UNIVARIATE METHODS FOR THE ANALYSIS OF THE INDUSTRIAL SECTOR IN SPAIN

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0. SUMMARY

In this work the study of Spanish industrial production is dealt with at an aggregate level following the methodology of short-term analysis of a specific phenomenon laid down in Espasa (1990). From the available statistical information, the Industrial Production Index (IPI) has been chosen.

In accordance with the guidelines set out in the above-mentioned methodology a univariate model with intervention analysis is specified for the IPI with which an estimate is made of the importance which, in the evolution of this variable, is possessed by such facts as: a) that Holy Week appears at different times on the calendar (Easter effect); b) the different composition and duration of the months (Calendar effect); c) the existence of public holidays not falling on Saturday or Sunday, (effect due to public midweek holidays); d) the trend change produced in 1980, as a consequence of the second energy crisis; e) seasonal changes occurring in the summers of 1980 and 1986, consisting of a greater reduction in production in the month of August.

Interventions estimated for the IPI, which have been enumerated in the previous paragraph, indicate that the trend and seasonal components of this variable are not purely stochastic, but that each of them has an important deterministic part, which should be borne in mind when estimating these

components. Consequently, the proposed model in this paper is an instrument of special interest for the prediction and extraction of signals (components) of the IPI.

Finally, from an annual growth measure of the trend, an analysis is made of the evolution of Spanish industrial activity in 1988 and the first half-year of 1989. The diagnosis based on this growth measure turns out to be more accurate than those deriving from more traditional growth rates.

I. 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 of a specific phenomenon laid down in Espasa (1990), which has been shown to be suitable for analysing other variables of the Spanish economy 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.

The rest of the document is as follows: Section II is devoted to presenting the statistical characteristics of the IPI; afterwards - in Section III -, 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 IV is devoted to extracting signals from the IPI, obtaining an estimate of the seasonal factors and trend.

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

II. 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 Graph 1.

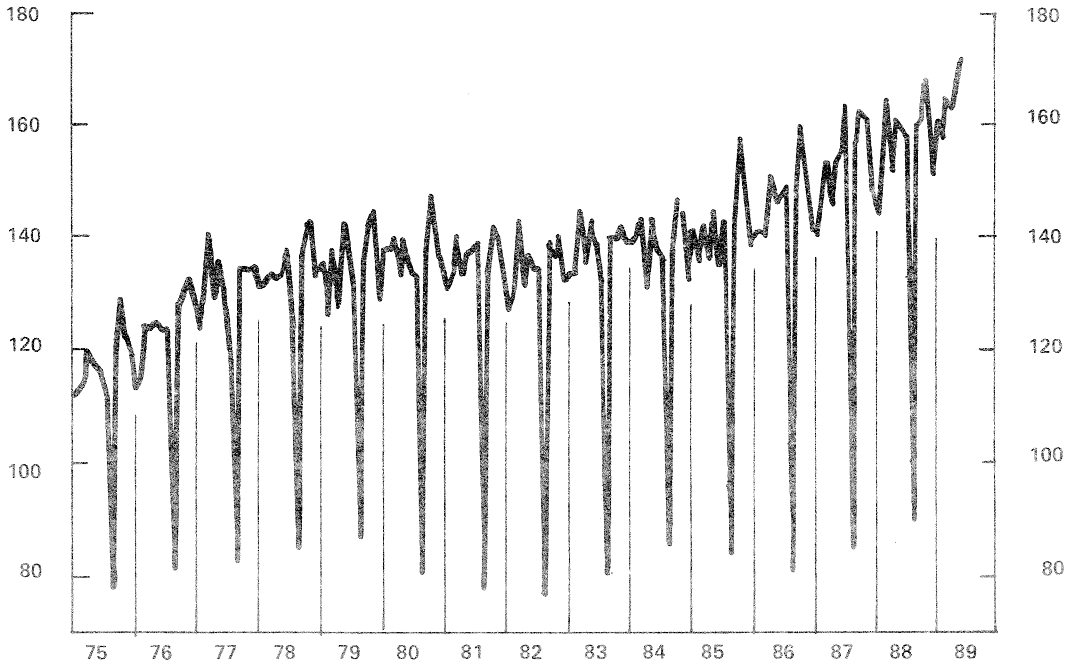
These characteristics, or rather, their effects upon the evolution of the IPI, are denominated: a) calendar effect; b) effect due to midweek public holidays; c) Easter effect. A description of these effects follows:

a) 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

Graph 1

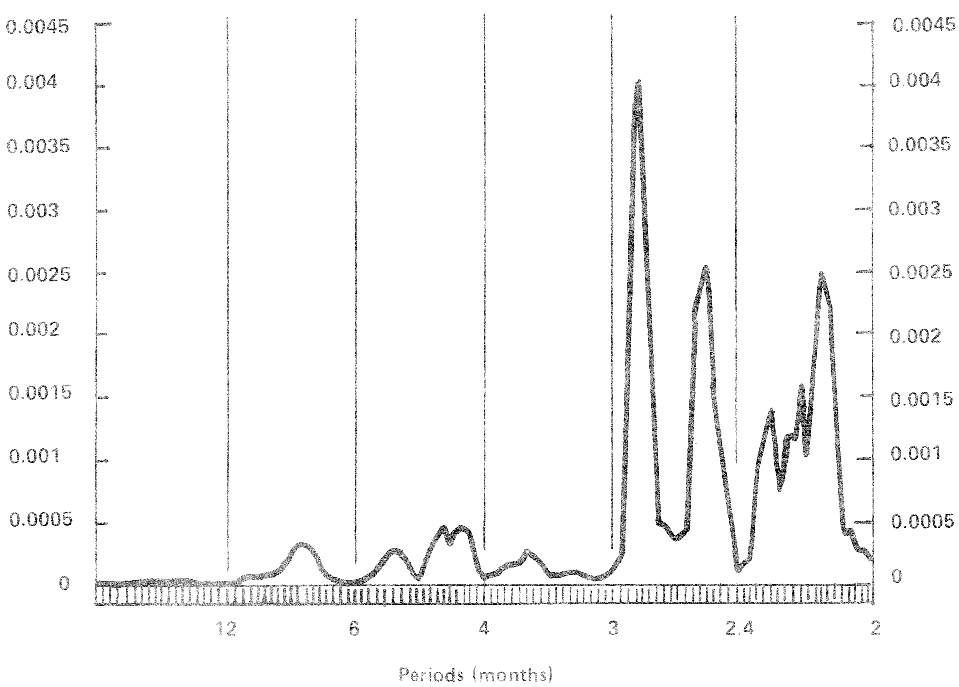
INDUSTRIAL PRODUCTION INDEX



Graph 2

INDUSTRIAL PRODUCTION INDEX

Spectrum of (1–L) $(1-L^{12})$ log IPI



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 Graph 2 we can see the spectrum of an IPI from which previously its stochatic 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.

b) 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.

c) 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 (Graph 1) one can note:

d) 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.

e) 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 of the INE of the "non-answers" that it obtains in the month of August.

f) 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.

III. 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 sample used in the specification stage covers the period from January 1975 to December 1988.

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)x(0,1,1).

Since the estimated coefficients for the parameters of the moving averages are significantly different to the unit, we have that the variable log IPI is characterised by having a stochastic trend of a quasi-lineal nature and an additive

Table 1

UNIVARIATE MODEL WITH INTERVENTION ANALYSIS FOR THE SPANISH INDUSTRIAL PRODUCTION INDEX (*)

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

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

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

Residuals standard deviation = 0.018623

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

(*) Figures under estimated coefficients are standard errors
L is the lag operator

stochastic seasonality 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 estimate and the correlogram of these are presented in Graph 3 and Table 2.

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

1. HSS: Dummy variable for the Easter effect.

This variable is constructed to be able to estimate the effect that is exerted on industrial activity by the fact that Holy Week appears at different months on the calendar -March and/or April- depending on the year. Consequently, HSS only takes values different from zero in these months, and the sum of these values within the natural year is equal to the unit.

Graph 3

RESIDUALS

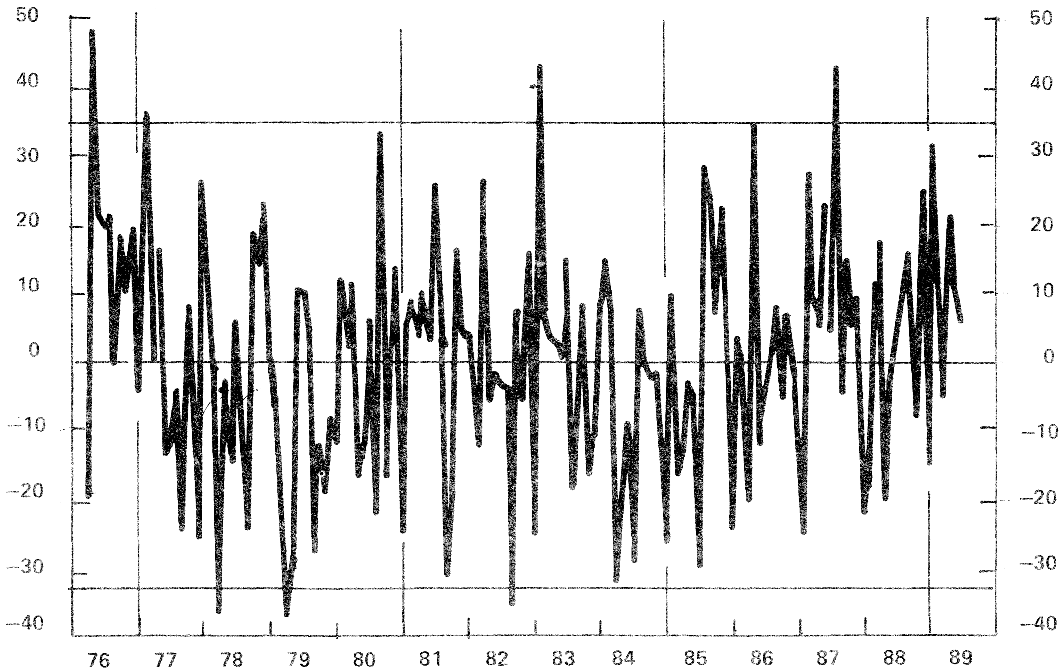


Table 2

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- 24	-.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

Q: Box-Pierce-Ljung statistic

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

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

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.

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.

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 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 restricted to taking the same value.

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.

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 diferent 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, Tuesdays, etc., and Sundays, in that month t, respectively. 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 0.3% the value of the index of industrial production.

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.

7. D7902, D7912, D8209 and D8408: <u>Dummy variables to record precise atypical residuals</u>.

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 that certain special events occurring in those particular months exert on industrial activity.

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.

IV. ESTIMATE OF THE TREND AND SEASONAL COMPONENT OF THE SPANISH INDUSTRIAL PRODUCTION INDEX

IV.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 Graphs 4a and 4b) - which incorporate, as well as the trend, the irregular component.

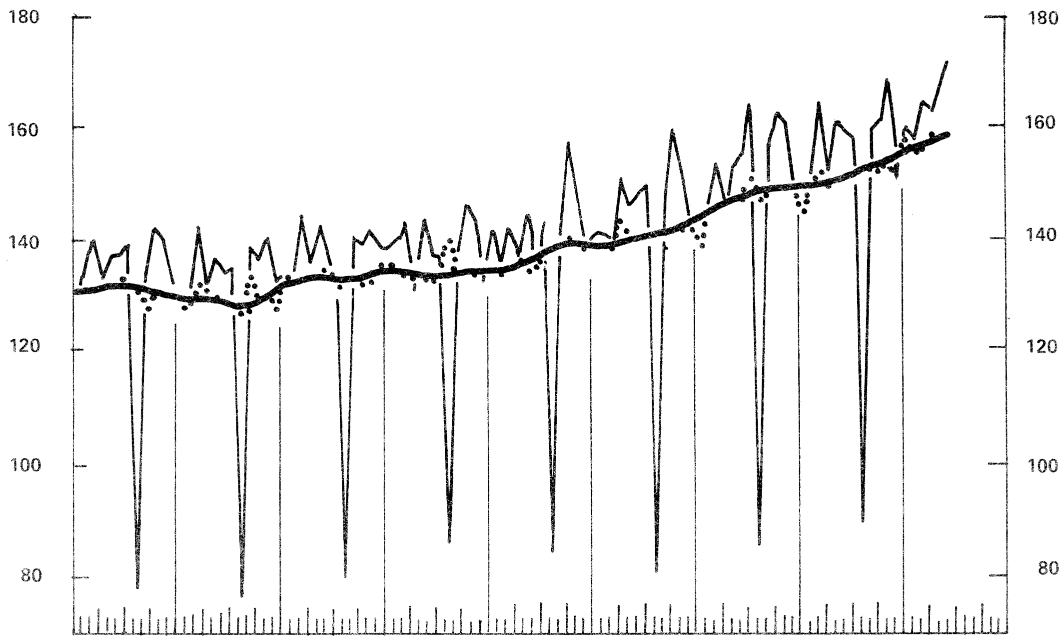
It has been explained in the previous section that the trend and seasonal components of the IPI series are of a mixed nature: deterministic and stochastic. Therefore the signal extraction procedure used for this series includes the following steps:

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 III.
3) Estimate the stochastic part of the signals (trend, seasonal and irregular component) by applying the X11 ARIMA procedure to the series obtained in step 2.
4) Extract deterministic trend, seasonal and impulse factors

Graph 4a

INDUSTRIAL PRODUCTION INDEX

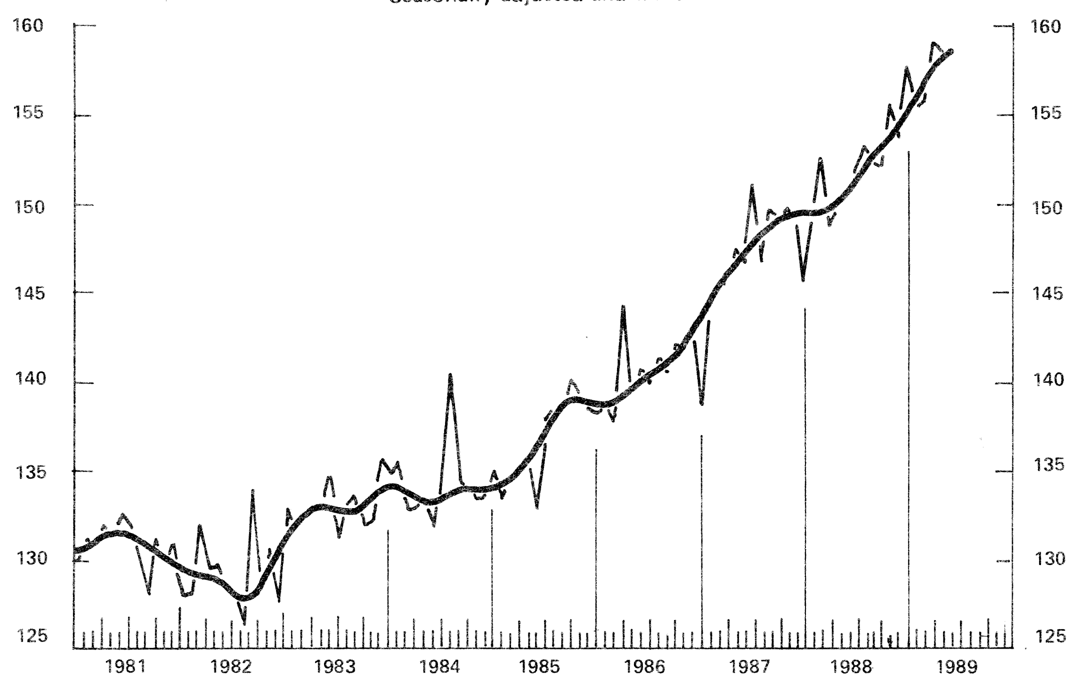
Original series, seasonally adjusted and trend



INDUSTRIAL PRODUCTION INDEX

Graph 4b

Seasonally adjusted and trend



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.

IV. 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.

Table 3

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

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 effects are identified, it is possible to obtain previous trend deterministic factors (FTDP), seasonal ones (FEDP) and irregular ones (PI). A detailed explanation of how to obtain these factors and the graphs of them is included in the Appendix.

IV. 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:

$$TEND_t = F12_t * FTDP_t / 100 ,$$

the final trend, TEND, is shown in Graphs 4a and 4b.

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

$$FACTES_t = F10_t * FEDP_t / 100 ,$$

where F10 represents the series of seasonal stochastic factors obtained by application of the X-11 Arima to the corrected series. In Graph 5 the final seasonal factors are displayed, and in Graph 6 they appear in deviations with respect to their means. Graph 6 also 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

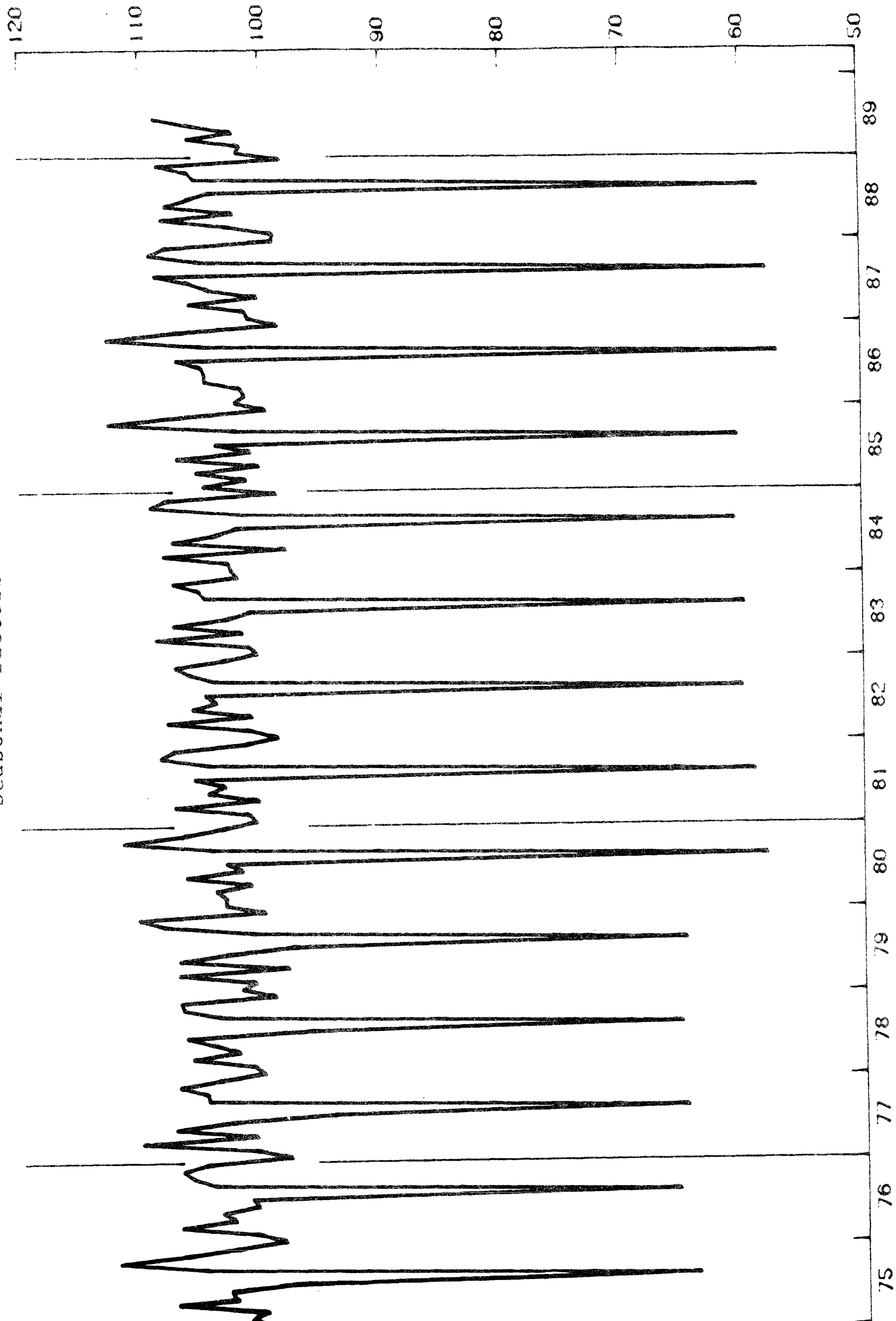
$$IRRE_t = F13_t * PI_t / 100$$

An idea of the importance of this latter component for the IPI series is shown in graph 4 where the trend and the seasonally adjusted series are jointly displayed. The differences between both series is due to the final irregular component.

GRAPH 5

INDUSTRIAL PRODUCTION INDEX

Seasonal factors

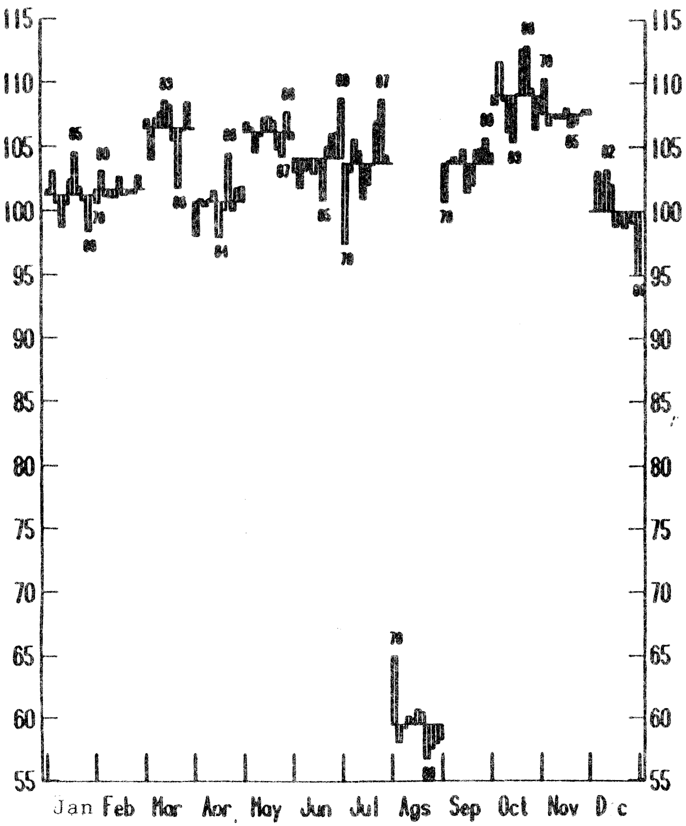


GRAPH 6

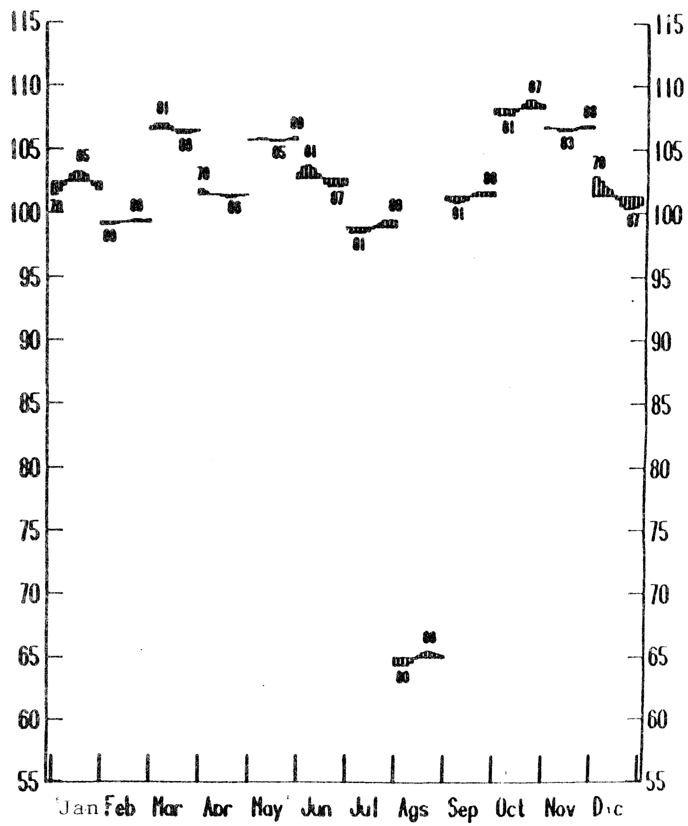
INDUSTRIAL PRODUCTION INDEX

Seasonal factors

Final seasonal factors
(deviations from mean)



Stochastic seasonal factors
(deviations from mean)



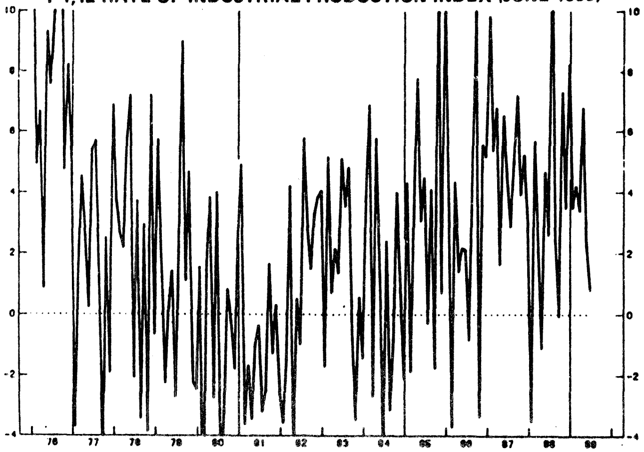
V. SPANISH INDUSTRIAL ACTIVITY IN 1988 AND THE FIRST HALF OF 1989

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 Graph 7a), so that it is extraordinarily difficult to establish the growth profile shown by the IPI in those years 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 Graph 7b. 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.

GRAPH 7.a.

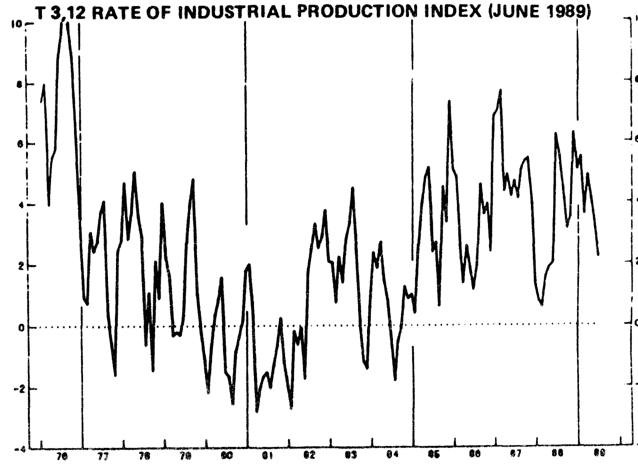
T 1,12 RATE OF INDUSTRIAL PRODUCTION INDEX (JUNE 1989)



T 1,12: Rate of growth in the level of a month over the level of the same month in the previous year.

GRAPH 7.b

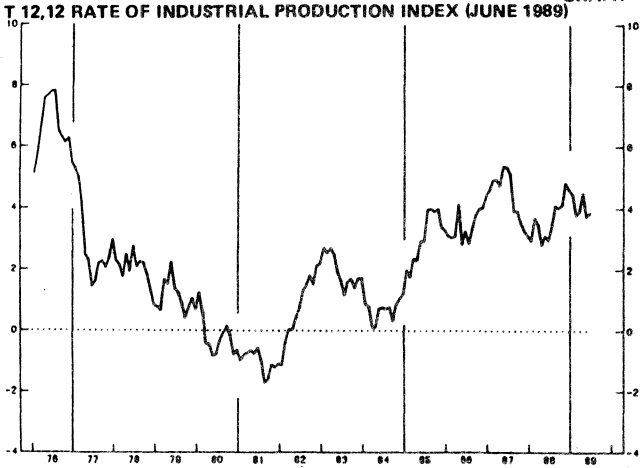
T 3,12 RATE OF INDUSTRIAL PRODUCTION INDEX (JUNE 1989)



T 3,12: Rate of growth in the mean level of three consecutive months over the mean level of the same three months in the previous year.

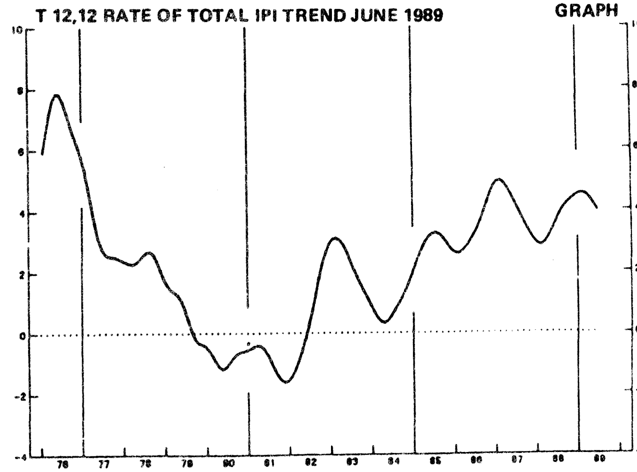
GRAPH 7.c.

T 12,12 RATE OF INDUSTRIAL PRODUCTION INDEX (JUNE 1989)



GRAPH 7.d.

T 12,12 RATE OF TOTAL IPI TREND JUNE 1989



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 coresponding twelve-month level, a year before. The resulting growth is denominated T^{12}_{12} and its values for the IPI are shown in Graph 7c. 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 contains strong oscillations (see Graph 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 or trend series. Both are shown in Graph 4, 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 Graph 7d 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 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 III. 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 calcuation without, implicitly or explicitly, using forecasts.

Through the fact of using forecasts (referring to t+1, t+2,....)for the calculattion 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

Table 4

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
	INERTIA	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

(t-j) using m+j forecasts, is very useful, since it shows us the effect that innovations (errors committed in the forecast 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 can be calculated month by month, as the value into which the annual rate of growth of the forecasts converges.

The thick line on Graph 8a 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. Graph 8b shows annual growths T^{12}_{12} corresponding to the previous trends.

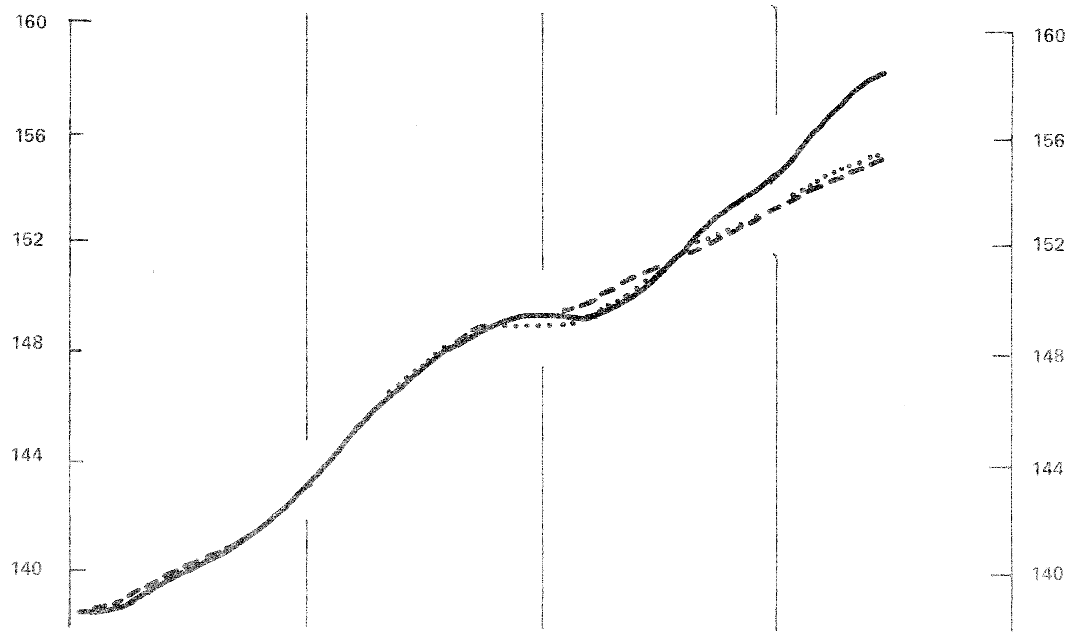
From these graphs one can deduce that:

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.

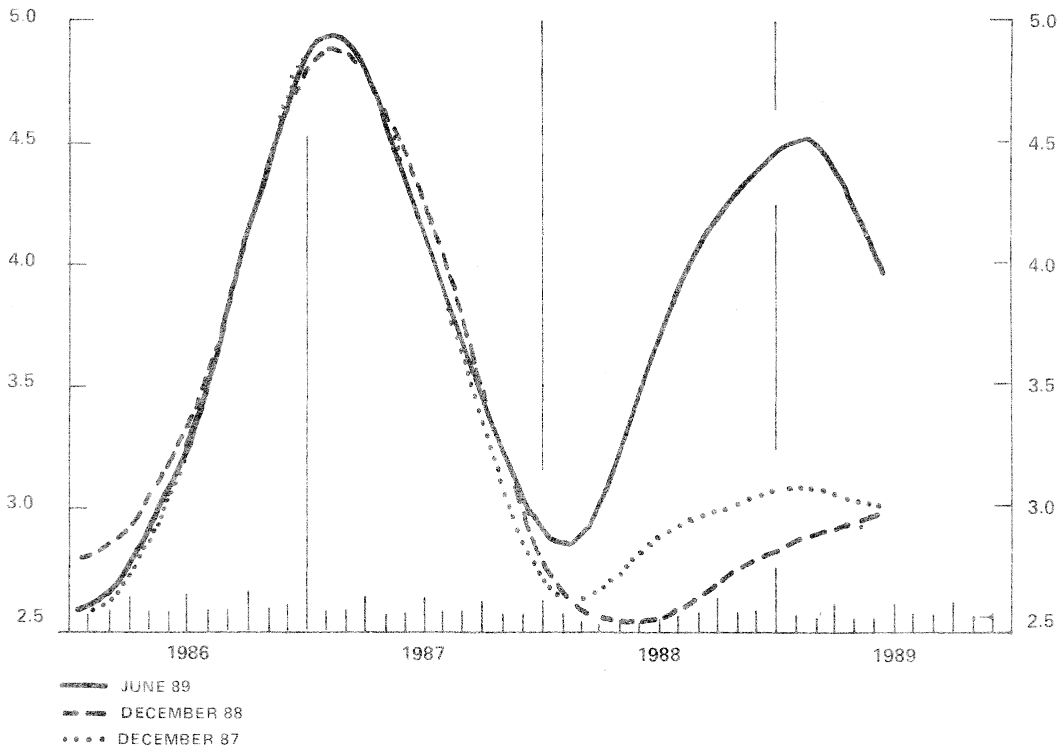
Graph 8a

TREND IN THE SPANISH INDUSTRIAL PRODUCTION INDEX



Graph 8b

GROWTH RATE IN THE SPANISH INDUSTRIAL PRODUCTION INDEX



3) This evolution of the IPI means (see Graph 8a) 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 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 graph 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 Graph 9. 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

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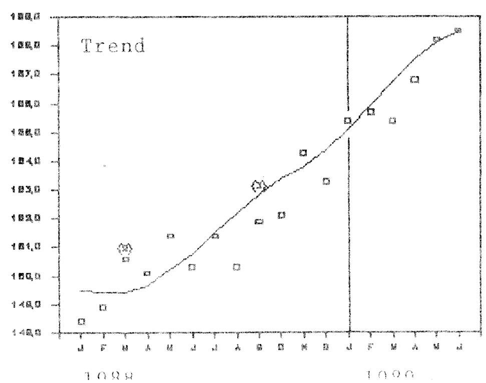
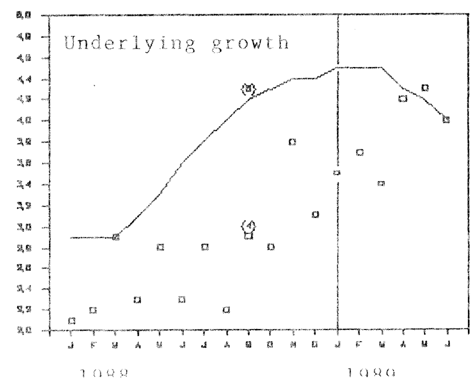
Table 5

Latest observation June 1989

DATE	ORIGINAL SERIES (1)	TREND: Estimated value in t for date t (2)	TREND: Present estimate for the whole sample (3)	Underlying growth: Estimated value in t for date t (4)	Underlying growth: Present estimate for the whole sample (5)	INERTIA: Medium-term growth expectations (6)	SEASONAL FACTOR: Estimated value in t for date t (7)	SEASONAL FACTOR: Present estimate for the whole sample (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
Septem.	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
Novemb.	168.9	154.3	153.8	3.8	4.4	3.2	108.65	108.48
Decemb.	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





1988 onwards. Thus, fom an expectation of medium-term growth of 2.85 in January 1988, we have moved to 3.6% in June 1989.

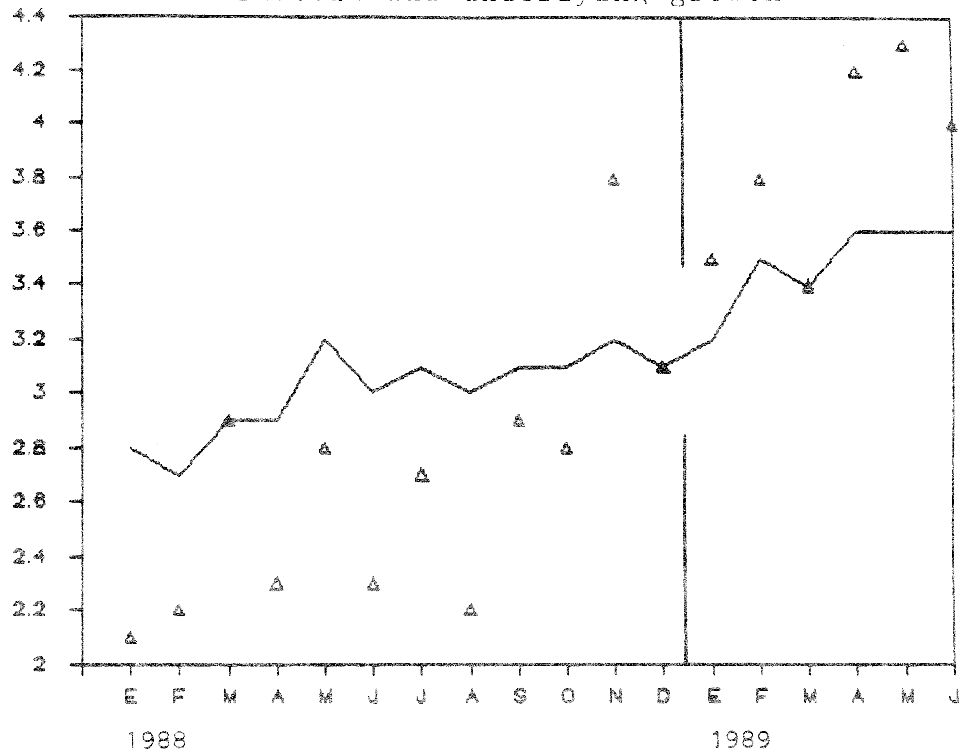
In Graph 9, by means of points, the trend growth that was estimated for each month at the particular time is specified (values highlighted in Table 4). By comparing the sequence of points with the thick line of medium-term growth expectations we see that there has always been a message of recovery, throughout 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 significantly 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, based 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^{12}_{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. Six months later we can say that this last diagnosis was very inadequate.

GRAPH 9

INDUSTRIAL PRODUCTION INDEX

Inertia and underlying growth



— Inertia (medium-term growth expectations)
Δ Underlying growth (T12x12 of the IPI trend).

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APPENDIX

DETERMINISTIC FACTORS

Underneath a detailed explanation is given of each of the effects, trend, seasonal and irregular, which produce each of the deterministic variables of the model.

Dummy variable for the Easter effect (HSS).

Following on from Hillmer, Bell and Tiao (1982) this variable can be broken down in the following way, at each moment of the time t:

$$HSS = H1 + H2 + H3$$

where:

$$H1 = HSS - 1/2\ MA ,$$

$$H2 = 1/2\ MA - 1/12 ,$$

$$H3 = 1/12 ,$$

MA being a dummy variable which takes value zero in all months except March and April when it takes the value 0.58 and 1.42 respectively; these values respond to the fact that throughout the years constituting the sample used, the weighted mean of the days affected by Easter falling in March is 29%, and in April 71%.

Let us notice then that H1 is a dummy variable which only takes values other than zero in the months of March and April and its sum each year is zero; H2 is a dummy variable whose values add up to zero on every twelve consecutive observations; and, finally, H3 is a constant.

In consequence, calling w_1 the coefficient estimated for the variable HSS in the model, we have that the joint effect - which we shall represent by E- will be given at each moment in time, by:

$$E = w_1 \ HSS = w_1 \ H1 + w_1 \ H2 + W_1 \ H3 = E1 + E2 + E3$$

where E1 represents the pure Easter effect, E2 registers a pure seasonal effect and E3 measures the influence on the level (trend effect).

2. <u>Seasonal change in summers from 1980 onwards</u> (S8007)

If we look at the model and abstract from the rest of the variables we can write:

$$\Delta\Delta_{12} \log IPI = \ldots + (w_2 + w_3 L) \ \Delta\Delta_{12} \ SS8007 \ + \ldots$$

where w_2 and w_3 are the estimated coefficients.

Given that, as we expressed before, the variable SS8007 takes the value one in the months of July for the year 1980 and the following ones, and zero in the rest, we have that w_2 and w_3

measure, respectively, the effect in the months of July and August from 1980 onwards on log IPI.

Now, since we are dealing with a seasonal change, it must happen that these effects are compensated in the year, the reason why this change will have effects not only in the months of July and August but, also, in the other months of the year; to estimate these latter effects we will proceed as follows. Let us represent by δ_j the influence of each of the months on log IPI; from what has been mentioned previously we have that the sum of the effects each consecutive twelve months has to be zero, therefore

$$\delta_j = h_j - \bar{h} \quad , j = 1, \ldots, 12$$

where:

$$\bar{h} = \frac{1}{12} \sum_{j=1}^{12} h_j$$

and $h_j = 0$; $j \neq 7$ and 8; $h_7 = w_2 = 0.0292$; and $h_8 = w_3 = -0.0854$.

From all the above it is derived that the coefficients δ_j estimated for the different months are:

January	0.004683
February	0.004683
March	0.004683
April	0.004683
May	0.004683
June	0.004683
July	0.033883
August	-0.080716
September	0.004683
October	0.004683
November	0.004683
December	0.004683

3. Seasonal change in summers from 1986 onwards (SS8606 and SS8608)

In this case the dummy variables used to register this effect take values which are compensated each consecutive twelve months and, since they are affected from the same number of differences as the variable log IPI we have that this seasonal change only has an effect other than zero in the months of June, July and August of 1986 and the following; and this effect is measured by simply multiplying the same coefficient -we should remember that in the estimate stage this value is restricted to being unique - by the values of the variables; that is, w_4 in June, w_4 in July and $-2w_4$ in August.

4. Trend change since 1980 (T80018208)

As we did previously, let us consider only a part of the model:

$$\Delta\Delta_{12} \log IPI = \ldots + w_5 \quad \Delta\Delta_{12}\, T80018208 + \ldots$$

According to that, the variable "truncated trend" directly affects log IPI, with this effect being equal to

$$w_5\ T80018208$$

5. Calendar.

To distinguish the effects on the non-observable components of the series induced by the calendar variables, following on from Hillmer, Bell and Tiao (1982), it is convenient to bear in mind the following equality:

$$T_{7t} = T_{7t} - LF + \frac{365.25}{12} + LF - \frac{365.25}{12} ,$$

where LF is a dummy variable which takes the value 0.75 in the month of February in Leap years; -0.25 in the month of February in non-Leap years and zero in the remaining months of the year.

In this way, by representing by w_6, w_7, w_8, w_9, w_{10}, w_{11} and w_{12} the coefficients which affect the variables DL, DM, DMX, DJ, DV, DS and DSS, we have that the joint effect of these variables can be broken down into:

$$TD_t = w_6\ DL_t + w_7\ DM_t + w_8\ DMX_t + w_9\ DJ_t + w_{10}\ DV_t + w_{11}\ DS_t$$

$$+ w_{12}\ LF_t + w_{12}\ (\ DSS_t - LF_t - \frac{365}{12}\ ) +$$

$$+ w_{12}\ \frac{365.25}{12}\ .$$

In the previous expression, the last number in the addition is a constant, the previous one is such that it adds up to zero each twelve consecutive periods - it is, thus, a seasonal effect - and, finally, the rest jointly represents the pure calendar effect, and it can be proved, (see Hillmer, Bell and Tiao (1982)) that in the long run it is zero.

6. <u>Midweek</u> <u>holidays</u> (DFFN and DFFA)

The effect of these two variables on log IPI is the result of multiplying the respective coefficient by each variable; nevertheless, such a joint efect can be broken down into a pure seasonal efect and an effect on the level.

Let us represent by N_t and A_t variables whose values are constant within each natural year, such a constant being the number of state and local holidays, respectively, of the year in question, except for Sunday and Saturday holidays; that is, if in 1983 the number of state holidays was five and local ones three, the variables N_t and A_t take these values in all the months for that year.

Let us now call FPN_t and FPA_t the percentage of state and local holidays, respectively, in month t in a natural year with regard to the total of each year; that is to say:

$FPN_t = DFFN_t / N_t$; and, $FPA_t = DFFA_t / A_t$

we then have that it is possible to write:

$$DFFN_t = N_t \quad (FPN_t - 1/12) \quad + 1/12 \; N_t$$

$$DFFA_t = A_t \quad (FPA_t - 1/12) \quad + 1/12 \; A_t$$

Now, the terms in brackets add up to zero each twelve consecutive periods- the effect of the first sum to be added is, therefore, of a seasonal nature -; the second sum to be added in both expressions is a constant and thus affects the level of the variable.

Thus, w_{13} and w_{14} being the coefficients estimated for DFFN and DFFA, the seasonal effects of both variables will be given in each month t by

$$w_{13} \; N_t \quad (FPN_t - 1/12); \text{ and,}$$
$$w_{14} \; A_t \quad (FPA_t - 1/12)$$

7. <u>Variables impulse</u> (D7902, D7912, D8209 and D8408)

They all exert their influence on the irregular component and their effect is measured by the result of multiplying the value of the coefficient estimated by the value of the corresponding variable.

Having reached this point it is worthwhile summarising what has so far been expressed, by classifying the effects according to the component of the series that is affected.

1. Trend

$$w_1\ H3 + w_5\ T80018208 + w_{12}\ 365.25/12 + w_{13}\ N_t/12 + w_{14}\ A_t/12$$

2. Seasonal

$$w_1\ H1 + w_1\ H2 + \sum_{j=1}^{12} \delta_j + (w_4 + w_4\ L)\ SS8606 +$$

$$+ w_4\ SS8608 + w_6\ DL + w_7\ DM + w_8\ DMX + w_9\ DJ$$

$$+ w_{10}\ DV + w_{11}\ DS + w_{12}\ LF + w_{12}\ (DSS - LF -$$

$$(365.25/12)) + w_{13}\ N_t\ (FPN_t - 1/12) +$$

$$+ w_{14}\ A_t\ (FPA_t - 1/12)$$

3. Irregular component

w_{15} D7902 + w_{16} D7912 + w_{17} D8209 + w_{18} D8408.

Thus, in this way, we have the following previous factors:

A. <u>Trend</u>

a) through change from 1980 onwards

$$PT_t = \exp\ (w_5 * T80018208) * 100 =$$
$$\exp\ (-0.0036 * T80018208) * 100$$

b) through midweek holidays

b.1. State

$$PN_t = \exp\ (w_{13} * N_t /12) * 100$$
$$= \exp\ (-0.0246\ N_t /12) * 100$$

b.2. Local

$$PA_t = \exp\ (w_{14} * A_t /12) * 100$$
$$= \exp\ (-0.0157\ A_t /12) * 100$$

b.3. Total

$$PFT_t = PN_t * PA_t /100$$

c) Total

$$FTDP_t = PT_t * PFT_t /100$$

B. Seasonal

a) through Easter

$$PH12_t = \exp (w_1 H1) \exp(w_1 H2) * 100$$
$$= \exp (-0.0428 * (H1 + H2)) * 100$$

b) through seasonal change in summers

b.1. From 1980 onwards

$$PV1_t = \exp (\delta_j) * 100$$

b.2. From 1986 onwards

$$PV2_t = \exp(w_4 * (SS8606+SS8607+SS8608)) * 100$$
$$= \exp (0.0201 * (SS8606+SS8607+SS8608) * 100$$

where SS8607 is a variable which takes the value one in the months of July for the year 1986 and following, and zero in the rest.

b.3. Total

$$PV_t = PV1_t * PV2_t /100$$

c) through the calendar effect

$$PC_t = \exp (w_6 DL_t + w_7 DM_t + w_8 DMX_t + w_9 DJ_t + w_{10} DV_t + w_{11} DS_t + w_{12} LF_t +$$

$$+ w_{12} (DSS_t - LF_t - (365.25/12)) * 100$$

$$= \exp (-0.0018 DL_t + 0.01 DM_t + 0.0005 DMX_t$$

$$+ 0.005 DJ_t + 0.0081 DV_t - 0.0069 DS_t +$$

$$+ 0.0132 LF_t + 0.0132 (DSS_t - LF_t -$$

$$- (365.25/12)) * 100$$

d) through midweek holidays

d.1. State

$$PFN_t = \exp (w_{13} N_t (FPN_t - 1/12)) * 100$$

$$= \exp (-0.0246 N_t (FPN_t - 1/12)) * 100$$

d.2. Local

$$PFA_t = \exp \; (w_{14} \; A_t \; (FPA_t - 1/12)) * 100$$

$$= \exp \; (-0.0157 \; A_t \; (FPA_t - 1/12)) * 100$$

d.3. Total

$$FEDP_t = PH12_t * PV_t * PC_t * PF_t / 100^3$$

C. <u>Irregular component</u>

$$PI_t = \exp \; (w_{15} \; D7902 + w_{16} \; D7912 + w_{17} \; D8209 +$$

$$+ w_{18} \; D8408) * 100$$

$$= \exp \; (-0.0515 \; D7902 - 0.0325 \; D7912 +$$

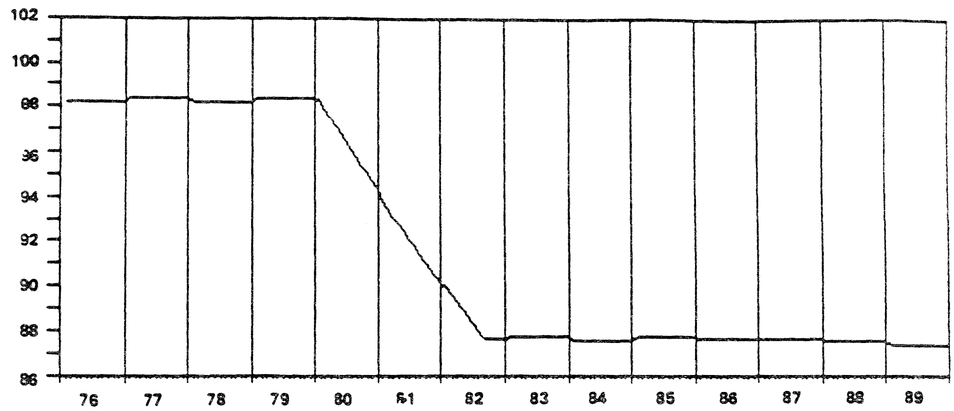
$$0.0397 \; D8209 + 0.0465 \; D8408) * 100$$

The trend and seasonals deterministic factors are presented in the graphs A.1 to A.4.

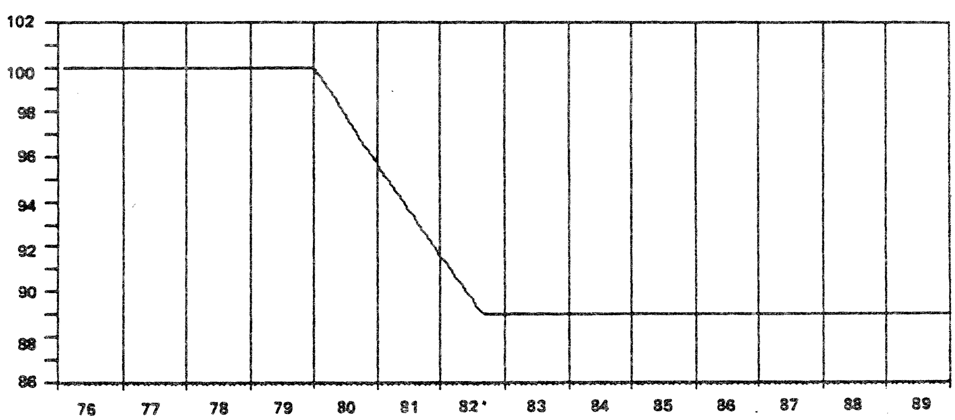
GRAPH A.1

TREND DETERMINISTIC FACTORS

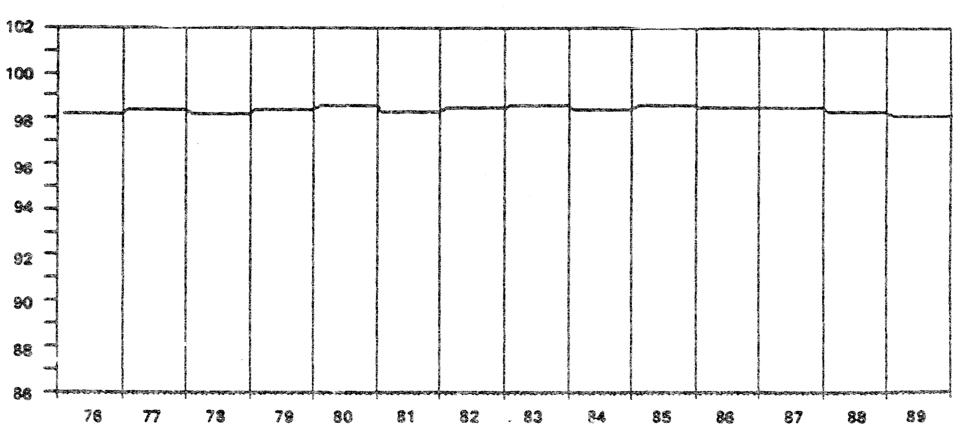
TOTAL



TREND CHNGE (JANUARY 1980/AUGUST 1982)

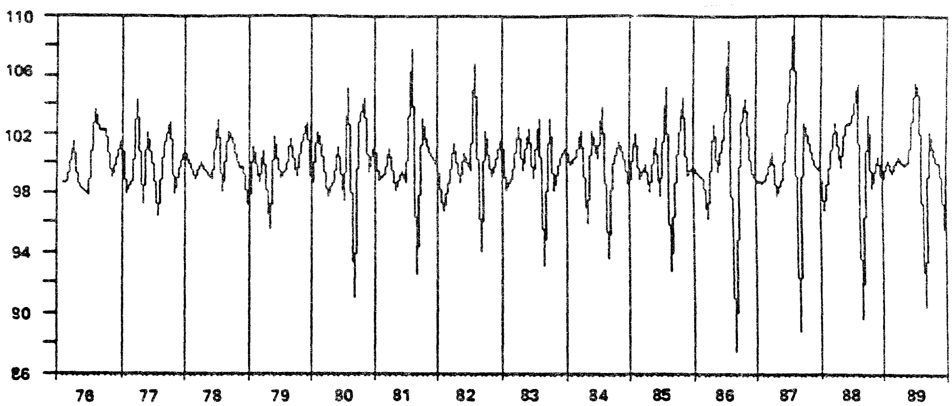


MIDWEEK PUBLIC HOLIDAYS (TOTAL)

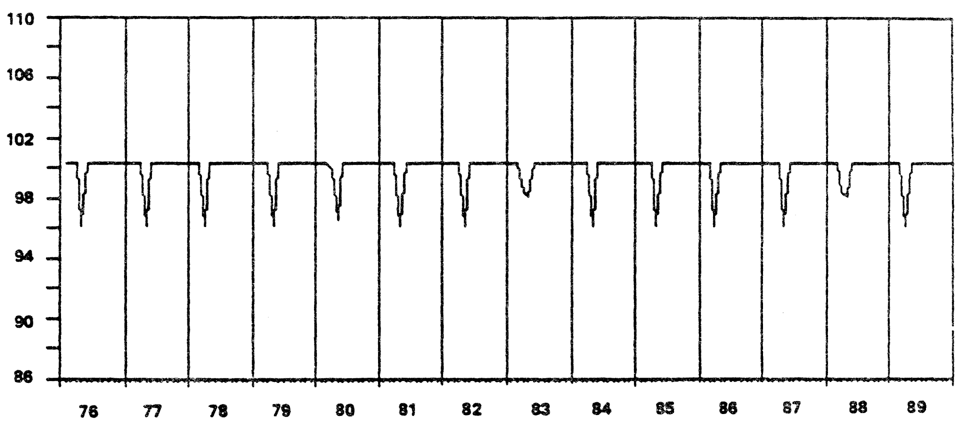


GRAPH A.2

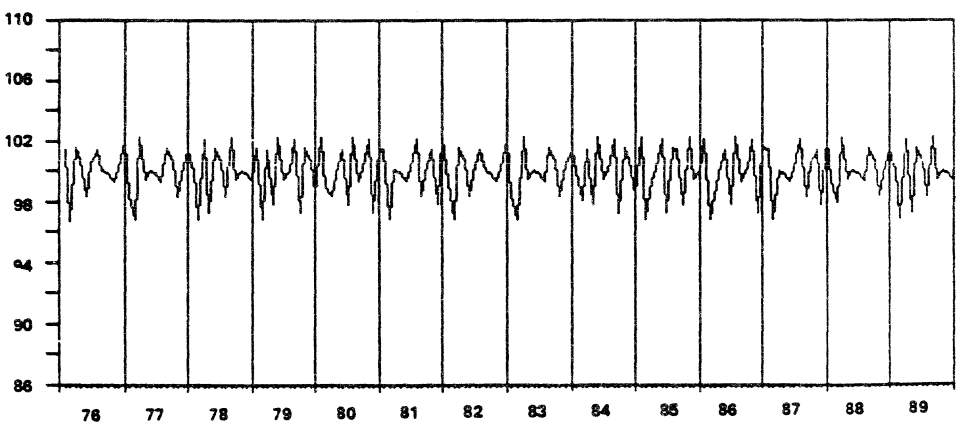
SEASONAL DETERMINISTIC FACTORS
TOTAL



EASTER EFFECT

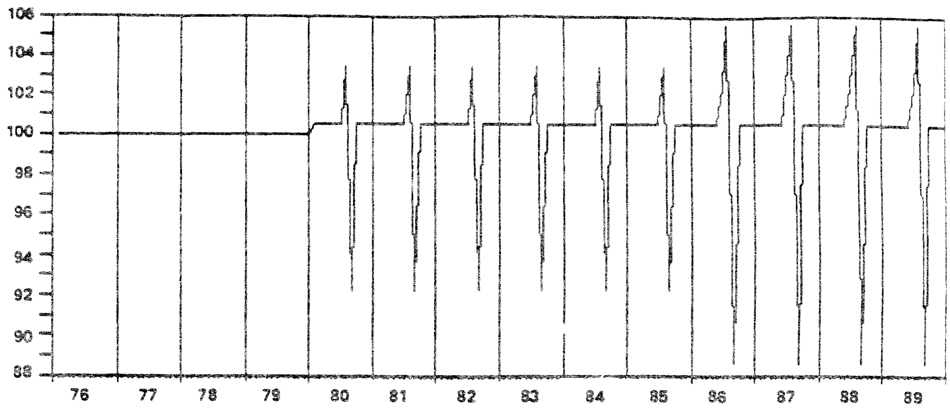


CALENDAR EFFECT

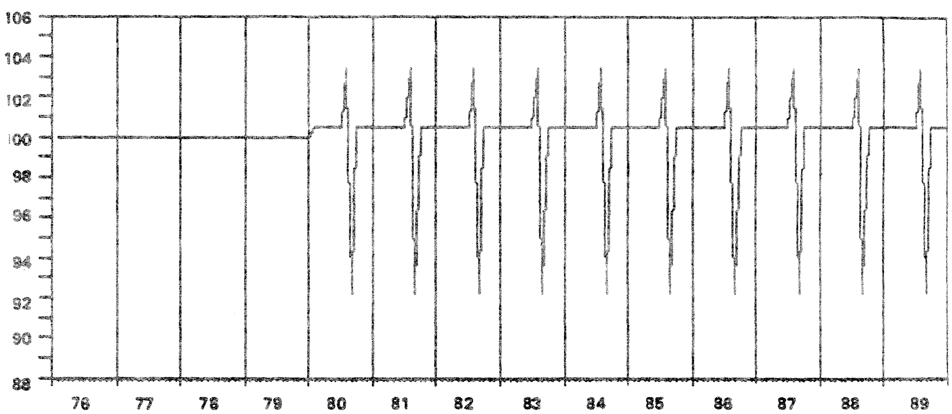


GRAPH A.3

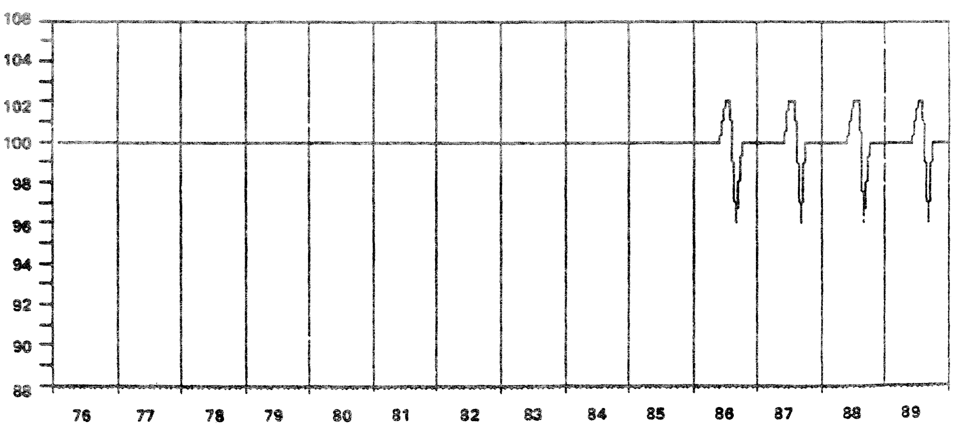
SEASONAL DETERMINISTIC FACTORS
SEASONAL CHANGE IN SUMMERS (TOTAL)



SEASONAL CHANGE IN SUMMERS FROM 1980 ONWARDS

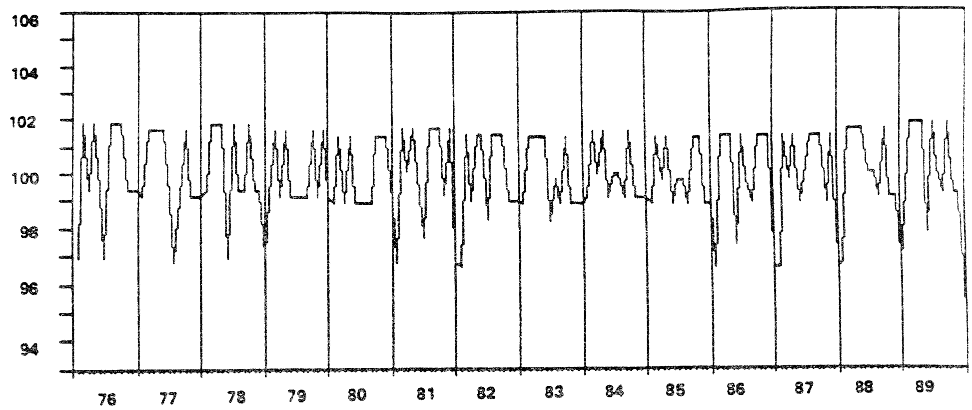


SEASONAL CHANGE IN SUMMERS FROM 1986 ONWARDS

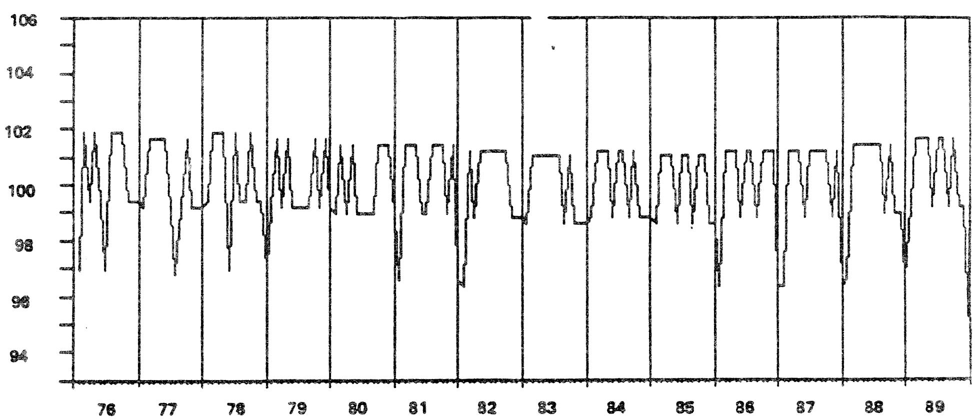


GRAPH A.4

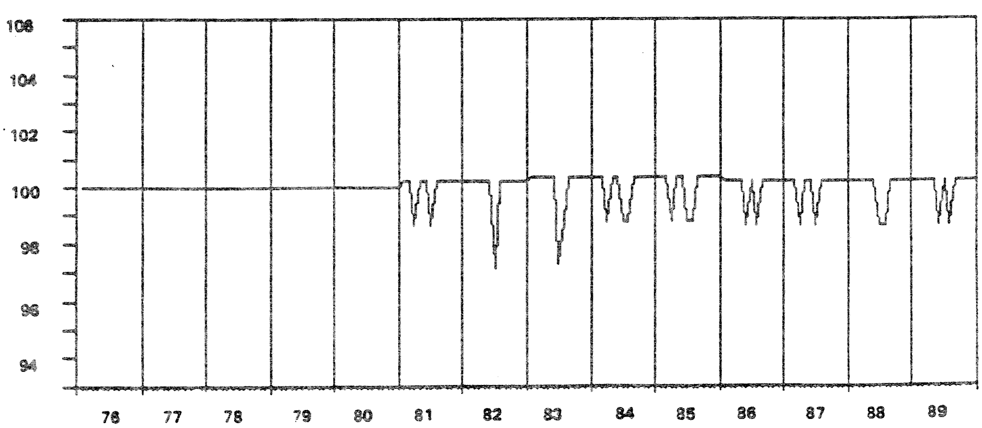
SEASONAL DETERMINISTIC FACTORS
MIDWEEK HOLIDAYS (TOTAL)



MIDWEEK HOLIDAYS (STATE)



MIDWEEK HOLIDAYS (LOCAL)



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