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**DEMAND RATIONING AND CAPITAL CONSTRAINTS IN THE  
SPANISH ECONOMY: 1964-88**

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Este trabajo es la ponencia presentada por los autores en el VI Congreso Mundial de la Econometric Society celebrado en Barcelona del 22 al 28 de Agosto de 1990. Los análisis, opiniones y conclusiones aquí presentados son los de los autores, con los que no tiene por qué coincidir, necesariamente, la Dirección General de Planificación.

## INTRODUCTION

This paper reports the results of estimating a structural model of the Spanish economy aimed at explaining the factors behind the evolution of employment in the last twenty-five years. During this period the Spanish economy has experienced the worst crisis of recent history, with very severe consequences for employment. In 1974, the peak year over the period, overall employment stood at 13,042 thousands, in 1985, the bottom year, that level had fallen to 10,855 thousands. A loss of 2 million 187 thousand jobs in eleven years; a rate of almost 200 thousand jobs per year.

The period considered is of economic interest, not only because it includes this substantial fall which needs to be explained, but also because it covers two subperiods of recovery: the second half of the sixties and the recent recovery that started in 1986. In addition to explaining why the Spanish economy was so vulnerable to the economic crisis of the seventies, it will be of interest to find out the similarities and discrepancies of these two periods of employment growth.

The remainder of the paper is organized as follows. Section 1 describes the main facts to be explained and presents an evaluation of how far the results obtained in the paper can help us understand the evolution of employment over a period of this length. This section, therefore, includes both an introduction to the problem and a summary of the main findings. Section 2 presents a brief outline of the model and Section 3 discusses the results obtained. The paper ends with a section that carries out several simulations that should give a feel of the main properties of the estimated model.

## 1. AN EXPLANATION OF SPANISH EMPLOYMENT FOR 1964-88.

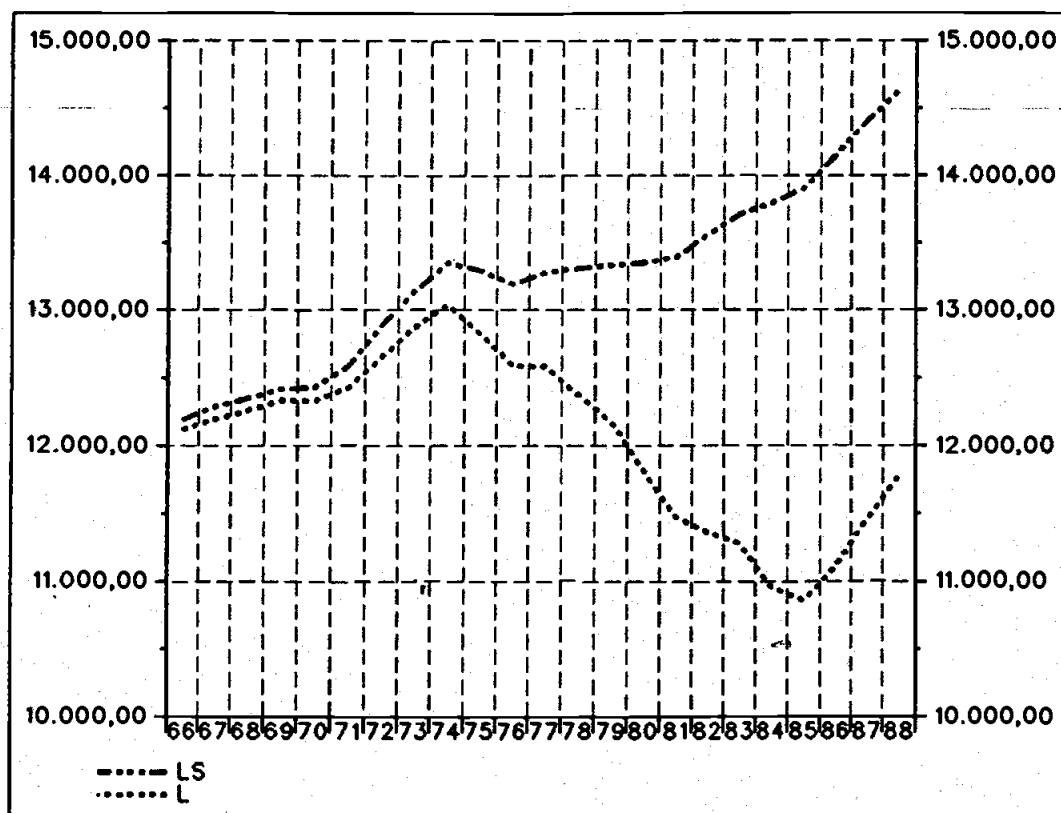
### 1.1 The facts

The main facts under explanation are summarized in Figure 1.1, which plots the evolution for the last 23 years of the labour force and of employment. Until 1974, the increase in the labour force was easily absorbed by a corresponding increase in employment. From 1966 to 1974 the labour force increased by 9.0 per cent, at a rate of 1 per cent per year, while employment increased by 7.0 per cent, at a rate of 0.8 per cent per year. Since then, however, the situation has changed dramatically. In the period that goes from 1974 to 1985, the labour force kept growing, although at a smaller pace (0.4 per cent per year). Employment, on the other hand, fell continuously over all these years. In 1985 overall employment stood at 10,855 thousands, while in 1974 it had reached 13,042 thousands. A loss of almost 2.2 million jobs, at a rate of almost 200 thousand jobs per year. Since then, there has been a strong recovery, with employment increasing to 11,781 thousand in 1988, an increase of 926 thousand jobs in 3 years, at a rate of over 300 thousand jobs per year. This means a 2.8 per cent growth per year, which has more than absorbed the also large growth of the labour force (1.7 per cent per year).

The mirror image of this facts is the evolution of unemployment. In 1974 the unemployment rate stood at 2.3 per cent of the labour force while in 1985 it had reached the 21.9 per cent level. The very rapid recovery of employment in the last three years has not had an equivalent impact on unemployment due to the considerable growth of the labour force commented above. Nevertheless, the unemployment rate in 1988 had already gone down to 19.5 per cent.

The years considered in Figure 1.1 are of interest because they include four distinct periods: two of recovery and two of crisis. The first period goes from the late sixties to the peak of 1974, and covers the last years of the upward cycle that spanned over the

FIGURE 1.1  
EMPLOYMENT AND LABOUR FORCE  
(Thousands)



sixties. The second period, that compares the mean levels of the years 1971-74 with the mean levels of the years 1975-82, captures the depressing effects of the first oil crisis. The third, that compares the mean levels of the years 1975-82 with those of 1983-86, covers the effects of the second oil crisis. And finally, the fourth period, dealing with the mean levels of 1983-86 versus those of 1987-88, contains information on the consequences for employment of the still going recovery.

A quantitative idea of these four periods is given by the following data. During the first period employment grew 3.4 per cent, during the second it fell by 4.7 per cent, during the third it also fell by a further 9.0 per cent and in the last period it increased 5.1 per cent. In annual rates, 1.6, -0.8, -1.5 and 1.7 per cent respectively.

## 1.2 An attempted explanation

What factors can explain the evolution of employment depicted in Figure 1.1? Sections 2 and 3 of this paper estimate an empirical model of the Spanish economy that attempts to identify some of these factors and their relative importance. Here we present a nontechnical discussion of the results.

The model in question considers employment as the result of decisions by firms that may find themselves in three different situations.

The first situation is when firms find that at the going wage rate they would like to hire more labour than is available, because they have the necessary stock of capital to employ this labour and sufficient demand at the going output price to sell all the resulting production. In this case, firms are constrained by the available labour supply(LS).

The second situation is when firms, in the short run, find themselves with a given stock of capital that imposes an effective restriction to the amount of workers that can be employed even when these workers are available and in the presence of sufficient demand. These firms are restricted by the stock of capital and the employment that they can generate is called "potential employment" (LP). This is the level of employment corresponding to the full use of the available stock of capital.

The third situation is when firms find themselves with sufficient capacity but with a level of demand so small that there is no incentive for them to use fully the capital stock available. In this situation, aggregate demand sets the effective constraint to the level of employment that can be generated. This is the "demand-determined employment" (LD), and is defined as the level of employment corresponding to a full satisfaction of demand for domestic output.

At any moment in time there will be some firms that are constrained by the available labour supply, others by capacity and still others by demand. The actual level of employment is a combination of these three situations, the respective weight depending on the proportion of firms in each regime. Naturally, these proportions are not constant through time and their evolution helps to understand the nature of the cycle. Before attempting to explain the relative role of these forces in explaining employment through the four periods singled out above, it is convenient to see how the concepts of "potential employment" and "demand-determined employment" have evolved through time and how they compare with both the labour force and actual employment.

Figure 1.2 plots the evolution of "potential employment" (LP), "demand-determined employment" (LD), labour supply (LS) and actual employment (L). Potential employment follows an increasing trend until 1975, growing at an annual rate of 0.7 per cent, and then falls

FIGURE 1.2  
EMPLOYMENT: L, LP, LD, LS  
(Thousands)

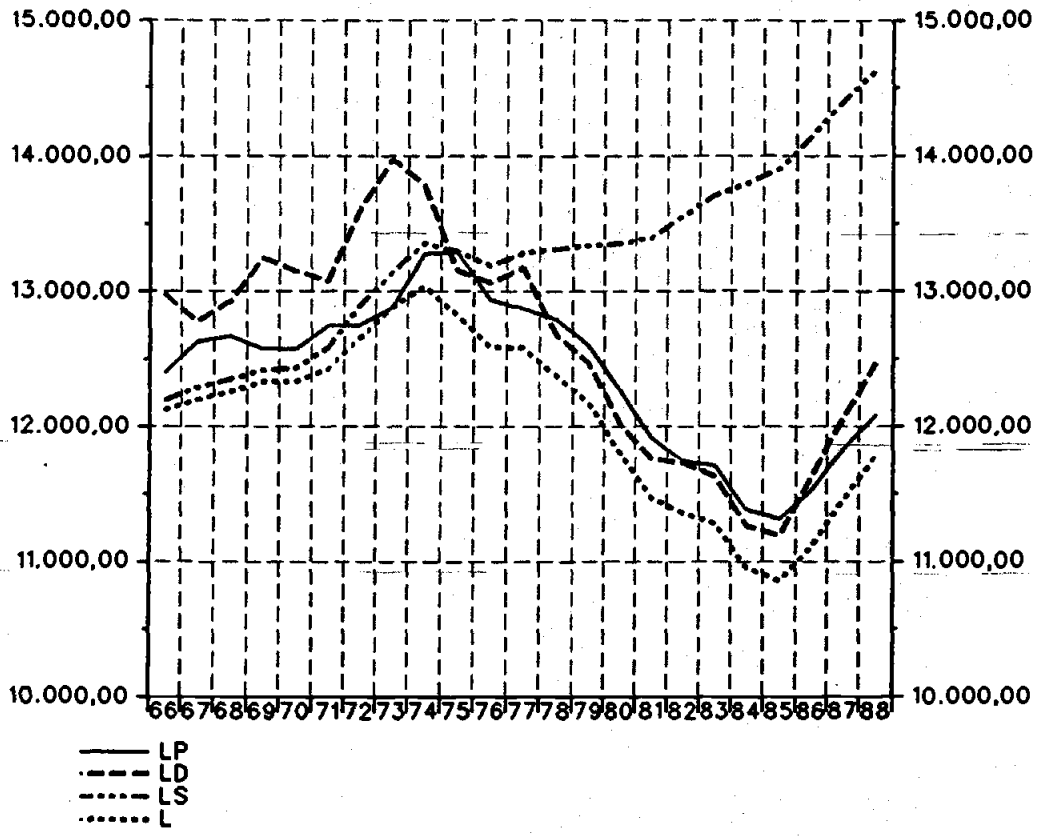
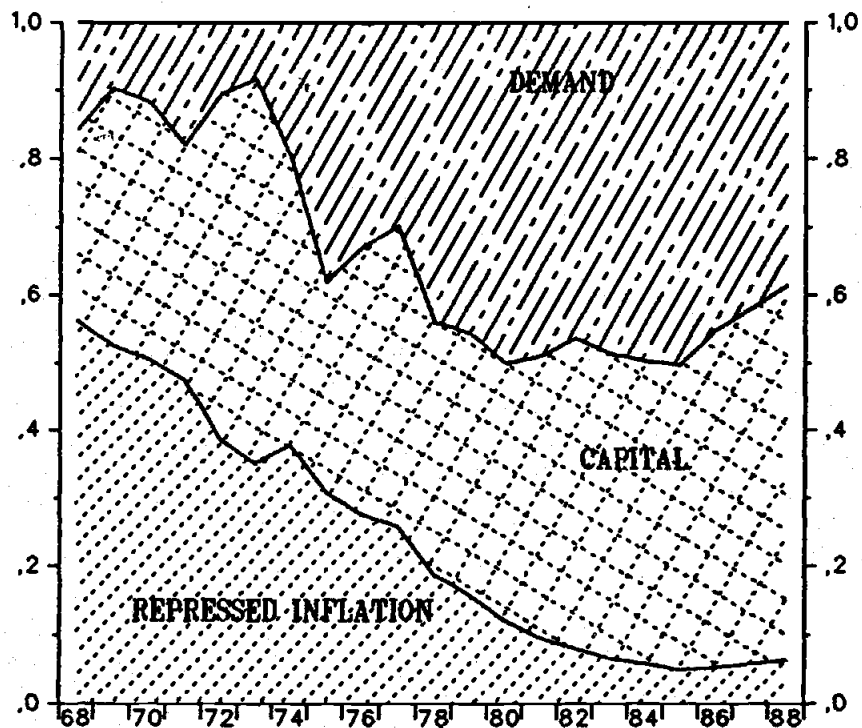


FIGURE 1.3  
RATIONING REGIMES SHARES



monotonically until 1985, at an annual rate of 1.5 per cent. Finally, in the last three years, it begins to increase again at an annual rate of 2.2 per cent. Demand employment follows a similar pattern, although it presents more oscillations and peaks 2 years earlier than potential employment. The respective annual rates of growth are 1.6 per cent in the period that goes until 1973, -1.8 per cent in the period 1973-85 and 3.7 per cent in 1985-88. The relation between the two schedules suggests that the capital stock was a more important constraint than demand until 1975. It also indicates that from then until 1985 the reverse was true, although both constraints exerted a very similar effect. Finally, that after 1985 the capital constraint started again to be stronger than the demand constraint. Also, while until 1975 both constraints tended to be above labour supply, after that date they are clearly below.

How have these constraints combined to generate the observed evolution of employment? Table 1.1 attempts to answer this question. For each of the four periods considered it shows how the three types of employment have contributed to explain the change in actual employment. In addition it considers the effect of structural mismatch and labour hoarding.

During the first period actual employment grew by 2.0 per cent<sup>1</sup>. The results obtained in this paper suggest that capacity, demand and availability of labour would together explain an increase in employment of 3.6 per cent, and that the increase in the level of mismatch and labour hoarding detract 1.6 points to this effect.<sup>2</sup> The first oil-price shock brings a fall in employment of 7.7 per cent. The reduction of capacity explains a quarter of this effect, and the

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1 This is measured as the difference between the means of the subperiods considered (eg. 1969-70 and 1971-74) and refers to non-public employment only.

2 This applies the predicted combinations of each variable to the actual observed employment change.



TABLE 1.1

**CONTRIBUTIONS OF CAPACITY EMPLOYMENT, DEMAND-DETERMINED EMPLOYMENT  
AND LABOUR SUPPLY TO CHANGES IN ACTUAL EMPLOYMENT**

	<u>1971-74</u> <u>1969-70</u>	<u>1975-82</u> <u>1971-74</u>	<u>1983-86</u> <u>1975-82</u>	<u>1987-88</u> <u>1983-86</u>
CAPACITY EMPLOYMENT (LP)	.006	-.021	-.056	.015
DEMAND-DETERMINED EMPLOYMENT (LD)	.003	-.048	-.059	.025
LABOUR SUPPLY (LS)	.013	.001	.001	.002
STRUCTURAL MISMATCH	-.004	-.033	-.033	.000
DEGREE OF LABOUR UTILIZATION (DUL)	-.006	.019	.006	-.009
EXPLAINED CHANGE IN EMPLOYMENT	.012	-.082	-.141	.033
ACTUAL CHANGE IN EMPLOYMENT	.020	-.077	-.129	.038

reduction of demand almost a 60 per cent. The other factor that contributes negatively to employment is the worsening of mismatch that explains a 40 per cent of the total effect. These influences are partially compensated by less labour hoarding and more labour supply. The explanation of the 12.9 per cent fall in employment during the second oil-price shock is very similar to that of the first, although the relative influence of capacity is larger. Finally, the 3.8 per cent increase in the recent recovery is again mainly explained by demand.

Overall, the results in Table 1.1 suggest that:

- a) demand tends to have a larger effect than either capacity or labour availability in the determination of employment;
- b) despite this, the influence of capacity has been growing over time, while that of mismatch has decreased; and
- c) as expected, labour hoarding tends to increase in periods of depression and diminish in periods of expansion.

The results a) and b) are consistent with the evolution of the estimated proportions of firms in each of the three rationing regimes, as shown in Figure 1.3.

Naturally, these results say little unless we also find out how the evolution of capacity, employment, demand, employment and labour supply are determined. Table 1.2 takes the latter as given and provides an explanation of the evolution of LP and LD depicted in Figure 1.2.

Potential employment depends on the optimal labour-capital ratio, given relative factor prices and production conditions, and on

TABLE 1.2

CONTRIBUTIONS OF TECHNICAL COEFFICIENTS, DEMAND AND CAPITAL STOCK  
TO CHANGES IN CAPACITY EMPLOYMENT AND DEMAND-DETERMINED EMPLOYMENT

	<u>1971-74</u> <u>1969-70</u>	<u>1975-82</u> <u>1971-74</u>	<u>1983-86</u> <u>1975-82</u>	<u>1987-88</u> <u>1983-86</u>
LABOUR TECHNICAL COEFFICIENT(A)	-.164	-.250	-.184	-.065
CAPITAL TECHNICAL COEFFICIENT(B)	-.060	-.138	-.085	.012
CAPITAL STOCK	.238	.334	.148	.080
EXPLAINED CHANGE IN CAPACITY EMPLOYMENT (LP)	.014	-.054	-.121	.027
	<u>1971-74</u> <u>1969-70</u>	<u>1975-82</u> <u>1971-74</u>	<u>1983-86</u> <u>1975-82</u>	<u>1987-88</u> <u>1983-86</u>
LABOUR TECHNICAL COEFFICIENT(A)	-.164	-.250	-.184	-.065
NOTIONAL DEMAND	.183	.136	.061	.126
EXPLAINED CHANGE IN DEMAND-DETERMINED EMPLOYMENT (LD)	.019	-.114	-.123	.061

the evolution of the capital stock<sup>3</sup>. The upper panel of Table 1.2 shows that over the whole period there has been a decreasing trend in the optimal labour-capital ratio, together with a deceleration in the rate of increase of the stock capital<sup>4</sup>. In the first period the capital stock grew more than enough to absorb the amount of workers freed by the lower requirement of labour per unit of capital and this meant an increase in employment. In the second and third periods, however, the capital stock grew much less than in the first, not being able to absorb all workers freed by the lower labour-capital ratio. Finally, in the last period the rate of growth of the capital stock picks up again compensating the lower labour requirement.

The lower panel shows that something similar has happened as far as the level of demand-determined employment. There is an upward trend in labour productivity, which is more than compensated by the increase in notional demand in the first and fourth periods, but not in the second and third. It is interesting to point out the substantial drop of notional demand during the years of crisis. The annual rate of growth of notional demand was 9.1 per cent in the first period, 2.7 per cent in the second and 1.2 per cent in the third. In the last period of recovery, on the other hand, it picks up to a 6.3 per cent annual rate.

What explains the substantial increase in labour productivity and the more moderate fall in capital productivity? We show in the sections below that the evolution of labour productivity (technical

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<sup>3</sup> In turn, the optimal labour-capital ratio can itself be expressed as the product of the inverse of labour productivity times capital productivity (both at the optimal input mix). Since the model estimates empirically these two productivities, the table is also expressed identifying both of them. In the text here, however, we turn directly to the effect of the labour ratio, which is simply the sum of the two first rows of the table.

<sup>4</sup> This statement takes into account the different length of the periods considered.

coefficient A) depends on the real labour cost and on the relative price of energy, and that of capital productivity (technical coefficient B) on the user cost of capital and also on the relative price of energy. Table 1.3 identifies the contribution of these factors in each of the four periods considered. The increase in labour productivity was, to a large extent, a response to the increase of real labour costs, partially compensated in the first three periods by the rise in energy prices, and compounded in the last period by the fall in these prices. The fall in capital productivity, on the other hand, was much more severely affected by the rise in energy prices which, particularly in the two intermediate periods, explains the practical totality of this downward trend.

Table 1.4 brings together all these results and shows the contribution to employment of the basic explanatory variables. Centering first our attention on the two intermediate periods, we see that the increase in real labour costs and in the degree of structural mismatch are the main reasons behind the substantial fall of employment between 1974 and 1985. Due to these two factors, other things equal, employment would have fallen by 29.4 per cent in the 1971-74 to 1975-82 period, and by 27.3 per cent in the 1975-82 to 1983-86 period. Naturally, things did not remain equal, and the main compensatory factors of these negative effects were capital accumulation and demand, that together would explain a rise in employment of 18.9 per cent and of 9.8 per cent for each of the two periods. Whereas the effects of labour costs and mismatch were very similar in both periods, those of the capital stock and demand were somewhat different. The positive effects of the capital stock on employment are much smaller in the second half of the crisis than in the first. Also, aggregate demand management was more accommodating in the first half contributing a 5.7 per cent increase in employment, than in the second, when it only contributed a 3.0 per cent increase.

Another result worth remarking in these two periods of crisis is the effect of the relative price of energy. Somewhat

TABLE 1.3

## CHANGE IN TECHNICAL COEFFICIENTS: CONTRIBUTIONS OF RELATIVE FACTOR PRICES

Labour Technical Coefficient (A)

	<u>1971-74</u> <u>1969-70</u>	<u>1975-82</u> <u>1971-74</u>	<u>1983-86</u> <u>1975-82</u>	<u>1987-88</u> <u>1983-86</u>
REAL LABOUR COST	.131	.321	.257	.061
RELATIVE PRICE OF ENERGY IMPORTS	.006	-.081	-.067	.012
EXPLAINED CHANGE IN A	.137	.240	.190	.073
ACTUAL CHANGE IN A	.164	.250	.184	.064

Capital Technical Coefficient (B)

	<u>1971-74</u> <u>1969-70</u>	<u>1975-82</u> <u>1971-74</u>	<u>1983-86</u> <u>1975-82</u>	<u>1987-88</u> <u>1983-86</u>
USER COST OF CAPITAL	-.044	-.012	.002	-.050
RELATIVE PRICE OF ENERGY IMPORTS	-.005	-.139	-.075	.056
EXPLAINED CHANGE IN B	-.049	-.151	-.073	.006
ACTUAL CHANGE IN B	-.059	-.138	-.085	.012

TABLE 1.4

## CHANGES IN EMPLOYMENT: FINAL CONTRIBUTIONS

	<u>1971-74</u> <u>1969-70</u>	<u>1975-82</u> <u>1971-74</u>	<u>1983-86</u> <u>1975-82</u>	<u>1987-88</u> <u>1983-86</u>
REAL LABOUR COST	-.079	-.261	-.242	-.057
USER COST OF CAPITAL	-.020	-.004	.001	-.008
RELATIVE PRICE OF ENERGY IMPORTS	-.006	.011	.062	.004
CAPITAL STOCK	.110	.132	.068	.043
NOTIONAL DEMAND	.026	.057	.030	.051
LABOUR SUPPLY	.013	.001	.001	.002
STRUCTURAL MISMATCH	-.004	-.033	-.033	.000
DEGREE OF LABOUR UTILIZATION	-.006	.019	.006	-.009
EXPLAINED CHANGE IN EMPLOYMENT	.034	-.078	-.107	.026
ACTUAL CHANGE IN EMPLOYMENT	.020	-.077	-.129	.038

counterintuitively, this effect is positive and, particularly in the second oil crisis, sizeable (1.1 and 6.2 per cent). The reason is that, the way it is specified, this result captures the pure factor substitution effect generated by the increase in the price of energy. The output effect, which is undoubtedly negative, is already taken into account through other variables.

There are also some noticeable differences between the two recovery periods. In the first one (1969-70 to 1971-74), the negative impact of the rise in input costs (9.9 per cent) is more than compensated by the positive effect of capital accumulation and demand, which together make employment rise by 13.6 per cent, most of the effect coming from the increase in the stock of capital. In the second (1983-86 to 1987-88), the negative impact of input prices is much smaller (6.5 per cent), the positive effect of capital accumulation is also smaller (4.3 per cent), but demand picks up again with an effect of 5.1 per cent, about twice as large as that in the first period of expansion, and even larger than the capital stock effect.

Overall the results of this paper confirm the significant negative impact that labour costs have had on employment between 1974 and 1985, and present additional evidence that suggest that structural mismatch during the period may have aggravated the problem. The deceleration in capital accumulation also had an influence, but throughout the period its effect on employment was positive. Finally, we are also able to corroborate that the stance of demand was stronger during the first than during the second oil crisis.



## 2. THE MODEL

The sample period under study combines episodes of both record growth and unemployment. As it is well known, the difficulties lie in the explanation of the stagflation period of the late 70's and early 80's. In this section we present a sketch of the theoretical model used in this paper aimed to address these issues. The model is based on the work of Layard and Nickell (1985), Sneessens and Dréze (1986), Sneessens (1987) and Bean and Dréze (1989).

Inflationary pressures are mainly caused by distortions in the distribution mechanism. Employment, on the other hand, is affected by a variety of factors. The Second Generation Disequilibrium Models constitute a useful framework to assess the relative importance of different factors such as capital shortages, low aggregate demand, labour supply developments, structural mismatches and long-run permanent changes in relative prices<sup>5</sup>. Given the importance of the determinants of aggregate demand and capital accumulation, the labour market block must be enlarged to account for the evolution of investment, consumption, trade balance, etc, so that it becomes a small macro model.

The main assumptions that underline the theoretical set up of the model can be summarized as follows:

- i) Firms and workers set wages before prices and employment are known. Bargaining refers only to expected real wages ( $W/P^e$ ) and the firm keeps the right to decide about prices and employment.
- ii) There are  $n$  firms which operate in a monopolistic competition framework. Each firm  $i$  faces a downward sloping demand curve on

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<sup>5</sup> By Second Generation we mean the set of models in which an overall disequilibrium regime characterising the economy at a point in time is substituted by a distribution of regimes across markets which hence can suffer from different disequilibrium situations.

its price relative to the aggregate price level  $d(P_i/P)$ . Aggregate demand is given by  $YD$ . The firm sets its price as a mark-up over normal unit costs, taking into account the expected price of its competitors (in aggregate,  $P^e$ ) before the actual value of exogenous random disturbances on demand ( $e_i$ ), capacity ( $\epsilon_i$ ) and labour supply ( $v_i$ ) are known.

- iii) Technology is of the putty-clay type, with large ex-ante substitution possibilities and fixed ex-post factor proportions. Assuming separability, the firm's value added  $Y_i$  is subject to the following short run constraints (Sneesens (1987)):

$$Y_i \leq d \left( \frac{P_i}{P^e} \right) \frac{YD}{n} e_i \quad \equiv YD_i \quad (2.1)$$

$$Y_i \leq A \cdot LS_i v_i \quad \equiv YS_i \quad (2.2)$$

$$Y_i \leq B \cdot K_i \epsilon_i \quad \equiv YP_i \quad (2.3)$$

The firm chooses ex-ante the optimal technical proportions ( $A^*, B^*$ ) and capacity ( $K_i$ ) to minimize long-run costs.  $LS_i$  is the labour supply exogenously given to the firm.

- iv) Labour is the only variable factor and it is chosen once  $P_i/P$ ,  $e_i$ ,  $v_i$ ,  $\epsilon_i$  are known.  
v) Finally, we consider a large number of firms.

## 2.1. Wages and Prices

### Prices (Feasible mark-up)

Given the stochastic structure of the model it is assumed that each firm sets its price as a mark-up over normal unit costs defined at the full employment level of resources. Firms also take

into account the expected rivals' price and hence prices are set according to:

$$P_i = g \left( \mu \cdot W \cdot \frac{E(LS_i)}{E(YP_i)}, p^e \right) \quad (2.4)$$

where  $\mu$  is the mark-up,  $W$  is the nominal labour cost,  $E(LS_i)$  represents the expected available labour force and  $E(YP_i)$  the expected output at full capacity or potential output as defined in (2.3). If we assume (Nickell (1986)) that  $g$  is homogeneous of degree one in both arguments, dividing by  $P_i$  and solving, we can rewrite:

$$\frac{P_i}{W} = \mu \left[ \frac{E(LS_i)}{E(YP_i)} \right] \cdot h \left( \frac{P_i}{p^e} \right) \quad (2.5)$$

The mark up,  $\mu$ , may be a function of cyclical demand pressure which we represent by  $E(YD_i)/E(Y_i)$ , and we proxy by the degree of capacity utilization. On the other hand, we assume  $E(LS_i)/E(YP_i) = \alpha(K_i/L_i)$ , a measure of productivity.

Aggregating over firms and taking logs, our price equation is

$$P/W = P/W (P/P^e, DUC, K/L, Z_p) \quad (2.6)$$

where  $Z_p$  is a vector of fiscal policy or imported price effects that may influence (2.5).

#### Real Wages (Desired mark-up)

We obtain our wage equation as the outcome of a bargaining process over ex-ante desired real wages, which can be thought of as coming from a Nash bargaining type model:

$$W/P = W/P (P/P^e, U, K/L, Z_w) \quad (2.7)$$

where  $U$  is the unemployment rate and  $Z_u$  is a vector of push factors including some measure of union power and the variables driving a wedge between the producer's price ( $P$ ) and the consumer price index ( $PC$ ). Among these we consider indirect taxes ( $T_3$ ) and Social Security contributions ( $SS$ ), as well as a function of the ratio of imported goods prices over the CPI, ( $PC/P$ ), that takes into account terms of trade effects.

As in Layard and Nickell (1985), solving out (2.6) and (2.7) we could get an expression that has the conventional Phillips Curve interpretation, where distributional factors are explicitly allowed for. It is not a theory of unemployment, for it involves other endogenous variables such as price surprises and the degree of capacity utilization, yet such an expression shows how much inflation is required to make the desired and feasible mark ups consistent for a given level of unemployment and demand pressure. In order to turn it into an operative theory of inflation we need independent explanations of unemployment and demand. This is the main subject of the next pages, where we only explain one side of the story since we consider labour supply exogenous.

## 2.2. The determinants of employment

### Production Coefficients

Given a CES technology, the joint choice of factor proportions and firm's size is the outcome of the cost minimization problem:

$$\begin{aligned} \min (WLP_j + CCK_j) \\ \text{s.t. } YP_j = f(LP_j, K_j) \end{aligned} \quad (2.8)$$

The first order conditions result in technical coefficients associated with the optimal factor proportions:

$$A^* = \frac{YP_i}{LP_i} = A^* \left( \sigma, \frac{W}{CC} \right) \quad (2.9)$$

$$B^* = \frac{YP_i}{K_i} = B^* \left( \sigma, \frac{W}{CC} \right) \quad (2.10)$$

where  $W$  and  $CC$  are the nominal wage rate and user cost of capital respectively,  $\sigma$  is the (constant) elasticity of substitution and  $LP_i$  is the level of employment corresponding to a full utilization of  $K_i$ , which is required to produce  $YP_i$ . We implicitly use the assumption of  $n$  identical firms.

Assuming that in the long-run prices are set as a mark-up over total unit costs and that there is free entry yielding zero normal profits, we can write, in aggregate:

$$P = WA^{*-1} + CCB^{*-1}$$

which allows us to write  $A^*$  and  $B^*$  in terms of  $W/P$  and  $CC/P$  respectively.

In the short-run, as factor prices change,  $A^*$  and  $B^*$  cannot be reached instantaneously. The relation between the given technical coefficients  $A$  and  $B$  and their optimal values follow a partial adjustment process:

$$A_t = A_t^{*\theta} A_{t-1}^{1-\theta} \quad (2.11)$$

and similarly for  $B$ .

Combining (2.9), (2.10) and (2.11) we obtain:

$$\begin{aligned} A &\equiv Y/LU = a ((Y/LU)^{-1}, W/P) \\ B &\equiv Y/KU = b ((Y/KU)^{-1}, CC/P) \end{aligned} \quad (2.12)$$

where LU and KU stand for the use of labour and capital respectively.

**Short-run employment function: aggregation over regimes**

At a given point in time, the firm takes  $K_i$ , A and B as given, and therefore there are no substitution possibilities. The production set is then represented by right angle isoquants. Prices have been fixed before the realization of the shocks, and when these take place, each firm will face one of the following disequilibrium regimes:

- (i) Capital becomes the binding constraint. If there are no constraints elsewhere, labour demand must lie along the ray through the origin (optimal proportions). Use of labour will then be given by the labour demand at its potential level.

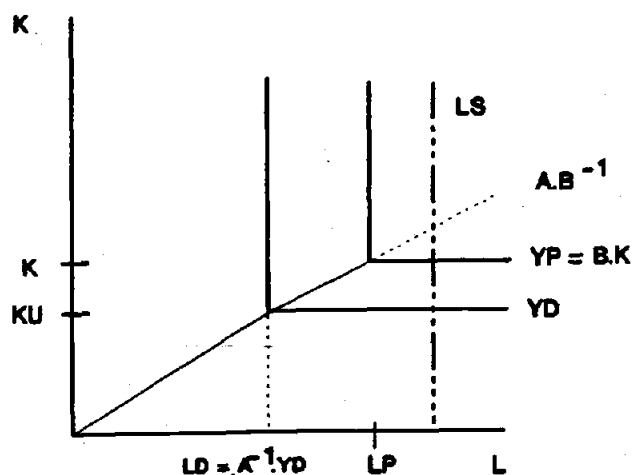
$$LU_i = LP_i = A^{-1} B K_i \quad \text{if} \quad \begin{aligned} LP_i &< LS_i \\ YP_i &< YD_i \end{aligned} \quad (2.13)$$

- (ii) The firm is in a sales constraint. Since prices are set prior to the realizations of  $e_i$  and  $v_i$ , it may be the case that the firm's demand ( $YD_i$ ) falls short of  $YP_i$ . If that is the case, employment is given by

$$LU_i = LD_i = A^{-1} YD_i \quad \text{if} \quad \begin{aligned} LD_i &< LS_i \\ YP_i &> YD_i \end{aligned} \quad (2.14)$$

This is the situation portrayed in Fig. 2.1:

FIGURE 2.1



(iii) Alternatively the labour availability is short, hence

$$LU_i = LS_i \quad \text{where } LS_i < \min(LP_i, LD_i)$$

The three situations can be represented in a more compact fashion by the traditional min condition,

$$LU_i = \min(LP_i, LD_i, LS_i) \quad (2.15)$$

which can also be written, in the output space as:

$$LU_i = \min(A^{-1}YP_i, A^{-1}YD_i, LS_i) \quad (2.16)$$

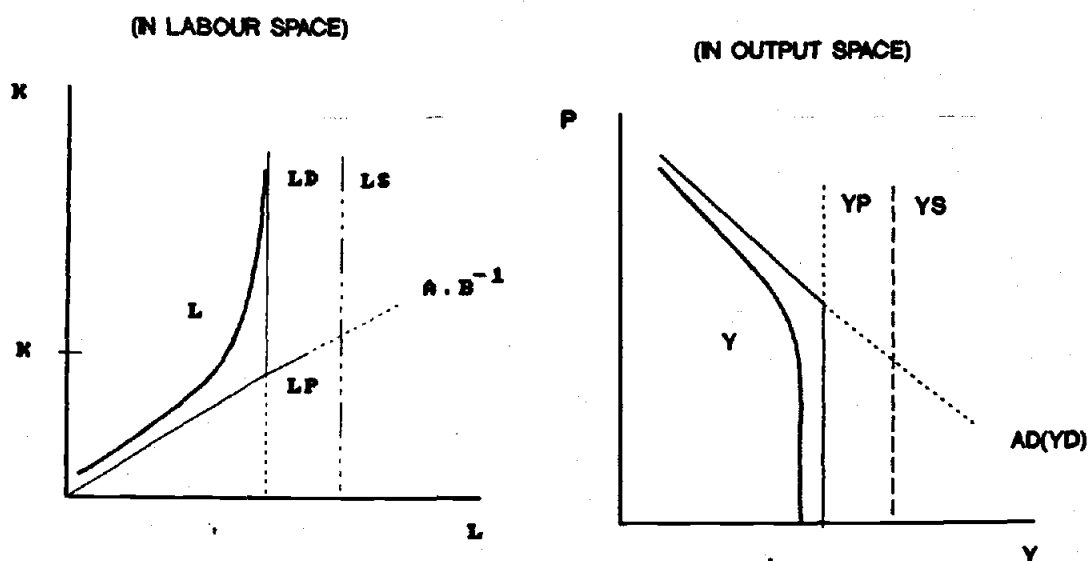
If the number of firms is very large, the aggregate demand for labour will be given by  $LU = nE(LU_i)$

Under some assumptions about the joint distribution of  $e_i, v_i, \epsilon_i$ , it can be shown (Lambert (1987)) that (2.16) can be written as a CES type function:

$$LU = [ (A^{-1} YD)^{-\delta} + (A^{-1} BK)^{-\delta} + (LS)^{-\delta} ]^{-1/\delta} \quad (2.17)$$

A similar expression can be obtained in the output space  $Y$ . The parameter  $\delta$  is an index of the degree of uncertainty about demand, capacity and labour supply. It introduces a frictional element that makes employment always lie below its notional demand, capacity level and labour availability. Note that if  $LS=LP=LD$ , then  $LU=3^{-1/\delta} LS < LS$  (a measure of "structural unemployment"). This is represented in Figure 2.2, both in labour and output spaces.

FIGURE 2.2



Each of the following changes will shift the  $L$  locus leftwards: a fall in the labour supply  $LS$ , a fall in  $LP$  due to capital stock or technical coefficients changes, a fall in  $LD$  and an increase in the structural mismatch (measured by  $1/\delta$ ). The fifth element behind the determination in  $L$  is the degree of labour hoarding,  $LU < L$ . Both the use of capital  $KU$  and the use of labour  $LU$  are not observable, and are related to installed  $K$  and hired  $L$  through some measure of the degree of capital and labour utilization:

$$LU = \tau_u(L, DUL) \quad , \quad KU = \kappa_u(K, DUC) \quad (2.18)$$



This allows us to estimate actual factor productivities rather than technical coefficients.

Given (2.17) the elasticity of aggregate employment with respect to LP, LD, LS will be time varying and smaller than one; and given the CES type function, it will be equal to the proportion of firms in each disequilibrium regime. This has important policy implications since it means that the implicit policy multipliers are not only endogenous, but also change over time depending upon the dominant regime that prevails at the moment of the intervention.

### Demand

The change in technical coefficients are induced either by technical progress or long lasting changes in relative prices, which can only be compensated by increase in aggregate demand and the capital stock.

In this sense, YD and K become the main determinants of L. If we want to explain the ultimate causes of the evolution of labour growth, we need to know the determinants of both notional demand (YD) and investment (I). YD itself is unobservable, so we use an operational expression for it.

Notional demand can be expressed as:

$$YD = CD + ID + GD + XD - MD$$

We shall assume that domestic absorption is never rationed and that any potential excess demand is satisfied increasing imports or reducing exports. Hence:

$$YD = C + I + G + XD - MD \quad (2.19)$$

$XD$  and  $MD$  are functions of the fundamental determinants of exports and imports:

$$\begin{aligned} XD &= XD(WT, PRX) \\ MD &= MD(Y, PRM) \end{aligned} \quad (2.20)$$

where  $WT$  is an index of world-trade,  $Y$  real GDP and  $PRX$ ,  $PRM$  some competitiveness indices for exports and imports, respectively.

The discrepancies between actual and notional values of foreign trade will depend on how tight domestic markets are. Using the deviation of  $DUC$  with respect to its minimum value as a proxy for such tightness, we can specify:

$$\begin{aligned} \log X &= \log XD - \phi_X (\log DUC - \log DUC_{min}) \\ \log M &= \log MD + \phi_M (\log DUC - \log DUC_{min}) \end{aligned} \quad (2.21)$$

Where  $\phi_X$ ,  $\phi_M$  are positive parameters: as internal demand overheats, actual exports go below their notional level and imports above theirs.

Consumption and investment are left unrationed and therefore they have not been considered to correct GDP for spillovers. However, it is still interesting to analyze these two components of GDP, not only as major determinants of total demand, but also to provide an explanation of the evolution of the stock of capital and of savings.

The consumption function is a standard one, being real disposable income and real wealth its long-run determinants, and allowing for short-run effects for inflation tax and real interest rate.

The investment function comes from (2.10), where we have taken an exogenously given desired capacity level. In such a case, (2.10)

becomes an investment function where we have assumed that firms wish to satisfy expected total demand in the long run.

Aggregating (2.10) over firms and taking its inverse we can get:

$$\frac{K}{YD} = g\left(\frac{CC}{P}\right) \quad (2.22)$$

This specification implies that an additional spillover effect  $YD/Y = \Omega(DUC)$  runs from excess demand to accelerated investment:

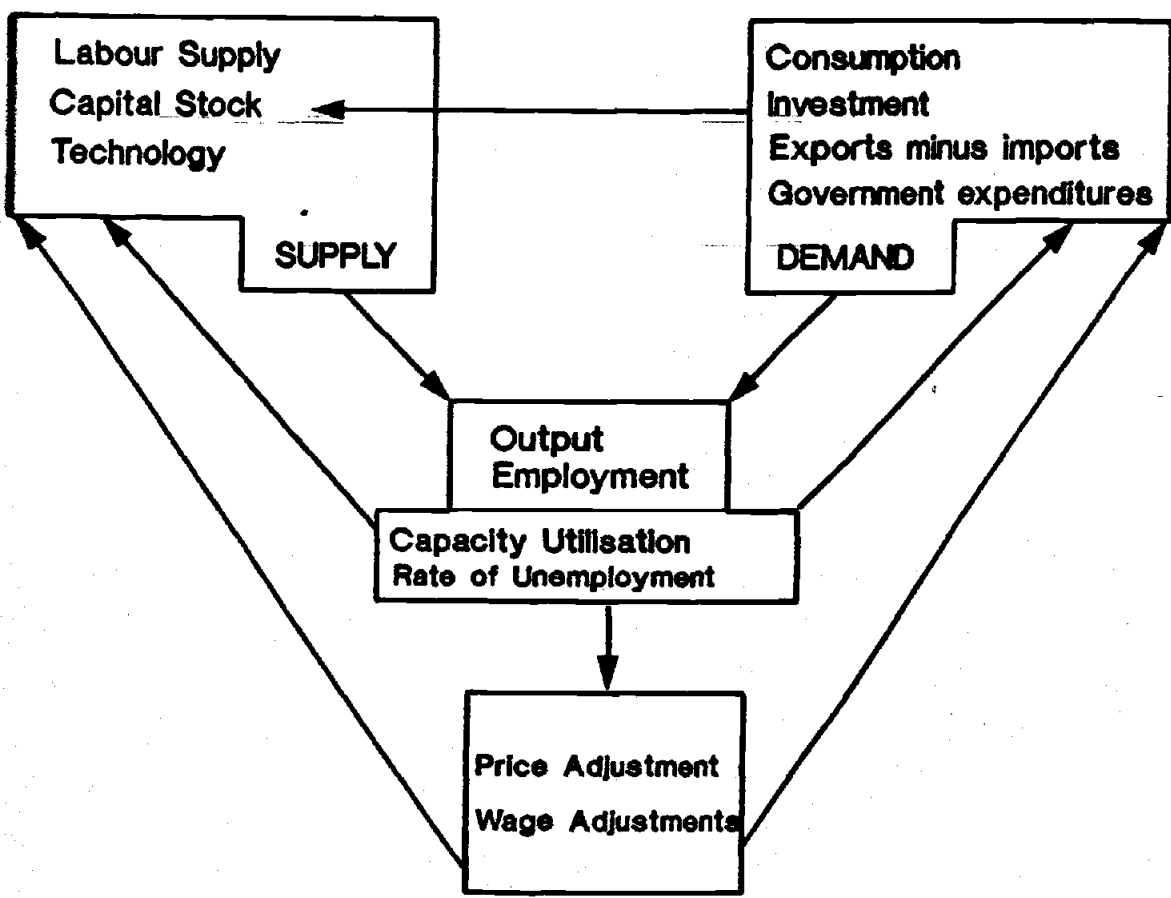
$$\frac{K}{Y} = \frac{K}{YD} \cdot \Omega(DUC) = k \left( \frac{CC}{P}, DUC \right) \quad (2.23)$$

Equation (2.22) can be reinterpreted as a proper investment function: assuming that the rate of growth of the capital stock is small relative to the depreciation rate and not too volatile, it can be shown (see Bean (1981)) that the long run determinants of the  $I/Y$  ratio are those of  $K/Y$ .

### 2.3 A summary of the model

Figure 2.3 portrays a graphical summary of the model taken from Bean and Dréze (1990). Labour force, capital stock and technical coefficients, in the supply side, determine both full employment and potential output (or employment). The notional demand side determines the other possible constraint. The interaction between demand and supply defines both utilization of capacity and of labour, and unemployment. These affect directly the technology, and the external spillover and the wage settlement processes. Wages and prices will, in turn, feed back the technological coefficients, and via competitiveness, the demand side.

FIGURE 2.3



### 3. EMPIRICAL RESULTS

In this section we present the most relevant equations estimated, and we refer to other equations that close up our model.

#### 3.1. Wage and price equations

Tables 3.1 and 3.2 present the results of the estimation of (2.6) and (2.7). Real labour costs are divided by the social security contributions rate in order to convert them into gross wages. Indirect taxes are also included to get market prices. The elasticity of real wages to unemployment is high. Productivity, measured by (lagged) capital over employment is very significant. "Push factors" include the wedge between consumer prices and producers prices which tries to pick up the effect of prices of imported consumption goods. There is also a dummy variable reflecting price and wage controls in 1970-71.

Our price equation conveys a partial adjustment process from labour costs to mark-ups. In the long-run the elasticity of prices with respect to productivity, close to -1, is higher in absolute value than that with respect to wages. The opposite happens in the short-run.

#### 3.2. Production coefficients and aggregation

Table 3.3 presents the results of the observed factor productivity equations. We combine the partial adjustment process of technical coefficients (2.12) with the estimation of the degree of utilization of labour and capital (2.18). Since data for DUL are not available, we used DUC to account also for the degree of labour hoarding. From Table 3.3 it follows that:

- (i) Factor proportions adjust in a very sluggish fashion. The partial adjustment is roughly 15%.

- (ii) The relative price of imported energy attempts to capture the negative effects that the two oil shocks may have had over value added, either directly or via the industrial reorganization that those shocks implied.
- (iii) The technical coefficients A and B needed to get YP, LP and LD are obtained correcting the observed productivities Y/L, Y/K for labour hoarding and capital underutilization, so that we abstract from cyclical considerations.
- (iv) Given  $\hat{A}$  and  $\hat{B}$  we get YP, LP and LD from (2.13) and (2.14), where YD is obtained as mentioned below. The results are graphed in Figure 1.2 and the regime proportions in Figure 1.3. Once LP and LD are estimated, with LS exogenous, we estimate the aggregation equation (2.17) to get actual output or employment. The estimation is carried out in the output space, using  $YP = B \cdot K$  and  $YS = A \cdot LS$ ; YD is estimated directly. Table 3.4 presents these results.

The measure of frictional unemployment,  $1/\delta$ , is explained by a time trend, the relative prices of imported energy, and a measure of sectorial shift among agriculture, industry and services, that we take as an index of mismatch.

### 3.3 Demand

Government expenditure is taken to be exogenous. The other components of demand are estimated using an error correction mechanism around a long-run relationship determined using cointegration analysis.

The export equation, that excludes tourism in order to isolate the spillover effect of internal demand, is reported in Table 3.5. An index of Spanish trade with OECD countries is the scale variable. Cointegration analysis suggested the inclusion of a

competitiveness index, built as a relative price of Spanish exported goods to world imports' prices times the appropriate exchange rate (a version of the real exchange rate). The equation was estimated in first differences, but an error-correction coefficient equal to one was obtained so that it was rewritten in levels. The long-run elasticity with respect to world trade, 1.7, is similar to other studies about Spanish exports. The spillover coefficient that corrects notional from observed exports is low, but significant. Short-run variables include the inflation differential to account for services, whose prices are not included in our competitiveness index, and for those goods which have not been exported for price reasons. The dummy variables capture the evidence of statistical problems for 1976 and the loss of the Latinamerican and OPEC markets in 1986 (see Fernández and Sebastián (1990)).

The imports equation is presented in Table 3.6. It includes both energy and non-energy purchases. The long-run equation is determined by real GDP and a competitiveness index defined as the price of non-energy imports relative to the GDP deflator. The spillover effect is much higher than for exports, being close to unity. In the short-run, the key variable happens to be the change in real investment (both current and lagged). The change in demand pressure is also a significant variable, with the same elasticity than in the long-run. Notional exports and imports, XD and MD, are obtained using (2.2).

Investment and consumption are reported in Tables 3.7 y 3.8. For consumption, the cointegration relationship includes real disposable income and households' real wealth, defined as the sum of real productive plus residential capital, real bonds and money holdings. In the short-run, changes in the inflationary tax, the real interest rate and the unemployment rate, the latter picking up distributional effects (see Andrés, Molinas y Taguas (1990)), appear to have a very significant influence.

The investment function is estimated following the right-hand side of (2.23). Inflation appears not only in the user cost of capital but also affecting negatively the ratio investment/output. Imperfect information or expected transaction uncertainty justifies this specification (see Andrés, Escribano, Molinas y Taguas (1990)).



TABLE 3.1

WAGESEquation

$$\log (W/P (1 + SS)) = \beta_0 + \log (1 + T3) + \beta_1 \log (PC/P (1 + T3)) + \beta_2 \log K(-1)/L + \beta_3 U + \beta_4 DUM$$

Definition of variables

W	=	Nominal labour cost
P	=	GDP deflator (factor cost)
PC	=	Private consumption deflator
SS	=	Employer's Social Security contributions
T3	=	Indirect tax rate
K	=	Capital stock
L	=	Employment
U	=	Unemployment rate
DUM	=	Dummy with value 0.5 in 1970, 1 in 1971, 0 elsewhere

Estimation results:

		<u>Coefficient</u>	<u>t-statistic</u>
Constant	$\beta_0$	-.922	-85.69
Terms of trade effect	$\beta_1$	.730	8.04
Capital/Employment ratio	$\beta_2$	.688	60.38
Unemployment	$\beta_3$	-1.232	-23.22
Dummy	$\beta_4$	-.087	-10.65

$\bar{R}^2 = .999$       DW = 2.05      SEE = .008

Estimation period : 1967 - 1988

Estimation method: Non-linear 3SLS jointly with prices

**TABLE 3.2**  
**PRICES**

**Equation**

$$\log P = \alpha_0 + \alpha_1 \log W + (1-\alpha_1) \log P(-1) + \alpha_2 \log (K(-1)/L) + \\ + \alpha_3 \log \left[ \frac{PC(-1)}{P(-1)} \cdot (1 + T3(-1)) \right] + \alpha_4 \text{DUM}$$

**Definition of variable**

P	=	GDP deflator (factor cost)
W	=	Nominal labour cost
K	=	Stock
L	=	Employment
PC	=	Private consumption deflator
T3	=	Indirect tax rate
DUM	=	Dummy with value 0.5 in 1970, 1 in 1971, 0 elsewhere

**Estimation results:**

		<u>Coefficient</u>	<u>t-statistic</u>
Constant	$\alpha_0$	.496	27.74
Labour cost	$\alpha_1$	.636	25.61
Capital/Employment ratio	$\alpha_2$	-.343	-22.62
Imports effect	$\alpha_3$	.300	3.24
Dummy	$\alpha_4$	.050	5.70

$\bar{R}^2 = .999$       DW = 2.19      SEE = .008

Estimation period: 1967 - 1988

Estimation method: Non-linear 3SLS, jointly with wages

TABLE 3.3  
TECHNOLOGY

Equations

Labour productivity

$$\log Y/L = a_0 + (1-\theta_A) \log (Y/L)_{-1} + \theta_A \log W/P + a_1 \log DUC - \\ - a_1(1-\theta_A) \log DUC_{-1} + a_2 \log PRM_{-1}$$

Capital productivity

$$\log Y/K = b_0 + (1-\theta_B) \log (Y/K)_{-1} + \theta_B \log CC/P + b_1 \log DUC - \\ - b_1(1-\theta_B) \log DUC_{-1} + b_2 \log PRM$$

Definition of variables

- Y = GDP factor costs  
L = Private sector's total employment  
K = Capital Stock  
DUC = Capacity utilization  
W = Nominal labour cost  
CC = User cost of capital  
P = GDP deflator (factor cost)  
PRM = Relative price of imported energy

Estimation results:

<u>Labour productivity</u>			<u>Capital productivity</u>		
	<u>Coefficient</u>	<u>t-stat</u>		<u>Coefficient</u>	<u>t-stat</u>
a <sub>0</sub>	.066	4.5	b <sub>0</sub>	-.154	-3.9
a <sub>1</sub>	.30	*	b <sub>1</sub>	.65	*
a <sub>2</sub>	-.012	-3.3	b <sub>2</sub>	-.020	-2.3
θ <sub>A</sub>	.123	20.7	θ <sub>B</sub>	.154	20.1

$$\bar{R}^2 = .998 \quad DW = 2.3 \quad SEE = .011 \quad \bar{R}^2 = .991 \quad DW = 2.1 \quad SEE = .013$$

Estimation period: 1965-1988

Estimation method: Non-linear 3SLS. \*Denotes restricted coefficient

TABLE 3.4

SHORT-RUN PRODUCTION: AGGREGATION OVER REGIMESEquation

$$Y = \left[ YD^{**} (-c_0 - c_1D - c_2PRM - c_3MM) + YP^{**} (-c_0 - c_1D - c_2PRM - c_3MM) + YLS^{**} (-c_0 - c_1D - c_2PRM - c_3MM) \right]^{**} \left( \frac{-1}{c_0 + c_1D + c_2PRM + c_3MM} \right)$$

Definition of variables

D = time trend  
 PRM = relative price of imported energy  
 MM = a measure of sectorial mismatch  
 Y = Real GDP  
 YP = Capacity output  
 YD = Notional demand  
 YLS = Full employment output

Estimation results

		<u>Coefficient</u>	<u>t-statistic</u>
Constant	c <sub>0</sub>	24.4	19.2
Trend	c <sub>1</sub>	-0.64	-9.6
Energy price	c <sub>2</sub>	-3.2	-5.5
Mismatch	c <sub>3</sub>	-10.1	-1.8

$\bar{R}^2 = .998$       DW = 1.95      SEE = .007  
 Estimation period: 1968-1988  
 Estimation method: Non-linear Least Squares

TABLE 3.5

EXPORTSEquation

$$\log XR_t = \beta_1(1-L)\log WT_t + \beta_2(1-L)^2WT_t + \beta_3(1-L)\log PRX_t + \beta_4 DIF_t + \beta_5 D76_t + \beta_6 D86_t + \alpha_0 + \alpha_1 \log WT_{t-1} + \alpha_2 \log PRX_{t-1} + \alpha_3 (\log DUC_{t-1} - \log DUC_{min})$$

Definition of variables

XR =	Real exports (excluding tourism)
WT =	Index of real world trade
PRX =	Competitiveness index of Spanish exports
DIF =	Inflation differential with respect to OECD countries
DUC =	Degree of capacity utilization
D76 =	Dummy with value 1 in 1976, 0 elsewhere
D86 =	Dummy with value 1 in 1986, 0 elsewhere

Estimation resultsLong-run equation

		<u>Coefficient</u>	<u>t-statistic</u>
Constant	$\alpha_0$	0.858	3.1
World trade (lagged)	$\alpha_1$	1.699	159.1
Competitiveness (lagged)	$\alpha_2$	-1.190	-22.4
Capacity utilization (lagged)	$\alpha_3$	-0.413	-3.8

Short-run equation

Change in world trade	$\beta_1$	0.791	9.8
Acceleration in world trade	$\beta_2$	0.681	8.8
Change in competitiveness	$\beta_3$	-0.709	-10.1
Inflation differential	$\beta_4$	-0.364	-3.9
D76	$\beta_5$	-0.175	-8.1
D86	$\beta_6$	-0.083	-5.5

 $\bar{R}^2 = 0.999$ 

DW = 2.40

SEE = 0.0126

Estimation period: 1966-1988

Estimation method: Non-linear 3SLS, jointly with imports

TABLE 3.6

## IMPORTS

Equation

$$(1-L)\log MR_t = \beta_1(1-L)\log I_t + \beta_2(1-L)\log I_{t-1} + \alpha_3(1-L)\log DUC_t + \\ + \beta_3(1-L)\log DUC_{t-1} + \\ + \Gamma \left[ \log MR_{t-1} - \alpha_0 - \alpha_1 \log GDP_{t-1} - \alpha_2 \log PRMNE_{t-1} - \right. \\ \left. - \alpha_3 (\log DUC_{t-1} - \log DUC_{\min}) \right] + \epsilon_t$$

Definition of variables

MR = Real imports  
 I = Real productive private investment  
 DUC = Degree of capacity utilization  
 GDP = Real GDP, market prices  
 PRMNE = Relative price of non-energy imports

Estimation resultsLong-run equation

		<u>Coefficient</u>	<u>t-statistic</u>
Constant	$\alpha_0$	-8.002	-9.3
Real GDP	$\alpha_1$	1.659	18.6
Competitiveness	$\alpha_2$	-0.249	-2.3
Capacity utilization	$\alpha_3$	0.930	2.9

Short-run equation

Private investment	$\beta_1$	0.717	9.2
Private investment (lagged)	$\beta_2$	0.254	3.6
Capacity utilization	$\alpha_3$	0.930	2.9
Capacity utilization (lagged)	$\beta_3$	-1.194	-5.1
Error correction	$\Gamma$	-0.414	-4.0

 $\bar{R}^2 = 0.924$ 

DW = 1.97

SEE = 0.0224

Estimation period: 1966-88

Estimation method: Non-linear 3SLS jointly with exports

TABLE 3.7

## INVESTMENT

Equation

$$\begin{aligned}
 (1-L)\log(I/Y)_t &= \beta_1(1-L)\log(I/Y)_{t-1} + \beta_2(1-L)\log DUC_t + \\
 &+ \beta_3(1-L)(CC/P)_t + \beta_4(1-L)(CC/P)_{t-1} + \beta_5(1-L)^2 \pi_t + \\
 &+ \Gamma \left[ \log(I/Y)_{t-1} - \alpha_0 - \alpha_1 (CC/P)_{t-1} - \right. \\
 &\left. - \alpha_2 \log DUC_{t-1} - \alpha_3 \pi_{t-1} \right] + \epsilon_t
 \end{aligned}$$

Definition of variables

- I = Real private productive instrument  
 Y = Real GDP (factors costs)  
 DUC = Degree of capacity utilization  
 CC/P = User cost of capital  
       CC =  $P_I (r + \delta - \pi_I)$   
 P = GDP deflator (factor cost)  
 $P_I$  = Private investment deflator  
 $\pi$  = Rate of inflation as of GDP deflator  
 $\pi_I$  = Rate of inflation as of investment deflator

Estimation results

		<u>Coefficient</u>	<u>t-statistic</u>
<u>Long-run equation</u>			
Constant	$\alpha_0$	-0.578	-2.5
User cost of capital	$\alpha_1$	-4.552	-4.5
Capacity utilization	$\alpha_2$	1.883	4.0
Inflation	$\alpha_3$	-3.011	-3.3
<u>Shor-run equation</u>			
I/Y ratio (lagged)	$\beta_1$	0.625	5.6
Capacity utilization	$\beta_2$	2.415	7.8
User cost of capital	$\beta_3$	-1.491	-4.5
User cost of capital (lagged)	$\beta_4$	0.833	3.5
Inflation tax	$\beta_5$	-1.670	-4.9
Error correction	$\Gamma$	-0.623	-5.7

 $\bar{R}^2 = 0.830$ 

DW = 2.30

SEE = 0.0311

Estimation period : 1966-88

Estimation method : Non-linear 3SLS, together with consumption.

**TABLE 3.8**  
**CONSUMPTION**

Equation

$$(1-L)\log C_t = \beta_1(1-L)\log Y_t^d + \beta_2(1-L)^2\log WE_t + \beta_3(1-L^2)\log IT_t + \\ + \beta_4(1-L)r_t + \beta_5(1-L^2)U_t + \Gamma(\log C_{t-1} - \alpha_0 - \\ - \alpha_1 \log Y_{t-1}^d - \alpha_2 \log WE_{t-1}) + \epsilon_t$$

Definition of variables

C	=	Real Domestic private consumption
$Y^d$	=	Households' real net disposable income
WE	=	Households' real wealth
IT	=	Inflation tax
r	=	Real (ex-post) long-term interest rate
U	=	Unemployment rate

Estimation results

		<u>Coefficient</u>	<u>t-statistic</u>
<u>Long-run equation</u>			
Constant	$\alpha_0$	0.383	3.1
Real disposable income	$\alpha_1$	0.801	21.6
Real wealth	$\alpha_2$	0.131	5.9
<u>Short-run equation</u>			
Real disposable income	$\beta_1$	0.494	7.6
Acceleration in real wealth	$\beta_2$	0.484	4.6
Inflation tax	$\beta_3$	-0.007	-2.5
Real interest rate	$\beta_4$	-0.151	-5.5
Unemployment rate	$\beta_5$	-0.356	-5.9
Error correction	$\Gamma$	-0.708	-8.5
$\bar{R}^2 = 0.983$	DW = 2.11	SEE = 0.0035	

Estimation period : 1966-88

Estimation method : Non-linear 3SLS together with investment.



#### 4. SIMULATIONS

The main purpose of this Section is to provide a feeling of how the model works. We try to illustrate how different is the response of the endogenous variables to exogenous shocks depending on the disequilibrium regime prevailing in the economy: demand rationing, capital constraints or labour supply shortages.

We carry out two sets of simulations: those generated by demand shocks (eg. changes in the pattern of World Trade) and those generated by supply shocks (eg. changes in the Labour force and in the exogenous component of Real Wages)

In order to endogeneize the exchange rate and the nominal interest rate  $R$  we use a demand for money and a balance of payments equation. We tie up most of the prices to the GDP deflator at factor cost (the behavioral equation), except for some of them, where a reduced form is estimated. Also a reduced form for  $duc$  is used that allows us to close up the model. For presentational purposes, the estimation errors are added to the above equations so that the baseline path is recovered. However, there are no convergence difficulties when these errors are not included.

We report results for the following endogenous variables: trade balance (TB), as a measure of the external constraint, unemployment (U), real wages (W/P), GDP, inflation (INF) and for some cases, employment (L). Tables 4.1 to 4.3 report the deviations from the baseline.

##### 4.1 World Trade

In this simulation we replace the exogenous World Trade series by a variable that for 1964-73 includes its actual values, for 1974-83 follows an annual growth rate of 4% and for 1984-88 grows at a 8%. The actual average growth rates were 2.7% for 1974-83 and 7.9%

TABLE 4-1

## SIMULATION 1: INCREASE IN WORLD TRADE (\*)

	U	TB	W/P	GDP	Inf
1976	-0.2	0.7	0.1	0.3	0.4
1977	-0.3	0.5	-0.2	0.3	0.5
1978	-0.4	0.6	0.3	0.6	0.9
1979	-0.4	0.3	0.3	0.6	0.6
1980	-0.6	1.3	0.5	1.0	1.3
1981	-0.9	1.9	0.8	1.5	1.8
1982	-1.2	2.8	1.0	2.0	2.4
1983	-1.5	3.3	1.4	2.5	2.9
1984	-1.3	3.1	1.6	2.3	2.5
1985	-1.3	4.1	1.9	2.5	2.5
1986	-0.8	3.2	2.1	1.8	1.6
1987	-0.6	3.0	2.3	1.6	1.8
1988	-0.6	2.8	2.3	1.6	1.8

(\*) TB: Trade balance:  $X-M/GDP$  (in nominal terms). Deviations from baseline.

Inf: Inflation rate. Deviations from baseline.

U: Unemployment rate. Deviations from baseline.

L: Employment. Percentage growth with respect to baseline.

W/P: Real labour cost. Percentage growth with respect to baseline.

GDP: Real GDP. Deviations from baseline.

for 1984-88. That is, we try to simulate the effects of a better international stance during the main years of the crisis.

The results are shown in Table 4.1. As expected, the higher values for the world trade variable in 1974-83 imply an accumulative reduction in unemployment, given the important role of the demand constraint in our estimated model. The release of the demand constraint, however, hits rapidly the capital ceiling, and real wages per worker increase. This explains the slowdown in employment and output growth. In spite of the high elasticity of exports with respect to World Trade, from 1986 onwards there is a relative deterioration in the trade balance. The explanation lies in that the competitiveness indices and the degree of utilization of capital both affect more strongly imports than exports.

#### 4.2 Labour force

We first simulate a 3% increase in the labour force in 1970, the corresponding constant being added to all ensuing years. This amounts to approximately 400 thousand people that if considered jobless in that year would rise the unemployment rate from 0.8 to 3.4 per cent. However, in this period labour availability was scarce, so we would expect a relatively high increase in employment. We then simulate the same innovation from 1980 onwards, a period where the labour supply was not binding, expecting a smaller impact on employment. The results of both simulations are presented in Table 4.2.

In the first simulation, as expected, there is a strong growth on employment, consistent with the labour availability constraint prevailing in the early seventies. The release of this restriction implies an initial reduction in real wages, but this reduction becomes smaller as the economy generates additional employment and output. Note that, eventually, the "scale" of the economy's productive resources has grown, output is higher and unemployment lower. All this happens with a small deterioration of competitiveness

and of the capacity ceiling, so that the final effect on the current account is negligible.

In the second simulation, as expected, initial impact on employment is about half the size than in the first, so that most of the increase in labour supply becomes unemployed. However the final effect is very similar and the economy "catches up" to the new situation very rapidly.

#### 4.3 Real Wages

We finally run a simulation regarding the growth rate of the exogenous (that means not explained) component in labour costs. As the wage equation is specified in levels, we include a trend component that allows us to simulate a cumulative change in the path of real wages. We assume two different shocks: a 1% annual increase from 1976 onwards and a 1% annual increase starting in 1982. The results are shown in Table 4.3. The employment series are not reproduced, given that all its relevant information is embodied in the unemployment column. As expected, there is a negative impact on unemployment which feeds back into the endogenous component of wages so that only 70% of the exogenous change in wages actually takes place. On the other hand, prices rise rapidly so that real wages stabilize at the new level without a permanent episode of inflation. In the long-run there exists a one-to-one negative impact on both employment and output, the new stationary levels being reached very rapidly. In the short-run, the model predicts only a slight deterioration in the current account, since the worsening of competitiveness is compensated by the demand and imports slowdown.

Interestingly enough, the results are quite independent of the year in which the shock takes place. This is due partly to the fact that labour supply, whose regime share is the one that differs most in 1982 with respect to 1976, is assumed to be exogenous in our model.

TABLE 4-2

## SIMULATION 2: 3% INCREASE IN LABOUR FORCE IN 1970

$$LS' = LS + (0.03 \cdot LS (1970))$$

	U	L	W/P	GDP	Inf
1970	1.4	1.5	-2.6	1.4	-3.3
1971	1.0	1.9	-2.1	1.5	-2.6
1972	0.8	2.0	-2.0	1.5	-1.9
1973	0.6	2.2	-2.0	1.5	-1.4
1974	0.3	2.5	-2.0	1.7	-1.1
1975	0.2	2.6	-2.0	1.7	-0.9
1976	0.1	2.7	-2.0	1.8	-0.7
1977	-0.1	2.9	-1.9	2.0	-0.2
1978	-0.3	3.1	-1.8	2.2	0.1
1979	-0.4	3.2	-1.7	2.3	0.5
1980	-0.5	3.4	-1.6	2.4	0.6
1981	-0.5	3.4	-1.5	2.5	0.7
1982	-0.5	3.4	-1.4	2.6	0.7
1983	-0.5	3.4	-1.3	2.6	0.7
1984	-0.4	3.2	-1.2	2.6	0.6
1985	-0.4	3.1	-1.1	2.5	0.5
1986	-0.3	3.0	-1.0	2.5	0.4
1987	-0.3	2.9	-0.9	2.4	0.4
1988	-0.3	2.8	-0.8	2.4	0.4

## SIMULATION 2 (cted.): 3% INCREASE IN LABOUR FORCE IN 1980

	U	L	W/P	GDP	Inf
1980	1.8	1.0	-2.7	0.7	-4.2
1981	1.1	1.7	-2.2	1.2	-2.7
1982	0.4	2.4	-1.9	2.0	-1.2
1983	0.0	2.9	-1.8	2.3	-0.3
1984	-0.2	3.1	-1.7	2.4	0.0
1985	-0.4	3.3	-1.6	2.5	0.2
1986	-0.5	3.4	-1.5	2.6	0.4
1987	-0.5	3.4	-1.4	2.6	0.5
1988	-0.5	3.4	-1.4	2.6	0.5

TABLE 4-3

SIMULATION 3: 1% INCREASE IN REAL WAGES (EXOGENOUS) STARTING 1976  
 $\text{LOG } W' = \text{LOG } W + 0.01$

	U	TB	W/P	GDP	Inf
1976	0.2	0.1	0.8	-0.1	1.5
1977	0.3	-0.1	0.7	-0.2	1.3
1978	0.5	-0.2	0.7	-0.3	0.9
1979	0.6	-0.1	0.7	-0.5	0.5
1980	0.8	0.2	0.7	-0.6	0.2
1981	0.9	0.3	0.7	-0.7	0.1
1982	0.9	0.2	0.7	-0.8	0.0
1983	1.0	0.1	0.7	-0.9	-0.2
1984	1.0	0.0	0.7	-0.9	-0.2
1985	1.0	0.0	0.7	-1.0	-0.1
1986	1.0	0.0	0.7	-1.0	-0.1
1987	1.0	0.0	0.7	-1.0	-0.1
1988	1.0	0.0	0.7	-1.0	-0.1

SIMULATION 3 (cted.): INCREASE IN REAL WAGES STARTING 1982

	U	TB	W/P	GDP	Inf
1982	0.3	0.2	0.8	-0.2	1.3
1983	0.5	0.0	0.7	-0.5	0.8
1984	0.7	-0.1	0.7	-0.7	0.4
1985	0.8	0.0	0.7	-0.8	0.2
1986	0.8	0.1	0.6	-0.8	0.2
1987	0.9	0.2	0.6	-0.8	0.1
1988	0.9	0.1	0.6	-0.8	0.0

LIST OF VARIABLES AND DATA SOURCESVariables

- C: Real domestic private consumption (in thousands 1980 pts) (INE-CN)
- CC: User cost of capital =  $P_I (r + \delta - \pi_I)$ . For  $P_I$ ,  $\pi_I$  (INE-CN),  $\delta$  own estimates,  $r$  see below.
- DIF: Inflation differential between CPI of Spain (INE) minus that of OECD countries (IFS).
- DUC: Capacity utilization in industry (Survey of Entrepreneur's Opinions, BE).
- DUM: A dummy variable taking 0.5 value for 1970, 1 in 1971, 0 elsewhere.
- D76: A dummy variable taking value 1 in 1976, 0 elsewhere.
- D86: A dummy variable taking value 1 in 1986, 0 elsewhere.
- GDP: Real GDP, market prices (in ths. of 1980 pts.) (INE-CN).
- I: Real productive private investment. Total investment (ths. of 1980 pts.) minus public investment minus residential investment (INE-CN and own estimates)
- IT: "Inflation tax": lagged real money holding (BE, INE) times current inflation rate (INE).
- K: Capital series (own estimates).
- L: Number of employed (in thousands) (INE-EPA).
- LS: Labour supply (thousands) (INE-EPA).
- MR: Real imports (in thousands of 1980 pts.) (INE-CN).
- MM: An index of mismatch. Sum of absolute changes in the proportion of total employees in each sector relative to total employees (GTE and EPA).
- P: GDP deflator, factor cost (INE-CN).
- PC: Private consumption deflator (INE-CN).
- PI: Private investment deflator (INE-CN)
- PRM: Relative price of oil imports. Oil imports deflator divided by GDP deflator (INE, MECO).
- PRMNE: Relative price of non-energy imports. Non-energy imports deflator divided by GDP deflator (INE-CN, MECO).

- PRX:** Relative price of exports (relative to world) . Spanish exports unit value (MECO) divided by world exports unit value (IFS) times the appropriate exchange rate.
- r:** Real interest. Nominal interest rate (BE) minus CPI inflation rate (INE).
- SS:** Social Security contributions (IGAE, own estimates).
- T3:** Indirect tax rate. Total excise collections divided by nominal private consumption (IGAE and INE).
- U:** Unemployment rate (INE-EPA).
- W:** Nominal labour cost (INE-CN).
- WE:** Households' real wealth (see text)(INE, BE).
- WT:** Industrial countries' trade: OECD exports in \$ (IFS) divided by OECD exports unit prices in \$ (IFS).
- XR:** Real exports (in thousands of 1980 pts.) excluding tourism expenditures (INE-CN).
- Y:** Real GDP at factor costs (in ths. 1980 pts.)(INE-CN).
- Y<sup>d</sup>:** Real disposable income (INE-CN, IGAE).

#### Abbreviations for sources

<b>BE</b>	Boletín Estadístico (Bank of Spain)
<b>CN</b>	Contabilidad Nacional (INE)
<b>EPA</b>	Encuesta de Población Activa (INE)
<b>GTE</b>	Grupo de Trabajo del Ministerio de Economía y Hacienda
<b>IFS</b>	International Financial Statistics (IMF)
<b>MECO</b>	Ministerio de Comercio
<b>IGAE</b>	Intervención General de la Administración del Estado
<b>INE</b>	Instituto Nacional de Estadística



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