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UNIVARIATE METHODS FOR THE ANALYSIS OF THE INDUSTRIAL SECTOR IN SPAIN*

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En este trabajo se presenta un modelo univariante con análisis de intervención para el Indice de Producción Industrial de España con el que se estima la influencia de la Semana Santa, la distinta composición y longitud de los meses —efecto calendario—, el cambio tendencial producido en 1980 y los cambios estacionales que se detectan en los veranos de 1980 y 1986. Este modelo se utiliza para la predicción y extracción de señales del citado Indice de Producción Industrial. Finalmente, se propone una medida de crecimiento anual para el análisis coyuntural de la actividad industrial en España comprobándose que los diagnósticos basados en esta medida son más precisos que los basados en otras medidas alternativas.

1. Introduction

A complete analysis of the short-term situation which the industry of a country is undergoing at a particular time requires us to study, at least: the demand for industrial products —in both aspects, domestic and foreign—, industrial production, imports, industrial prices and costs, and the level of employment generated by industry, at a sectorial and aggregate level.

Of all that, in the present paper only the study of Spanish industrial production in itself is dealt with, that is, without relating it to the variables which determine it. The study is carried out at an aggregate level and following the short-term analysis methodology for a specific phenomenon laid down in Espasa (1990), which has been shown to be suitable for analysing other economic variables such as prices, monetary aggregates, exports and imports, etc.

The variable chosen for making the analysis is the Industrial Production Index, hereinafter IPI, prepared by the Instituto Nacional de Estadística, INE.

* This paper was writen while the second author was working at Banco de España. The views expressed are of the authors and do not necessarily reflect those of the Institutions.

The rest of the document is as follows: Section 2 is devoted to presenting the statistical characteristics of the IPI; afterwards —in Section 3—, an ARIMA model with intervention analysis for the IPI series is described, stipulating in detail the dummy variables which are included in it, as well as the effects that each one has on the denominated non-observable components of the series, namely, trend, seasonality and irregular element. The latter is very important for an appropriate estimate of these components. Section 4 is devoted to extracting signals from the IPI, obtaining an estimate of the seasonal factors and trend.

Finally, in Section 5, the results of the previous sections are used to carry out an analysis of Spanish industrial activity in 1988 and the first half of 1989.

2. Characteristics of the Spanish Industrial Production Index

The IPI is prepared from a sample of some 3,000 establishments which provide information on a monthly or quarterly basis, depending on the different branches. This is aggregated according to a weighting system which uses 1972 as a base.

Leaving on one side the technical aspects of this, it is worth highlighting some characteristics of Spanish industrial production which affect the evolution of the IPI, the consideration of which is basic in the successful culmination of the initial specification of a univariate model for this variable. The IPI is shown in Figure 1.

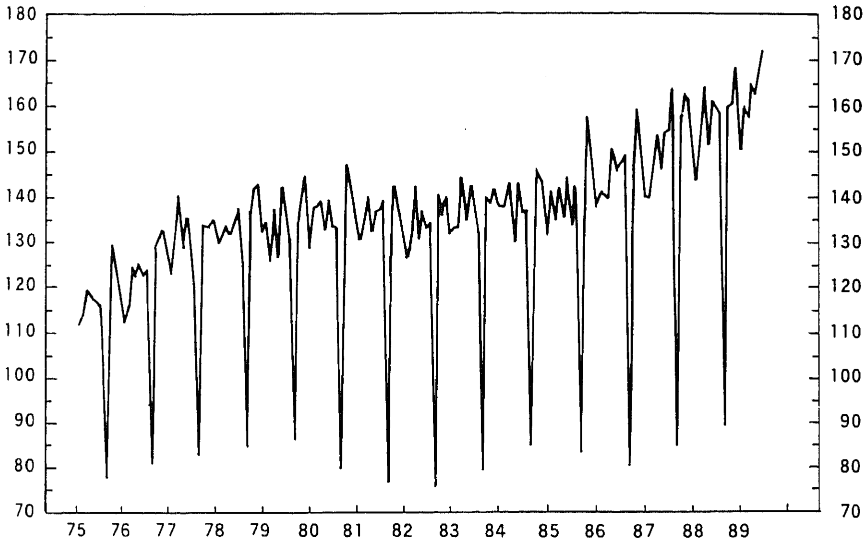


Figure 1
Spanish Industrial Production Index

These characteristics, or rather, their effects upon the evolution of the IPI, are denominated: 2.1. calendar effect; 2.2. effect due to midweek public holidays; 2.3. Easter effect. A description of these effects follows:

2.1. Calendar effect

This effect refers to the fact that a higher level of production can be expected in those months with a larger number of working days, which means taking into account not only the different length of the months, but their different composition in terms of the number of Mondays, Tuesdays, etc. This effect is the result both of the different duration and the composition of each month. Cleveland and Devlin (1980) suggest a procedure for detecting the presence of the calendar effect in monthly-observed series. This procedure is based on the spectrum of the series and its foundation is the fact that when a series has a weekly cycle (that is, it has what we call a calendar effect), the spectrum of the stationary transformation of this series should show a «peak» in what are denominated «calendar frequencies»: 0.348 cycles per month or, in equivalent fashion, 4.179 cycles per year, from which it can be seen that the period of the calendar cycle is roughly 2.87 months.

In Figure 2 we can see the spectrum of an IPI from which previously its stochastic trend and seasonality have been eliminated; there the «peak» corresponding to a cycle of a period equal to 2.84 months stands out, denoting the presence of a marked calendar effect.

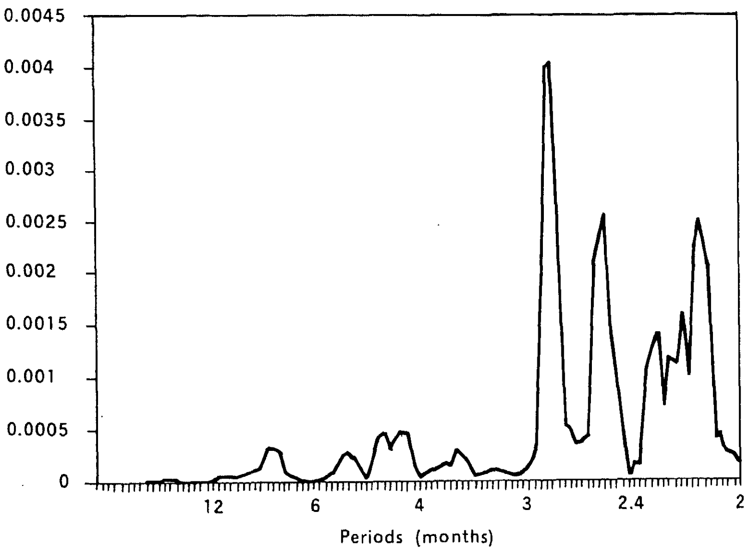


Figure 2
Spectrum of $(1 - L)\ (1 - L^{12})$ Log IPI

2.2. Effect due to midweek public holidays

This effect reflects the influence which is shown on industrial production in a particular month by the fact that in that month there is a public holiday, either national or local, on a day other than Saturday or Sunday.

2.3. Easter effect

With this Easter effect an attempt is made to present the influence which the movable feast of Easter exerts on industrial production in the months of March and April.

Furthermore, in a more detailed analysis of the graph of the original series (Figure 1) one can note:

- A trend change in the series from the beginning of 1980, a consequence of the so-called «second energy crisis». This change means a curtailment in the growth profile shown by the IPI from the beginning of 1975, and which was regained from mid-1982 onwards.
- From 1980 onwards, a greater than usual fall in industrial production is seen in the months of August, partially compensated by a rise in production in the preceding months of July. This may be reflecting a greater trend for companies to close down in the month of August but, also, it is due to a better treatment by the INE of the «non-answers» that it obtains in the month of August.
- A seasonal change from 1986 onwards consisting of smaller production in the months of August of that year and subsequent ones, compensated by an increase in the immediately preceding months of June and July.

3. A univariate model to explain the behaviour of the Spanish Industrial Production Index

In the past several attempts have been made to seek a model to explain IPI behaviour in terms of its own past for the Spanish economy. The model included in this paper is an updated version incorporating the latest available observations of the one presented in Espasa (1989).

The coefficients which appear in Table 1 are the result of estimating the model by the maximum likelihood method with a sample of 174 observations: from January 1975 to June 1989. In the model two types of components can be clearly distinguished: deterministic and stochastic. In the first group all the dummy variables are included: HSS, SS8007, SS8606, SS8608, T80018208, DL, DM, DMX, DJ, DV, DS, DSS, DFFN, DFFA, D7902, D7912, D8209 and D8408, and these are explained in more detail later in this section; the rest constitute the stochastic part of the model which is ARIMA $(0,1,1) \times (0,1,1)$.

Since the estimated coefficients for the parameters of the moving averages are far from unity, we have that the variable log IPI is characterised by having a stochastic trend of a quasi-lineal nature and an additive stochastic seasonality

TABLE 1
Univariate Model With Intervention Analysis for the Spanish Industrial Production Index

$$(1 - L)(1 - L^{12}) \text{ Log. IPI} =$$

DETERMINISTIC EXPLANATORY VARIABLES	Easter	$- \underset{(0.0069)}{0.0428} (1 - L)(1 - L^{12})$ HSS +
	Seasonal change in summers from 1980 onwards	$(\underset{(0.0117)}{0.0292} - \underset{(0.0120)}{0.0854}L)(1 - L)(1 - L^{12})$ SS8007 +
	Seasonal change in summers from 1986 onwards	$(\underset{(0.0049)}{0.0201} + \underset{(0.0049)}{0.0201}L)(1 - L)(1 - L^{12})$ SS8606 +
		$\underset{(0.0049)}{0.0201} (1 - L)(1 - L^{12})$ SS8608 +
	(Truncated Linear trend)	$- \underset{(0.0010)}{0.0036} (1 - L)(1 - L^{12})$ T80018208
	CALENDAR EFFECT	$- \underset{(0.0033)}{0.0018} (1 - L)(1 - L^{12})$ DL +
		$\underset{(0.0035)}{0.0100} (1 - L)(1 - L^{12})$ DM +
		$\underset{(0.0033)}{0.0005} (1 - L)(1 - L^{12})$ DMX +
		$\underset{(0.0034)}{0.0050} (1 - L)(1 - L^{12})$ DJ +
		$\underset{(0.0033)}{0.0081} (1 - L)(1 - L^{12})$ DV
		$- \underset{(0.0035)}{0.0069} (1 - L)(1 - L^{12})$ DS +
		$\underset{(0.0095)}{0.0132} (1 - L)(1 - L^{12})$ DSS
	National holidays	$- \underset{(0.003)}{0.0246} (1 - L)(1 - L^{12})$ DFFN
	Local holidays	$- \underset{(0.0046)}{0.0157} (1 - L)(1 - L^{12})$ DFFA
	(Impulse)	$- \underset{(0.0170)}{0.0515} (1 - L)(1 - L^{12})$ D7902
	(Impulse)	$- \underset{(0.0174)}{0.0325} (1 - L)(1 - L^{12})$ D7912 +
	(Impulse)	$\underset{(0.0173)}{0.0397} (1 - L)(1 - L^{12})$ D8209 +
	(Impulse)	$\underset{(0.0178)}{0.0465} (1 - L)(1 - L^{12})$ D8408 +
		$(1 - \underset{(0.0547)}{0.7380}L)(1 - \underset{(0.0508)}{0.8025}L^{12})\, a(t)$

Number of residuals: 160 (March 1976 to June 1989)
Number of observations: 174 (January 1975 to June 1989)

Residuals standard deviation = 0.018623

TABLE 1 (continuation)
Univariate Model With Intervention Analysis for the Spanish Industrial Production Index

Box-Pierce-Ljung statistic for the residuals

14 Lags = 8.5
26 Lags = 19.8
38 Lags = 34.4
50 Lags = 46.0

Parameter correlations: < |0.65|

Standard deviation of forecast errors:
One month ahead: 0.0186
Twelve months ahead: 0.0247

Residuals greater than two standard deviation (in absolute value):

Observation	Date	Value of residual (number of standard deviations)
16	April 1976	2.61
97	January 1983	2.41
151	July 1987	2.31

Note: Figures under estimated coefficients are standard errors; L is the Lag operator.

on this same trend. Given that the model also incorporates dummy variables with trend and/or seasonal effects it can be concluded that the IPI is characterised by trend and seasonal components with mixed structures: stochastic and deterministic.

The residuals of the model and the correlogram of these are presented in Figure 3 and Table 2.

Underneath the explanatory deterministic variables included in the model are explained:

3.1. HSS: Dummy variable for the Easter effect

The dummy HSS only takes values different from zero in the months of March and April, and the sum of these values within the natural year is equal to the unit.

In the model presented it has been considered that the duration of the Easter effect is eight days long and that the intensity is shown by the different weighting system [1]:

[1] The underlying idea under the weights assigned to the Easter's days —different from those directly derived from the calendar effect— is that this holiday period affect not only the level of industrial production but also the seasonal weekly cycle.

Monday, Tuesday and Wednesday of Holy Week	0.5
Thursday, Friday and Saturday of Holy Week	1.0
Sunday of Holy Week	0.0
Easter Monday	0.75
Total	5.25

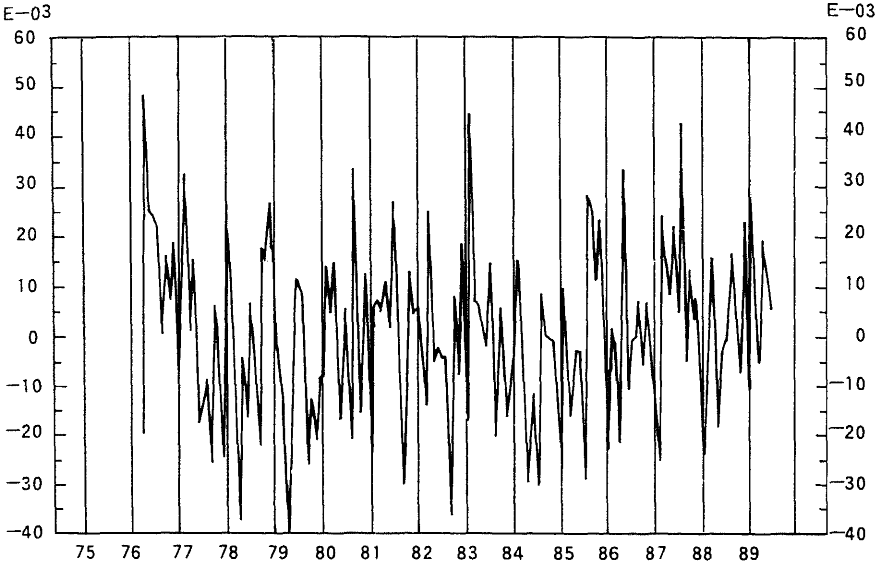


Figure 3
Residuals.

TABLE 2
Residuals Correlogram

1-12	.02	.09	.01	−.08	.00	−.02	−.00	.10	.04	.01	.01	.06
ST.E.	.08	.08	.08	.08	.08	.08	.08	.08	.08	.08	.08	.08
Q........	.1	1.5	1.5	2.6	2.6	2.7	2.7	4.5	4.8	4.8	4.8	5.4
13-14	−.02	−.13	.02	−.11	−.09	−.03	.09	.06	.15	−.01	.02	−.02
ST.E.	.08	.08	.08	.08	.08	.08	.08	.09	.09	.09	.09	.09
Q........	5.5	8.5	8.6	10.6	12.1	12.2	13.7	14.4	18.8	18.8	18.9	19.0
25-36	−.07	.01	−.07	−.00	−.02	.03	.07	−.03	−.09	.06	−.20	−.02
ST.E.	.09	.09	.09	.09	.09	.09	.09	.09	.09	.09	.09	.09
Q........	19.8	19.8	20.7	20.7	20.8	21.0	21.9	22.1	23.8	24.5	32.8	32.9
37-48	−.03	−.08	−.07	.01	−.02	.09	−.03	−.11	.05	−.07	−.06	−.09
ST.E.	.09	.09	.09	.09	.09	.09	.09	.09	.09	.09	.09	.09
Q........	33.1	34.4	35.5	35.5	35.6	37.5	37.7	40.6	41.2	42.2	43.2	45.1

Note: Q is the Box-Pierce-Ljung statisic.

In this way, the value taken by this dummy variable for the months of March and April is obtained by merely dividing by 5.25 the value resulting from adding up the quoted values or coefficients of weighting relative to the days which correspond to each month.

3.2. SS8007: Dummy variable for recording the seasonal change in summers from 1980 onwards

With this variable an attempt is made to record the effect of a seasonal change observed in the summers from 1980 onwards. SS8007 is such that it takes the value one in the months of July 1980 and the following years, and zero in the other months. This variable enters in the model with a first order filter, therefore it also affects to the months of August from 1980.

3.3. SS8606 and SS8608: Dummy variables for the seasonal change in summers from 1986 onwards

From the summer of 1986 onwards a seasonal change was observed, consisting of a marked fall in production in August compensated in the previous months of June and July. This fact is recorded with two variables: SS8606 which takes the value one in the month of June 1986 and in the months of June for subsequent years and zero in the rest, and SS8608 which takes the value —2 in the month of August 1986 and subsequent years, taking value zero in the remaining months.

Compensation for the fall in August with equal rises in June and July is produced when the variable SS8606 is affected with a first order moving average filter and when the coefficients of these variables are rectricted to taking the same value.

3.4. T80018208: Dummy variable for the trend truncation caused by the second energy crisis

This variable takes the value zero from the beginning of the sample till December 1979, the values 1, 2, 3,..., 32 from January 1980 till August 1982, and the value 32 in all subsequent months after August 1982; it is, thus, a truncated trend type variable.

3.5. DL, DM, DMX, DJ, DV, DS, DSS: Dummy variables to record the calendar effect

These seven variables are the denominated calendar variables with which an attempt is made to record the influence which the different composition and length of months exerts on activity as measured by the IPI. These variables have been constructed in accordance with Hillmer, Bell and Tiao (1982).

The first six variables take as values in each month *t* the difference between the number of Mondays and Sundays, for DL; the number of Tuesdays and Sundays, for DM; etc. The value of the seventh variable (DSS) is the number of days of each month, that is, the length of the month.

By using the corresponding coefficients of Table 1, we have that the contribution to production in one month of an extra day, depending on whether it is Monday, Tuesday, etc., would be 1.1 %, 2.3 %, 1.4 %, 1.8 %, 2.1 % and 0.6 % for the first six days of the week, respectively, while the contribution of Sundays would be to reduce by 0.1 % the value of the index of industrial production.

3.6. DFFN and DFFA: Dummy variables to record the effects of midweek public holidays

The DFFN variable takes each month a value equal to the total number of national public holidays in that month and the DFFA variable a value equal to the total number of local holidays which affect 60 % or more of the national territory. In the construction of both variables holidays falling on Saturday or Sunday are not counted.

3.7. D7902, D7912, D8209 and D8408: Dummy variables to record precise outliers

These four variables are of the impulse type, insofar as they take value zero in all observations except in the months of February 1979, December 1979, September 1982 and August 1984, respectively, in which they take the value one. With their inclusion in the model the aim is to estimate the effect on industrial activity of certain unknown events or errors in collecting data.

To sum up, the univariate model with intervention analysis which is proposed to explain the observed behaviour of the IPI and on the basis of which forecasts are made, is characterised by the presence of trend and seasonal components with mixed structures, both of a stochastic and deterministic nature.

4. Estimate of the trend and seasonal component of the Spanish Industrial Production Index

4.1. Extraction of signals

The trend and the seasonally adjusted series normally constitute the signals in a time series on which short-term analysis can be based. The choice of the trend component for this purpose is due to the fact that this signal shows less variability than the seasonally adjusted series (see Figures 4 and 5) —which incorporate, as well as the trend, the irregular component.

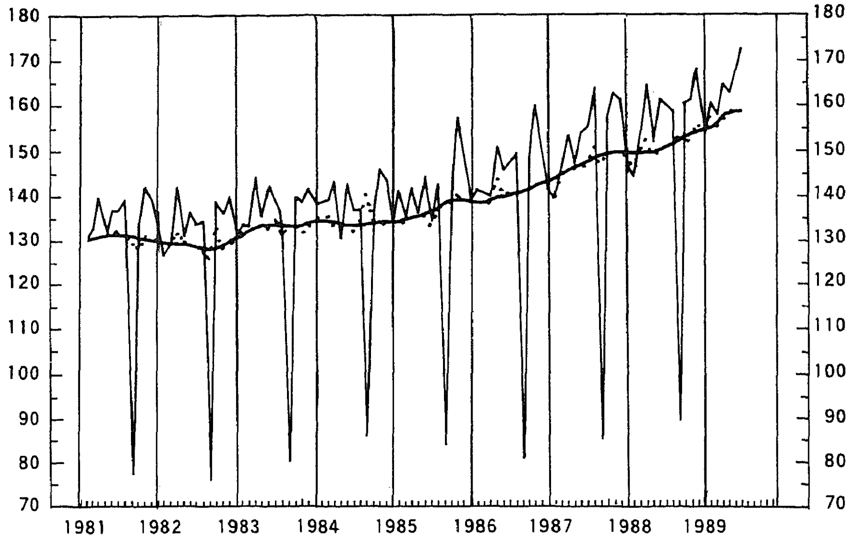


Figure 4
Spanish Industrial Production Index: _____ Original Series; .... Seasonally Adjusted; ——— Trend.

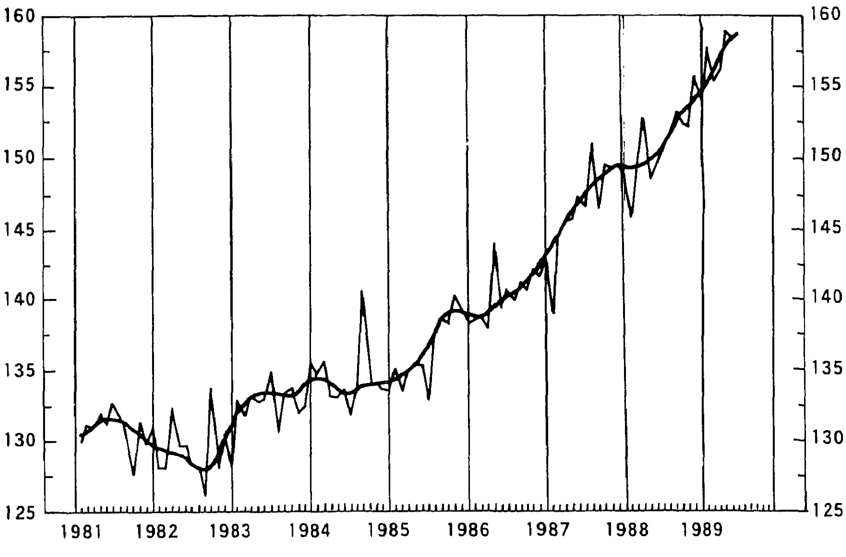


Figure 5
Spanish Industrial Production Index: _____ Seasonally Adjusted; ——— Trend.

It has been explained in the previous section that the trend and seasonal components of the IPI series are of a mixed nature: deterministic and stochastic. Therefore the signal extraction procedure used for this series includes the following steps:

1. Use the model to forecast the IPI values up to December 1991 and prolong the original series with those predictions.
2. Correct the prolonged series of the deterministic effects described in section 3.
3. Estimate the stochastic part of the signals (trend, seasonal and irregular component) by applying a signal extraction procedure to the series obtained in step 2. In this paper we shall use the X-11 Arima method but model based or structural methods could be applied instead.
4. Extract deterministic trend, seasonal and impulse factors from the dummy variables included in the model explaining the IPI series.
5. Aggregate the stochastic signals with their corresponding deterministic factors in order to obtain the final signals of the IPI series.

4.2. Deterministic factors

Table 3 contains in a diagrammatic form the deterministic elements of the model, indicating each of the effects, trend, seasonal and irregular, which they produce.

The interest of the breakdown of the effects of each dummy variable lies in the fact that the X-11 Arima procedure used to obtain the components of the series of the IPI allows the introduction of the denominated *a priori factors* with the aim of performing the extraction of components, not from the original series, but from the series corrected by these effects. Thus, once the different

TABLE 3
Deterministic elements of the model

Dummy variables	Deterministic effects on
1. Easter (HSS)	Seasonality Level (trend)
2. Seasonal change in summers from 1980 (SS8007)	Seasonality
3. Seasonal change in summers from 1986 (SS8606 & SS8608)	Seasonality
4. Trend change from 1980 (T80018208)	Trend
5. Calendar (DL, DM, DMX, DJ, DV, DS, DSS)	Seasonality Level (trend)
6. Midweek public holidays (DFFN & DFFA)	Seasonality Level (trend)
7. Impulse (D7902, D7912, D8209 & D8408)	Irregular component

effects are identified, it is possible to obtain previous trend deterministic factors (FTDP), seasonal ones (FEDP) and irregular ones (PI).

4.3. Final estimate of the trend and seasonal component

When the series has been corrected by all the previous factors, the resulting series is generated by a purely stochastic model and the X-11 Arima method can be applied to it. The components obtained by this method for the corrected series of the IPI are denominated as stochastic, in counterposition to the previous ones which were deterministic in character. Obviously the final components are obtained by integrating the corresponding stochastic and deterministic components.

Thus, if we denominate the stochastic trend estimated by X-11 Arima as F12, we have that the trend of the original series (TEND) will be obtained from the expression:

$$.TEND_t = F12_t \times FTDP_t / 100,$$

the final trend, TEND, is shown in Figures 4 and 5.

In the same way, the final seasonal factors are calculated by simply carrying out the following operation:

$$FACTES_t = F10_t \times FEDP_t / 100,$$

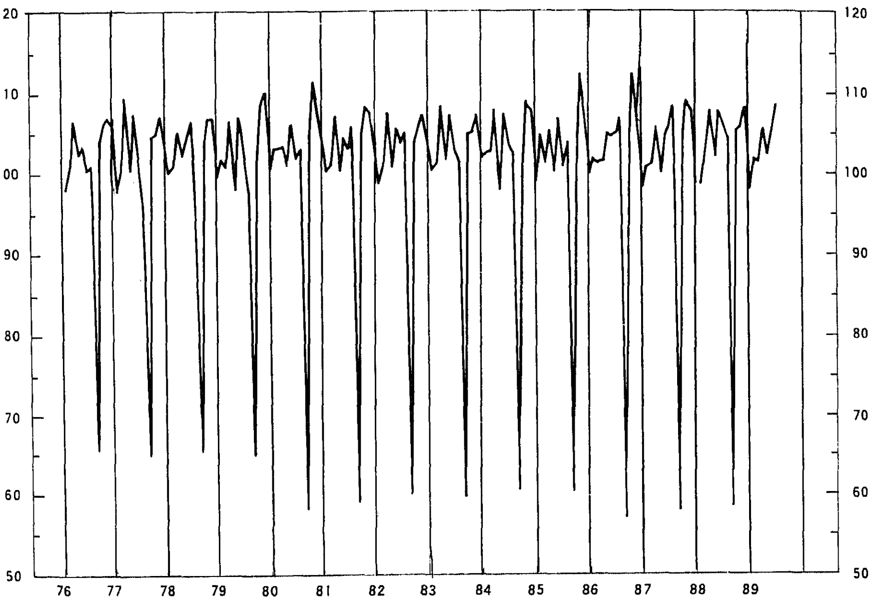


Figure 6
Spanish Industrial Production Index: Seasonal Factors.

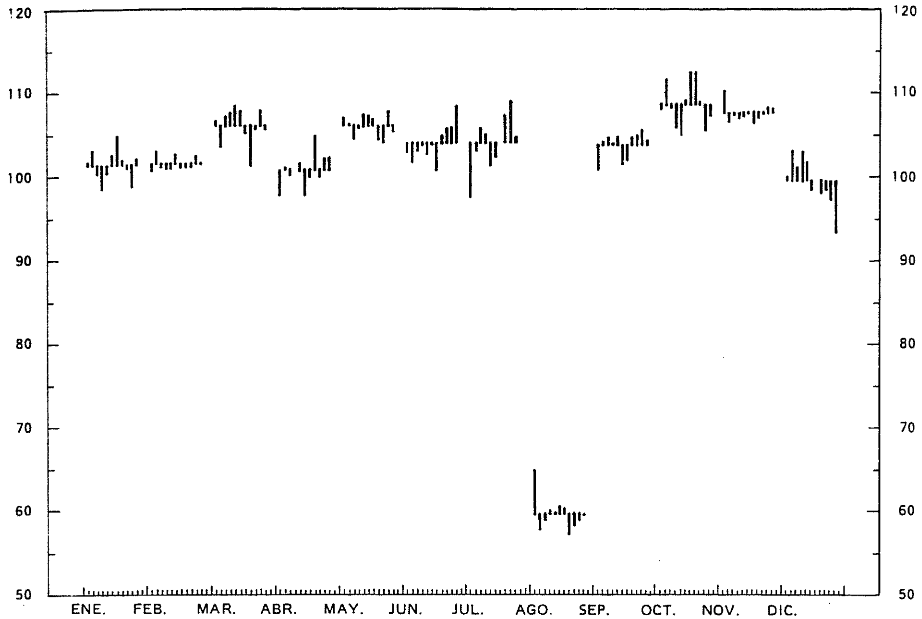


Figure 7
Spanish Industrial Production Index: Final Seasonal Factors (deviation from Mean).

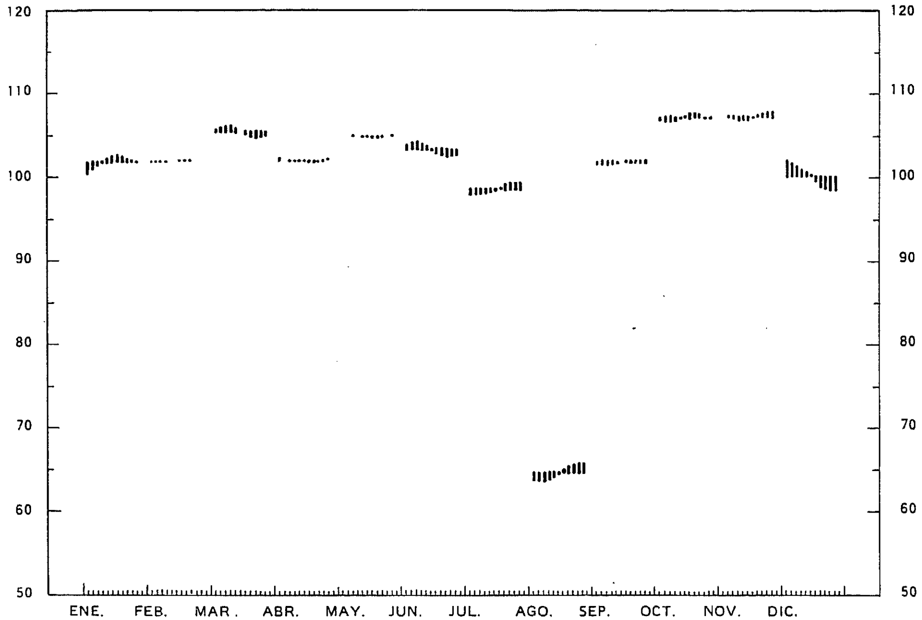


Figure 8
Spanish Industrial Production Index: Stochastic Seasonal Factors (deviation from Mean).

where F10 represents the series of seasonal stochastic factors obtained by application of the X-11 Arima to the corrected series. In Figure 6 the final seasonal factors are displayed, and in Figure 7 they appear in deviations with respect to their means. Figure 8 shows the stochastic seasonal factors obtained with the X-11 Arima.

Finally, the stochastic irregular component —which we represent by F13— will also have to be modified by the impulse deterministic factors, in such a way that the final irregular component, IRRE, will be given by

$$IRRE_t = F13_t \times PI_t / 100.$$

An idea of the importance of this latter component for the IPI series is shown in Figure 5 where the trend and the seasonally adjusted series are jointly displayed. The differences between both series is due to the final irregular component.

5. Spanish industrial activity in 1988 and the first half of 1989

In order to discover the evolution shown by Spanish industrial activity last year —and, in general in any year— it is important to estimate the growth profile, even if on a quarterly basis, presented by the IPI.

Annual growth rates, growth registered in one month compared to the same month of the previous year, T^1_{12}, of the IPI oscilated in 1987 and 1988 more than eight points throughout each year (see Figure 9), so that it is extraordinarily difficult to establish the growth profile shown by the IPI in those years

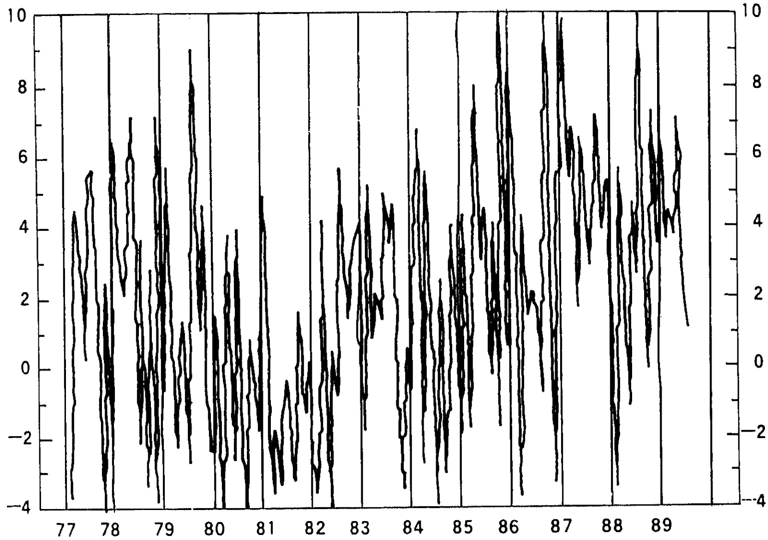


Figure 9
Rate of Growth in the Level of a Month Over the Level of the Same Month in the Previous Year (T^1_{12}).

from the rate mentioned. Now, if, as we have pointed out, interest is principally to be found in having a quarterly growth profile, we can, in principle, study the growth which the mean of three months registers against the mean of the corresponding months a year before. This growth rate is denominated T^3_{12} and is shown in Figure 10. There it is observed that this growth indicator is rather more clarifying than the previous one, but it still contains oscillations the mean magnitude of which is important with respect to the value of the growth rate of each moment. Consequently, the T^3_{12} is also a confused indicator, though less so, and hardly practical as a basis for the growth profile of industrial production.

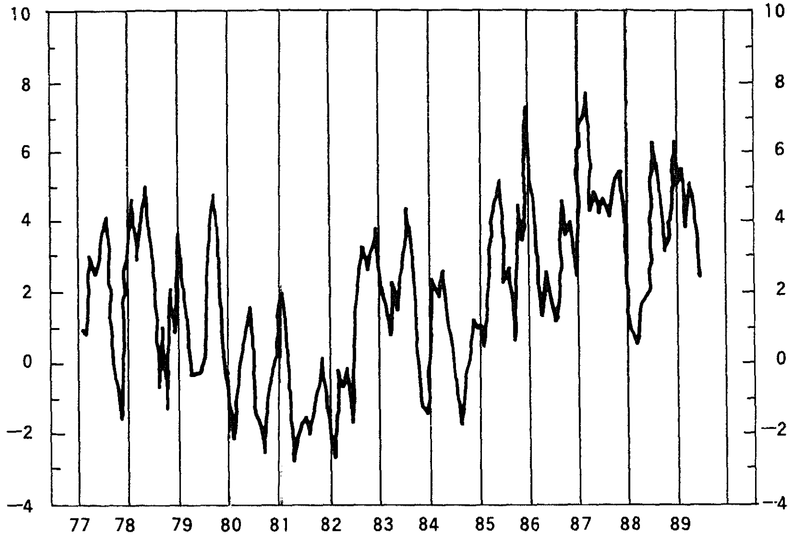


Figure 10
Rate of Growth in the Mean Level of Three Consecutive Months Over the Mean Level of the Same Three Months in the Previous Year (T^3_{12}).

The Annual National Accounts register the growths of the average values of macroeconomic variables throughout the year against the corresponding average values of the previous one. When a macromagnitude is then measured monthly, as is the case with industrial production, such growth is obtained by averaging the twelve-month level and comparing it with the corresponding twelve-month level, a year before. The resulting growth is denominated T^{12}_{12} and its values for the IPI are shown in Figure 11. With this graph a description is obtained of industrial growth that is much more illustrative than the previous ones, even though it contains certain oscillations which it would be desirable to eliminate.

So far, we have been concentrating on the industrial growth profile, but it is also of interest to have available a level indicator on production, since, for example, long-term money paths, prices and real activity are determined on the levels of these variables. The level obtained with the original IPI data con-

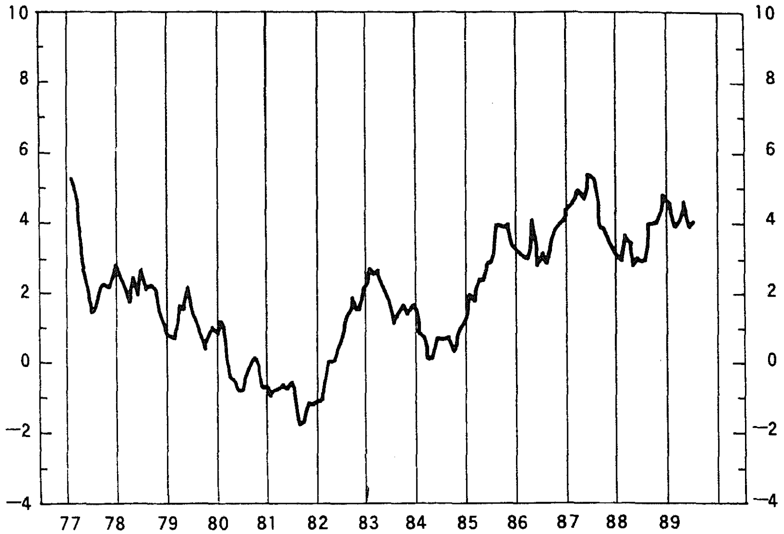


Figure 11
Rate of Growth in the Mean Level of Twelve Consecutive Months Over the Mean Level of the Same Twelve Months in the Previous Year ($T^{12}{}_{12}$).

tains strong oscillations (see Figure 1), so that it is worthwhile taking as an indicator a purified series of such oscillations. Such a level indicator may be the seasonally adjusted series or its trend. Both are shown in Figure 5, where it is easy to detect the suitability of using the trend and discarding the seasonally adjusted series.

If we have available a level indicator without seasonal and irregular oscillations we can base on it the growth profile we are seeking. Thus, in Figure 12 the rate $T^{12}{}_{12}$ of the IPI trend, which is the industrial growth indicator we are proposing, is shown. It has the characteristics of showing a barely oscillating evolution compared to other alternative indicators and is obtained directly from a level indicator: the trend.

Before using the $T^{12}{}_{12}$ of the IPI trend to analyse Spanish industrial production in 1988, certain points related to it must be clarified. The IPI offers a monthly measurement of industrial production and thus enables the possible changes which this production may undergo to be promptly known, so that, as an indicator of industrial activity, it serves to evaluate whether economic policy measures undertaken are producing the expected results, or whether it is advisable to think of readjustment or redesigning of these same measures. Thus, it is desirable to have available a monthly indicator of industrial activity.

On such an indicator we have seen that growth rates should be recorded. However, in a context in which macrovariables, all or some of which are measured on a monthly basis, are going to be related, annual growths must be

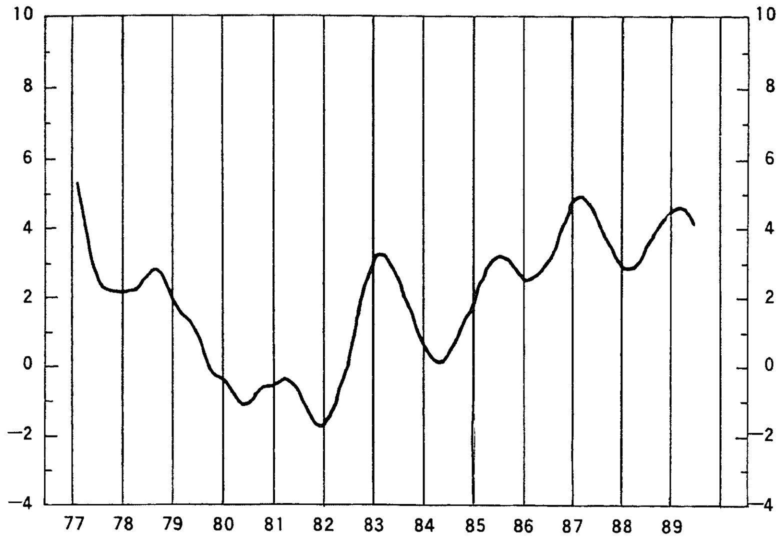


Figure 12
Rate of Growth in the Mean Level of the Trend of Twelve Consecutive Months Over The Mean Level of the Trend of the Same Twelve Months in the Previous Year (T^{12}_{12}).

phased with the monthly growths derived from base data, and this implies centering annual growth rates, that is, allocating them to the month corresponding to the central observation of all those involved in its calculation.

The latter implies that, in order to calculate the T^{12}_{12} rate centred on the moment referring to the latest available observation, forecasts must be made of the corresponding level series for the following eleven months. This can be performed with the univariate model proposed in section 3. It is worth pointing out that if one wishes to calculate an annual growth indicator referring to the latest month for which a variable has been observed, and it is required that this indicator should be in phase with monthly growths, there is no chance of making such a calculation without, implicitly or explicitly, using forecasts.

Through the fact of using forecasts (referring to $t+1$, $t+2$,...) for the calculation of the T^{12}_{12} of the IPI trend in the moment t, we have that over time forecasts can be substituted by real observations, so that the value of the T^{12}_{12} for the moment t will be updated, till in $t+k$ its definitive value will be known. This aspect is shown in Table 4, where the estimated T^{12}_{12} values are included, using as the latest observation the one at the head of each column, for past, present and future months.

Comparison of trend growth of the IPI as estimated in t, by using m forecasts, with previous estimates, for example in $(t-j)$ using $m+j$ forecasts, is very useful, since it shows us the effect that innovations (errors committed in the fore-

TABLE 4
Spanish Industrial Production Index
(Estimated underlying growth: T^{12}_{12} of the IPI trend)

	Latest information available																	
	1988												1989					
	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.
1988 January	2.1	2.3	3.1	2.6	3.2	2.3	2.5	2.1	2.6	2.6	3.0	2.7	2.9	2.9	2.8	2.9	2.9	2.9
February	2.1	2.2	3.0	2.5	3.1	2.2	2.4	2.0	2.5	2.5	3.0	2.6	2.9	2.9	2.8	2.8	2.9	2.9
March	2.1	2.1	2.9	2.4	3.0	2.1	2.5	1.9	2.5	2.5	3.2	2.6	3.0	3.0	2.9	2.9	3.0	2.9
April	2.2	2.2	2.8	2.3	2.9	2.1	2.5	1.9	2.6	2.6	3.3	2.7	3.1	3.1	2.9	3.1	3.2	3.1
May	2.2	2.2	2.7	2.3	2.8	2.2	2.5	1.9	2.7	2.7	3.4	2.8	3.2	3.2	3.1	3.2	3.4	3.3
June	2.3	2.2	2.6	2.4	2.7	2.3	2.6	2.0	2.7	2.7	3.6	2.8	3.4	3.4	3.2	3.4	3.6	3.6
July	2.3	2.3	2.6	2.4	2.7	2.4	2.7	2.1	2.8	2.8	3.7	2.9	3.5	3.5	3.3	3.6	3.9	3.8
August	2.4	2.3	2.6	2.5	2.7	2.5	2.8	2.2	2.8	2.8	3.8	2.9	3.6	3.6	3.3	3.8	4.1	4.0
September	2.5	2.4	2.7	2.6	2.7	2.6	2.9	2.2	2.9	2.9	3.8	3.0	3.7	3.7	3.4	3.9	4.2	4.2
October	2.6	2.5	2.7	2.6	2.7	2.6	2.9	2.4	2.9	2.8	3.8	3.0	3.7	3.8	3.4	4.0	4.4	4.3
November	2.7	2.6	2.7	2.7	2.8	2.7	3.0	2.6	2.9	2.9	3.8	3.0	3.7	3.8	3.4	4.1	4.5	4.4
December	2.7	2.6	2.8	2.8	2.8	2.8	3.0	2.7	3.0	2.9	3.7	3.1	3.6	3.8	3.5	4.2	4.5	4.4
1989 January	2.8	2.7	2.8	2.8	2.8	2.8	3.0	2.8	3.0	2.9	3.5	3.1	3.5	3.8	3.4	4.2	4.6	4.5
February	2.8	2.7	2.8	2.9	2.8	2.9	3.0	2.8	3.0	2.9	3.4	3.1	3.4	3.8	3.4	4.2	4.6	4.5
March	2.8	2.8	2.8	2.9	2.9	2.9	3.0	2.8	3.0	2.9	3.3	3.1	3.3	3.7	3.4	4.2	4.5	4.5
April	2.8	2.7	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	3.2	3.1	3.2	3.6	3.3	4.2	4.4	4.3
May	2.8	2.7	2.9	2.9	3.0	2.9	2.9	2.9	2.9	2.9	3.1	3.0	3.1	3.5	3.3	4.1	4.3	4.2
June	2.8	2.7	2.9	2.9	3.0	2.9	2.9	2.9	2.9	2.9	3.1	3.0	3.0	3.4	3.2	4.0	4.1	4.0
Medium-term growth expectations	2.8	2.7	2.9	2.9	3.2	3.0	3.1	3.0	3.1	3.1	3.2	3.1	3.2	3.5	3.4	3.6	3.6	3.6

cast of the values of the IPI for $t-j, t-j+1,..., t$) have had on trend growth of industrial production.

Finally, regarding industrial production, it is also of interest to ascertain medium-term growth expectations, which for each month j can be calculated, as the value into which the annual rate of growth of the forecasts based on month j converges (this convergency is ensured by the fact that model in Table 1 contains a double differencing operator).

The thick line on Figure 13 shows, for the period from January 1986 to June 1989, the IPI trend, as estimated with information up to June 1989. Furthermore, the trend estimate which was made in December 1987 and December 1988 is included. Figure 14 shows annual growths $T^{12}{}_{12}$ corresponding to the previous trends.

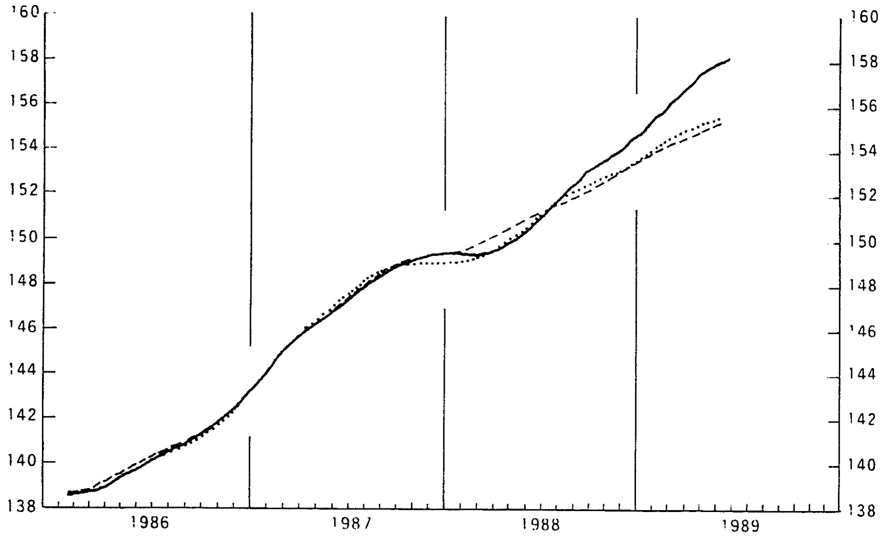


Figure 13
Trend in the Spanish Industrial Production Index.

From these graphs one can deduce that:

1. Industrial production showed growth rates of around 5 % at the beginning of 1987 and from then on slowed down, till it showed rates of around 3 % in the initial months of 1988.
2. Throughout 1988 industrial activity speeded up, reaching in the first quarter of 1989 a trend growth of 4.5 %, but then slowed down, though with rates markedly above those that were estimated in December 1988.
3. This evolution of the IPI means (see Figure 13) that during the first half of 1988 industrial activity has shown a trend level below the one expected for that period, in December 1987. On the contrary, the level in the second

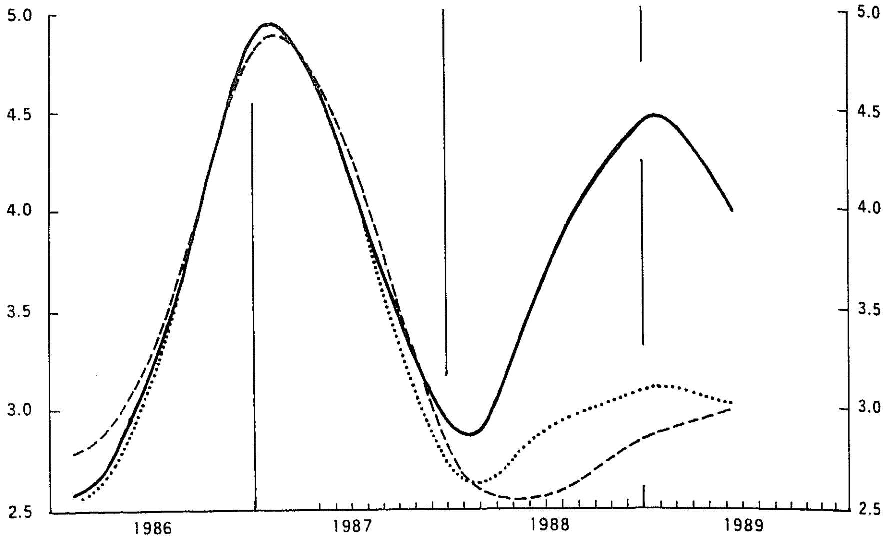


Figure 14
Rate of Growth in the trend of the Spanish Industrial Production Index:
______June 89, ... December 88, ——— December 87.

part of 1988 and the first half of 1989 has been higher than those expectations.

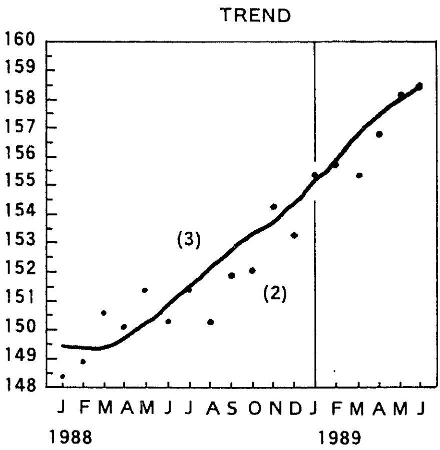
4. In the estimates made in the intermediate months it was always detected that in the first quarter of 1988 the slowdown in industrial activity was going to come to an end, and a slight recovery was going to begin. Likewise, in the first quarter of 1989 there were signs that acceleration in industrial production was coming to a halt. This can be seen in Table 5, simply by comparing columns (4) and (6), and in the figure on the right of the same table.

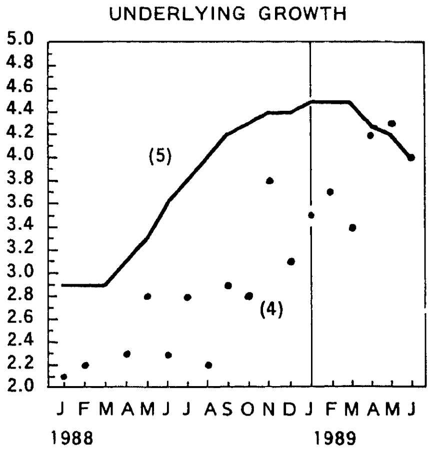
To evaluate the magnitude of the recovery which had been forecast throughout 1988 and the initial months of 1989 we can look at medium-term growth expectations which were estimated each month. These expectations are shown in Tables 4 and 5, and in Figure 15. From this graph one can deduce that the expectations have been fairly stable in their evolution, but have systematically shown a slight recovery from the beginning of 1988 onwards. Thus, from an expectation of medium-term growth of 2.85 in January 1988, we have moved to 3.6 % in June 1989.

In Figure 15, by means of points, the trend growth that was estimated for each month at the particular time is specified (values highlighted in Table 4). By comparing the sequence of points with the thick line of medium-term growth

TABLE 5
Spanish Industrial Production Index
(Latest observation June 1989)

	ORIGINAL SERIES	TREND		UNDERLYING GROWTH		Medium-term growth expectations	SEASONAL FACTORS	
		Estimated value in t for date t	Present estimate for the whole sample	Estimated value in t for date t	Present estimate for the whole sample		Estimated value in t for date t	Present estimate for the whole sample
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1988 January	143.9	148.4	149.5	2.1	2.9	2.8	98.07	98.83
February	154.0	148.9	149.4	2.2	2.9	2.7	102.58	102.58
March	165.1	150.6	149.4	2.9	2.9	2.9	108.45	108.11
April	151.6	150.1	149.7	2.3	3.1	2.9	101.94	102.08
May	161.7	151.4	150.2	2.8	3.3	3.2	107.59	107.78
June	159.5	150.3	150.8	2.3	3.6	3.0	105.66	105.96
July	158.4	151.4	151.5	2.8	3.8	3.1	105.01	104.28
August	89.6	150.3	152.2	2.2	4.0	3.0	57.84	58.44
September ...	160.5	151.9	152.8	2.9	4.2	3.1	105.68	105.42
October	161.0	152.1	153.4	2.8	4.3	3.1	106.37	105.91
November ...	168.9	154.3	153.8	3.8	4.4	3.2	108.65	108.48
December	150.8	153.3	154.4	3.1	4.4	3.1	98.57	98.19
1989 January	160.8	155.4	155.1	3.5	4.5	3.2	102.06	101.84
February	157.7	155.7	155.9	3.7	4.5	3.5	101.72	101.55
March	165.0	155.4	156.8	3.4	4.5	3.4	106.24	105.97
April	162.7	156.8	157.5	4.2	4.3	3.6	102.05	102.18
May	167.3	158.2	158.1	4.3	4.2	3.6	105.80	105.66
June	172.6	158.5	158.5	4.0	4.0	3.6	108.71	108.71





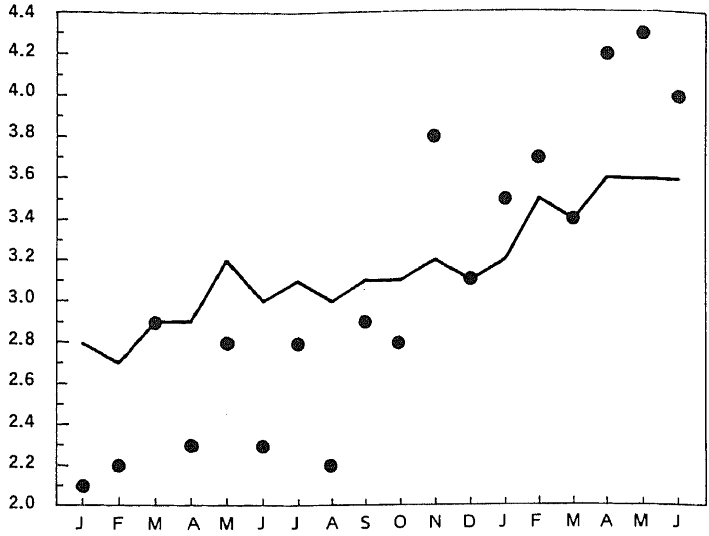


Figure 15
Spanish Industrial Production Index: ——— Inertia (Medium-Term Growth Expectations); • Underlying Growth (T^{12}_{12} of the Trend).

expectations we see that there has always been a message of recovery, throughout 1988, in the data, since contemporary trend growth was always below the expectations of future growth. The graph finally shows that in the last months of the year contemporary growth rates have ceased to be sistematically lower than expectations, and are even higher in the early months of 1989. This leads us to conclude that the level of industrial growth estimated for June 1989 will show a slight fall in the second half of the year.

The diagnosis that, bases on the underlying growth (T^{12}_{12} of the IPI trend) and the expectation of medium term growth which was derived in the second half of 1988 for the Spanish industrial sector, there was a direct contrast with the diagnosis obtained by those persons using the T^{1}_{12} rate, who in October 1988 were saying that the Spanish industrial sector was experiencing negative growth and monetary and fiscal measures were required to stimulate the sector.

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Abstract

In this paper a univariate model with intervention analysis is specified for the Spanish Industrial Production Index to estimate the importance of Easter, trading days, public midweek holidays, trend change produced in 1980 and seasonal changes ocurring in the summer of 1980 and 1986. This model is used to forecast and extract signals of the Index. Finally, a model based annual growth measure is used and an analysis is made of the evolution of Spanish industrial activity in the short term. Diagnosis based on this measure turns out to be more accurate than those based on alternatives ones.

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