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UNDERLYING INFLATION IN THE SPANISH ECONOMY: ESTIMATION AND METHODOLOGY

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Abstract

This paper presents a methodology to analyse the inflationary process in Spain. It is based on forecasts of the Consumer Price Index using quantitative models to obtain a measure of underlying inflation and the expected medium-term value of the annual price growth rate, which is called inertia in the paper. Every time a new observation becomes available, the study of the underlying inflation and inertia allows to be performed a systematic analysis of the inflationary process.

The estimation of underlying inflation and inertia has also proven useful to improve the measurement of some important economic indicators such as inflation differentials and ex-ante real interest rates.

Key words: Underlying inflation, Signals, Non-observable components, Trend, Medium-term expectations, Inertia, Growth Rates.

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This paper presents a summarized description of the methodology followed to analyse systematically the inflationary process in Spain. The approach is set forth in section 1.

The assessment of the inflationary situation through each new avaiblable observation of the Consumer Price Index (CPI) requires quantitative models capable of explaining the behaviour underlying each new datum (see section 2). These models also enable the series to be extended with forecasts and the underlying behaviour of prices and inflation to be estimated, as set out in section 3. With these forecasts and the estimation of the underlying behaviour of prices, the methodology proposed (section 4) is designed to answer the following questions:

1. Are price movements accelerating, decelerating or undergoing constant growth?.
2. Is this situation going to continue?.
3. What is the most adequate measurement of the inflation differential with respect to other countries?.
4. How are the most relevant real interest rates changing according to previous diagnostics?.

Considering the nature of the information available in Spain, price models are also required to estimate the inflationary effects of the introduction of Value Added Tax in 1986, as a consequence of Spain's accession to the EEC. The quantification of these effects is necessary to estimate adequately underlying inflation and to measure with some accuracy the inflation differential with respect to other countries.

Proper follow-up of the inflation differential with respect to given groups of countries is essential in any analysis of the inflationary situation (see section 5) since it provides us, among other things, with means which are helpful for formulating an opinion with which to implement economic policy. In section 6 the inflation results are used to provide estimates of real interest rates.

1. APPROACH AND RELEVANT PRICE SERIES

The inflation analysis must be made on final price indexes. In the Spanish economy, the only final price that can be readily observed is CPI. Moreover, this is the only final price index constructed on a monthly basis. Therefore, this study is based on that index.

[CHART 1]

The data on consumer price index increases are fluctuate strongly. See, for example, chart 1. This implies that the mere follow-up of these data is not directly useful to analyse thoroughly inflation in the Spanish economy. It is thus necessary to make a thorough quantitative study of the time series of the prices concerned, and such study must be designed in accordance with the objectives pursued with the inflation analysis.

These objectives are usually the following:

1) to evaluate to what extent a new datum observed in the price index is good or bad;

2) to predict the values of CPI in the short and medium run;

3) to estimate the underlying price trend; and

4) to analyse this underlying trend considering:

   a) its underlying velocity;

b) its improvement or deterioration with respect to former estimations;

c) comparing it with medium-term forecasts.

Before going on, we must establish the degree of price aggregation we shall work with. For this, we must take into account the fact that the same inflation level in the total aggregate index, CPI, may correspond to very different situations, since:

a) the trends and cyclical behaviour of the components of the total index may be quite different and may not offset each other;

b) the steps taken to curb inflation may differ according to the trends of the various prices included in the aggregate.

Therefore, the aggregation level must be selected according to a) and b) and to the objectives of the analysis. To investigate the trends and cyclical behaviour of all the components of CPI is a painstaking task that we have not performed. Instead, we have broken down CPI into five basic components shown in table 1 and we have studied their characteristics separately. It was ascertained that these components exhibit different trends (see chart 2) making advisable to analyse the total aggregate starting from the specific analyses of these five components.

[TABLE 1]
[CHART 2]

This is not the best solution, but it definitely incorporates a minimum disaggregation level starting from which the CPI should be analysed.

Based on the componentes of table 1, certain intermediate aggregates are obtained whose trends are also useful to analyse. These intermediate aggregates are defined in table 1.

Analysis of the basic components of CPI evidences the existence of a very erratic item -the non-processed food price index (NPF)- and of another item that moves in steps -energy prices-. The latter are official prices and their movements, of a rather deterministic nature, should to be considered on a special basis to obtain the underlying trend of CPI, but we shall return to that subject later. As regards the non-processed food (NPF) price index, chart 2 shows that the growth rates of its trend fluctuate around those of the trends of the other non-energy components of CPI. Likewise, chart 3 shows that the relationship between NPF and CPISN (price index of services and non-energy processed goods) fluctuates around a value that has been relatively stable since 1980. All the above demostrate that, to analyse the underlying inflation in the Spanish economy, the prices of non-processed food should be excluded from CPI, mainly in periods of stable relative prices (1).

[CHART 3]

This argument may also be applied to official energy prices. Thus, in periods in which the relative energy prices with respect to other prices are not expected to change in the medium run, the former may be

excluded from CPI in order to analyse the underlying inflation of the economy.

Later on, we shall see how the underlying trend in any time series could be estimated, but at this stage it should be emphasized that, in periods of a certain stability of relative prices around a constant value, the underlying inflation may be studied better in the consumer price index for services and non-energy processed goods (CPISN) than in the overall consumer price index.

Moreover, the basket of goods and services CPISN comprises is less sensitive than the basket of CPI to price variations of their components. For this reason, CPISN is probably more representative of the cost of living than CPI when non-processed food prices fall or rise, strongly but transitorily, with respect to the other goods. Thus, although it is true that the Spanish economy tends to be indexed on a price index, we can say that as long as the CPI fluctuates around CPISN, in the medium run, indexing is performed around CPISN. Furthermore, even in the short run, agents will be more willing to index below CPI in periods in which the underlying inflation of CPI stands above the underlying inflation of CPISN than in periods in which CPISN stands above CPI.

For all these reasons, CPISN is recommended as the relevant index, at least for a medium-term analysis. In any event, it will always be advisable to analyse inflation at the levels of CPI and CPISN. Thus, when CPI stands below CPISN, it is dangerous to assume that inflation will consolidate around the underlying level of CPI and not around the underlying level of CPISN.

2. QUANTITATIVE MODELS FOR INFLATION ANALYSIS

To evaluate a new observation, to predict the future values of a time series and/or to estimate the underlying trend, it is necessary to have quantitative models capable of explaining how the data arise.

Quantitative models may be classified, according to the information level used, into univariate, leading indicator and econometric models. Univariate models use the minimum information possible: the observed values of the series under review. In these models, the current value of a time series is explained according to its past values, giving rise what are known as ARIMA models; they may be extended by including dummy explanatory variables, mainly of binary type, to capture important atypical movements recorded by the time series. These movements are due to institutional causes that must be incorporated an exogenously since they are not included in the regular behaviour of the economic series.

For the purpose of this article, we term as a leading indicator an economic variable which moves ahead of the dependent variable (CPI, in our case). Leading indicator models are models that include leading indicators as explanatory variables. We shall consider the following indicators in this study: industrial prices, import prices and agricultural prices.

Structural econometric models specify a relationship between the variable under review and a set of explanatory variables according to a given economic theory. By solving structural models, we obtain

reduced-form models. Therefore, in the latter, the causal variables determined within the structural system have been replaced by the variables that determine them in turn.

Structural econometric price models are, for instance, mark-up models. At the monthly level on which we based our study, mark-up models cannot be constructed for the Spanish economy, since a significant portion of the cost variables included in these models is not observed on a monthly basis. An alternative could be to formulate condensed mark-up models in which consumer prices are explained as a function of a domestic wholesale price index -in our case, the consumer goods industrial price index, INPI- as a variable that embodies the production costs of domestic production goods, a foreign wholesale price index -the consumer goods import price index denominated in pesetas, IMPI- as a variable that embodies production at-border costs of foreign production goods and, perhaps, an agricultural price index, API, as an indicator of raw material costs.

The INPI and API variables are observed monthly, but IMPI data are available only on a quarterly basis. Therefore, IMPI has been interpolated monthly, using the monthly information on the nominal effective peseta value. When this IMPI variable, thus interpolated, is entered in a condensed mark-up model, it does not appear to be significant in any of the consumer price indexes. Agricultural prices appear significant only explaining the non-processed food and the wholesale price index is an indicator for the consumer prices of processed food and non-energy industrial products. For the service component of CPI we could not find an adequate indicator, therefore for this index we shall use univariate models.

Forecasts with leading indicator models are more efficient than univariate predictions but less so than econometric ones. In our study, we use agricultural prices and consumer goods wholesale prices as indicators. The univariate models currently being used are those proposed by Espasa et al., 1984, but their estimation has been updated. Leading indicator models have been published in Matea, 1989.

3. ESTIMATION OF UNDERLYING INFLATION AND LONG-RUN EXPECTATIONS

The underlying path in a time series is a signal, or non-observable component, representing a robust line around which the original series oscillates.

When dealing with a price index, it is advisable to distinguish between the original series, which represents a price level, and the inflation series, which we define as the series obtained by applying annual rates, month over the same month of the previous year (T_{12}^{1}), to the original series. Hence, the underlying path of a price index will be the trend of its corresponding time series and the underlying inflation will be given by the annual rate (T_{12}^{1}) of the trend of this index.

For consumer price indexes, it can be seen that the annual growth rates T_{12}^{1} of their trends are in line with the rates of growth of the twelve-month mean over the preceding non-overlapping twelve-month mean of the original price data. We denote by T_{12}^{12} this type of annual growth. Therefore, the rate of growth T_{12}^{12} of a price index is an acceptable estimation of the corresponding underlying inflation.

The observed values of the consumer price inflation are the monthly rates of growth of CPI. We call this series the basic increments of prices (BIP). But BIP is not a good indicator of inflation and many analysts have proposed alternative measures, see, for instance, Moore, 1983, and Rhoades and Elhawary-Rivet, 1983. These measures will be useful indicators if they are a smoothed version of BIP and at the same time are in phase with BIP.

Our measure for underlying inflation -the T_{12}^{12} growth rate of CPI- will be in phase with BIP if we lag it twelve periods. When we do so we say that the T_{12}^{12} growth rate is correctly centered, and we shall proceed in that way for the rest of the paper (2).

To calculate the correctly centered value of rate T_{12}^{12} at moment t, it is necessary to know the values of the series at t+1,t+2,...t+11 that are unknown at moment t. We propose to calculate this rate T_{12}^{12} using predictions for the non-observed values. It can be seen that this inflation measure generalized Moore's proposal and gives a current indication of underlying inflation.

This way of calculating underlying inflation is valid for the non-energy components of CPI. Energy prices move in steps, hence exhibiting a deterministic trend. Therefore, for the energy goods price index, underlying inflation is estimated as rate T_{12}^{1}, assigned to the last observation entered in the calculation thereof, of the original series. Thus, sudden changes in energy prices are not averaged over time but assigned to their underlying inflation at the moment in which they occur.

The growth rates accumulated over the last twelve months, T_{12}^{1}, which are widely publicised by the mass media, cannot be used to reflect the underlying inflation of the various price indexes due to their excessive oscillations (see chart 4).

[CHART 4]

In fact, the following-up of underlying inflation through CPI rate T_{12}^{1} was highly misleading in 1986, mainly in March and September. These misleading effects could be palliated using price forecasts that enable it to be seen quite clearly that rises or falls are interpreted as stable were going to stop in the following months. The message of rate T_{12}^{1} was also quite misleading at the beginning and end of 1987.

In analyzing inflation there is another concept of great importance, it is the expected medium-run value of the annual price growth rate, which we call inertia. In ARIMA models this inertia can be calculated from the forecasting function and is related to the trend-component of this function studied by Box et al., 1987. This trend-component contains a time polynomial of degree d-1, where d is the number of positive unit roots of the non-stationary autoregressive operator of the ARIMA model. It also contains and damped terms based on the roots of the stationary autoregressive operator. These damped terms tend to zero and can be ignored and, therefore, in the medium-run the trend-component of the forecasting functions only contains a time polynomial.

If the number of positive unit roots is two, as is the case with the time series used in this paper, this polynomial is a straight line and our concept of inertia is the slope of this line in annualized terms. Therefore, given the origin of the forecast, the inertia for these models is a constant. The same argument applies when these variables are explained by leading indicator or structural econometric models.

This inertia changes with the origin of the forecast, which means it changes with the initial conditions of the system.

When the expected annual price growth rate in the medium-run, or inertia, is calculated with complete structural econometric models, it constitutes an adequate estimation of medium-term inflationary expectations, and is, in fact, the inflation equilibrium level. When inertia is calculated with other types of model, whether econometric or not, it will constitute an acceptable approximation of the inflation equilibrium level, if no substantial changes are expected in causal variables.

4. METHODOLOGY TO ANALYSE THE INFLATIONARY SITUATION

The underlying inflation chart (see chart 5) is a key instrument for analysing the inflationary situation of the Spanish economy.

[CHART 5]

This chart shows whether the price trend is:

1. accelerating (in which case, the last values of the underlying inflation are increasing).

2. decelerating (in which case, the last values of the underlying inflation are decreasing).

3. stagnant (in which case, the last values of the underlying inflation are practically constant).

It should be taken into account that, as the underlying inflation is estimated through the centered rate T_{12}^{12}, the last values -at moment t the values of the T_{12}^{12} corresponding to moments t-j for j less than twelve- are calculated with predictions, so these values are being revised as new information appears. Thus, the comparison of the underlying inflation values, as revisions are made, allows one to deduce whether inflationary prospects are improving or not.

Therefore, through the contemporaneous underlying inflation path, we can analyse whether prices are accelerating, decelerating or growing at a constant rate and, through revision, as more information becomes

available, we can see whether inflationary prospects are improving or deteriorating in the short-run. However, it is no doubt advisable to analyse whether the current situation of price movements will persist in the future or whether there will be a turnaroud. This analysis may be performed by comparing the underlying inflation at moment t with the expected medium-term value of the annual price growth rate, which we have called inertia.

The forecasting functions derived from the different price models allow one to predict from a given time horizon (2-5 years according to the series) an annual growth rate that remains practically constant from that point onwards. This constant is inertia and changes with the origin of the forecast, i.e. each time a new observation becomes available and predictions for the future are updated.

[TABLE 2]

Table 2 shows the different circunstances that can be derived from the comparison between underlying inflation and inertia when trying to assess the inflationary situation and the persistence or not over time of current price movements. Table 3 presents an application of the methodology on the basis of information available to June 1990.

[TABLE 3]

Inertia is calculated each time a new observation becomes available. By comparing the latest value of inertia with previous ones, it can be deduced whether medium-run inflationary expectations are improving or not.

Now we can analyse the inflationary situation on the basis of information available up to June 1990. The underlying situation of the CPISN exhibits a decelerated growth (line A in chart A), there seem to exist a margin for deceleration to continue. The value of the underlying inflation in June 1990 is 6.3% and the medium-term expectations are 5.7% (see chart 5 and table 3). Comparing the underlying inflation path in June 1990 (line A, chart 5) with the path estimated in July 1989 (line B), when the Spanish Government introduced certain restrictions to reduce inflation and to eliminat other macroeconomic disequlibria, it can be observed that the most recent estimation is worse than that made in July 1989. Therefore, it may be concluded that the inflationary situation has deteriorated in the short-run. Moreover, comparing the inertia in these two months, it may be concluded that in the medium-term inflation expectations have improved slightly.

Chart 5 also shows how the inflationary situation was deteriorating from December 1989 to February 1990 and that since then the inflation prospects have improved.

5. INFLATIONARY SITUATION AND DIFFERENTIAL WITH RESPECT TO OTHER COUNTRIES

The analysis of the inflationary situation is important not only with regard to the internal equilibrum of an economy but also to its external equilibrium, since both are interrelated.

Indeed, the inflation differential is significant both for trade flows and for the implementation of economic policy, particularly monetary policy.

The inflation differential between one country and others should be calculated on the basis of the corresponding levels of underlying inflation, since the erratic movements of the price growth rate do not provide information on the disequilibrium of the economy. Chart 6 contains the underlying inflation for different countries, using ARIMA models to extrapolate the series at the end of the sample. We have already discussed before what should be the most adequate measure of underlying inflation but certain comments are still necessary.

[CHART 6]

It is important to emphasize that, to calculate the differential, the levels of underlying inflation considered are to be calculated net of indirect taxes, since the latter affect both domestic and imported production goods.

For this reason, it would be a mistake to analyse the inflation differential between Spain and the EEC over

the first months of 1987 using rates T_{12}^{12} without discounting the VAT effect (which is quite normal practice in certain circles). If, in the case of Spain, T_{12}^{12} is used without discounting VAT, this rate exhibits a sharp fall in the first three months of 1987 because of the effects of the introduction of VAT took place in 1986 (see chart 4). If the calculations are made in the erroneous way described above, the differential with respect to the EEC drops artificially from approximately 4.6 percent in December 1986 to 2.5 percent in January 1987. On the contrary, if the differential is calculated according to the above recommendations, it declines from 2.0 percent in December 1986 to 1.7 percent in January 1987, i.e. a smaller value than the former one. This implies that the differential gain actually took place in 1986 and not in 1987, as it would appear to be the case from the T_{12}^{12} rates not adjusted for VAT.

In the calculation of the differential, it should be pointed out that not only indirect taxes should be eliminated from CPI but also the prices of final imported goods and nontradeable goods (3). This suggests that it would be preferable to calculate the differential on the wholesale price index, the construction of which does not include indirect taxes. However, this suggestion raises the problem that this index does not include the prices of services -for instance, tourism- which are undoubtedly significant in the differential. For these reasons, we still propose calculating the differential as described above, warning however that it is also best to complete the study on our competitiveness with other countries by calculating the differential on industrial prices and analysing if the possible differences between both differentials may be explained by the service price trend

or if they are due to the prices of final imported goods or non-tradeable goods. In this latter case, the differential obtained through CPI will have to be corrected, even if on a subjective basis.

6. MEASUREMENT AND PATH OF REAL INTEREST RATES

The estimation of inflationary expectations is relevant per se as long as the expected inflation rate is an argument to be taken into account in the behaviour functions of some economic variables, for instance, in money demand, in nominal interest rate equations, etc. Moreover, the estimation of the expected inflation rate is necessary to have adequate measurements of the real interest rates of the economy which are key variables in transmitting the effects of monetary policy throughout the real sector.

It should be emphasized that inflationary expectations depend on the time scale within which the economic agents are performing their plans. Thus, expectations are not the same in the short as in the medium-run.

In the medium-run, inflationary expectations are measured by annual growths over expected prices. Thus, the seasonal component disappears. However, in the short run, expected inflation may contain a seasonal variation. Then, the seasonal behaviour of prices would give rise to interpretation problems when comparing short and medium-term real interest rates. Hence, it is advisable to eliminate the seasonal component from the calculation of the short-term expected inflation rate.

Yet if inflation rates incorporate information on the economic situation (see Litterman and Weiss, 1983), the seasonal price variations hardly provide any information on the internal and external disequilibria of the economy. Therefore, both in the short and in the

medium-run, it would seem advisable to determine the expected inflation rate on the basis of the expected price trend.

The expectations estimated in this paper are not true expectations, since they do not embody all the information existing in the system, nor do they do so efficiently. However, they are consistent expectations and may thus be used for the purposes pursued here.

The estimation of the future values of the price trend is thus necessary if it is intended to approximate to inflationary expectations. With the methodology presented here for the inflationary analysis, it seems justified to "measure" these expectations through the underlying trend (T_{12}^{12} centred with predictions) of the services and non-energy processed good component of CPI (CPISN).

In the short run -one year or less- the underlying inflation forecast for the relevant time scale seems a good indicator of inflationary expectations.

On the other hand, in the medium-run, these expectations will be better approximated through the estimated value towards which the trend tends in the medium-run, called price inertia.

"Ex-ante" real interest rates are non-observable variables that must be approximated in some way. The practice of approximating to contemporaneous expected inflation by actually observed inflation rates implies that the economic agents are systematically mistaken in the formation of their expectations. Therefore, it would seem more advisable to approximate to these expected

inflation rates assuming that the agents "learn" from the systematic movements observed in the inflation rate. Thus, the "ex-ante" real interest rates estimated here constitute a better approximation to non-observable real interest rates than the real interest rates obtained through the inflation rates observed at each moment, if we assume that agents are not short-sighted and that, as is the case in Spain, the inflation rate trend does not respond to a stochastic random walk process.

The interest rates selected in this paper are:

a) Interbank three-month deposit.

b) Domestic yield on Government debt maturing in two years or more.

c) Treasury bills.

d) Loans maturing in 1-3 years.

e) Loans maturing in over 3 years.

[CHART 7]

In chart 7 we offer the selected "ex-ante" real interest rates from January 1988 to June 1990.

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NOTES

(1) The Boletín Económico (Banco de España) of February 1987 includes an article by Juan José Camio in which he analyses a series of reasons, related to the treatment given to seasonal goods in CPI, for which the monthly movements of the non-processed food consumer price index does not represent the actual behaviour of the relevant prices.

(2) When the centre of a moving average lies between two months we assign it to the last of these two months.

(3) We are grateful to José Viñals for drawing our attention to this point.

1. Basic components of CPI

CPI (100%)

- A) Non-processed food (15.46)
- B) Processed food (17.56%)
- C) Non-energy industrial products (25.74%)
- D) Services (34.24%)
- E) Energy (7%)

Useful intermediate aggregates

1) A+B, food (33.02%)
2) C+D+E, non-food (66.98%)
3) B+C+D, services and non-energy processed goods (CPISN) (77.54%)

2. Underlying inflation and inertia

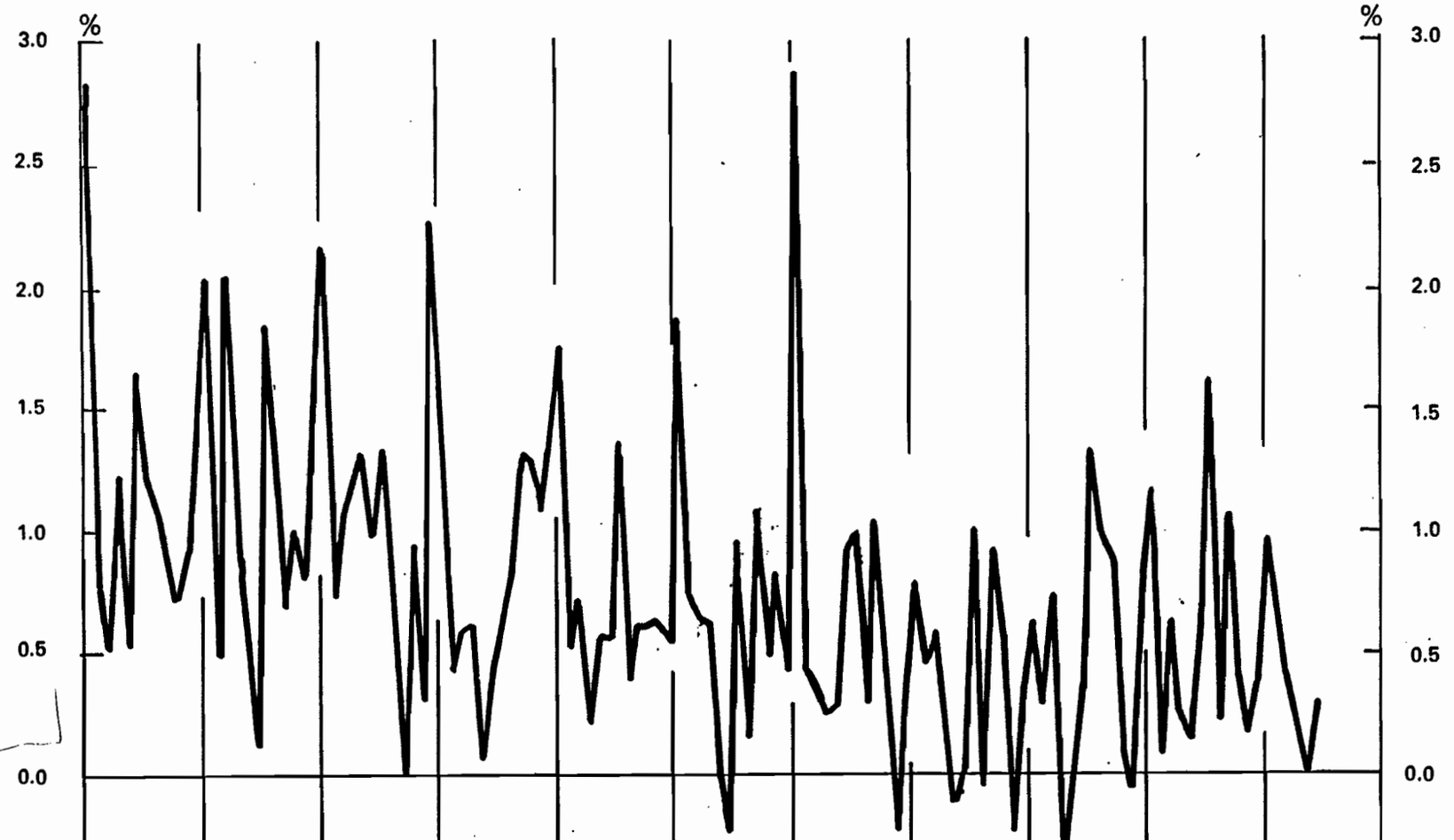
	Inertia smaller than current underlying inflation	Inertia equal to current underlying inflation	Inertia greater than current underlying inflation
Decelerating prices	Margin for deceleration to continue	Deceleration tends to stagnate	Price deceleration may be converted into acceleration
Constant growth in prices	Constant increase may be converted into deceleration	Constant increase expected to continue at the same rate	Constant increase may be converted into acceleration
Accelerating prices	Acceleration may be converted into deceleration	Acceleration may be converted into constant growth	Margin for acceleration to continue

3. Analysis of consumer price index situation

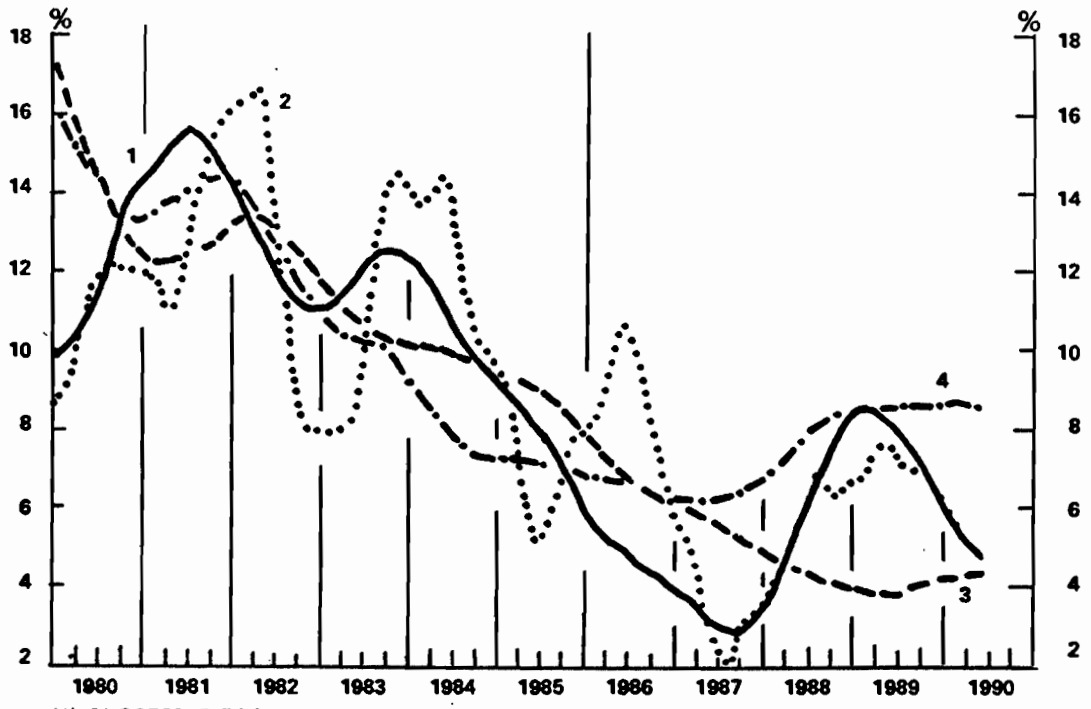
(using leading indicator models)

COMPONENT Nature	UNDERLYING SITUATION OF PRICE		INFLATIONARY EXPECTATIONS (Inertia)
	Price level	Inflation	
PROCESSED FOOD (17.56%)	DECELERATED GROWTH (worse than April forecast)	4.8%	3.4%. Margin for deceleration to continue
NON-PROCESSED FOOD (15.46%)	DECELERATED GROWTH (better than May forecast)	4.6	4.5%. Margin for deceleration to continue
FOOD (33.02%)	DECELERATED GROWTH (better than May forecast)	4.7%	3.9%. Margen for deceleration to continue
SERVICES (34.24%)	DECELERATED GROWTH (similar to April and May forecast)	8.6%	8.1%.Margin for deceleration to continue
NON-ENERGY INDUSTRIAL (25.74%)	START OF DECELERATED GROWTH (worse than April and May forecast)	4.4%	3.4%. Margin for deceleration to continue
NON-FOOD (66.98%)	CONSTANT GROWTH (similar to May forecast)	6.8%	6.0%. Constant increase may be converted into deceleration.
SERVICES & NON-ENERGY PROCESSED GOODS (77.54%)	DECELERATED GROWTH (similar to May forecast)	6.3%	5.7%. Margin for deceleration to continue
TOTAL (100%)	DECELERATED GROWTH (better than May forecast)	6.1%	5.3%. Margin for deceleration continue.

1. MONTHLY INCREASES IN CONSUMER PRICE INDEX

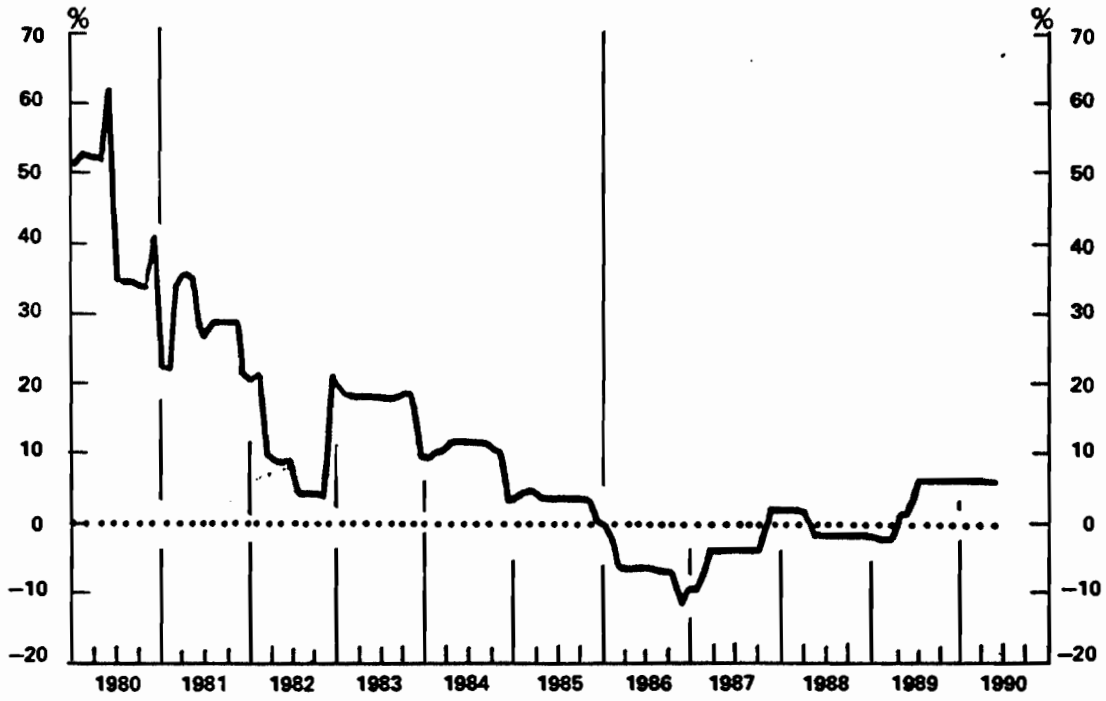


2. ANNUAL GROWTH RATES OF THE TRENDS OF NON–ENERGY COMPONENTS OF CPI

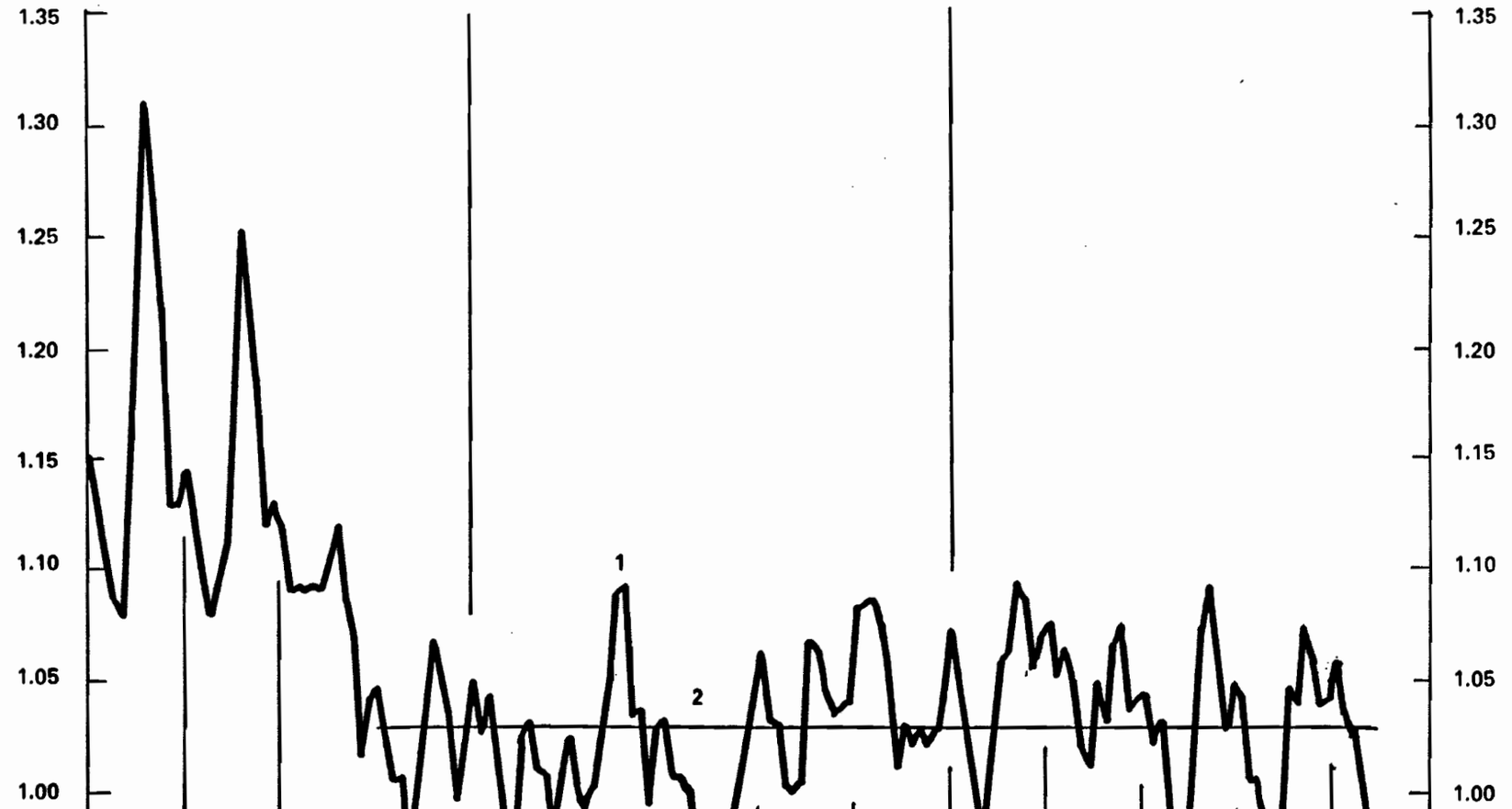


(1). PROCESSED FOOD.
(2). NON–PROCESSED FOOD.
(3). NON–ENERGY INDUSTRIAL PRODUCTS.
(4). SERVICES.

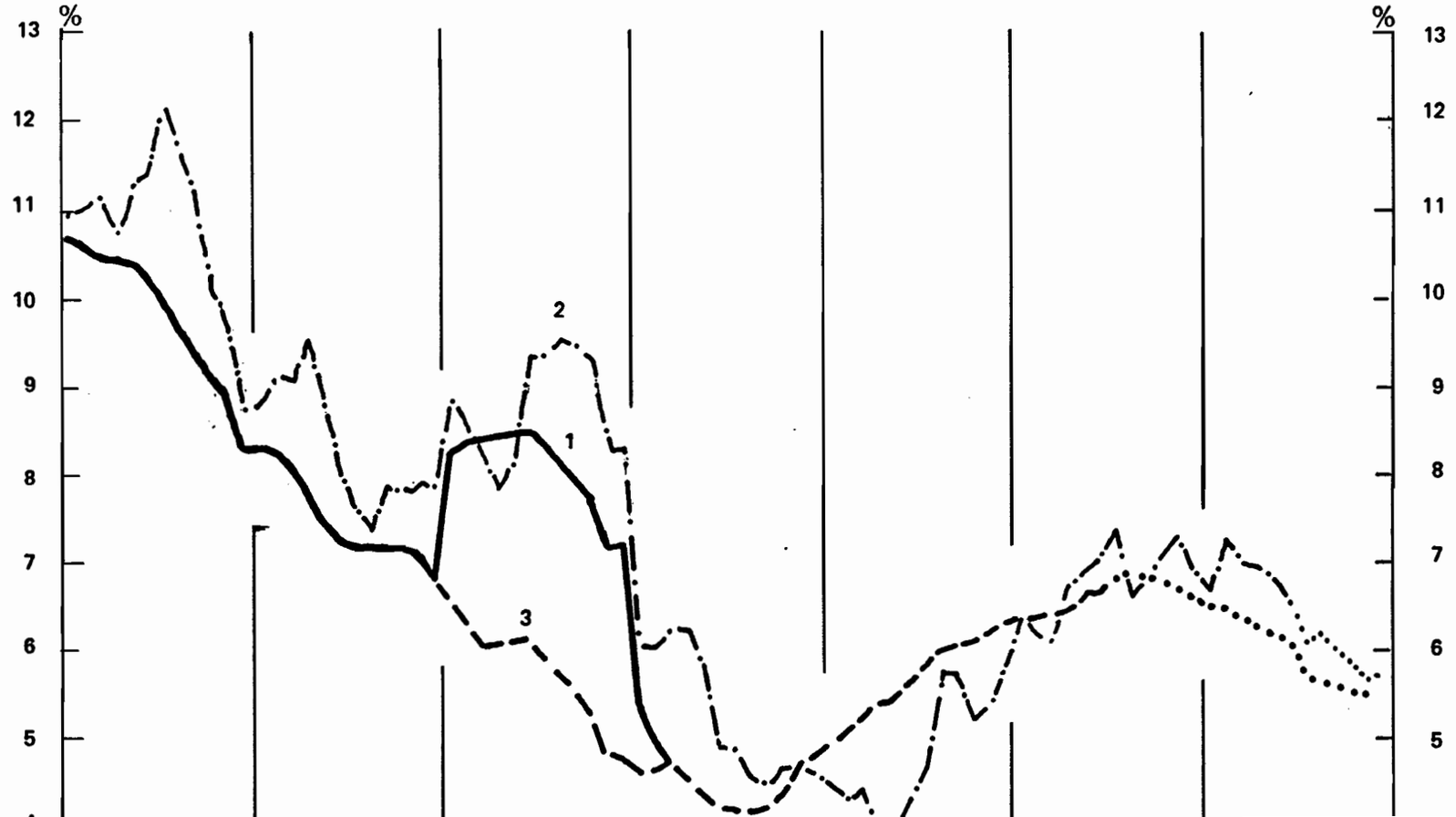
ANNUAL GROWTH RATE OF ENERGY PRICE INDEX



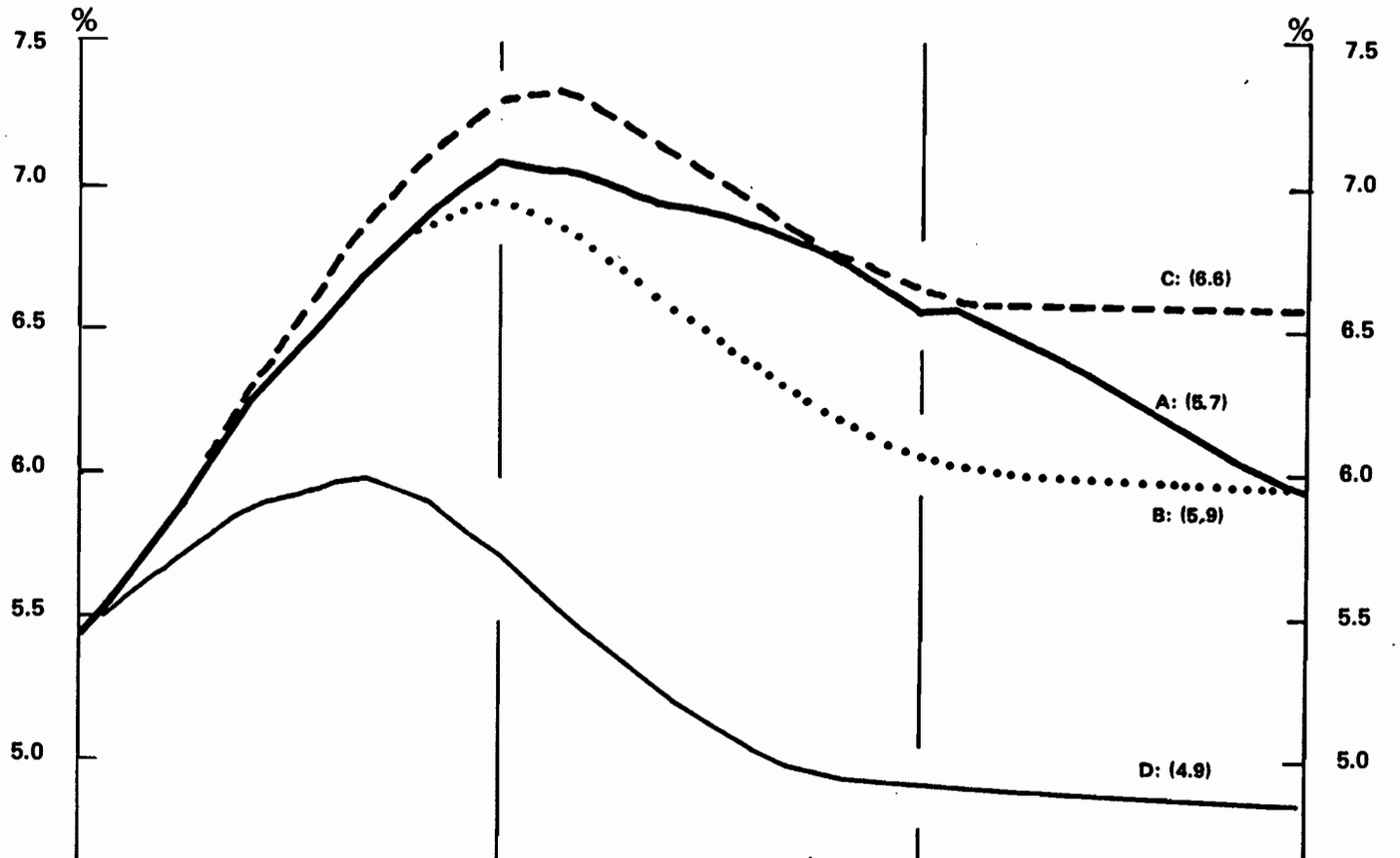
3. NPF/CPISN



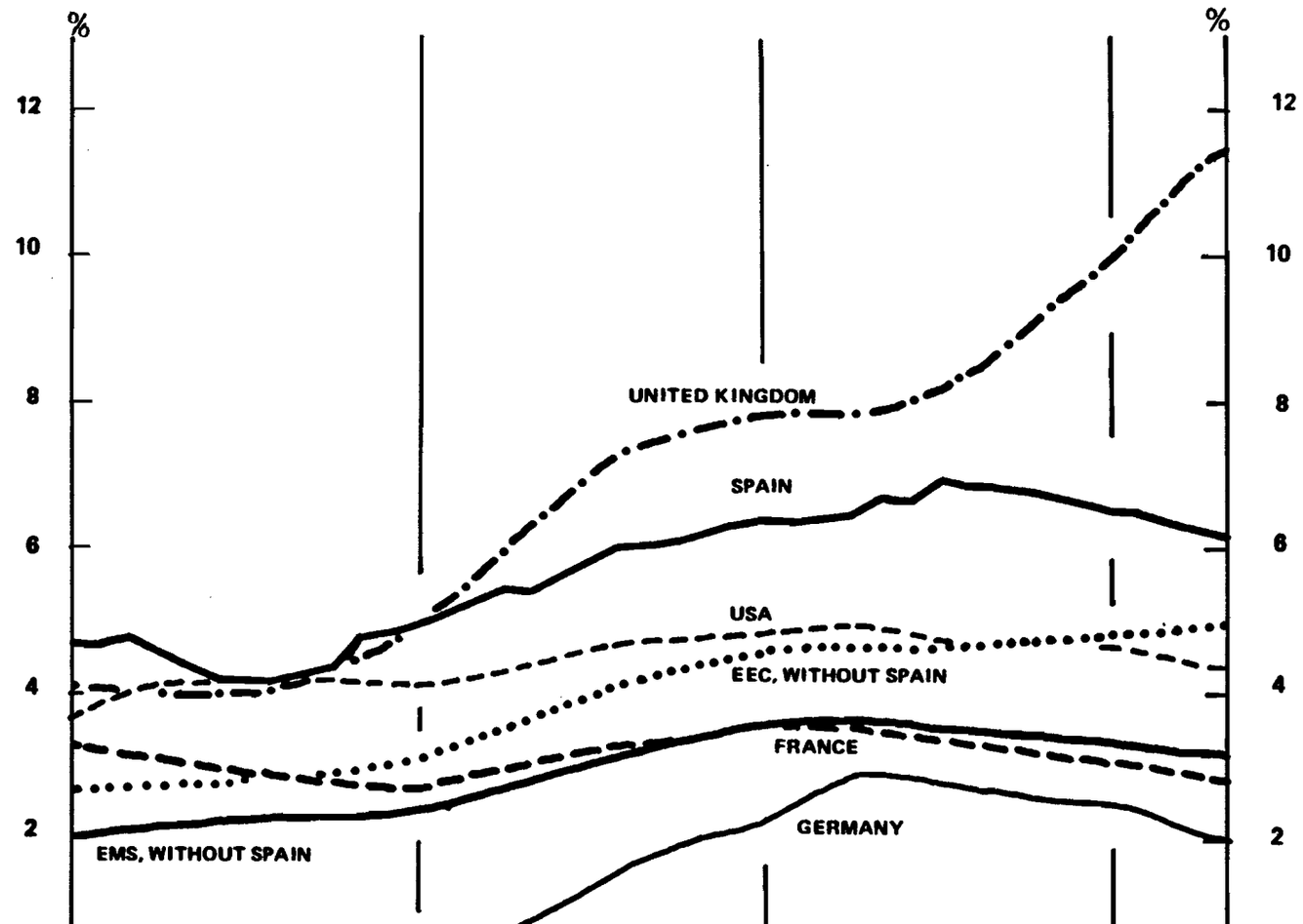
4. T_{12}^{12} AND T_{12}^{1} OF CONSUMER PRICE INDEX



5. UNDERLYING INFLATION OF CPISN



6. UNDERLYING INFLATION



7. EX–ANTE REAL RATES