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Monetary Targets, Real Exchange Rates, and Macroeconomic Stability

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Summary

Since the beginning of the 1970s, many industrial countries have announced targets for the growth rates of their monetary aggregates as an important component of programs to restrain the inflationary process. Nonetheless, it has been argued that rigid quantitative money growth rules are sub-optimal policies when unexpected disturbances affect an economy, because they induce large movements in real exchange rates that can be very costly in terms of output and price stability. Therefore, it has been suggested that deviations from established money growth targets should occasionally be permitted in order to smooth the fluctuations of the real exchange rate around its perceived equilibrium level. This policy problem is the subject matter of the present paper. First, we develop a simple macroeconomic model, which incorporates the salient features of small open industrialized economies, to determine the optimal degree of flexibility in attaining quantitative monetary targets when the domestic financial and labor markets are the major sources of unanticipated disturbances. Second, we assign values to the parameters of the model that are intended to represent the "stylized facts" of Spain's economy, and use them to obtain a rough estimate of the optimal degee of monetary policy flexibility for that economy. Spain represents an ideal case study for the issues addressed by this paper. The Bank of Spain has publicly announced annual targets for the growth rate of broad money since 1977 and, in contrast to many other countries, the actual growth rates of monetary aggregates have never diverged significantly from their targeted paths. In addition, during this period Spain's real exchange rate has experienced greater variability than have those of most other industrial countries.

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The simulation experiments that are undertaken using the model suggest that rigid adherence to monetary targets may indeed be an optimal policy for the Spanish monetary authorities, thus supporting the actual policy choice of that country. Of course, this conclusion is very sensitive to a number of the assumptions that have been employed in making the simulations. These simulations also suggest that if the Spanish economy were to become more open to international transactions, or if labor market flexibility increased, it might be optimal for the Bank of Spain to implement monetary targeting more flexibly.

I. Introduction

In a world of perfect certainty and complete price flexibility, a fixed money growth rule would be the optimal monetary policy, because it would maintain both stability of the general price level and full employment. In practice, however, policy choices are complicated by the various unexpected shocks that affect economies. Since the beginning of the 1970s, industrial countries have had to face major disturbances that originated both domestically and in world markets: two energy crises caused sudden and sharp changes in the terms of trade of industrial coun- countries; financial innovations have induced shifts in the private sector's demand for money; and trade unions have sometimes obtained wage rates inconsistent with full employment.

If monetary authorities adhered rigidly to quantitative targets for the growth of the money stock, unexpected disturbances would cause movements in prices and exchange rates by affecting money market conditions. Because exchange rates can respond to these disturbances much faster than goods prices, which are often set in contract markets, a monetary policy that focused exclusively on a fixed target for the growth rate of the money stock would inevitably produce large fluctuations of the real exchange rate around its long-run equilibrium level. Many policymakers would view these fluctuations as having harmful effects on domestic economic developments for at least two reasons. First, substantial real exchange rate movements would induce costly reallocations of productive resources among the various sectors of the domestic economy, owing to the less-than-perfect mobility of factors of production. Second, these movements would impose external constraints on domestic economic policies by transmitting disturbances that originate in one economy to the rest of the world.

In view of the costs of wide movements in real exchange rates, many countries have, since the advent of the present system of floating exchange rates, assigned a high priority to exchange rate considerations in formulating their domestic economic policies. 1/ During the same period, however, an increasing number of countries have also begun to rely on preannounced quantitative money targets as indispensable tools to restrain inflationary expectations and to achieve price stability. Thus there has been a potential conflict between the objectives of monetary and exchange rate policies. In principle, this conflict could be resolved if sterilized intervention--that is, the exchange of non-monetary assets

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1/ The costs of real exchange rate movements and their policy implications are clearly expressed in the Report of the Working Group on Exchange Market Intervention (March 1983); the Group was established at the Versailles Summit in June 1982.

denominated in domestic and foreign currencies--could be used to influence exchange rates. In this case, countries would be able to pursue independent exchange rate and monetary policies, since sterilized intervention would be used to oppose undesired movements in real exchange rates while quantitative targets for money growth were adopted to control inflation. Unfortunately, there is increasing evidence that sterilized intervention is either ineffective or non-viable (see Rogoff, 1983 and Frenkel, 1983). Therefore, the choice of an exchange rate policy becomes equivalent to choosing a monetary policy, and countries are left with a policy problem; namely, how responsive monetary policy should be to deviations of the real exchange rate from the level that they perceive to be the long-run equilibrium. To put the matter differently: what is the optimal degree of flexibility that the authorities should exercise with regard to their quantitative money-growth targets?

This policy problem is the subject matter of the present paper. In the paper, we analyze the optimal degree of flexibility with which the authorities should adhere to a given quantitative monetary target in circumstances where domestic financial and labor markets are the major sources of disturbances. The focus on these two types of disturbances is warranted by the recent experience of many industrial countries, where labor market rigidities and shifts in portfolio preferences have often hindered both the formulation and the implementation of monetary policies. We do not deal with real sector shocks, such as permanent changes in production technology or in the terms of trade, because monetary policy cannot be usefully adopted to stabilize an economy that is affected by these shocks.

In Section II, we develop an aggregate stochastic model that incorporates the salient features of small open industrialized economies. 1/ In the model, monetary authorities adopt flexible quantitative targets; that is, they set a quantitative target for the money stock but they may allow the stock to diverge from its targeted path in response to real exchange rate movements if unexpected shocks in the financial and labor markets disturb the equilibrium of the economy. The objective of their policy is to minimize the deviations of both output and prices from the levels that are consistent with full employment. Given the authorities' loss function, we determine the elasticity of the deviations of the money supply from its fixed target in response to real exchange rate movements, and we show how this elasticity is related to the parameters of the structural model.

1/ The model belongs to the class of models that have been utilized recently to investigate policy problems such as the optimal degree of wage indexation, the optimal path of disinflation and optimal exchange market intervention (for example, see Turnovsky, 1983, Taylor, 1983, Aizenman and Frenkel, 1984, Fisher, 1984 and Marston, 1982).

In Section III, we assign values to the parameters of the model that are intended to reflect the "stylized facts" of the Spanish economy, and we then calculate the optimal degree of monetary policy flexibility for these structural parameters. Spain represents an ideal case study for three reasons. First, since the beginning of the 1970s the Bank of Spain has adopted the growth rate of the money stock as the intermediate target of monetary policy. In 1977, the Bank began the practice of publicly announcing a yearly target for the rate of growth of broad money (M3). Since that year, in contrast to what has happened in many other countries, the actual rates of money growth in Spain have never diverged significantly from their targeted rates (Table 1). Second, as might

Table 1. Spain: Annual Monetary Growth Targets

(In percent)

Year	Preannounced Target Growth Rate for M3	Target Band	Actual Growth Rate of M3
1978	17.0	±2.5	20.1
1979	17.5	±2.0	19.0
1980	18.0	±2.0	17.0
1981	16.5	±2.0	15.5
1982	15.5	±2.0	16.2
1983	13.0	±2.0	12.7

Source: Bank of Spain, Informe Anual (various years).

have been expected, the variability of Spain's real exchange rate has been among the largest experienced by any industrial country (Table 2). This variability was particularly pronounced after 1978, the year when the policy of preannounced monetary targets was first implemented. Third, in recent years the implementation of monetary policy in Spain

Table 2. Real Exchange Rate Variability in Selected Industrial Countries

	Variance of Trade Weighted Real Exchange Rate 1/	
	1974-83	1978-83
Australia	36.6	17.4
Austria	30.8	43.3
Belgium	75.1	109.0
Canada	69.1	30.7
Denmark	55.7	84.9
Finland	19.6	13.3
France	39.2	49.9
Germany	49.5	64.6
Ireland	39.3	24.4
Italy	22.8	13.3
Netherlands	36.4	49.8
Norway	12.8	5.6
Spain	73.5	96.2

1/ Monthly data; the real exchange rates were calculated by using consumer price indexes and the trade weights of the IMF, Multilateral Exchange Rate Model. For each country, the base of the real exchange rate index was set at its average level during the periods 1974-83 and 1978-83, respectively. Data are from IMF, International Financial Statistics.

has often been hindered by extensive labor market rigidities, owing to the existence of strong trade unions, and by portfolio shifts due to financial innovations and international capital flows. 1/

II. The Model

In this section, we develop an aggregative stochastic model of a small open industrial country. The model is described by the following set of equations.

$$y_t-\bar{y} = a[(m_t^s-\bar{m})-(p_t-\bar{p})] + b[(e_t-\bar{e})-(p_t-\bar{p})] \qquad a,b > 0 \qquad (1)$$

$$m_t^s = \bar{m} + \theta[(e_t-\bar{e})-(p_t-\bar{p})] \qquad -\infty < \theta < +\infty \qquad (2)$$

$$m_t^d = k\bar{y} + p_t - gr_t + v_t \qquad g > 0, \quad v_t \sim N(0,\sigma_v^2) \qquad (3)$$

$$r_t = r_t^* + E_t\, e_{t+1} - e_t \qquad (4)$$

$$m_t^s = m_t^d \qquad (5)$$

$$w_t-\bar{w} = f_1(w_{t-1}-\bar{w}) + f_2\, E_{t-1}(y_t-\bar{y}) + f_3\, E_{t-1}(p_t-\bar{p}) + u_t \qquad (6)$$

$$f_1,f_2,f_3 > 0, \quad u_t \sim N(0,\sigma_u^2)$$

$$p_t-\bar{p} = h_1(w_t-\bar{w}) + h_2(w_{t-1}-\bar{w}) + h_3(e_t-\bar{e}) \qquad h_1 + h_2 + h_3 = 1 \qquad (7)$$

All variables (except the interest rate, which is in level form) are expressed as natural logarithms; a bar above a variable indicates its steady state value; the exchange rate is defined as the domestic currency price of one unit of foreign exchange; expectations are formed rationally, so that the symbol $E_{t-i}\, Z_{t+j}$ indicates the expected value at time t-i of the variable Z at time t+j.

The deviation of real output y_t from its steady state level $\bar{y}$ is a function of the deviations of the real stock of money (m_t-p_t) and of the real exchange rate (e_t-p_t) from their steady state values, which are indicated as $\bar{m}-\bar{p}$ and $\bar{e}-\bar{p}$ respectively (equation (1)). A depreciation of the real exchange rate can stimulate output because domestic goods are viewed by both domestic and foreign consumers as imperfect substitutes

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1/ The Informe Anual 1982 of the Bank of Spain (pp. 196-203) contains an analysis of the impact of financial innovations on monetary policy in Spain.

for foreign goods. Assuming that the model is stable, the real exchange rate always moves back to the long-run equilibrium level--which depends on the equilibrium current account position and on the characteristics of the labor market--after a disturbance affects the economy. Because we do not analyze permanent shocks to the production function or the terms of trade, the long-term equilibrium real exchange rate is a constant in the model. When y_t is equal to $\bar{y}$, the economy reaches both the natural rate of unemployment and the equilibrium current account.

Equation (2) reflects the assumption that the monetary authorities adopt a "flexible" quantitative rule for the money stock. If there were no shocks to the economy, the authorities would set the money stock at the preannounced level $\bar{m}$, which would be consistent with both price stability and the full employment level of real output. However, because several types of shock can disturb the steady state equilibrium of the economy, the monetary authorities may choose to abandon temporarily their monetary target and vary the money stock in response to movements in the real exchange rate. The parameter θ, which is the elasticity of deviations of the money stock from its targeted path in response to real exchange rate movements, measures the degree of flexibility or rigidity with which the authorities adhere to their fixed quantitative money stock target $\bar{m}$.

The demand for money is a function of the price level p_t, permanent income (which we set equal to the steady state level of output, $\bar{y}$), the domestic interest rate r_t, and a stochastic shock, v_t, which captures the effect of velocity shifts due to financial innovations (equation (3)). Capital mobility ensures that the domestic interest rate is always tied to the interest rate prevailing in the world capital market through the uncovered interest parity condition (equation (4)). 1/ We also assume that the money market is always in equilibrium (equation (5)).

In the labor market, wage rates w_t are set by contract (equation (6)). At the beginning of any contract period, workers and entrepreneurs establish a wage rate that reflects the expected level of prices during the period covered by the contract, as well as expected changes in labor productivity, $E_{t-1}(y_t-\bar{y})$. In addition, wage settlements in any period will also reflect previous wage settlements, w_{t-1}, because labor contracts are never all renewed at the same time, even in those countries where collective bargaining is highly centralized. Given that we want to apply the model to the Spanish economy, no automatic wage indexation

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1/ The interest parity condition can be expressed as $(1+r_t)=(1+r_t^*)F_t/e_t$, where F_t is the forward exchange rate. By taking the logarithm of the condition and substituting $E_t e_{t+1}$ for F_t, we obtain equation (4).

scheme is assumed. 1/ Finally, as a result of the bargaining process, wage settlements can turn out to be above or below the levels that could have been expected on the basis of historical relationships. The stochastic term u_t captures the uncertainty characterizing the wage bargaining process. A reasonable assumption is that shocks to the labor market are independent of shocks in the financial market, that is $E(u_t\ v_t) = 0$.

The last equation of the model, equation (7), defines the domestic price index--which depends on the current wage rate, the price of imported goods, and the wage rate prevailing in the previous period--given that there is some overlapping in wage contracts. The model thus consists of seven equations that determine the variables m_t^s, m_t^d, y_t, e_t, p_t, w_t, and r_t as functions of the two disturbance terms v_t and u_t.

We assume that there are no stochastic shocks in the steady state, so that all expectations are realized. Because there is no uncertainty in the steady state, the optimal monetary policy is achieved by fixing the money supply at a level that is proportional to potential output, or

$$m_t^s = \bar{m} = k\bar{y}. \tag{8}$$

When this policy is adopted, the price level is stabilized at a level that is compatible with full employment. This can be seen by setting $m_t^d = \bar{m}$ and $v_t = 0$ in the money demand equation, and by inserting the steady state value of the domestic interest rate, which is equal to the constant world interest rate, r^*.

$$\bar{p} = g\ r^* \tag{9}$$

By subtracting (8) and (9) from (3) and by adopting the convention that all the symbols indicate deviations of variables from their steady state values, we can rewrite the model as follows:

$$y_t = a(m_t^s - p_t) + b(e_t - p_t) \tag{10}$$

$$m_t^s = \theta(e_t - p_t) \tag{11}$$

$$m_t^d = p_t - g(E_t\ e_{t+1} - e_t) + v_t \tag{12}$$

1/ Recent labor contracts in Spain contain a revision clause that is triggered when the inflation rate exceeds a specific level established at the beginning of the contract period. Nonetheless, wage indexation is not a characteristic of the Spanish labor market.

$$m_t^s = m_t^d \tag{13}$$

$$w_t = f_1 w_{t-1} + f_2 E_{t-1} y_t + f_3 E_{t-1} p_t + u_t \tag{14}$$

$$p_t = h_1 w_t + h_2 w_{t-1} + h_3 e_t \tag{15}$$

To solve the system (10)-(15), we first use equation (15) to eliminate the price level from the model. Second, we use the money supply equation to eliminate m_t^s from (10). Third, we eliminate money by using the money market equilibrium condition (13). The model can thus be reduced to three equations in three variables, w_t, e_t and y_t.

$$y_t = Q_1 e_t + Q_2 w_t + Q_3 w_{t-1} \tag{16}$$

$$w_t = (f_1+f_3h_2) w_{t-1} + f_2 E_{t-1} y_t + f_3 h_1 E_{t-1} w_t + f_3 h_3 E_{t-1} e_t + u_t \tag{17}$$

$$g E_t e_{t+1} = [g+h_3-\theta(1-h_3)]e_t + (1+\theta)h_2 w_{t-1} + (1+\theta)h_1 w_t + v_t \tag{18}$$

where

$$Q_1 = (\theta a+b)(1-h_3) - ah_3$$

$$Q_2 = -h_1[a(1+\theta)+b]$$

$$Q_3 = -h_2[a(1+\theta)+b]$$

The model can now be reduced further to two difference equations in e_t and w_t. The first equation is (18), while the second equation can be obtained by taking expectations conditional on information available at t-1 in (16), and substituting the resulting expression into (17):

$$w_t = (f_1+f_3h_2+f_2Q_3) w_{t-1} + (f_3h_3+f_2Q_1) E_{t-1} e_t + (f_3h_1+f_2Q_2) E_{t-1} w_t + u_t \tag{19}$$

In order to solve the difference equation system (18) and (19), we shift the time subscript one period forward in equation (19) and then take expectations conditional on information at t-1. The system becomes:

$$E_{t-1} w_{t+1} = Z_o E_{t-1} w_t + Z_1 E_{t-1} e_{t+1} \tag{20}$$

$$E_{t-1} e_{t+1} = Z_2 E_{t-1} w_t + Z_3 w_{t-1} + Z_4 E_{t-1} e_t \tag{21}$$

where

$$Z_o = (f_1 + f_3\ h_2 + f_2\ Q_3)/(1 - f_3\ h_1 - f_2\ Q_2)$$

$$Z_1 = (f_3\ h_3 + f_2\ Q_1)/(1 - f_3\ h_1 - f_2\ Q_2)$$

$$Z_2 = h_1(1+\ \theta)/g$$

$$Z_3 = h_2(1+\ \theta)/g$$

$$Z_4 = [g + h_3 - \theta(1-h_3)]/g$$

The system of equations (20) and (21) can be solved for $E_{t-1}\ w_{t+1}$ and $E_{t-1}\ e_{t+1}$, and expressed in matrix form as:

$$\begin{bmatrix} E_{t-1}\ w_{t+1} \\ E_{t-1}\ e_{t+1} \end{bmatrix} = \begin{bmatrix} Z_o+Z_1Z_2 & Z_1Z_4 \\ Z_2 & Z_4 \end{bmatrix} \begin{bmatrix} E_{t-1}\ w_t \\ E_{t-1}\ e_t \end{bmatrix} + \begin{bmatrix} Z_1Z_3 & 0 \\ Z_3 & 0 \end{bmatrix} \begin{bmatrix} w_{t-1} \\ e_{t-1} \end{bmatrix}$$

or more compactly

$$Y_t = B_1\ Y_{t-1} + B_2\ Y_{t-2} \tag{22}$$

In order to find a solution for the second order system of difference equations (22), we first reduce its order by rewriting it (Chow 1975) as:

$$\begin{bmatrix} Y_t \\ Y_{t-1} \end{bmatrix} = \begin{bmatrix} B_1 & B_2 \\ I & 0 \end{bmatrix} \begin{bmatrix} Y_{t-1} \\ Y_{t-2} \end{bmatrix}$$

where I is the identity matrix. This system can be rewritten as:

$$Y = B\ Y_{-1} \tag{23}$$

The solution of the system (23) is

$$Y_t = \sum_{i=1}^{4} b_i\ y_o\ \lambda_i^t$$

where λ_i is the ith eigenvalue of the matrix B, b_i is its associated eigenvector, and y_o is a linear combination of initial conditions. By construction, one eigenvalue of B is always equal to zero. When we evaluate the model in the next section, we always find that only one of of the three remaining eigenvalues is a real number greater than zero and less than one. If we call this eigenvalue λ, impose stability, and rule out oscillatory paths for the endogenous variables, we can express the solution for the expected wage and exchange rates uniquely as functions of the stable root λ:

$$E_{t-1} w_t = b_1 w_o \lambda^t \tag{24}$$

$$E_{t-1} e_t = b_2 e_o \lambda^t \tag{25}$$

Unfortunately, we cannot obtain an explicit solution for λ as a function of the parameters of the model. Such a solution, however, is not essential since the main purpose of the paper is to obtain numerical simulations of the model. In addition, the lack of an explicit solution can be viewed as the price that has to be paid to obtain a model that is sufficiently realistic.

By inspecting equation (19), one can see that it is possible to write the wage rate as:

$$w_t - E_{t-1} w_t = u_t \tag{26}$$

Combining (24) and (26), we obtain the final solution for the wage rate:

$$w_t = \lambda w_{t-1} + u_t \tag{27}$$

The solution for the exchange rate is somewhat more complicated, and several steps are needed. First, because equation (18) holds for every t, we can move its time subscript one period backwards. Second, we use the relationship

$$E_{t-1} e_t = \lambda e_{t-1},$$

which stems from (25), to eliminate expectations from equation (18). Third, we move the time subscript one period forward. The solution for the exchange rate can then be written as

$$e_t = A_o w_t + A_1 w_{t-1} + A_3 v_t \tag{28}$$

where

$$A_o = h_1(1+\theta)/A_3$$

$$A_1 = h_2(1+\theta)/A_3$$

$$A_3 = 1/[g(1-\lambda) - h_3 + \theta(1-h_3)]$$

In order to find the solution for output and the price level in terms of the stochastic disturbances of the model, we substitute (27) and (28) into (15) and (16).

$$p_t = (h_1 + A_o h_3)/(1-\lambda L)u_t + (h_2 + A_1 h_3)/(1-\lambda L)u_{t-1} + A_3 h_3 \; v_t \qquad (29)$$

$$y_t = (Q_2 + Q_1 A_o)/(1-\lambda L)u_t + (Q_3 + Q_1 A_1)/(1-\lambda L)u_{t-1} + Q_1 A_3 \; v_t \qquad (30)$$

where L is the backshift operator. Given that the process characterizing both output and the price level is an ARMA (1,1), it is a straightforward matter to calculate the variances of p_t and y_t as functions of the variances of the shocks:

$$\sigma_p^2 = (H_o^2 + H_1^2 + 2\, H_1 H_o \lambda)/(1-\lambda^2)\sigma_u^2 + A_3^2 \, h_3^2 \, \sigma_v^2$$

and

$$\sigma_y^2 = (K_o^2 + K_1^2 + 2\, K_1 K_o \lambda)/(1-\lambda^2)\sigma_u^2 + A_3^2 \, Q_1^2 \, \sigma_v^2$$

where

$$H_o = h_1 + h_3 \, A_o$$

$$H_1 = h_2 + h_3 \, A_1$$

$$K_o = Q_2 + Q_1 \, A_o$$

$$K_1 = Q_3 + Q_1 \, A_1$$

The expressions for the variances σ_y^2 and σ_p^2 are the bases for the simulation exercise of the next section.

III. The Optimal Monetary Policy

In the model of Section II, the policymaker's problem is that of deciding on the degree of flexibility in adhering to the quantitative monetary target that is "optimal" in the sense that it minimizes the deviations of output and the price level from their full-employment levels. Given the structure of the economy and the nature of the shocks, the policymaker selects a value of θ that minimizes his loss function which, in turn, depends on some measure of output and price variability. The selected value of θ will depend on all the parameters of the model, and will affect economic agents' behavior.

In this section, we choose a set of parameter values that are intended to reflect the broad structural characteristics of the Spanish economy, in order to calculate the value of θ that would minimize output and price variability in that country. The objective of the exercise is to see whether the conclusions of the simulation experiments appear to be consistent with the actual policy choice of the Spanish authorities.

1. A model for Spain

In order to obtain parameter values that appear to be relevant to Spain, we mainly rely on existing empirical studies. On a few occasions, we either estimate a parameter by fitting a reduced form or assume a value that appears reasonable on a priori grounds. We take the year to be the relevant unit of time for the model. The parameter 'a' measures the direct impact of monetary policy on the deviation of output from its trend value. In the absence of prior beliefs about the magnitude of 'a', and because it is very difficult to find empirical estimates of it, we obtain a value by simply regressing the annual rate of change of gross domestic product (GDP) at constant prices on the rate of change of the real money stock lagged one period. We use the lagged value of real money simply to minimize simultaneity problems and because the coefficient of contemporaneous real money was never significantly different from zero. Because rates of change filter out the trend component from the variability of a time series, the dependent variable in these regressions can be interpreted as the deviation of output from its trend level. The estimated regression, which we fitted using yearly observations from 1953 to 1983, is:

$$\Delta \ell n Y_t = \underset{(1.78)}{.01} + \underset{(6.92)}{.53}\, \Delta \ell n (M/P)_{t-1} + \hat{u}_t \qquad R^2 = .68 \qquad SE = .019 \qquad \hat{\rho}_1 = .19$$

where Y_t is GDP at constant prices; M_t is the stock of money M3; P_t is the the GDP deflator; $\hat{\rho}_1$ is the estimated first order serial correlation coefficient of the fitted residuals, u_t; and the t statistics are shown in parentheses below the coefficients. 1/

1/ Data are from IMF, International Financial Statistics.

The parameter 'b' measures the impact of real exchange rate movements on output, and is roughly equivalent to the sum of the import and export elasticities weighted by the ratios of import and export volumes to real GDP. We took the values of the elasticities from Bonilla-Herrera (1978). The export elasticity is 1.7 and the import elasticity -0.8; both are close to the "benchmark" values for the price elasticities of manufactures--1.65 and -0.9--that are used for small industrial countries in the IMF's, Multilateral Exchange Rate Model (see Artus and McGuirk, 1981). The elasticities are then multiplied by .2, the level of Spain's average ratios of imports and exports to GDP over the last five years. It is relevant to note that because these are long-run elasticities they may overstate the impact of real exchange rate movements on output, owing to the J-curve effect.

Collective bargaining in Spain has undergone considerable changes during the last few years. Trade unions were not allowed until 1977. In that year it was also decided that, in order to enhance competition in labor markets, national contracts could not be used to establish guidelines for wage settlements at the regional and plant level. In 1980, one trade union and the Employers' Association stipulated an agreement (known as Acuerdo Macro Interconfederal) that, for the first time set guidelines for the wage settlements of the following year. 1/ In one year, 1982, the Government was a full-fledged partner in the wage agreement (known as Acuerdo Nacional sobre el Empleo). In 1984, however, no agreement on wage guidelines was reached between workers and employers. Although the collective bargaining process has become more centralized and has been extended to an increasing fraction of the labor force, individual wage contract renewals are still spread throughout the year. As a consequence, wage increases in one period tend to affect the wage bargaining process in the following period. Data for 1982 indicate that two thirds of the work force renewed their one-year contracts in the first half of that year, while the remaining third renewed theirs in the second half (Ministerio de Trabajo y Seguridad Social, 1984). In view of the overlapping of wage contracts, we assign the value of .3 to the parameters f_1 and h_2.

Spanish trade unions have often been successful in maintaining, and even increasing, the purchasing power of wages, even though the prevailing wage rates were incompatible with full employment. From 1975 to 1983, real wages grew at the same rate as labor productivity, while the unemployment rate increased from 3.7 percent to 17.4 percent, the highest rate among industrial countries (Table 3). The value of 0.2 that has been chosen for f_2 reflects the insensitivity of the Spanish labor market to general economic conditions, while the value chosen for f_3, 0.9, reflects the high elasticity of wage settlements with respect to inflationary expectations.

1/ Ministerio de Economia y Comercio (1981) contains a description of labor market developments before 1982.

Table 3. Labor Market Indicators

Unemployment Rates in Selected Industrial Countries 1/

	1975	1979	1983
Australia	4.8	6.2	9.8
Austria	1.7	2.1	4.2
Belgium	5.1	8.4	14.5
Canada	6.9	7.4	11.8
Finland	2.2	5.9	6.1
France	4.1	5.9	8.1
Germany	3.6	3.2	7.5
Italy	5.8	7.5	9.7
Netherlands	5.2	5.4	13.7
Norway	2.3	2.0	3.3
Sweden	1.6	2.1	3.5
United Kingdom	4.6	5.6	13.1
OECD - Total	5.2	5.1	8.7
Spain	3.7	8.5	17.4

Spain (1975-83): Annual Percentage Growth Rate of: 2/

Wage Cost Per Dependent Worker	Consumer Price Index	Real Wage Cost Per Dependent Worker	Labor Productivity
20.8	16.4	3.6	3.9

Sources: OECD, Labor Force Statistics, 1970-81, May 1983, and Labor Force Statistics Quarterly, No. 1, 1984.

1/ Data are standardized unemployment rates as a percent of total labor force.

2/ Data provided by the Bank of Spain.

The value of h_3, .25, which measures the impact of the exchange rate on the domestic price level, is obtained from input-output tables, 1/ while that for the interest semi-elasticity of the money demand, g, is taken from Bank of Spain's (1983) estimates of the money demand. The implied average interest elasticity during the sample period over which money demand was estimated is rather high, ranging from -0.6 to -1.0 depending on whether the interest rate on non-deposit bank liabilities or the yield on long-term government debt is taken to measure the opportunity cost of holding money. 2/ The set of parameter values described in this section is hereafter called Model A, and is shown in Table 4.

Table 4. Parameter Values

Parameter	Model A	Model B	Model C
a	0.50	0.50	0.50
b	0.50	0.88	0.50
g	8.00	8.00	8.00
f_1	0.30	0.30	0.18
f_2	0.20	0.20	0.50
f_3	0.90	0.90	0.75
h_1	0.45	0.45	0.57
h_2	0.30	0.25	0.18
h_3	0.25	0.30	0.25

In order to estimate the "optimal" value of θ for Spain, three additional assumptions are needed: the form of the loss function, the relative size of the variances of the shocks and a range of "feasible"

1/ See Bank of Spain, Informe Anual (1982), p. 121.

2/ Dolado (1982) also finds a very elastic demand for money. The main conclusions of the paper, however, are not affected if a smaller interest rate elasticity for the demand for money is assumed.

values for θ. For illustrative purposes, we assume that the authorities' loss function (Loss) is equal to the sum of the price and output variances which, for convenience, we take as measures of price and output variability:

$$\text{Loss} = \sigma_p^2 + \sigma_y^2$$

As for the variances of the shocks, we assume for simplicity that $\sigma_u^2 = \sigma_v^2 = 1$ because there is little empirical evidence about the relative magnitude of the shocks. We also assume that the two shocks occur simultaneously. Finally, we minimize the loss function for values of θ ranging between -1.6 and +0.4. We only consider a few positive values of θ on theoretical grounds; a positive θ implies that a central bank opposes an exchange depreciation by expanding the money supply, a policy that would not be consistent with the implications of existing exchange rate models. 1/ We do not consider values of θ that are smaller than -1.6 on empirical grounds; given the size of the real exchange rate fluctuations that industrial countries have experienced since the beginning of the floating period, a θ smaller than -1.6 does not seem to be realistic. Indeed, in all the simulation exercises of this paper, we find that the loss function achieves its minimum value for a θ between 0 and -1.2.

In Figure 1, we depict the loss function for Model A. The function declines very quickly as monetary policy becomes less responsive to real exchange rate movements, reaching a minimum at θ equal to -0.2. Given that the "optimal" θ turns out to be close to zero, the simulation exercise suggests that for the structural parameters and loss function chosen here, rigid adherence to quantitative monetary targets may indeed constitute an optimal monetary policy in Spain, thus supporting the actual policy choices of that country during the period under consideration.

The shape of the loss function for Model A is accounted for by the behavior of price and output variances: as monetary policy becomes more responsive to real exchange rate movements, the variance of output declines while that of prices increases (Table 5). The differing behavior of the two variances can be explained with the help of Figure 2, which shows the response of the exchange rate and the price level to a unitary increase in the two disturbances of the model, u_t and v_t. Positive disturbances create an excess demand for money, thus increasing the domestic interest rate and, consequently, appreciating the nominal and real exchange rates. The monetary authorities may try to neutralize the

1/ When the real exchange rate appreciates $[(e_t-e)-(p_t-p)]$ becomes negative.

FIGURE 1

LOSS FUNCTION FOR MODEL A

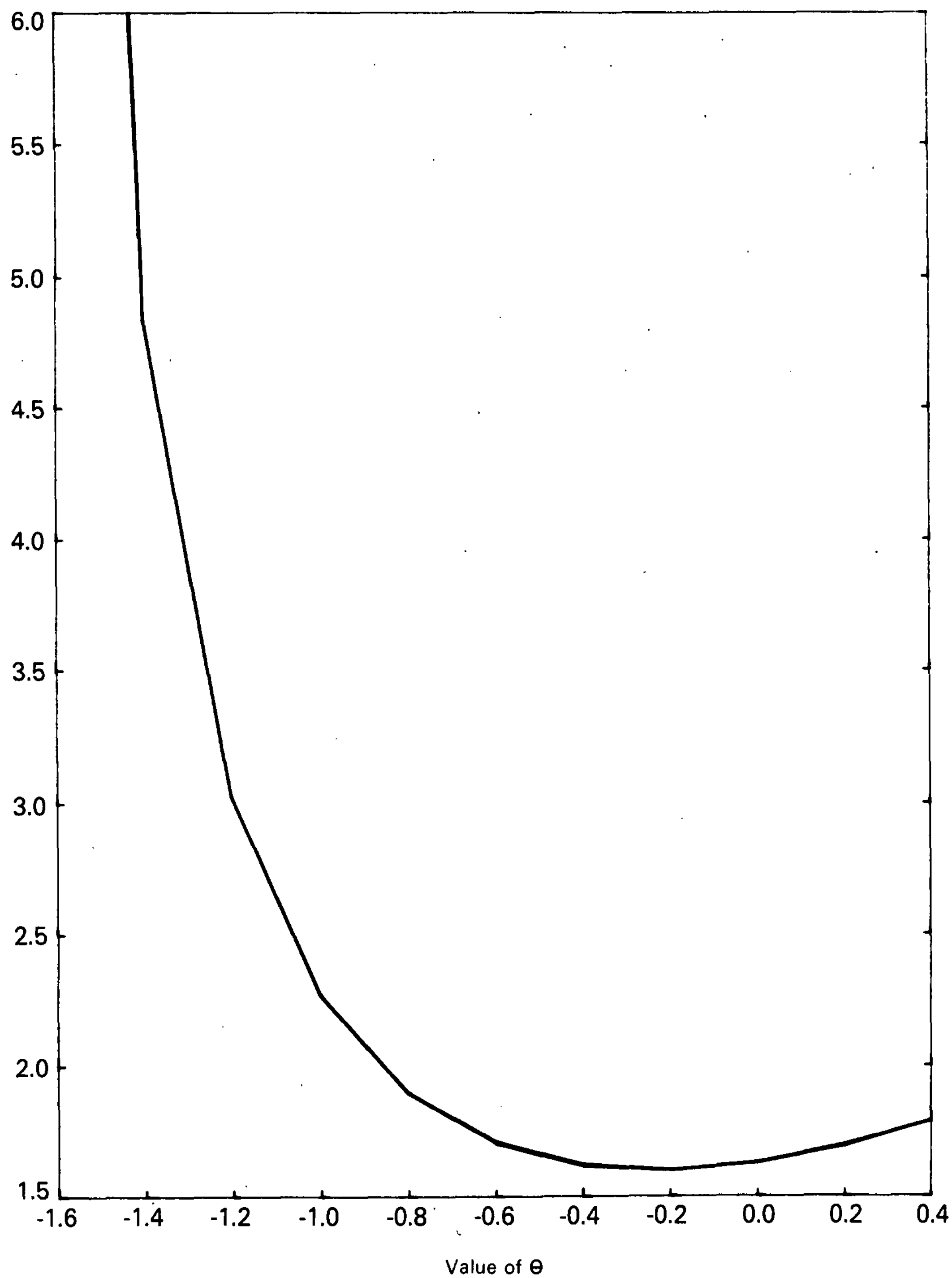
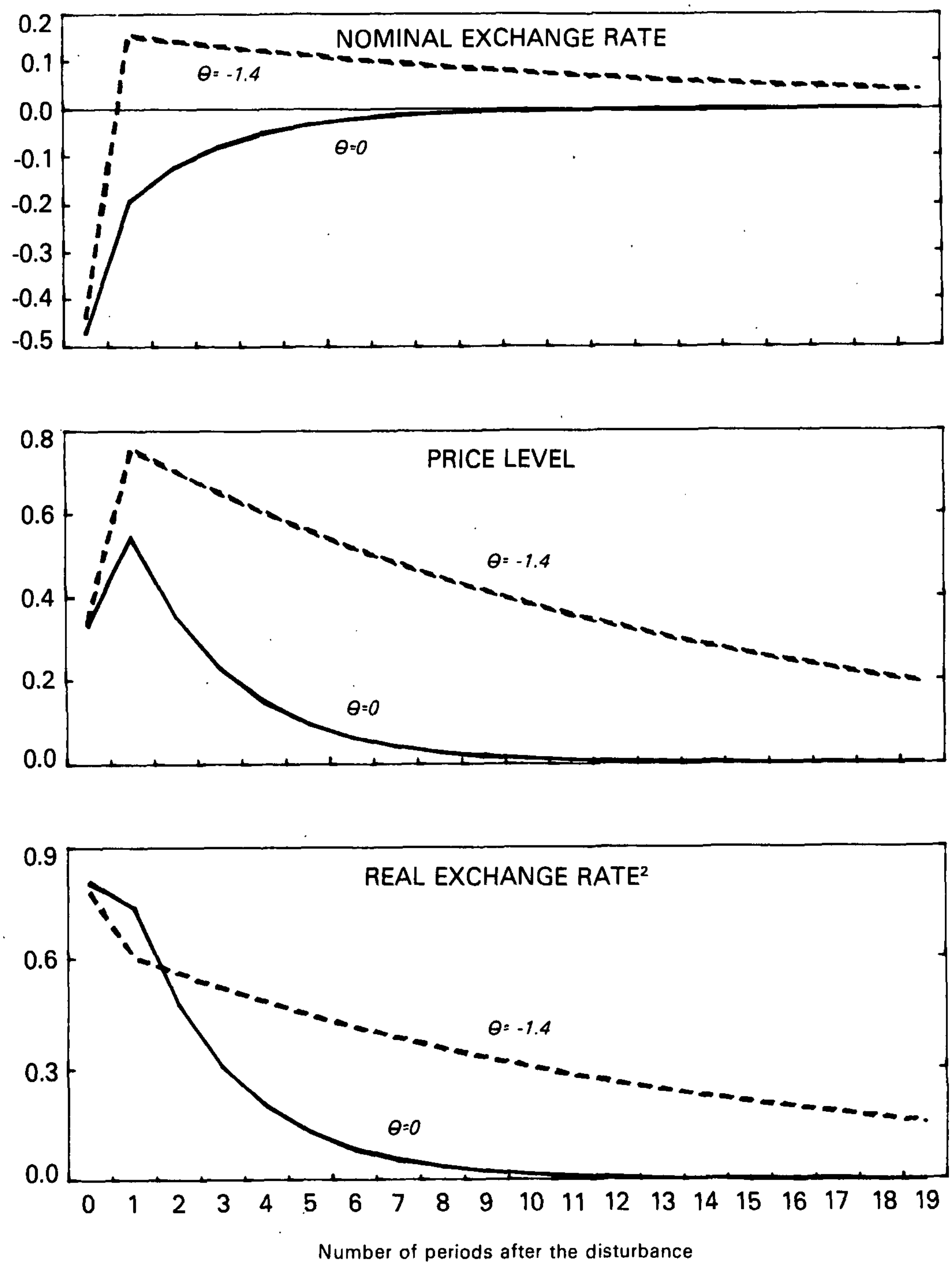


FIGURE 2

SIMULATED RESPONSE OF ENDOGENOUS VARIABLES TO A UNITARY DISTURBANCE[1]



[1]The simulations are based on Model A which is described in the text. All variables are espressed as logarithms.
[2]The real exchange rate is defined as (p-e).

Table 5. Spain: The Simulations of the Model

	Value of θ										
	-1.6	-1.4	-1.2	-1.0	-0.8	-0.6	-0.4	-0.2	0.0	0.2	0.4
Model A											
σ_p^2	11.9	4.3	2.6	1.8	1.4	1.1	0.9	0.8	0.7	0.6	0.5
σ_y^2	1.1	0.5	0.4	0.4	0.5	0.6	0.7	0.8	0.9	1.1	1.2
Model B											
σ_p^2	1.6	1.2	1.0	0.9	0.8	0.7	0.6	0.5	0.5	0.4	0.4
σ_y^2	0.5	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.4	1.6
Model C											
σ_p^2	0.62	0.57	0.54	0.51	0.48	0.46	0.43	0.41	0.39	0.38	0.36
σ_y^2	0.04	0.06	0.09	0.13	0.17	0.23	0.30	0.37	0.46	0.56	0.67

Note: The symbols σ_p^2 and σ_y^2 represent the variances of prices and output, respectively. The parameter values characterizing Models A, B, and C are described in the text.

impact of these disturbances on money market conditions by allowing the money stock to overshoot its target. This temporary monetary expansion stabilizes output, because it prevents real cash balances from declining and checks the real appreciation of the exchange rate. A monetary policy that accommodates disturbances, however, increases the persistence of wages and prices, thus increasing the variance of the price level. 1/

Given the values of the structural parameters that we have chosen, the results of the model suggest that a non-accommodating monetary policy achieves the best mixture of a reduced price variability and increased output variability. This conclusion depends crucially on the assumption that the monetary authorities attribute the same importance to output and price variability in formulating their policies. If the authorities' concern for output variability increased, a more accommodating monetary policy would be desirable; that is, the money stock would be expanded in response to an unanticipated increase in the wage rate; the opposite would be true if the authorities' emphasis on price stability increased.

2. Two alternative models

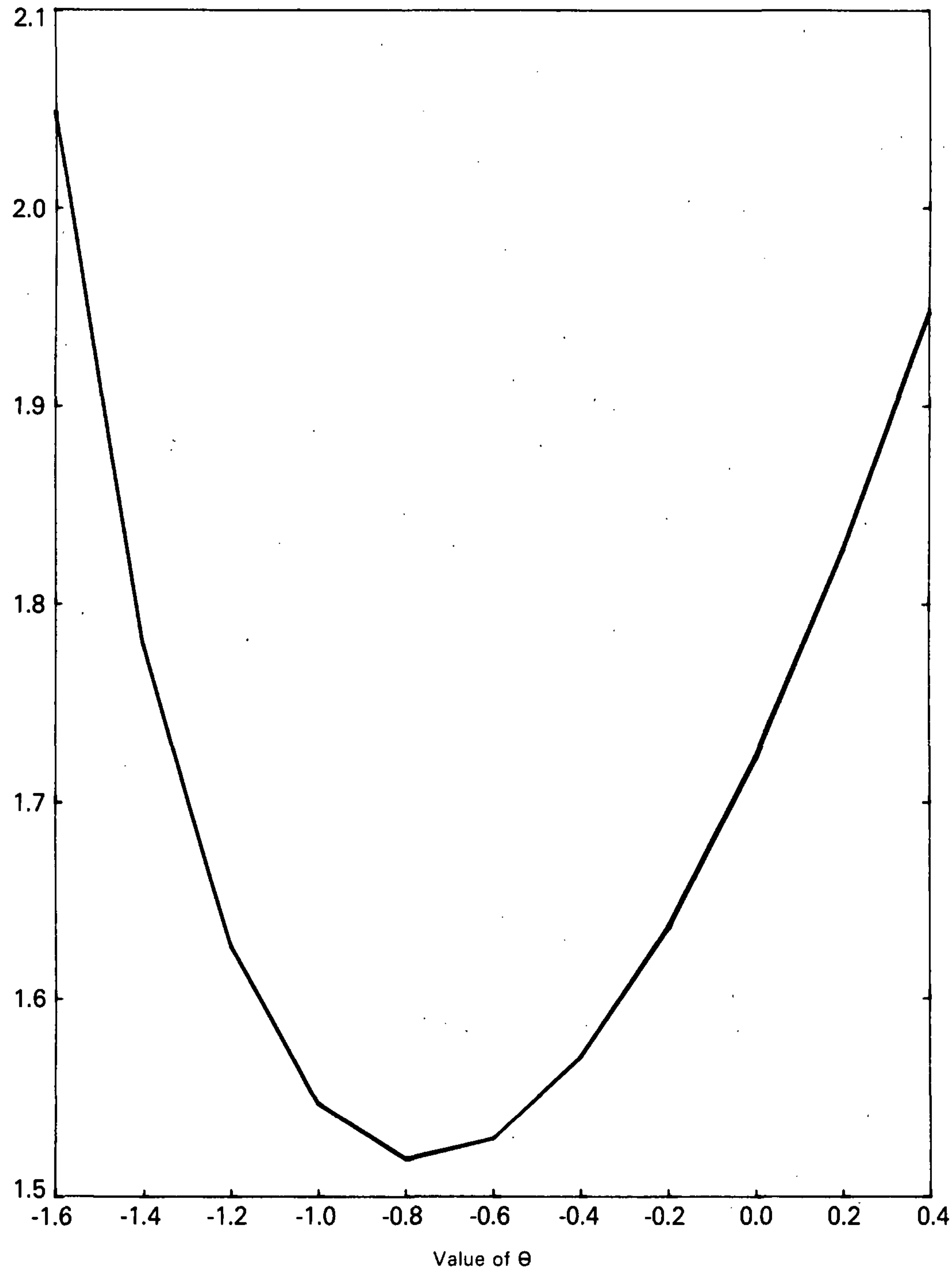
How might changes in the structure of the Spanish economy affect the conclusions of Model A? In order to answer this question, we carry out two additional numerical simulations with two models that we call Model B and Model C. In the first simulation, Model B, we assume that the Spanish economy becomes more open to international trade (perhaps as a consequence of its entry into the European Common Market). Accordingly, we assume that the ratios of exports and imports to GDP increase from their current level of around 20 percent to 35 percent, with the parameter 'b' rising from 0.5 to 0.88; we also assume that the impact of the exchange rate on the domestic price level increases from 0.25 to 0.3. In the second simulation, Model C, we assume that as a result of an increase in the flexibility of the labor market, wage settlements become more sensitive to general economic conditions and less sensitive to the expected inflation rate. Accordingly, we reduce the value of f_3 (which links wages to price expectations) from 0.9 to 0.75, while we increase f_2 (which links wages to expected changes in the level of output) from 0.2 to 0.5. The parameter values for Models B and C are summarized in columns 2 and 3 of Table 4.

Figure 3 shows that in the case of Model B the loss function reaches its minimum at θ equal to -0.8, thus indicating that monetary policy should become more responsive to real exchange rate movements if the Spanish economy becomes more open. As the relative size of the traded

1/ Taylor (1979) stresses the trade-off between output stabilization and wage persistence.

FIGURE 3

LOSS FUNCTION FOR MODEL B



goods sector expands, real exchange movements have a larger impact on output. As a consequence, a shift in policy towards rigid monetary targets becomes more costly in terms of output variability. This can be seen by comparing the behavior of the output variance in Models A and B (Table 5).

A similar conclusion applies to Model C. Figure 4 shows that the loss function for Model C reaches a minimum at a value of θ equal to -1.2, so that flexible monetary targets appear to be the "optimal" policy, even in the case of greater labor market flexibility. The main reason for this result is that changes in monetary policy have only a minor impact on the variance of the price level because a flexible labor market does not propagate inflationary impulses from one period to the next. Under these circumstances, an active monetary policy can be adopted to stabilize the real exchange rate (and hence output) without incurring a sharp increase in price variability.

The simulations of this section yield two broad conclusions. First, there is no single "optimal" monetary policy that suits every country regardless of its circumstances. Rather policies should reflect the different structures of the different economies. Second, the choice of exchange rate, monetary, and labor market policies should be treated as a joint problem--an important policy recommendation that has recently emerged in the literature (Aizenman and Frenkel, 1984).

IV. Concluding Remarks

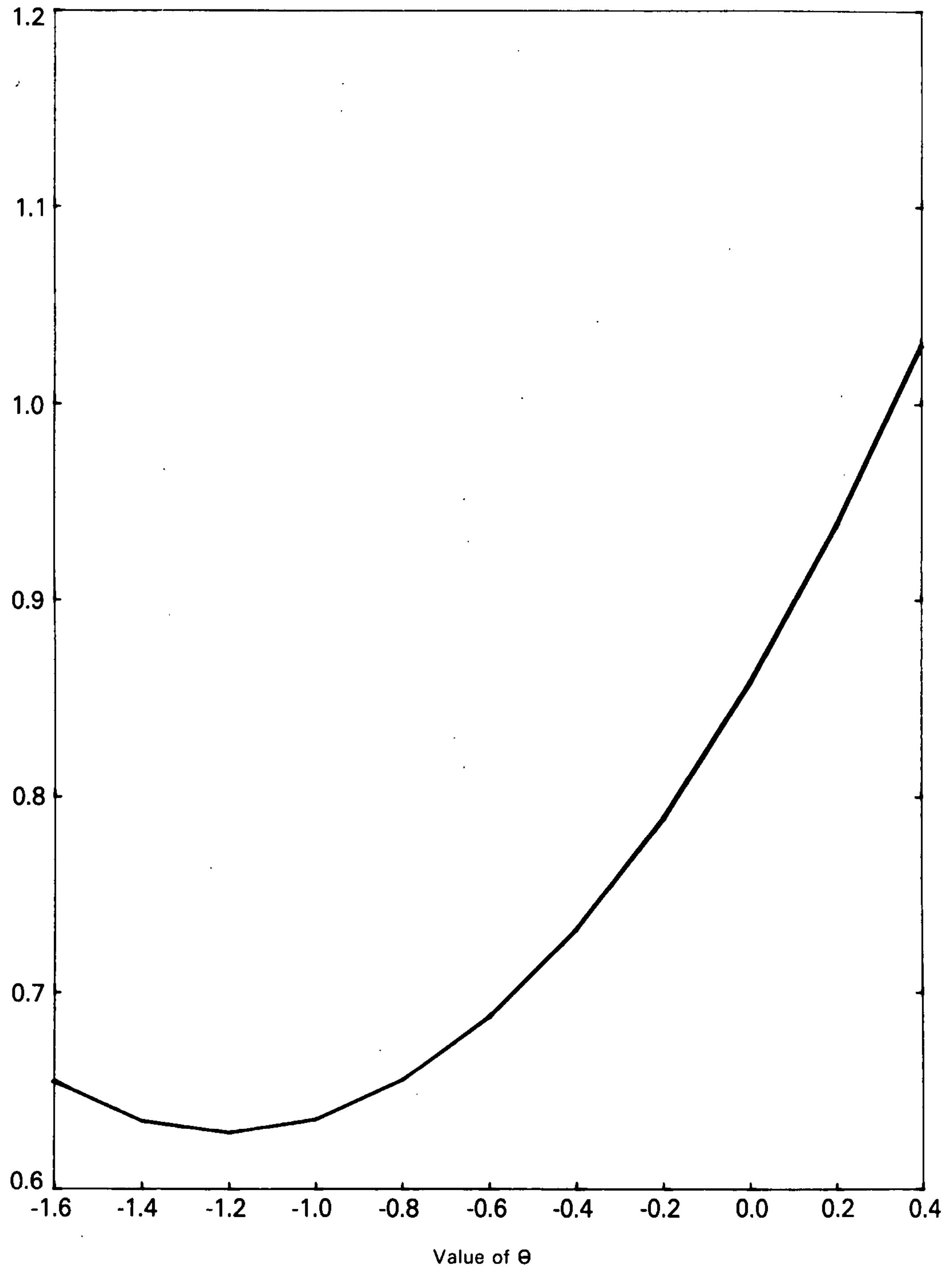
Since the beginning of the 1970s, many industrial countries have announced targets for the growth rates of their monetary aggregates in conjunction with programs to restrain both inflation and inflationary expectations. An interesting policy problem that has arisen in connection with the use of quantitative money growth targets is the determination of the optimal degree of flexibility that should be adopted in attaining the targets. In view of the large real exchange rate movements that have occurred during the last decade and the perceived costs associated with them, it has been suggested that monetary authorities should also aim at smoothing the fluctuations of the rate around the perceived equilibrium level, in order to stabilize output and prices at levels consistent with high employment.

In this paper, we have developed an aggregative stochastic model that can be used to assess the optimal degree of monetary policy flexibility when disturbances originate mainly in labor and financial markets. Using parameter values that are intended to represent the stylized facts of Spain's economic structure, we undertook simulation experiments to show that the 'optimal' monetary rule given by the model is consistent with the policy currently operated by the monetary authorities in Spain. That is, on the assumptions of the model it appears to be optimal for the Spanish authorities to adhere rather strictly to their preannounced quantitative monetary targets in the face of domestic disturbances. This conclusion, however, depends crucially on the specification of the authorities' loss function. The simulation results also suggest that the authorities should attribute more importance to real exchange rate movements in choosing their policies if the Spanish economy becomes more open to international trade, or if wages become more responsive to general economic conditions. The main point that emerges from this paper is that a monetary policy cannot be chosen without taking into account the characteristics of financial and labor markets.

Two final remarks are warranted concerning the limitations of the present study and some possible extensions. First, we neglect the "credibility problem." In the model, we implicitly assume both that the deviations of the money stock from its targeted path are always expected to be temporary and that these expectations are always fulfilled by the monetary authorities. In practice, this occurs very rarely, and monetary authorities may have to pay a high price in terms of output variability in order to establish credibility for their policies. One way to model the cost of credibility would be to add the deviations of money from its target level to the authorities' loss function along the lines indicated by Barro and Gordon (1983). Second, we assume that the probability of a real sector shock is equal to zero. As this probability becomes larger, it is likely that the monetary authorities may want to opt for a policy that reduces the persistence of wages. This persistence is increased, as we pointed out before, by a monetary policy that is responsive to real exchange rate movements. This element could be incorporated into the model by adding the eigenvalue that drives the dynamics of the system to the loss function. Finally, it is interesting to note that the optimal degree of flexibility in attaining monetary targets decreases, ceteris paribus, the higher are the costs of credibility and the larger the probability that a real shock will occur in the near future.

FIGURE 4

LOSS FUNCTION FOR MODEL C



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