Working Paper 91-28
November 1991

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CHARACTERIZATION OF PRODUCTION IN DIFFERENT BRANCHES OF SPANISH INDUSTRIAL ACTIVITY, BY MEANS OF TIME SERIES ANALYSIS

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Abstract

This work presents a quantitative study of the evolution of Spanish industrial activity, measured by the indices of industrial production, by means of Time Series analysis. Univariate ARIMA models with intervention analysis for all the series of these indices have been constructed.

The use of Univariate Time Series models to characterise economic phenomena is justified and the type of characterisation made for each industrial branch is described. The procedures for automatic modelling of series are presented. Then the characteristics of the Spanish industrial branches are shown. These results are collected in a diskette for use of researchers.

Key words: ARIMA model, intervention analysis, univariate model, industrial production, automatic modelling.

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1. INTRODUCTION

This paper presents a quantitative study of the evolution of Spanish industrial production, as measured by the indices of industrial production, with a high degree of breakdown by sectors, by means of Time Series analysis.

To characterise the evolution of production in the different branches of industrial activity the ARIMA models with intervention analysis (ARIMA-IA) are used. The branches or sectors have been studied at four successive levels of breakdown in accordance with the "Clasificación Nacional de Actividades Económicas" (National Classification of Economic Activities) existing in Spain (see Instituto Nacional de Estadística 1984):

1) The whole of industry (except building)
2) The four divisions
3) The twenty-six classes
4) The eighty-nine groups

For each of the sectors, and on the basis of models that have been estimated to describe their production indices, a set of characteristics, as trends, seasonal variations, cyclical oscilations, unpredictability, etc., which make up the essential traits of the different industrial productions, are extracted. Thus for each sector we construct a vector of values corresponding to the characteristics above mentioned. The information for all the sectors has been organized in a matrix form and can be used to look for groupings of sectors.

In order to carry out this work computerised procedures and programs have been developed with the aim of modelling sets of series, within the Box-Jenkins modelling strategy.

The data used were the indices of industrial production (I.P.I.), base 1972=100. In all series the sample contains 168 observations concerning the period between January 1975 and December 1988.

The remainder of this work is organised in the following way. In section 2 we justify the use of Univariate Time Series models to characterise an economic phenomenon and the type of characterisation made for the production of each industrial branch is presented. In section 3 there is a brief description of the automatic procedure for initial specification, estimation and validation used to build ARIMA-IA models for a broad set of time series. Finally, in section 4 comment is made on the type of results obtained for the different Spanish industrial branches.

2. UNIVARIATE TIME SERIES ANALYSYS AS AN INSTRUMENT TO CHARACTERISE AN ECONOMIC PHENOMENON: THE TYPE OF CHARACTERISATION USED IN THIS PAPER.

Under fairly general conditions (see Prothero and Wallis (1976), Wallis (1977, 1980), Zellner and Palm (1974), Zellner (1979), etc.) any economic variable which is determined within a structural simultaneous and dynamic econometric model (SEM) is generated in a univariate way by an ARIMA-IA model, in which the intervention analysis component picks up the contribution of the dummy variables of the SEM model and/or the effect of certain intervention analysis which affect the exogenous variables of that model.

To the extent that the SEM model reflects the characteristics of the real world, the ARIMA -IA univariate model corresponding to an endogenous variable of the SEM model incorporates inefficiently but certainly consistently the basic characteristics of that variable.

In the following, we will considerer one by one the differents aspects we have studied in the models, justifying its use for the purpose of characterisation of the corresponding variable, and describing how they have been implemented.

(a). In the models it is contained an adequate description of the nature of the long-term trend of the series in question. This trend is determined by the contribution in the final forecast function (see Box-Jenkins 1970) of the real positive unit roots of the autoregresive factor and by the contribution of the possible non-zero mean of the stationary series. The presence of d roots of the type already mentioned means that the long-term trend is a time polynomial of order (d-1), the coefficients of which are determined by the initial conditions in which the system is located. The presence of a non-zero mean increases the previous polynomial with a term of order d with a deterministic coefficient. The automatic specification, estimation and validation procedure used in this paper is geared towards the building of models with a zero mean in the stationary transformation. This has been done because in a dynamic and stochastic world the identification of non-zero means is possibly more a problem of small samples than a characteristic of such world.

Thus, whenever the series is stationary would not require differences and its level will move around zero. When the model specifies a difference the series will show local oscilations in level; when the model specifies two differences the series will have a quasilinear trend, etc.

(b). The models also can contain a factor which picks up a seasonal cycle with a period of s time units. This factor is formed by the complex unit roots and real negatives of the autoregressive polynomial. If none of these roots is repeated its contribution in the final forecast function consists of s stable, additive, seasonal factors which at all times are determined by the initial conditions of the system. As a result, the long-term path of the series is made up of these seasonal factors and the trend described in (a).

Whenever a seasonal cycle has been found the seasonal factors of the final forecast function have been calculated, following Espasa and Peña (1990).

When the corresponding model has been specified on the logarithmic transformation of the series, these seasonal factors act as multiplicative factors in the original series and can be interpreted as percentage increments in the long-term trend of the original data. In this paper all the models are eventually specified using the logarithmic transformation.

(c). In the ARIMA-IA models is possible to find deterministic contributions in the trend and/or seasonal factors of the series derived fron the intervention analysis which may be included in the univariate model. These deterministic contributions, which have a limited effect on time, should not be seen as elements which challenge the hypothesis of a purely stochastic world, but as factors which are useful to relax the linear restriction of the ARIMA models.

Different dummy variables have being considered to detect these contributions in the series studied in this paper.

In order to find the existence of <u>abrupt changes in trend</u> as a consequence of the second energy crisis the models have been estimated by incorporating an artificial truncated trend variable which evolves from mid-1979 to mid-1982. When the estimated parameter asociated with this dummy variable is significantly non-zero, trend evolution is considered to have been affected by the second energy crisis. The global effect on the series level consists of displacing this level to a magnitude equal to the value of the estimated parameter multiplied by the number of periods in which the interruption takes place (see Box and Tiao 1975). Logarithms having been taken in all models this can be translated into a percentage effect on the level of the original series.

Various interruption periods have been tested for the different industrial branches and it was found that their beginning and end do not coincide in all the branches affected.

To study the sensitivity of production to <u>the effects of the working days</u> a dummy variable has been created to measure the total number of working days in each month, considering as such week days from Monday to Fryday which are not national holidays, (the days of Holy Week are also considered to be working days, since the effect of these is studied separately).

By constructing the model on the logarithmic transformation of the series the parameter associated with this dummy variable can be interpreted as the reduction (as a proportion) in production in comparison with that in a similar month with one more working day.

The study of the effect of Holy Week was carried out by including in the model a dummy variable which takes in the month of March and April each year the values that indicate the proportion of days affected by these holydays and in the other months value zero (see Hillmer, Bell and Tiao 1983). The parameter which affects this artificial variable can be interpreted such as the variation as a proportion suffered by production as a result of this effect.

(d). The models also contain a stationary factor which expresses the form and speed with which the process tends to a long-term path.

Using the model's eventual forecasting function, it is possible to obtain, at a particular moment in time, a long-term path for the process, from the contribution made to this function by the unit roots of the autoregressive factor. Furthermore, the stationary factors determine the way in which the process would tend to approach this long-term path if in the future there were no more innovations.

In this way, if the stationary model does not have an autoregressive part, the approach to a long-term path takes place from the moment F in which the eventual forecast function comes into operation. When an stationary autoregressive part exists this approach takes place progressively from the moment F following a function which has an exponential or oscilating structure (or a mixture of them), and its speed or slowness is determined by the value of the dominant autoregressive root. The lower the latter's absolute value, the slower the approach to the equilibrium path. Even though the structure determines that the equilibriun path would only be obtained after infinite period of time, in practice, after a more or less large finite number of periods, the process could be considered to have attained it.

The moving average part of the model also intervenes in the form of approaching to the long-term path insomuch as the order of the moving average polynomial intervenes in the determination of the moment F.

(e). From the models we have an indication of the innovations (residuals) than can be considered outliers and their magnitudes.

The outliers are those observations whose residuals, once the models have been estimated, fall outside an interval determined by a number of times the residual standard deviation. For this work the values outside three standard deviations have been taken as outliers.

The study of outliers can be used to detect special circunstances which may affect production at a particular time, to analyse if they appear fortuitously or not in the different branches, to analyse in what periods of time they appear more frequently, etc.

(f). The last characteristic we have considered is a measure of the unpredictability of the future evolution of the series expressed by the variance of the one period ahead forecasting errors.

Each series at a given time can be broken down into two components: its prediction based on previous observations and a prediction error. A good measure of uncertainty is given by the standard deviation of these prediction errors.

The development of the methodology adopted in this paper requires, previously, the availability of ARIMA models with intervention analysis which can adequately explain the behaviour of each of the sectors. In the next section we discuss an automatic modelling procedure useful for this prupose.

3. AUTOMATIC MODELLING OF SEVERAL TIME SERIES

In order to carry out the automatic modelling of time series procedures have been deviced and computer programs developed which allow univariate treatment, by means of ARIMA models with intervention analysis, of large number of series.

The procedures allow flexibility in the sense that a choice can be made between different degress of automation, by increasing or decreasing expert intervention, as one wishes. In the most automatic option the intervention of the latter is completely eliminated.

The procedures developed fit into Box-Jenkins iterative modelling strategy for initial specification, estimation and validation. The result of these procedures is the choice of an ARIMA model within the general class

$$(1-\phi_1 L-\phi_2 L^2 -\phi_3 L^3)\ (1-\Phi_1 L^s -\Phi_2 L^{2s})\ (1-L)^{d=0,1,2}$$

$$(1-L^s)\quad X_t \text{ (or } \ln X_t)= (1-\theta_1 L-\theta_2 L^2 -\theta_3 L^3)$$

$$(1-\Theta_1 L^s -\Theta_2 L^{2s})a_t ,$$

where X_t is the observed serie, a_t is white noise, s is the seasonality order and L is the backshift operator such that $L^p X_t = X_{t-p}$.

It also allows for the inclusion of intervention analysis of impulse type, step, trend and calendar effects.

For each stage a set of programs has been designed to perform different tasks: on the one hand, rules for action are established which try to synthesize the interpretations and decisions that an expert would make, and further more, tables are produced which summarise the important information so that he can work comfortably, as well as devices to avoid his carrying out routine tasks.

Once these models have been validated, forecasts and their confidence intervals can be automatically generated.

The procedures are computerised using the SCA system (Liu, Hudak, Box, Muller and Tiao 1983).

In order to carry out this task experiments have been made with various sets of Spanish economic series: industrial price indices, industrial production indices, consumer price indices, wages, wage earners, etc.

The strategy followed in the automatic modelling procedures is detailed described in Revilla, Rey and Espasa (1990).

4. CHARACTERISATION OBTAINED FOR THE PRODUCTION IN THE SPANISH INDUSTRIAL SECTORS

In this section an analysis is made of the results of using the above-mentioned methodology in the production of the Spanish industrial sectors.

All the information about each one of the industrial branches has been collected in a diskette and through a personal computer a particular researcher can look for groupings of sectors according to certain values in a set of characteristics.

The main results are synthesized in Table 1 obtained for the four levels of breakdown studied (whole industry, divisions, classes and groups).

The following are shown in the chart:

1) Identification of the sector by means of the code of the "Clasificación Nacional de Actividades Económicas" (National Classification of Economic Activities) (C.N.A.E.).

2) The weight in a per thousand points that each sector has in relation to industry as a whole.

3) Behaviour of the level.

4) Measurement of the change in trend caused by the second energy crisis in the sectors where this interruption is produced.

5) Whether the sector has seasonal behaviour or not.

6) Measuring the effect of trading days, when this affects the series.

7) Measuring the effect of Holy Week, when this affects the series.

8) Outliers, the date when they are produced and their importance measured in terms of standard deviations in the series of residuals of the model.

Table 1. Characteristics of the Spanish Industrial Sectors

SERIE NCEA [a]	WEIGHT IN 0/00	BEHAVIOUR OF LEVEL	CHANGE IN TREND [b]	SEASON-ALITY	EFFECT WORK DAY	EFFECT HOLY WEEK	OUTLIERS DATE	OUTLIERS ST.DEV.	RES. DEVIATION SPEED	UNCER-TAINTY (%)
IN.G.	1000.00	TREND	-8.32 %	YES	-1.9%	-4.5%				2.45
1	103.00	TREND		YES	-.9%	-2.8%				2.83
11	18.95	TREND	34.24 %	YES	-1.7%	-.2%	FEB 81	3.2		7.75
111	15.81	L.OSCILATION	45.44 %	NO	-2.1%	-1.0%				8.89
114	3.15	TREND		YES						4.00
12	.21	L.OSCILATION		NO	-1.8%	-2.9%	JAN 78 FEB 82	-3.3 -5.0		15.30
122	.21	L.OSCILATION		NO	-1.8%	-2.9%	JAN 78 FEB 82	-3.3 -5.0		15.30
13	10.30	L.OSCILATION		NO			APR 77 JUN 77	-3.2 4.2		8.06
130	10.30	L.OSCILATION		NO			APR 77 JUN 77	-3.2 4.2		8.06
14	.10	TREND	-87.68 %	YES	-6.0%		DEC 80	-3.1	FAST	33.17
140	.10	TREND	-87.68 %	YES	-6.0%		DEC 80	-3.1	FAST	33.17
15	73.44	TREND		YES	-.6%	-3.5%				2.83
151	71.53	TREND		YES	-.7%	-3.2%				2.83
152	1.91	TREND		YES		-12.1%	NOV 85 DEC 86	3.3 -3.8	FAST	6.93
2	212.00	TREND		YES	-1.2%	-2.4%	AUG 80 AUG 86	-4.1 -3.0		3.00
21	6.15	TREND		YES	-1.1%		DEC 83 AUG 86	3.8 -3.8		9.11
211	2.21	L.OSCILATION		NO	-1.0%		JUL 79 JUL 82	-3.9 -3.5		9.54
212	3.94	TREND		YES	-1.7%		OCT 75 DEC 83 AUG 86	-3.3 3.4 -3.7		11.22
22	71.66	L.OSCILATION		YES			AUG 86	-3.7	FAST	5.39
221	56.54	L.OSCILATION		YES			AUG 86	-3.3	FAST	6.24
224	15.12	TREND		YES						4.90
23	4.88	L.OSCILATION		YES	-2.8%	-8.4%				9.38
232	2.06	TREND		YES	-3.8%	-10.0%	MAR 76 AUG 80 JUN 83	-3.6 -3.3 -3.3		11.14
233	.80	TREND		YES			JUL 75 JUL 78 APR 83 JUL 83 JAN 85	3.7 3.5 -3.7 4.0 -4.0		18.63
234	.79	L.OSCILATION		YES	-2.7%		JUL 78	-3.3	MODER.	12.88
239	1.23	L.OSCILATION		NO	-3.0%	-12.3%	DEC 78 MAY 81 AUG 82	-3.1 6.2 -3.7		13.42
24	50.24	TREND		YES	-.9%	-2.7%				2.83

[a] NCEA= National Classification of Economic Activities

[b] Due to the second energy crisis

Table 1. Characteristics of the Spanish Industrial Sectors(cont.)

SERIE NCEA[a]	WEIGHT IN 0/00	BEHAVIOUR OF LEVEL	CHANGE IN TREND[b]	SEASONALITY	EFFECT WORK DAY	EFFECT HOLY WEEK	OUTLIERS DATE	OUTLIERS ST.DEV.	RES. DEVIATION SPEED	UNCERTAINTY (%)
241	7.99	TREND		YES	-1.7%	-2.9%	OCT 77 OCT 79 JAN 81 OCT 84	3.2 -3.5 -3.7 3.1		4.24
242	13.62	TREND		YES			JAN 85	-3.7		5.10
243	11.81	TREND		YES	-2.0%	-6.5%	MAY 82	3.4		5.29
245	.85	TREND	-29.76 %	YES	-3.5%	-12.5%	JUN 79 NOV 80 NOV 81 DEC 82	-3.3 -3.7 -3.5 -3.1		11.27
246	8.39	TREND		YES						6.32
247	7.59	TREND		YES			MAR 77 AUG 81 AUG 82	3.3 -3.0 -3.4		5.39
25	79.08	TREND	-20.16 %	YES	-1.7%	-3.6%	AUG 81	-3.3		3.46
251	29.65	TREND	-22.72 %	YES						4.00
252	7.83	TREND		YES			JAN 82	-3.5		11.53
253	12.89	TREND		YES	-2.6%	-7.0%	AUG 80 AUG 82	-3.0 -3.3		4.80
254	18.82	L.OSCILATION	-12.16 %	YES	-2.9%	-6.5%	AUG 80 AUG 82	-3.2 -3.6	SLOW	7.62
255	9.88	TREND		YES	-2.2%	-9.6%	AUG 81 AUG 82	-4.1 -3.4		6.93
3	242.00	TREND		YES	-3.3%	-5.6%	FEB 77 SEP 82	3.3 -3.9		5.83
31	64.37	L.OSCILATION		YES	-2.7%	-6.6%	AUG 81	-5.5	FAST	6.40
314	9.85	TREND		YES	-3.6%	-4.1%	APR 76 APR 77 JUL 80	3.1 3.0 3.2		9.22
315	5.66	TREND		YES	-4.4%	-13.2%	JAN 77 APR 85	4.0 4.1		12.61
316	48.86	TREND		YES	-2.5%	-7.0%	AUG 81	-5.5		6.24
32	35.82	L.OSCILATION		YES	-2.8%	-5.5%	AUG 82	-3.1	FAST	8.72
321	2.79	TREND		YES	-3.3%	-10.2%	OCT 77 JAN 78	-4.1 3.3		10.86
322	5.59	TREND		YES	-2.6%	-8.1%	APR 80 AUG 82	3.9 -3.1		8.49
323	5.19	TREND		YES	-3.4%	-8.5%	JUL 76 APR 77	3.4 3.4		10.82
324	3.51	TREND		YES			OCT 78 JAN 80	-4.8 3.2		11.87
325	7.23	TREND		YES			AUG 81 AUG 82	-3.1 -3.8		15.72
326	1.11	TREND		YES	-3.4%	-7.5%	AUG 81 AUG 86	-4.7 -6.7	FAST	23.79
329	10.39	TREND		YES						15.94
33	1.94	TREND		YES	-3.8%	6.9%	AUG 77 AUG 86	-3.3 -9.3		24.80
330	1.94	TREND		YES	-3.8%	6.9%	AUG 77 AUG 86	-3.3 -9.3		24.80
34	43.32	L.OSCILATION		YES	-3.0%	-4.9%	AUG 81	-3.3	SLOW	7.81
341	6.89	TREND		YES		6.4%	AUG 81 AUG 84	4.7 -3.4	MODER.	20.49
342	16.11	TREND		YES	-2.9%	-6.5%	AUG 82	-3.2		8.25

[a] NCEA= National Classification of Economic Activities

[b] Due to the Second energy crisis

Table 1. Characteristic of the Spanish Industrial Sectors (cont.)

SERIE NCEA[a]	WEIGHT IN O/OO	BEHAVIOUR OF LEVEL	CHANGE IN TREND[b]	SEASON-ALITY	EFFECT WORK DAY	EFFECT HOLY WEEK	OUTLIERS DATE	OUTLIERS ST.DEV.	RES. DEVIATION SPEED	UNCERTAINTY (%)
343	2.04	TREND		YES			AUG 78 AUG 79 AUG 80 AUG 83 AUG 84	-3.2 -3.1 -4.6 -3.3 4.7		14.32
344	1.86	L.OSCILATION		YES	-4.3%	-19.3%	OCT 77 OCT 85	-4.0 -6.2		18.06
345	13.08	L.OSCILATION	-28.16 %	YES	-3.8%	-6.1%	NOV 81 OCT 83 OCT 86	-3.6 -3.3 3.8	FAST	15.03
346	3.34	L.OSCILATION	-37.76 %	YES			FEB 82 OCT 84	-4.1 -3.6	FAST	13.15
35	16.70	TREND		YES	-2.1%		AUG 84	-6.2		15.00
351	9.17	TREND		YES			AUG 84	-4.7		21.91
355	7.53	TREND		YES			AUG 81 AUG 82	-4.7 -3.2		19.16
36	44.04	TREND	-34.56 %	YES	-3.8%	-6.5%	AUG 80 AUG 83	3.3 -3.1		10.70
361	44.04	TREND	-34.56 %	YES	-3.8%	-6.4%	AUG 80 AUG 83	3.3 -3.1		10.70
37	22.51	TREND		YES	-3.9%		JUL 79 JAN 82 OCT 84	3.1 4.6 -5.1		14.42
371	22.51	TREND		YES	-3.9%		JUL 79 JAN 82 OCT 84	3.1 4.6 -5.1		14.42
38	9.44	TREND		YES	-4.5%		AUG 84 AUG 87	-3.1 -5.8		22.09
381	5.28	TREND		YES	-5.2%		AUG 84 AUG 87	-3.1 -5.3		29.31
382	2.57	TREND		YES			SEP 77 AUG 81 AUG 87	-9.7 -3.2 -4.2		20.86
383	1.60	L.OSCILATION	-18.24 %	YES	-5.5%	-10.5%	AUG 85	-3.5	FAST	15.20
39	3.87	L.OSCILATION		YES	-5.3%		AUG 80 AUG 85 AUG 87	-3.1 -6.5 .0	FAST	23.87
391	3.44	L.OSCILATION		YES	-6.9%		JUL 77 AUG 80 AUG 81 AUG 85 AUG 87	-3.5 -3.2 -5.6 -3.2 -3.2	FAST	33.17
399	.43	TREND		YES			AUG 84	-8.8		41.50
4	443.00	TREND	-11.34 %	YES	-1.8%	-4.4%	AUG 81	-3.3		3.32
41	100.12	TREND		YES	-1.9%	-4.5%				3.87
411	3.50	TREND		YES			AUG 86 NOV 86	-6.1 5.1		57.44
412	3.31	TREND		YES	-1.4%	-8.8%	JUL 86	-3.9	MODER.	9.75
413	5.71	L.OSCILATION		NO	-1.8%	-7.0%	JUL 79	4.8		4.24
414	12.51	TREND		YES	-1.1%		SEP 76	3.1		3.61
415	8.21	TREND		YES	-1.4%	-6.9%	JAN 77 APR 77 OCT 77 JUL 78	-3.1 -3.2 3.8 -3.7		9.70
416	4.31	TREND	-10.56 %	YES	-3.0%	-8.8%	AUG 83	-3.5		9.59
418	2.10	TREND		YES	-1.5%	-9.1%	AUG 78	3.3		9.17

[a] NCEA= National Classification of Economic Activities

[b] Due to the second energy crisis

Table 1. Characteristics of Spanish Industrial Sectors (cont.)

SERIE NCEA [a]	WEIGHT IN O/OO	BEHAVIOUR OF LEVEL	CHANGE IN TREND [b]	SEASON-ALITY	EFFECT WORK DAY	EFFECT HOLY WEEK	OUTLIERS DATE	OUTLIERS ST.DEV.	RES. DEVIATION SPEED	UNCER-TAINTY (%)
419	1.80	TREND		YES	-2.8%	-7.1%				6.48
420	5.51	L.OSCILATION		YES			JUL 80 JUN 84	-4.8 -3.4	MODER.	94.56
421	3.70	TREND		YES	-3.4%	-8.2%	DEC 78 AUG 79	-3.0 -3.2		9.06
422	7.51	TREND		YES	-1.5%	-3.7%	JAN 80 OCT 80	-3.1 -4.2		5.29
423	4.91	TREND		YES	-2.1%	-7.8%	AUG 81	-4.8		10.72
424	7.61	TREND		YES			DEC 81 MAR 86 DEC 86	3.0 -4.4 3.8		11.45
426	.20	TREND	-25.60 %	YES	-1.7%	-4.4%	OCT 79 JAN 81 OCT 81	3.7 -3.7 3.4		7.55
427	9.21	TREND		YES	-3.8%	-.8%				7.07
428	6.61	TREND		YES	-1.8%	-5.5%	OCT 77 AUG 81	4.9 -3.0	MODER.	4.80
429	7.41	TREND		YES	-5.0%	-9.1%	AUG 83 AUG 84 AUG 85 AUG 86	-3.5 3.0 -3.4 -3.2		15.30
43	80.18	L.OSCILATION		YES	-1.2%	-5.4%	AUG 77	-4.5	MODER.	6.56
431	30.31	TREND		YES			AUG 77 AUG 83	-5.6 -3.8		8.25
432	21.49	L.OSCILATION		YES	-1.3%	-7.0%	AUG 77 JUL 78 AUG 78	-3.8 3.4 -3.5	MODER.	9.06
433	11.71	L.OSCILATION	-15.04 %	YES	-2.7%	-10.1%	OCT 79 OCT 82	-3.1 -5.0	FAST	9.36
434	2.41	TREND		YES	-2.3%	-13.0%	MAY 86 AUG 86	-3.1 -4.7		16.34
435	2.65	L.OSCILATION		YES			AUG 77 AUG 81 AUG 85	-5.5 3.9 3.2	FAST	10.25
436	6.17	L.OSCILATION		YES	-3.3%		OCT 80 OCT 81 OCT 86 NOV 86	-3.1 -3.0 -3.0 3.1	FAST	13.04
439	5.45	TREND		YES	-2.0%	-4.4%	AUG 78 SEP 78 SEP 81	3.1 -3.4 -5.7	FAST	8.37
44	17.28	TREND	-51.51 %	YES	-2.0%	-10.4%	AUG 80 SEP 80	-4.2 3.9		7.87
441	16.85	TREND	-51.34 %	YES	-2.2%	-10.3%	AUG 80 SEP 80	-4.3 3.9		7.81
442	.43	TREND	-21.92 %	YES	-1.6%	-10.7%	AUG 86	-3.8		18.33
45	103.22	TREND		YES			AUG 83	3.2		6.71
451	28.18	TREND		YES	-1.5%	-5.4%	JUL 80	4.0		5.57
453	75.04	TREND		YES			AUG 83	3.6		8.37
46	34.55	TREND		YES	-1.0%	-7.0%	SEP 76	-3.6		6.24
462	7.33	TREND		YES		-10.9%	AUG 77 AUG 84	-3.5 4.5		8.89
463	19.04	L.OSCILATION		YES	-.5%	-6.2%	SEP 76	-5.5		8.49
464	6.01	L.OSCILATION	-16.96 %	YES	-2.4%	-7.7%	MAY 85	-5.0		16.67
466	2.18	L.OSCILATION	-24.32 %	YES	-2.5%	-7.2%			SLOW	10.25
47	59.36	TREND	-26.91 %	YES	-1.2%	-4.4%	AUG 78	-3.1		4.90

[a] NCEA= National Classificacion of the Economic Activities

[b] Due to the second energy crisis

Table 1. Characteristics of Spanish Industrial Sector (cont.)

SERIE NCEA [a]	WEIGHT IN O/OO	BEHAVIOUR OF LEVEL	CHANGE IN TREND [b]	SEASON-ALITY	EFFECT WORK DAY	EFFECT HOLY WEEK	OUTLIERS DATE	OUTLIERS ST.DEV.	RES. DEVIATION SPEED	UNCER-TAINTY (%)
471	5.22	TREND	-15.04 %	YES	-.8%					6.08
472	14.96	TREND	-27.52 %	YES	-.8%	-3.8%	AUG 78	-3.2		3.87
474	39.18	TREND		YES	-1.8%	-4.7%	AUG 78	-3.5		6.63
48	48.29	TREND		YES	-3.9%	-3.9%	AUG 77	-3.7	MODER.	7.68
481	33.12	TREND		YES	-2.6%	-11.7%	AUG 77 JUL 78	3.1 -4.7		8.43
482	15.16	TREND		YES	-1.4%	-6.1%				4.24

[a] NCEA= National Classification of Economic Activities

[b] Due to the second energy crisis

9) Response to a deviation from the long-term path. When there is not indication in this column it means that the model does not include a stationary autoregressive factor.

10) The degree of uncertainty about future production levels.

To illustrate the information that can be obtained from the above table the characteristics of industry as a whole are described:

Industrial production from 1975 onwards shows a trend in its level. This trend was truncated from January 1980 till August 1982 with the second energy crisis. The fall in the level of production caused by this crisis can be put at 8,3%.

Production shows a stochastic seasonal nature, which implies different behaviour in production activity in different months of the year. (See Figure 1.(a)). In particular it shows a fall in the holiday months, particularly in the month of August.

The amounts produced are sensitive to the way in which the calendar is made up of days in the week and to periods of holidays. More specifically, the existence of one working day less causes a 1,9% drop in production. Likewise, Holy Week brings about a fall in production of 4,5% distributed between the months of March and April according to the proportion of days affected by this holiday in each year.

It does not show outliers above three standard deviations.

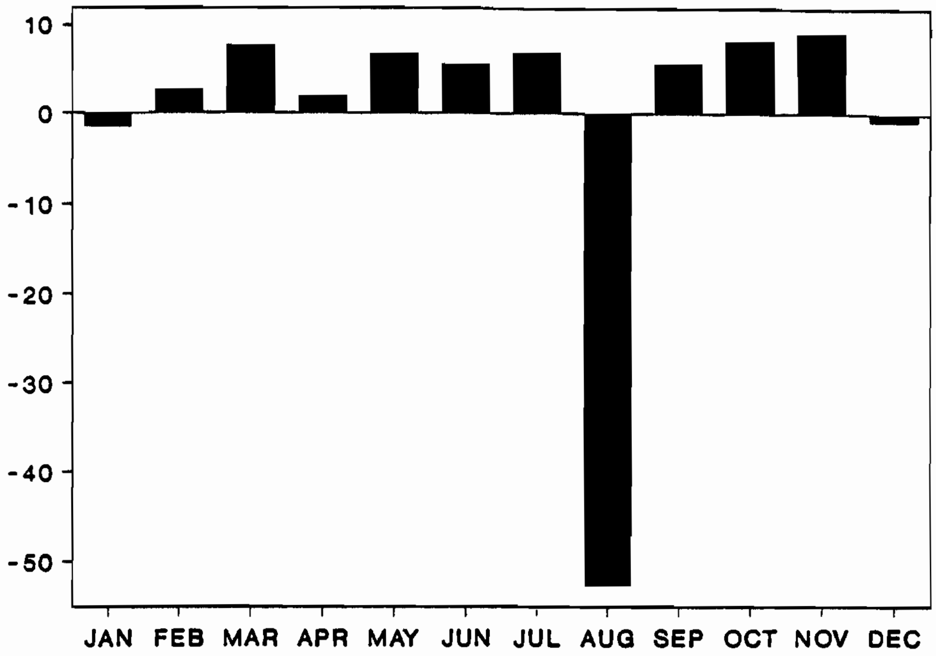

FIGURE 1.(a) SEASONALITY TOTAL INDUSTRY

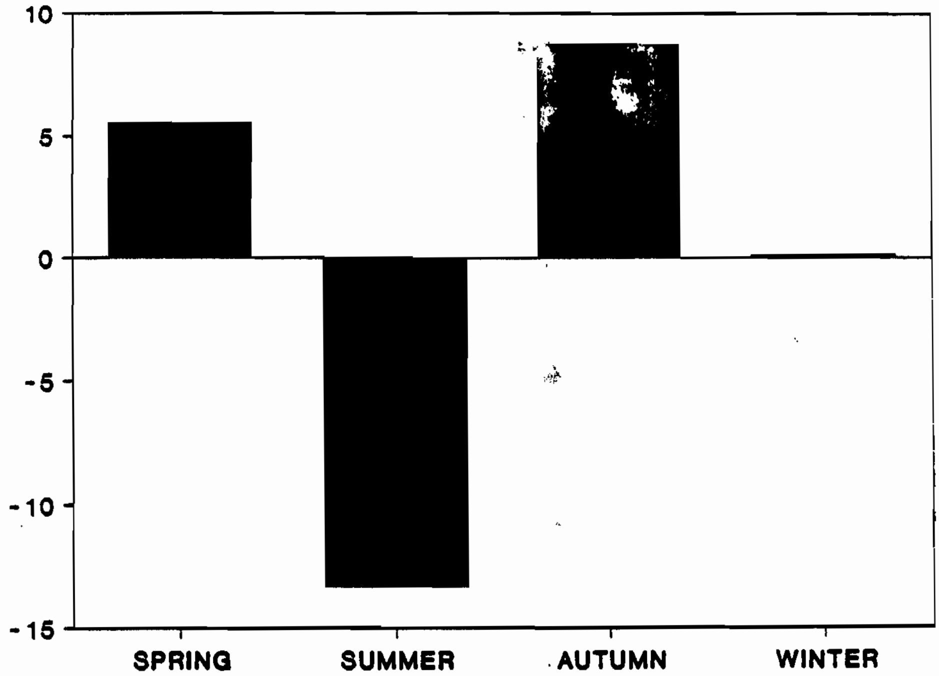

FIGURE 1.(b) SEASONALITY PATTERN

The degree of uncertainty regarding production next month is 2,45%.

Similarly, important information can be gained for the different industrial sectors and subsectors. In this work we do not intend to study each of them in detail, but simply to summarise certain aspects for all of them: trend, seasonal behaviour, the effects of the calendar, outliers, the response to deviations to the long-term path and uncertainty regarding future production.

Trend Behaviour

There are very important diferences as far as trend evolution in different industrial branches is concerned.

The 4 divisions, 17 of the 26 classes and 68 of the 89 groups, show trend movements, while the rest show simple local oscilations in level.

The trend movements are of a very different nature, with coexisting sectors of growth and decline trends.

Break in the production trend

This break shown for industry as a whole as a consequence of the second energy crisis affected diferent sectors unequally. Some sectors in which this break has appeared significant are: vehicle manufacturing, where the trend is interrupted from January 1980 till August 1982, and the accumulated drop in production which it gave rise can be evaluated at 34.6%, the leather industry, from June 1979 till November 1980, with a 51% fall, the paper and paper articles, graphic arts and publishing industry, from July 1981 till July 1982, with a 26.9% fall, etc.

Particularly noteworthy is the break in the trend in the extraction and preparation of solid fuels and coke, which presents an opposite sign to the remaining sectors. In this sector the second energy crisis caused a positive break in the trend, a consequence of the intensification of the effect of substituting oil-based energy by energy based on solid fuels. The effect extended from January 1980 till August 1982 and the resulting increase in production can be evaluated at 34.2%. From a further breakdown it can be seen that this effect is located in the subsector of soft coal, anthracite and lignite extraction. Production increase for this can be evaluated at 45.4%.

Seasonal Behaviour

Most sectors show seasonal characteristics, which implies different behaviour of production processes in different months of the year.

Thus, seasonal characteristics are shown in the 4 divisions, 24 of the 26 classes and 82 of the 89 groups.

From the observation of the seasonal factors of the final forecast functions based on December 1988, it is possible to find the existence of quite differents patterns. As an example in Figures 2 are shown the factors of 4 sectors with patterns which are different from that of the total industry and also different between them.

A study has been made about the way of following the seasonal pattern of the total industry by the differents sectors. This pattern (see Figure 1.(b)) is characterised by the fall in production in the months where the incidence of vacations and holidays is greater, specially in August.

For this purpose, the months have been grouped in four periods similars to the four seasons: spring (mean of the factors of March, April, May and June), summer (July, August and September), autumn (October and November) and winter (December, January and February).

The features for the seasonality of the total industry index so calculated are that the autumn and the spring are greater than the winter which, in his turn, is greater than the summer, by the influence of the big fall in August.

This pattern is followed by 3 of the 4 divisions, 15 of the 26 classes and 54 of the 89 groups. These 54 groups represent the 66,5% of the weight of the industry. The 28 groups with a different seasonal pattern represent the 29,8% while the 7 remaining ones which have not seasonality represent the 3,6%.

The groups with a different seasonal patterm are concentrated on the energy, extraction and food industries.

In conclusion, a great number of sectors follow the

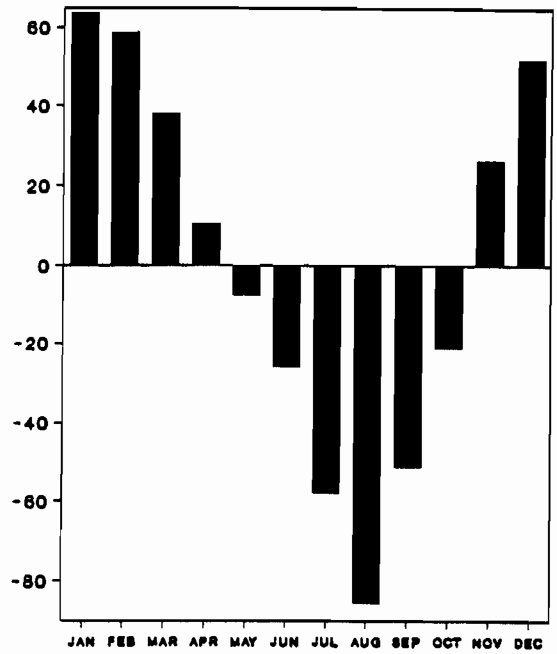

FIGURE 2.(a) SEASONALITY GAS MANUFACT

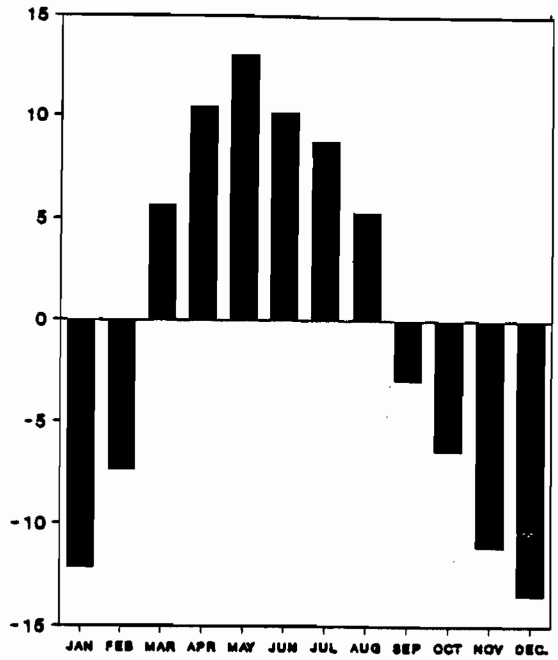

FIGURE 2.(b) SEASONALITY DAIRY INDUSTR.

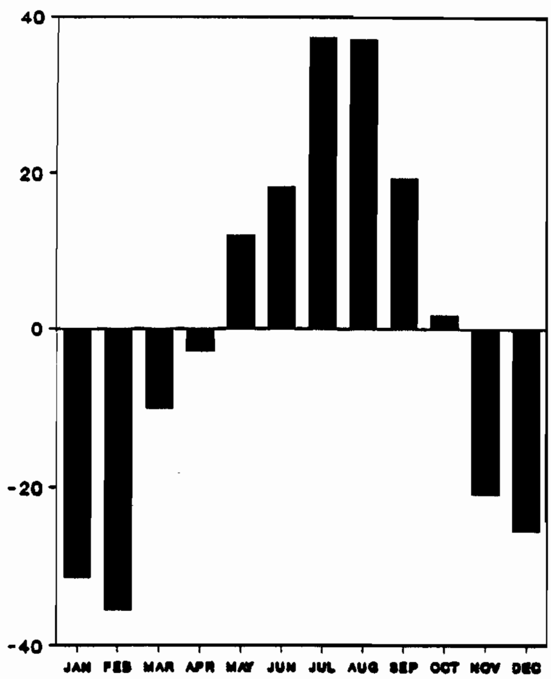

FIGURE 2.(c) SEASONALITY BEER BREWING

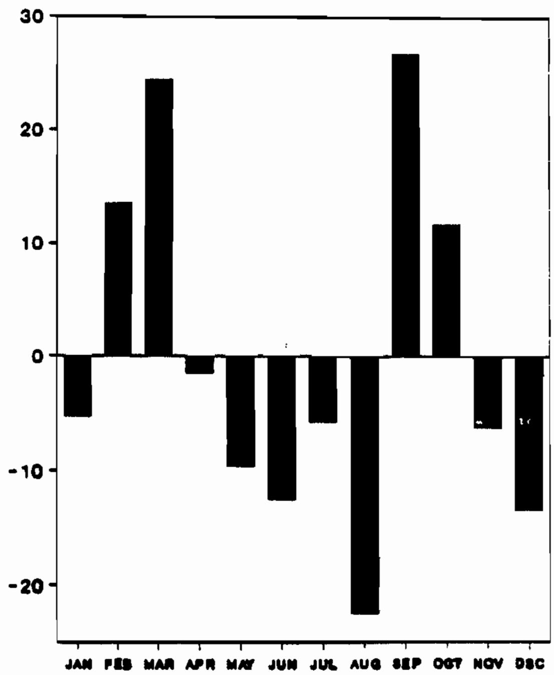

FIGURE 2.(d) SEASONALITY CLOTHING INDUS

pattern of the total industry, influenced by the working hours, specially those lost by vacations and holidays. On the other hand, between the sectors which do not follow it there are a lot of differents patterns.

Calendar effects

Most sectors are sensitive to calendar effects.

The effect of working days shows the influence on production of the different number of days in each month.

The Holy Week effect shows the influence on production of Holy Week holidays.

At an aggregate level (whole industry and divisions) sectors are sensitive to both effects. Breaking down the level more into classes and groups, a variety of situations can be found, with most sectors influencend by one of these effects. Many of the sectors for which none is significant are included in those of continous processes (steel and non-metallic metal, glass, ceramic products, etc.).

Although in principle both effects could be expected to be found in a simultaneous fashion, when this does not occur it could reflect more complex situations. For example, dairy industries are sensitive to working days and not to Holy Week since they are not affected by movable holidays nor by one-day holidays, but they are by the total number of days in each month, normally correlated with the number of working days.

In sectors where working days are significant the effect they have on production is, as might be expected, to cause it to fall when their number is less. This fall changes notably from one branch to another varying between 0.2% and 5.5%.

Likewise, in sectors where the influence of Holy Week is significant it has the effect of causing a fall in production, shared between the months of March and April. This fall varies from one branch to another. Most of them are between 2,5% and 15% .

Outliers

A high number of production outliers can be detected distributed among the different sectors.

Their appearance is due to a wide variety of factors, since production is affected by many situations: strikes and labour disputes, technical stoppages, abnormal weather conditions, bankrupticies and suspension of payments, product substitution, etc.

The dates when they take place do not coincide, normally, in different sectors which indicates that they are caused rather by partial phenomena affecting a sector at a particular moment rather than by circumstances of a more general nature to be found in the whole industry or an important part of it.

The distribution of outliers throughout the sample with their intensity measured in absolute value in terms of resi-dual standard deviations is shown in Figure 3.(a) for the groups. There it can be seen that their distribution in different years is fairly homogeneous. When this graph is analysed the first two years must not be considered because

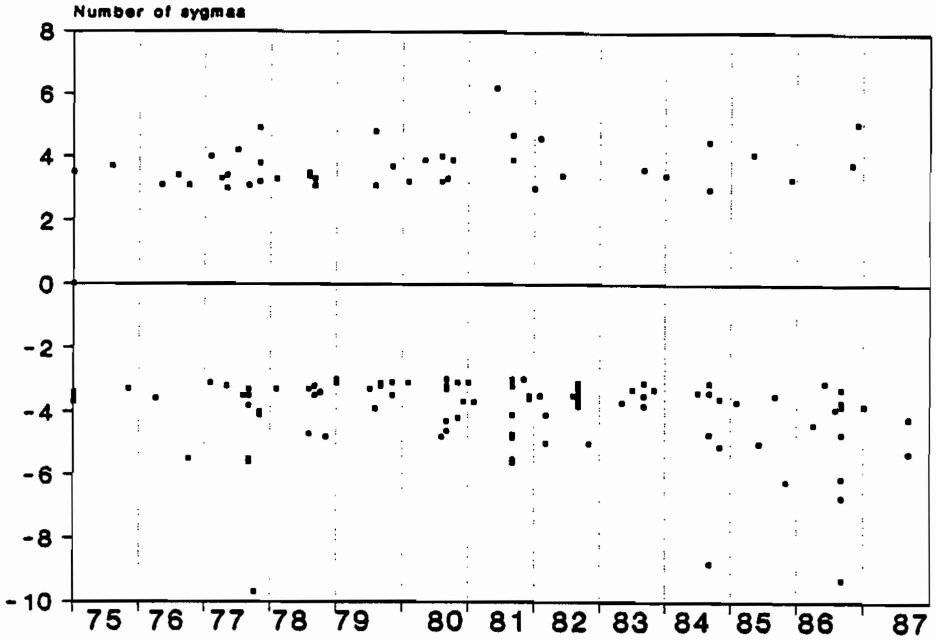

FIGURE 3.(a) GROUP OUTLIERS WITH THEIR MAGNITUDE

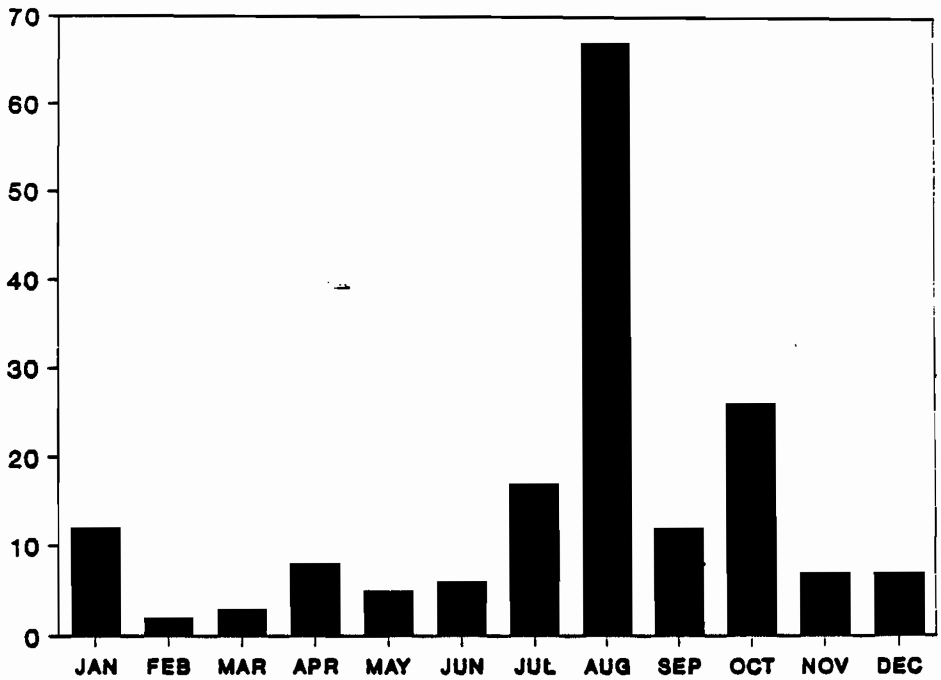

FIGURE 3.(b) GROUP OUTLIERS BY MONTHS

when the series is differentiated for modelling a number of values are lost from the first part of the sample depending on the order of differentiation and the order of the stationary autoregressive polynomial.

Furthermore, a larger number and a greater intensity of negative outliers compared to positive ones can be seen. The interpretation that can be made of this fact is that in the years following the economic crisis, productive activity has been affected by a larger number of specific circumstances having a negative influence on production (the closing down of companies, bankruptcies, suspension of payments, restructuring, strikes, etc.).

The monthly distribution of outliers for the groups is shown in Figure 3.(b). In this it can be seen that a very high proportion of outliers is concentrated in the month of August. The main reason for this situation is the irregular way in which summer holidays are taken, with establishments closing down or not and guidelines changing from year to year.

Response to deviation from long-term path

The return to a long-term path when a deviation from a previous one is produced takes place in most sectors (whole industry, the 4 divisions, 21 of the 26 classes and 64 of the 89 groups) in a way which does not show a predetermined form. The study of this response function is also useful to analyse the stable effect of an innovation on production in the case of series with local oscilations in level, or on its growth rate in the case of series with a quasi-linear trend. This gain can be obtained practically after a small number of monthly periods varying between zero and sixteen have gone by.

In Table 1 is shown the speed of the return to the long-term path when it takes place progressively following a function with exponential or oscilating structure. This speed has been classified in accordance with the value of ϕ (ϕ=1/δ and δ is the dominant zero of the autorregresive polynomial) as fast ($\phi \leq 0.5$), moderate ($0.5 < \phi \leq 0.8$) and slow ($\phi > 0.8$).

Uncertainty regarding future values

Uncertainty regarding future production varies considerably from branch to branch. On average, it is fairly high if we compare it with that of aggregated economic variables.

In fact, these uncertainties tend to be offset partially by the fact that if branches are grouped together important decreases in uncertainty are found.

Thus, by grouping together the four divisions into which industry is subdivided, with respective unpredictabilities of 2.8%, 3.0%, 5.8%, and 3.3%, an uncertainty of 2.5% is obtained for industry as a whole.

The disposal of these results on a file allows for a deep analysis on the behaviour of the industrial branches.

Thus, we can be interested in searching the branches with a firm evolution in trend at the level of three digits of the N.C.E.A.; in this case we could ask for the branches with a trend, (64 of 89), and between then, those with less than fifteen per cent unpredictability (52 of 64), and with a growth rate between 1983 and 1988 greater than that of the total industry (29 of 52).

These industrial branches show seasonal behaviour and represent the 42,6% of the whole industrial production. These branches are listed in Table 2.

Table 2.

N.C.E.A.	BRANCHES
151	Electrical energy
224	Non-ferrous metals
232	Potassium salts
241	Brickfield products for building (excep fireproof products)
243	Building materials in concrete, cement an others
245	Abrasives manufacturing
246	Glass industry
252	Manufacturing of chemical products designed mainly for agriculture
253	Manufacturing of chemical products designed mainly for industry
314	Structural metal products
316	Manufacturing of tools and finished metal products
322	Machines for working metal, wood and cork
323	Machinery for the textile, leather, footwear and clotting industry
324	Machinery for the food, chemical, plastic and rubber industry
342	Electrical Material
361	Motor Vehicles
414	Dairy industries
415	Vegetable juice and preserves
416	Fish preserves and other sea products
418	Manufacturing of edible pastes
421	Cocoa, chocolate and confectionary industry
426	Cider production
427	Beer brewing
428	Mineral water, sparking and soft drinks
471	Paper paste
472	Paper and cardboard
474	Graphic arts and printing
481	Rubber transformation
482	Transformation of plastic materials

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