicted by all leading indicators with some delay, the two first ones in particular. The peak in 1991 is predicted quite accurately by all LEI (exactly by SLEI3) whereas the prediction of the trough of 1994M10 is exact by LLEI3 (the longest run leading indicator), with few months advance by LEI1 and too early by LEI2 and SLEI3.

Table 5 provides us with some additional information regarding the out-of-sample performance of our leading indicators: again, they give a consistent picture and forecast in the second half of 1995 an ending of the recovery which started at the end of our sample period (except for LEI2 which misses that peak, predicting it too early). According to all four LEI the recovery phase is particularly short and also not very strong[9]. With the

[9]Only the LLEI3 gives this last recovery a size similar to previous recovery phases.

data observed up to 1994M10, the leading indicator having a longer leading time (LLEI3) predicts that an also "small" recession (10 months) would follow so that a new recovery period would start from 1996M8 onwards.

Table 5 confirms that the reason for LEI1 and LLEI3 to perform so bad in terms of the RMSE or the MAD is their high volatility (compare their amplitude of recessions and recoveries, i.e. the percentage change, to that of the CEI in table 3). Instead, they are the ones performing better in terms of predicting business cycles turning points. Both the LEI2 and the SLEI3 are able to predict accurately only the peak at 1991M5: they predict with too much delay the previous ones and too early the following. On the contrary, although LEI1 and LLEI3 predict also with too much delay the first four in-sample tuning points, they predict more accurately the last cycle, in particular the last observed turning point of the Spanish business cylce (which is exactly captured by LLEI3).

In sum, the choice of the "best" leading indicator will obviously depend on their use. Any of the four we suggested gives a similar and improved picture of the Spanish business cycle compared to the one offered by the GDP. If we want to track future changes in the state of the Spanish economy, the composite index of shorter leading time indicators (SLEI3) is a good choice. If we want to predict future turning points, the composite index of longer leading time indicators (LLEI3) appears to be more reliable. Because of the consistent picture and similar out-of-sample performance of all four leading indicators, we recommend the use of more than one, and possibly the four of them, to forecast the Spanish business cycle.

5 Concluding Remarks

This paper deals with the task of measuring the state of the Spanish economy during the recent past and proposes alternative leading indicators to forecast its future evolution.

Using economic criteria as well as formal statistical techniques (cointegration analysis), we select a set of coincident economic indicators with the largest informational content about the current state of the economy. These series are the Industrial Production Index (IP), Department Stores Retail Sales (RS) and Unemployment (UN). Following Kasa (1992) we estimate a single common trend that these three series share which we take as our estimate of the underlying driving force of the Spanish economy, the coincident economic indicator CEI.

We find that our proposed CEI outperforms the series normally used as estimator of the state of the Spanish economy, the real GDP. The CEI is sensitive to changes coming from a wider range of sources, and at the same time its sequence of turning points is a more realistic description of the turning points of the Spanish business cycle in the last years than the real GDP cycle chronology we have constructed in Section 1. We show that the CEI gives a delayed picture of the last recovery with respect to real GDP, and how this is due to the little confidence of private consumers following the still high levels of

unemployment at the end of 1994, while the production side of the economy was already growing driven by an active investment.

Finally we build four alternative leading indicators (LEI) which provide useful information to forecast how the Spanish economy is going to evolve in the future. Our proposed leading indicators are able to predict the recovery the Spanish economy entered at the end of 1994. According to all four LEI the recovery phase is particularly short (all but one identify a peak before the end of 1995) and also not very substained. With the data observed up to 1994M10, the leading indicator having a longer leading time (LLEI3) predicts that this "small" recovery would turn into a "small" recession period which would end by 1996M8.

APPENDIX

Following we provide the description of the series we have used in the paper and their source. The multivariate analysis conducted in the paper has taken the longest common period to the series involved starting early enough to fully include the last peak-to-peak and trough-to-trough cycle we identified in Section 2. The CEI is estimated for the period 1977M6-1994M10, and hence this is the period that applies for the selection of leading indicators. All individual coincident and leading indicators are transformed into log of index (base: 1977M6) of SA monthly series.

GDP: GDP, constant prices, seasonally adjusted (SA).
Source: Instituto Nacional de Estadística (INE). Period: 1970Q1-1995Q2.

INDIVIDUAL COINCIDENT INDICATORS

IP: Industrial Production Index. Source: INE.
UN: Total registered unemployment, thousands of people. Source: INE.
RS: Department stores retail sales index, base 1985. Source: OECD MEI.

INDIVIDUAL LEADING INDICATORS

LICITOF: Total official building permits, constant prices ("Licitación oficial, total"). Source: Ministerio de Obras Púlicas, Transportes y Medio Ambiente.
CONSELE: Electricity consumption. Source: Ministerio de Economía.
MATRIC: Total passenger cars registered, SA. Source: Dirección General de Tráfico.
IPIBSEQ: Industrial Production Index, equipment goods. Source: INE.
STOCKP: Stock prices index, Madrid Stock Exchange. Source: IMF, International Financial Statistics.
EXPREG: Number of employees affected by temporary and permanent layoffs agreements ("Trabajadores afectados por Expedientes de Regulación de Empleo"). Source: Ministerio de Trabajo y Seguridad Social.
STBSINV: Level of stocks, investment goods. Source: Encuesta de Coyuntura Industrial del Ministerio de Industria y Energía (MINER).
XRPDES: Nominal effective exchange rate of the peseta against developed countries. Source: Ministerio de Economía.

References

[1] Artis, M.J., Bladen-Hovell, R.C., Osborn, D.R., Smith, G.W. and W. Zhang (1995), "Predicting Turning Points in the UK Inflation Cycle", *The Economic Journal*, vol.105.

[2] Artis, M.J., Kontolemis, Z. and D.R. Osborn (1996), "Classical Business Cycles for G7 and European Countries", forthcoming, *Journal of Business.*

[3] Burns, A.F. and W.C. Mitchell (1946), *Measuring Business Cycles*, New York: NBER.

[4] Fernández, J. and J. Virto (1995), "Un Indicador Adelantado de la Inflación en España", mimeo, Universidad del País Vasco.

[5] Johansen, S. (1991), "Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models", *Econometrica*, No.59.

[6] Johansen, S. (1995), *Likelihood Based Inference in Cointegrated Vector Autoregressive Models: Theory and Applications*, Oxford: Oxford University Press.

[7] Johansen, S. and K. Juselius (1990), "Maximum Likelihood Estimation and Inference on Cointegration - With Application to the Demand for Money", *Oxford Bulletin of Economics and Statistics*, vol.52.

[8] Kasa, K. (1992), "Common Stochastic Trends in International Stock Markets", it Journal of Monetary Economics, vol.29.

[9] López, H., Ortega, E. and A. Ubide (1996), "Explaining the Dynamics of Spanish Unemployment", European University Institute Working Paper Eco 96/07.

[10] Lucas, R. (1977), "Understanding Business Cycles", *Carnegie-Rochester Conference Series on Public Policy* No.5.

[11] Ortega, E. (1996), "Coincident and Leading Indicators for the Spanish Economy", mimeo, International Monetary Fund.

[12] Sargent, T.J. and C.A. Sims (1977), "Business Cycle Modelling without Pretending to Have Too Much a Priori Economic Theory", in Sims et al. *New Methods in Business Cycle Research*, Federal Reserve Bank of Minneapolis.

[13] Stock, J.H. and M.W. Watson (1988), "A Probability Model of the Coincident Economic Indicators", NBER Working Paper No.2772.

[14] Stock J.H. and M.W. Watson (1989), "New Indexes of Coincident and Leading Economic Indicators", NBER Macroeconomics manual.

[15] Stock J.H. and M.W. Watson (1993), "A Procedure for Predicting Recessions with Leading Indicators: Econometric Issues and Recent Experience", in Stock, J.H. and M.W. Watson (eds.) *Business Cycles, Indicators and Forecasting*, NBER Studies in Business Cycles Vol.28.

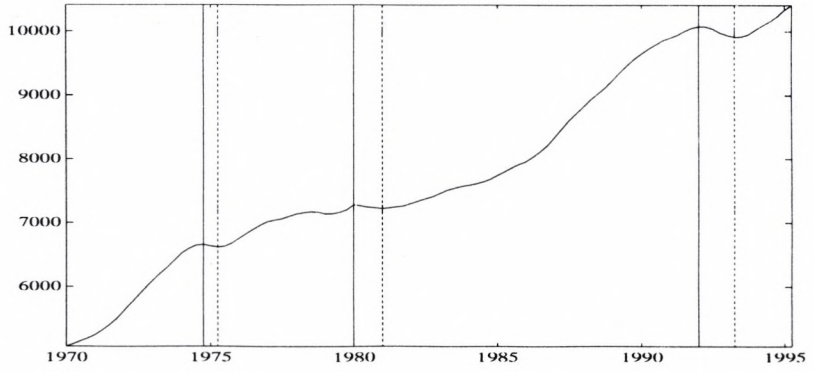

Figure 1: **Chronology of the Real Spanish GDP Cycle.** Peaks indicated by solid vertical lines (1974Q4, 1980Q1, 1992Q1) and troughs by dashed lines (1975Q2, 1981Q1, 1993Q2).

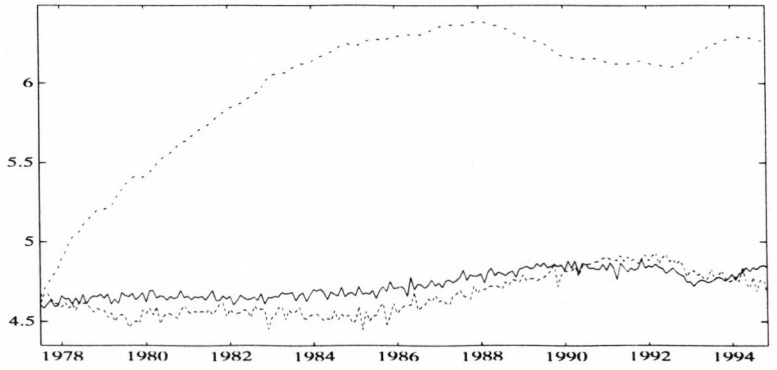

Figure 2: **The *Real* Economy: Individual Coincident Indicators.** Industrial Production Index (solid line), Retail Sales (dashed line) and Registered Unemployment (dash-dotted line). All variables in real terms, SA monthly indexes (base 1977M6) and in logs.

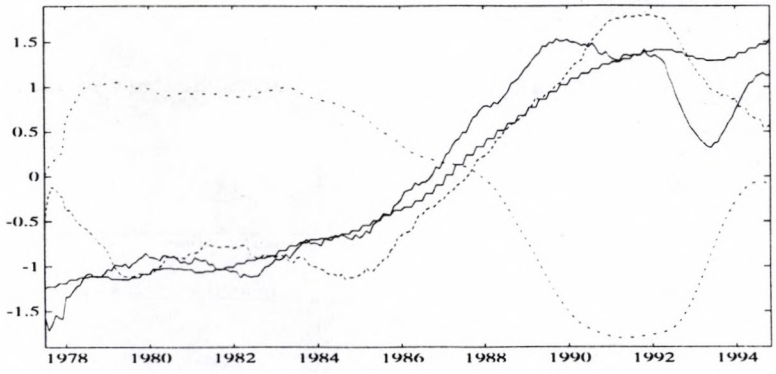

Figure 3: **The *Virtual* Economy.** Industrial Production Index (solid line), Retail Sales (dashed line), *virtual* Unemployment (dash-dotted line) and real GDP (step function).

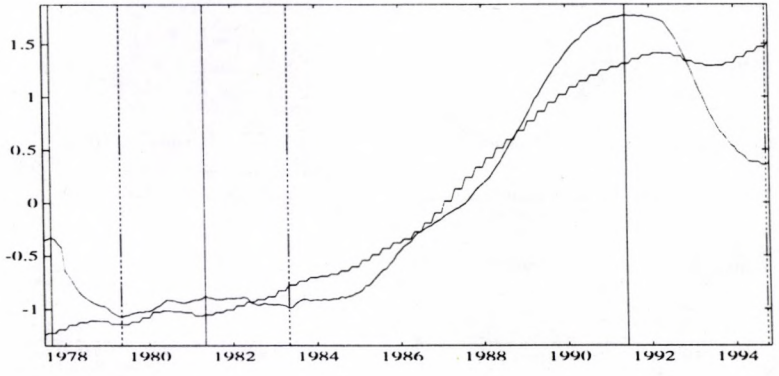

Figure 4: **GDP and the composite Index of Coincident Economic Indicators CEI.** CEI is plotted in 13-month moving average. GDP appears as a step function since it is only available on a quarterly basis. Peaks of the CEI in solid vertical lines, troughs of the CEI in dashed vertical lines.

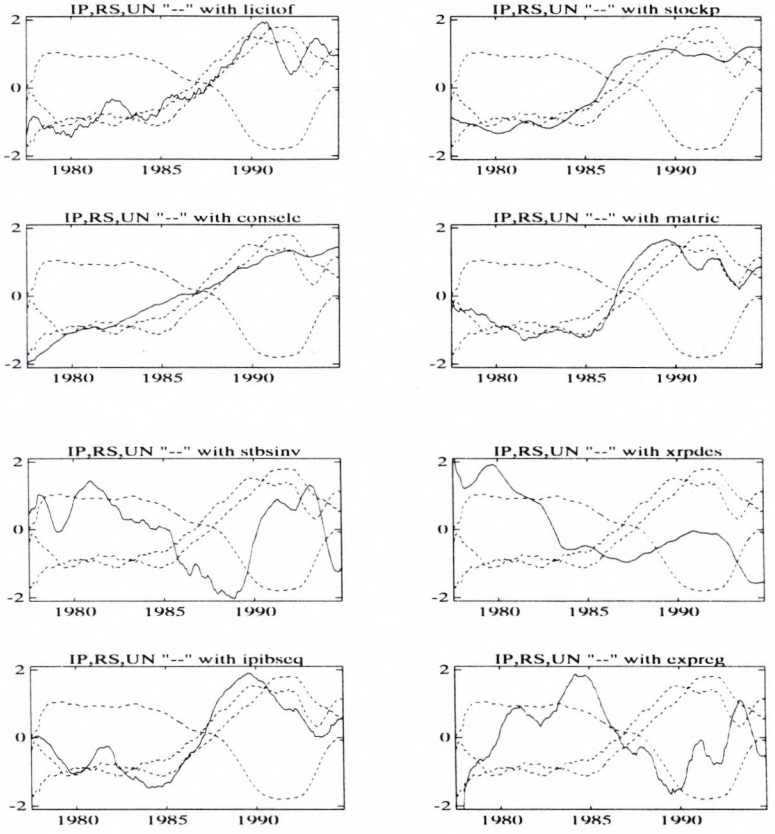

Figure 5: **Potential Individual Leading Indicator Series.** Each plot displays in solid line the corresponding individual leading indicator series and in dashed lines the three individual coincident indicators of the Spanish business cycle (IP, RS and UN). All series are displayed in their 13-month centered moving average.

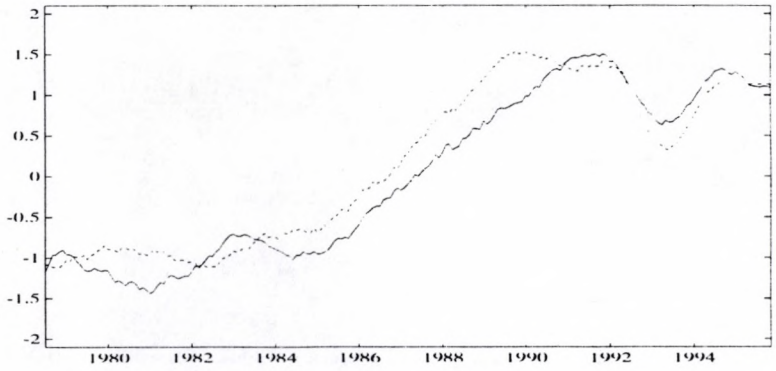

Figure 6: **IPI (dashed line) and forecast made by its corresponding Leading Indicator (LIP)** 12 months ago. The last 12 observations leading indicator are out-of-sample forecasts for the IP series.

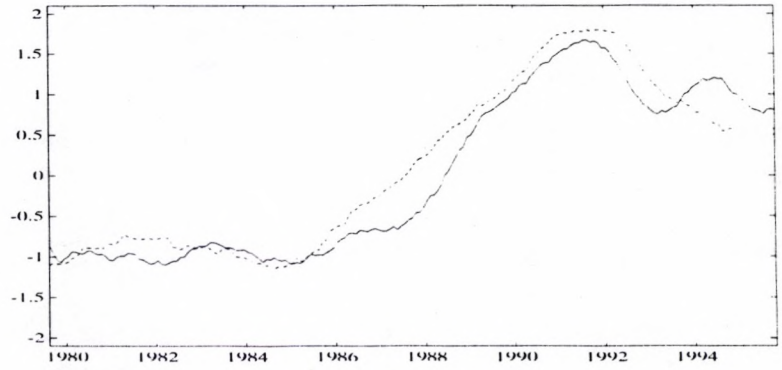

Figure 7: **RS (dashed line) and forecast made by its corresponding Leading Indicator (LRS)** 12 months ago. The last 12 observations leading indicator are out-of-sample forecasts for the RS series.

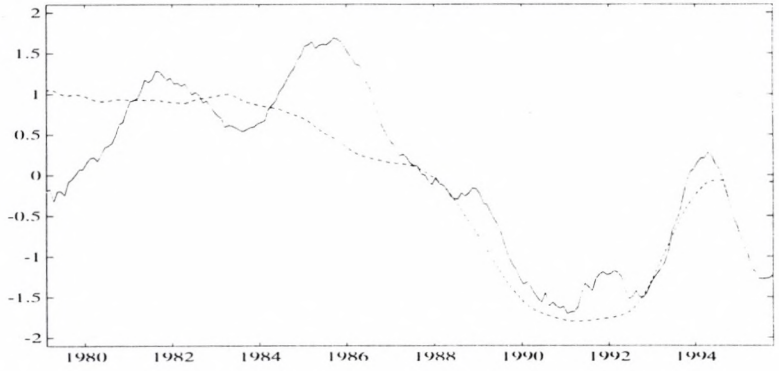

Figure 8: **UN (dashed line) and forecast made by its corresponding Leading Indicator (LUN)** 12 months ago. The last 12 observations leading indicator are out-of-sample forecasts for the UN series.

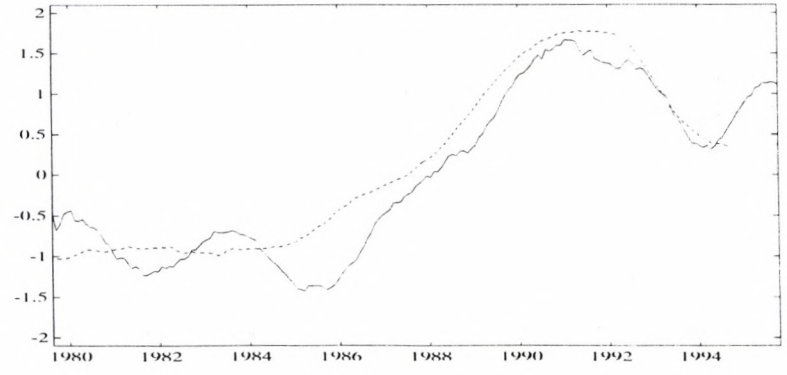

Figure 9: **CEI (dashed line) and LEI1 (solid line).** See the text for explanation.

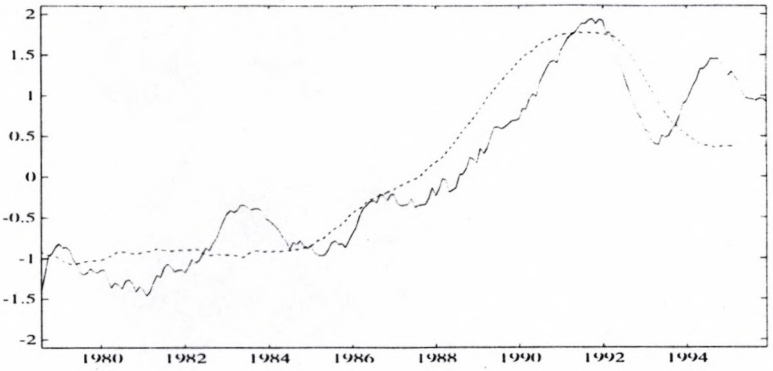

Figure 10: **CEI (dashed line) and LEI2 (solid line).** See the text for explanation.

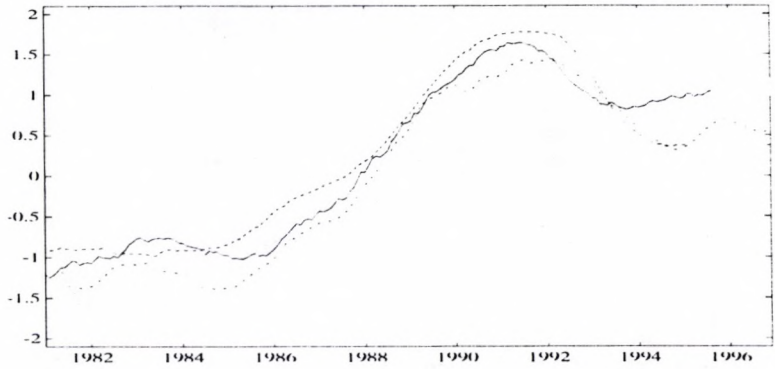

Figure 11: **CEI (dashed line), SLEI3 (dashed line) and LLEI3 (dash-dotted line).** See the text for explanation.

EUI WORKING PAPERS

EUI Working Papers are published and distributed by the
European University Institute, Florence

Copies can be obtained free of charge
– depending on the availability of stocks – from:

The Publications Officer
European University Institute
Badia Fiesolana
I-50016 San Domenico di Fiesole (FI)
Italy

Please use order form overleaf

Publications of the European University Institute

To

The Publications Officer
European University Institute
Badia Fiesolana
I-50016 San Domenico di Fiesole (FI) – Italy
Telefax No: +39/55/4685 636
E-mail: publish@datacomm.iue.it

From

Name .....
Address.....
.....
.....
.....
.....

❒ Please send me a complete list of EUI Working Papers
❒ Please send me a complete list of EUI book publications
❒ Please send me the EUI brochure Academic Year 1997/98

Please send me the following EUI Working Paper(s):

No, Author .....
Title: .....
No, Author .....
Title: .....
No, Author .....
Title: .....
No, Author .....
Title: .....

Date .....

Signature .....

Working Papers of the Department of Economics
Published since 1994

ECO No. 96/1
Ana Rute CARDOSO
Earnings Inequality in Portugal: High and Rising?

ECO No. 96/2
Ana Rute CARDOSO
Workers or Employers: Who is Shaping Wage Inequality?

ECO No. 96/3
David F. HENDRY/Grayham E. MIZON
The Influence of A.W.H. Phillips on Econometrics

ECO No. 96/4
Andrzej BANIAK
The Multimarket Labour-Managed Firm and the Effects of Devaluation

ECO No. 96/5
Luca ANDERLINI/Hamid SABOURIAN
The Evolution of Algorithmic Learning: A Global Stability Result

ECO No. 96/6
James DOW
Arbitrage, Hedging, and Financial Innovation

ECO No. 96/7
Marion KOHLER
Coalitions in International Monetary Policy Games

ECO No. 96/8
John MICKLEWRIGHT/ Gyula NAGY
A Follow-Up Survey of Unemployment Insurance Exhausters in Hungary

ECO No. 96/9
Alastair McAULEY/John MICKLEWRIGHT/Aline COUDOUEL
Transfers and Exchange Between Households in Central Asia

ECO No. 96/10
Christian BELZIL/Xuelin ZHANG
Young Children and the Search Costs of Unemployed Females

ECO No. 96/11
Christian BELZIL
Contiguous Duration Dependence and Nonstationarity in Job Search: Some Reduced-Form Estimates

ECO No. 96/12
Ramon MARIMON
Learning from Learning in Economics

ECO No. 96/13
Luisa ZANFORLIN
Technological Diffusion, Learning and Economic Performance: An Empirical Investigation on an Extended Set of Countries

ECO No. 96/14
Humberto LÓPEZ/Eva ORTEGA/Angel UBIDE
Explaining the Dynamics of Spanish Unemployment

ECO No. 96/15
Spyros VASSILAKIS
Accelerating New Product Development by Overcoming Complexity Constraints

ECO No. 96/16
Andrew LEWIS
On Technological Differences in Oligopolistic Industries

ECO No. 96/17
Christian BELZIL
Employment Reallocation, Wages and the Allocation of Workers Between Expanding and Declining Firms

ECO No. 96/18
Christian BELZIL/Xuelin ZHANG
Unemployment, Search and the Gender Wage Gap: A Structural Model

ECO No. 96/19
Christian BELZIL
The Dynamics of Female Time Allocation upon a First Birth

ECO No. 96/20
Hans-Theo NORMANN
Endogenous Timing in a Duopoly Model with Incomplete Information

*out of print

ECO No. 96/21
Ramon MARIMON/Fabrizio ZILIBOTTI
'Actual' Versus 'Virtual' Employment in Europe: Is Spain Different?

ECO No. 96/22
Chiara MONFARDINI
Estimating Stochastic Volatility Models Through Indirect Inference

ECO No. 96/23
Luisa ZANFORLIN
Technological Diffusion, Learning and Growth: An Empirical Investigation of a Set of Developing Countries

ECO No. 96/24
Luisa ZANFORLIN
Technological Assimilation, Trade Patterns and Growth: An Empirical Investigation of a Set of Developing Countries

ECO No. 96/25
Giampiero M.GALLO/Massimiliano MARCELLINO
In Plato's Cave: Sharpening the Shadows of Monetary Announcements

ECO No. 96/26
Dimitrios SIDERIS
The Wage-Price Spiral in Greece: An Application of the LSE Methodology in Systems of Nonstationary Variables

ECO No. 96/27
Andrei SAVKOV
The Optimal Sequence of Privatization in Transitional Economies

ECO No. 96/28
Jacob LUNDQUIST/Dorte VERNER
Optimal Allocation of Foreign Debt Solved by a Multivariate GARCH Model Applied to Danish Data

ECO No. 96/29
Dorte VERNER
The Brazilian Growth Experience in the Light of Old and New Growth Theories

ECO No. 96/30
Steffen HÖRNIG/Andrea LOFARO/ Louis PHLIPS
How Much to Collude Without Being Detected

ECO No. 96/31
Angel J. UBIDE
The International Transmission of Shocks in an Imperfectly Competitive International Business Cycle Model

ECO No. 96/32
Humberto LOPEZ/Angel J. UBIDE
Demand, Supply, and Animal Spirits

ECO No. 96/33
Andrea LOFARO
On the Efficiency of Bertrand and Cournot Competition with Incomplete Information

ECO No. 96/34
Anindya BANERJEE/David F. HENDRY/Grayham E. MIZON
The Econometric Analysis of Economic Policy

ECO No. 96/35
Christian SCHLUTER
On the Non-Stationarity of German Income Mobility (and Some Observations on Poverty Dynamics)

ECO No. 96/36
Jian-Ming ZHOU
Proposals for Land Consolidation and Expansion in Japan

ECO No. 96/37
Susana GARCIA CERVERO
Skill Differentials in the Long and in the Short Run. A 4-Digit SIC Level U.S. Manufacturing Study

***

ECO No. 97/1
Jonathan SIMON
The Expected Value of Lotto when not all Numbers are Equal

ECO No. 97/2
Bernhard WINKLER
Of Sticks and Carrots: Incentives and the Maastricht Road to EMU

ECO No. 97/3
James DOW/Rohit RAHI
Informed Trading, Investment, and Welfare

*out of print

ECO No. 97/4
Sandrine LABORY
Signalling Aspects of Managers' Incentives

ECO No. 97/5
Humberto LÓPEZ/Eva ORTEGA/Angel UBIDE
Dating and Forecasting the Spanish Business Cycle

*out of print