Monetary Targets, Real Exchange Rates and Macroeconomic Stability

by

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I. Introduction

In a world of no uncertainty and of flexible prices, a fixed money growth rule would be the optimal monetary policy because it would maintain both price stability and full employment. In practice, however, policy choices are complicated by the different unexpected shocks that affect economies. Since the beginning of the 1970s, industrial countries have had to face several disturbances that originated both in domestic economies and world markets: two energy crises have caused sudden and sharp changes in the terms of trade of industrial countries; financial innovations have induced shifts in the private sector demand for money; and trade unions have sometimes imposed wage rates inconsistent with full employment.

If monetary authorities pursued rigid 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 respond to these disturbances much faster than prices, a monetary policy that focused on 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 an economy due to the less-than-perfect mobility of production factors. And, 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 real exchange rate movements, many countries have attributed a high priority to exchange rate considerations in formulating their domestic economic policies since the beginning of the floating system of exchange rates. 1/

During the same period, however, an increasing number of countries have also regarded preannounced quantitative money targets as indispensable tools to check inflationary expectations and to achieve price stability. Thus, there has been a potential conflict between the objectives of monetary and exchange rate policies. The conflict could be resolved if sterilized intervention, that is, the trade in nonmonetary assets that are denominated in different currencies, could be used to adjust 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 the money growth rate would be adopted to control the inflation rate. Unfortunately, there is increasing evidence that sterilized intervention is either ineffective or not viable (see Rogoff, 1983 and Frenkel, 1983). Therefore, the choice of an exchange rate policy becomes the choice of a monetary policy and countries are left with a policy problem, namely, how responsive monetary policy should be to the deviations in the real exchange rate from the level that they perceive as being the long-run equilibrium, or, to put it differently, what the optimal degree of flexibility in attaining the monetary targets.

This policy problem is the subject matter of this paper. In the paper, I analyze the optimal degree of monetary policy flexibility when the domestic financial and labor markets are the major sources of disturbances. The focus on these two disturbances is warranted by the recent experience of many industrial countries where labor market rigidities and shifts in portfolio asset preferences have often hindered both the formulation and the implementation of monetary policies. I do not deal with real shocks, such as permanent changes in the 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, I develop an aggregated stochastic model that incorporates the salient features of small open industrialized economies. 2/ 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 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, I determine the elasticity of the deviations of the money supply from its fixed target with respect to real exchange rate movements, and I show how this elasticity is related to the parameters of the structural model.

In Section III, I assign values to the parameters of the model that typify the Spanish economy and then I calculate the optimal degree of monetary policy flexibility for this economy. 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 growth rate of broad money (M3). Since that year, unlike many other countries, the actual growth rates of money in Spain have never diverged from their targeted rates in a substantial way (Table 1). Second, as perhaps might have been expected, Spain is one of the industrial countries that have experienced the largest variability in the real exchange rate (Table 2). This variability was particularly pronounced between 1978 and 1983, when the policy of preannounced monetary targets was implemented. And third, the implementation of monetary policy has often been hindered by extensive labor market rigidities due to strong trade unions and portfolio shifts due to financial innovations and international capital flows. 3/

I find that, according to the model, rigid quantitative targets are the optimal monetary policy in Spain, thus supporting the policy choices of that country. This result, however, is quite sensitive to the specification of the authorities' loss function. I also show that it would be optimal for the Bank of Spain to implement monetary targeting more flexibly, thus letting the money stock deviate from its targeted path in response to unexpected real exchange rate movements, if the economy became more open or if the labor market became more flexible.

Table 1. Spain: Monetary Growth Targets

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).

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.

Three conclusions can be drawn from this exercise. First, there is not one "optimal" monetary policy that suits every country, but policies should reflect the different structure 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). And third, simple aggregated models, like the model presented in this paper, may be usefully adopted to evaluate country-specific monetary and exchange rate policies.

II. The Model

In this section, I develop an aggregated stochastic model that typifies 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 are expressed as logarithms with the exception of the interest rate that is expressed as a level; 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; and expectations are formed rationally so that the symbol $E_{t-i} Z_{t+j}$ indicates the expectations 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 as imperfect substitutes for foreign goods by domestic and foreign consumers. After a disturbance affects the economy, the real exchange rate always moves back to its long-term equilibrium level that depends on the equilibrium current account and on the characteristics of the labor market. Because I do not analyze permanent shocks to the production function or to the terms of trade, the steady state 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.

The monetary authorities adopt a flexible quantitative rule for the growth of the money stock. If there were no shocks in the economy, they would fix the money stock at the preannounced level of $\bar{m}$ which maintains both price stability and output at its full employment level. However, because several shocks can disturb the steady state equilibrium of the economy, the monetary authorities may choose temporarily to abandon their monetary target and change the money stock in response to movements in the real exchange rate (equation 2). The parameter θ, which measures the elasticity of the money stock deviations from its targeted path with respect to real exchange rate movements, thus indicates the degree of flexibility of the monetary targets. If the monetary authorities choose a negative θ, they will expand the money supply when faced with a real exchange rate appreciation so as to smooth the fluctuations of the rate around its steady state level. 4/

The demand for money is a function of the price level p_t, of permanent income, which I set equal to the steady state level of output, of the domestic interest rate r_t and of 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 interest parity condition (equation 4). 5/ I 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 entrepeneurs establish a wage rate that reflects the expected level of prices during the period covered by the contract and 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 renewed at the same point in time even in those countries in which collective bargaining is highly centralized. Given that I apply the model to the Spanish economy, there are no wage indexation schemes. 6/ Finally, as a result of the bargaining process, wage settlements can turn out 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 in the labor market are independent of the shocks in the financial market, that is $E(u_t\ v_t) = 0$.

The last equation of the model, equation 7, describes the price level 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 weights in the price index add up to one because I assume that the index is calculated with a geometric average. The model thus consists of seven equations that determine seven 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.

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

$$m_t^s = \bar{m} = k\bar{y}. \qquad (8)$$

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, I can rewrite the model as follows:

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

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

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

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

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

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

Written in this format, the model is ready to be solved.

a. <u>The solution for output and the price level</u>

First, I use equation (15) to eliminate the price level from the model. Second, I use the money supply equation to eliminate m_t^s from (10). And third, I 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.

$$y_t = P_1\, e_t + P_2\, w_t + P_3\, w_{t-1} \tag{16}$$

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

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

where

$$P_1 = (\theta a+b)(1-h_3) - ah_3$$

$$P_2 = -h_1[a(1+\theta)+b]$$

$$P_3 = -h_2[a(1+\theta)+b]$$

The model consists of two difference equations. 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):

$$w_t = (f_1+f_3h_2+f_2P_3)\ w_{t-1} + (f_3h_3+f_2P_1)\ E_{t-1}\ e_t + + (f_3h_1+f_2P_2)\ E_{t-1}\ w_t + u_t \tag{19}$$

In order to solve the difference equation system that consists of (18) and (19), I move 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

$$Z_o = (f_1 + f_3\ h_2 + f_2\ P_3)/(1 - f_3\ h_1 - f_2\ P_2)$$

$$Z_1 = (f_3\ h_3 + f_2\ P_1)/(1- f_3\ h_1 - f_2\ P_2)$$

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

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

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

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

$$\begin{bmatrix} E_{t-1}\ w_{t+1} \\ E_{t-1}\ e_{t+1} \end{bmatrix} = \begin{bmatrix} Z_0+Z_1Z_2 & Z_1Z_4 \\ Z_2 & Z_4 \end{bmatrix} \begin{bmatrix} E_{t-1}\ w_t \\ E_{t-1}\ e_t \end{bmatrix} + \begin{bmatrix} Z_1Z_3 & 0 \\ Z_3 & 0 \end{bmatrix} \begin{bmatrix} w_{t-1} \\ e_{t-1} \end{bmatrix}$$

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), I first reduce its order by rewriting it as (Chow 1975):

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

where I is the identity matrix. In a more compact form, the 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 I evaluate the model in the next section, I always find that only one of of the three remaining eigenvalues is a real number greater than zero and lower than one. If I call this eigenvalue λ, if I impose stability and if I rule out oscillatory paths for the endogenous variables, I can express the solution for the expected wage and exchange rates uniquely as a function 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, I 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 necessary price to pay for building a model that is sufficiently realistic.

Just 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), I 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 a little bit more complicated and several steps are needed. First, because equation (18) holds for every t, I can move its time subscript one period backwards. Second, I use the relationship

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

which stems from (25), to eliminate expectations from the equation (18).

Third, I 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, I substitute (27) and (28) into (15) and (16).

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

$$y_t = (P_2 + P_1 A_o)/(1-\lambda L)u_t + (P_3 + P_1 A_1)/(1-\lambda L)u_{t-1} + P_1 A_3 v_t \tag{30}$$

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

$$\sigma_y^2 = (K_o^2 + K_1^2 + 2 K_1 K_o \lambda)/(1-\lambda^2)\sigma_u^2 + A_3^2 P_1^2 \sigma_v^2$$

where

$$H_o = h_1 + h_3 A_o$$

$$H_1 = h_2 + h_3 A_1$$

$$K_o = P_2 + P_1 A_o$$

$$K_1 = P_3 + P_1 A_1$$

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 attaining the quantitative monetary targets that 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, I use a set of parameter values that typify the Spanish economy in order to calculate the θ that minimizes output and price variability in that country. As I argue in the introduction, Spain represents an interesting case study because the monetary authorities of that country have focused on quantitative targets for nearly a decade even though financial innovations have caused shifts in the demand for the monetary aggregate being targeted and trade unions have often set wages at levels incompatible with full employment. The objective of my simulation exercise is to see whether the model supports the policy choice of the Spanish authorities, that is, whether the characteristics of the Spanish economy and the structure of the stochastic disturbances call for rigid quantitative monetary targets.

a. A model for Spain

In order to obtain the parameter values for Spain, I mainly rely on existing empirical studies. On a few occasions, I either estimate a parameter by fitting a reduced form or I assume a value that I consider reasonable. I 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 deviations 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, I obtain a value for 'a' simply by 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. I use the lagged value of real money 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 deviations of output from its trend level. The estimated regression, which I 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 GDP deflator; $\hat{\rho}_1$ is the estimated first order serial correlation coefficient of the fitted residuals; and the t statistics are shown in parentheses below the coefficients. 7/

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 imports and exports to

GDP. I took the values of the elasticities from Bonilla-Herrera (1978). The export elasticity is 1.7 and the import elasticity -0.8, which are close to the "benchmark" values for the price elasticities of manufactures--1.65 and -0.9--that are used in the IMF, Multilateral Exchange Rate Model for small industrial countries (see Artus and McGuirk, 1981). Because these are long-run elasticities, they may overstate the impact of real exchange rate movements on output due to the J-curve effect. The elasticities are then multiplied by .20, or the average import and export ratios to GDP in the last five years.

Collective bargaining in Spain has undergone considerable changes during the last few years. Trade unions were allowed only in 1977. In that year, it was also decided that national contracts could not establish guidelines for wage settlements at the regional and plant level in order to enhance competition in labor markets. 8/ 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. 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 was reached between workers and employers on wage guidelines. Although the collective bargaining process has become more centralized and covered an increasing fraction of the labor force, the renewals of the wage contracts are still spread throughout the year. As a consequence, wage increases in one period tend to affect the wage bargaining process in

Table 3. 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 following period. Data for 1982 indicate that two thirds of the workers renewed their 1-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 wage contracts overlapping, I 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, or the highest rate among industrial countries (Table 3). The value chosen for f_2, .20, reflects the insensitivity of the Spanish labor market to general economic conditions, while the value chosen for f_3, .90, reflects the high elasticity of wage settlements with respect to inflationary expectations.

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. 9 / The value of 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 rate elasticity during the period in which the money demand is estimated is rather high as it ranges 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. 10/ The set of parameter values described in this section comprises what I call 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 determine the "optimal" value of θ for Spain, I need three additional assumptions: the form of the loss function, the relative size of the variances of the shocks and a range of "feasible" values for θ. In response to the inflationary waves of the 1970s, the emphasis of economic policies has clearly shifted from output stability to price stability in industrial countries; this is particularly true in Spain which has experienced a very high and variable inflation rate. As a consequence, I assume that the authorities' loss function (Loss) is equal to the sum of the price and output variances, which, for convenience, I take as measures of price and output variability:

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

As for the variances of the shocks, I assume that $\sigma_u^2 = \sigma_v^2 = 1$ because I have neither prior beliefs nor empirical evidence about the relative magnitude of the shocks. I also assume that the two shocks occur simultaneously. Finally, I minimize the loss function for values of θ ranging between -1.6 and 0.4. I 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 contrast the predictions of existing exchange rate models. I 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, I do not think that a θ smaller than -1.6 would be realistic. Indeed, in all the simulations exercises of this paper, I find that the loss function achieves its minimum value for a θ between 0 and -1.2.

In Figure 1, I depict the loss function for Model A. The function declines very quickly as the monetary policy becomes less responsive to real exchange rate movements, reaching a minimum at θ equal to -.2. Given that the "optimal" θ turns out to be close to zero, the simulation exercise suggests that rigid quantitative targets are the best policy in Spain.

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 different behavior of the two variances can be explained with the help of Figure 2, in which I show the response of the exchange rate and of 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 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

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 indicate the variance of prices and of output, respectively. The parameter values characterizing Models A, B, and C, are described in the text.

FIGURE 1

LOSS FUNCTION FOR MODEL A

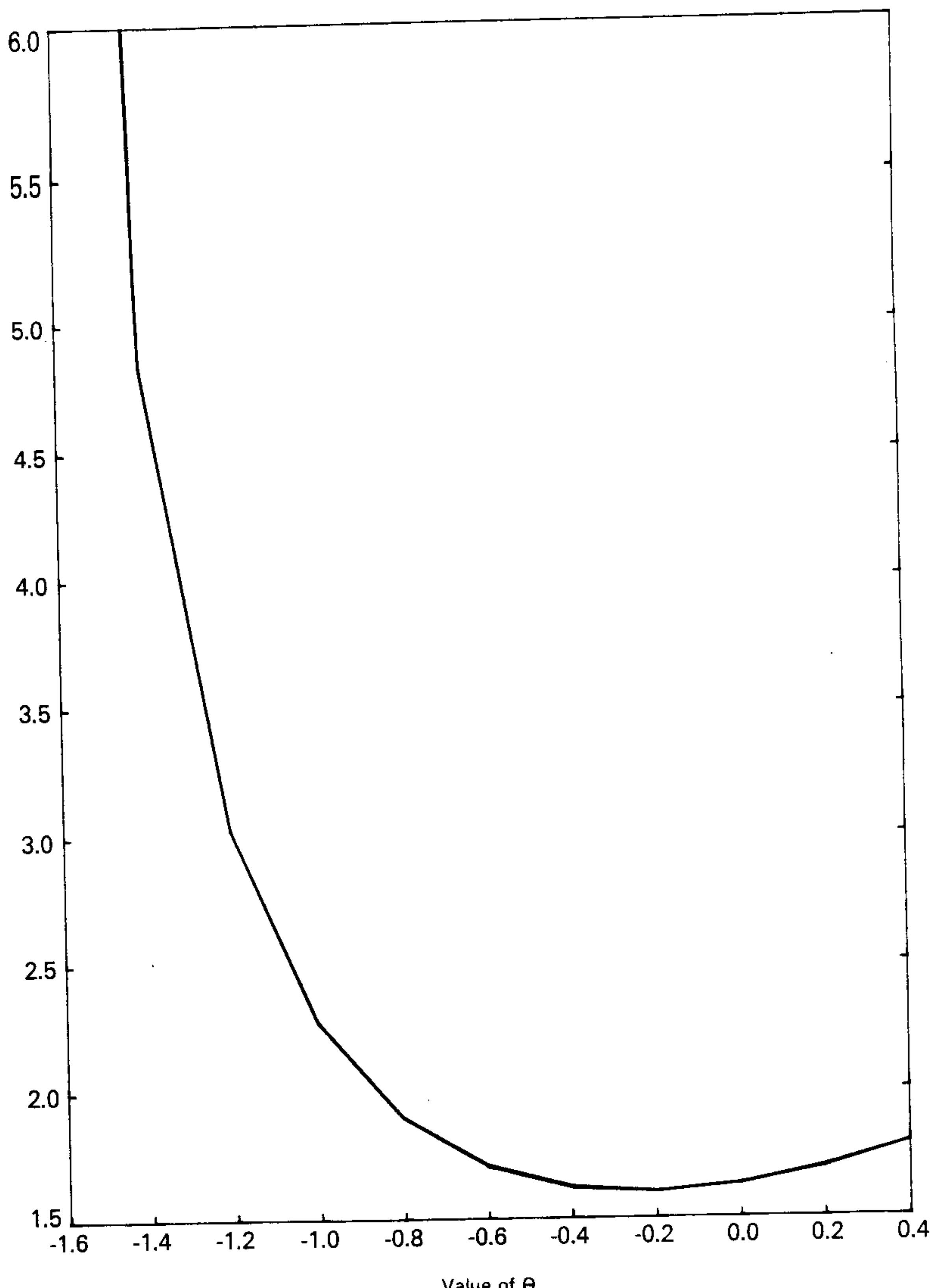
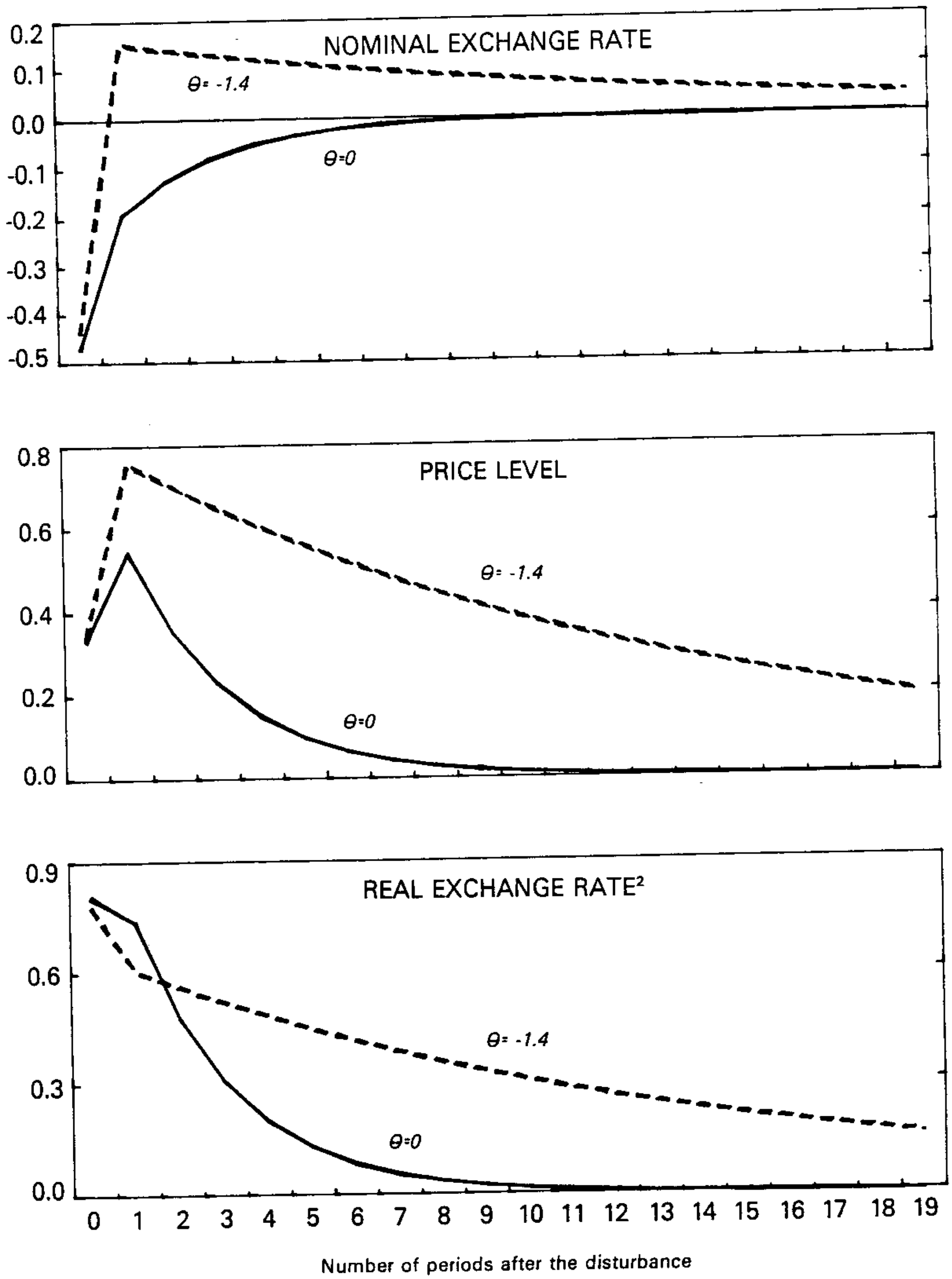


FIGURE 2

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).

that accommodates disturbances, however, increases the persistence of wages and prices thus increasing the variance of the price level. 11/

Given the structure of the Spanish economy, a non-accommodating monetary policy thus achieves the best mixture of a declining price variability and an increasing output variability. This conclusion, however, crucially depends 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; the opposite would be true if their concern for price variability rose.

b. Two alternative models

Would changes in the structure of the Spanish economy affect the conclusions of the previous section? In order to answer this question, I carry out two additional numerical simulations with two models that I call Model B and Model C. In the first simulation, Model B, I assume that the Spanish economy becomes more open to international trade, perhaps as a consequence of its entry into the European Common Market. Accordingly, I assume that the ratio of exports and imports to GDP increases from the actual 20 percent to 35 percent, with the parameter 'b' rising from .5 to .88, and that the impact of the exchange rate on the domestic price level increases from .25 to .30. In the second simulation, Model C, I assume that wage settlements become more sensitive to general economic conditions and less sensitive to the expected inflation rate as a result of an increase in the flexibility of the labor market. Accordingly, I reduce the value of f_3, linking wages to price expectations, from .9 to .75, while I increase f_2, linking wages to expected changes in the level of output, from .2 to .5. The parameter values for Model 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 -.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 goods sector increases, 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 the minimum at 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 changes in the price level variance because a flexible labor market does not propagate inflationary impulses from one period to the next (Table 5). 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.

FIGURE 3

LOSS FUNCTION FOR MODEL B

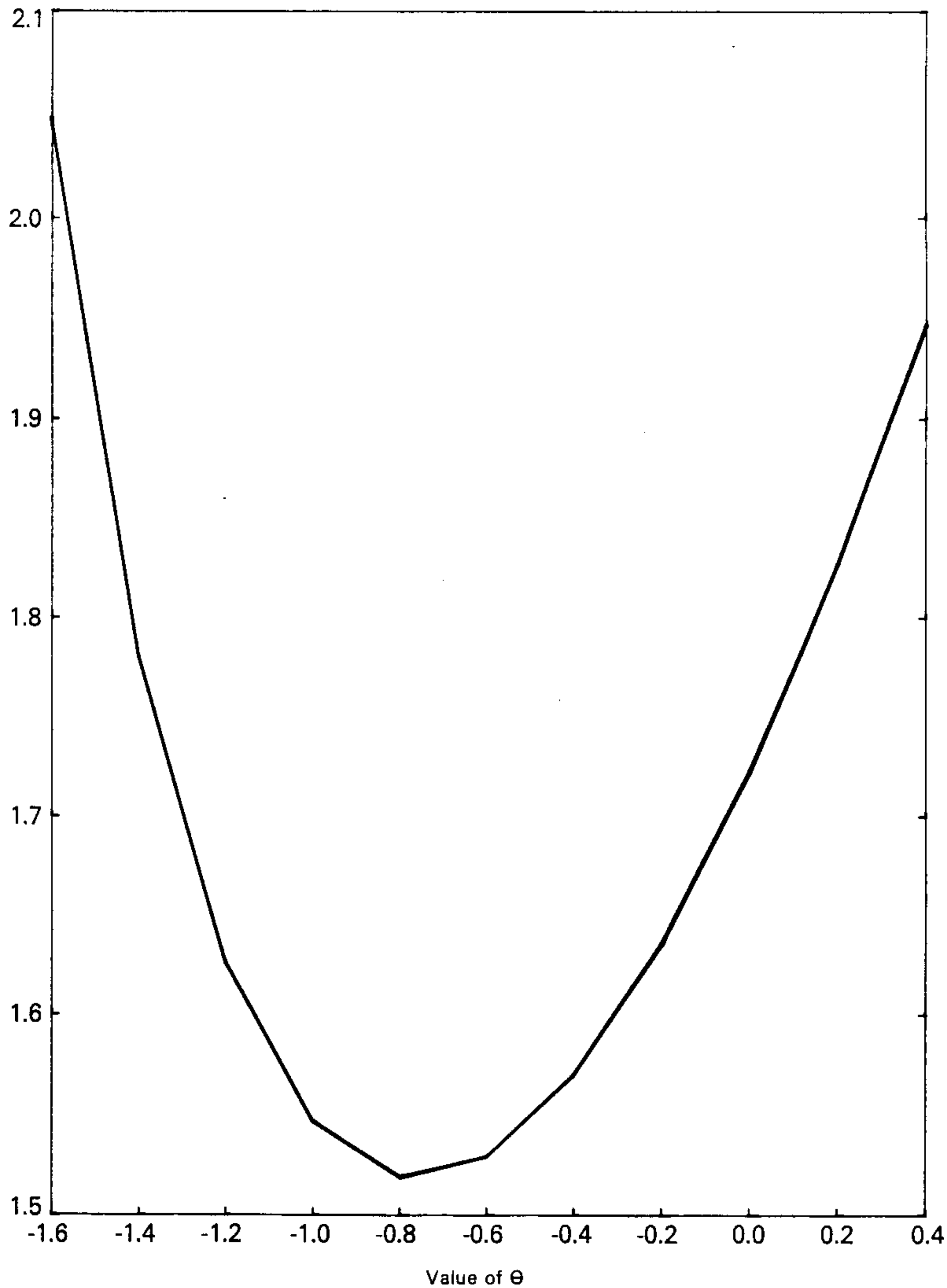
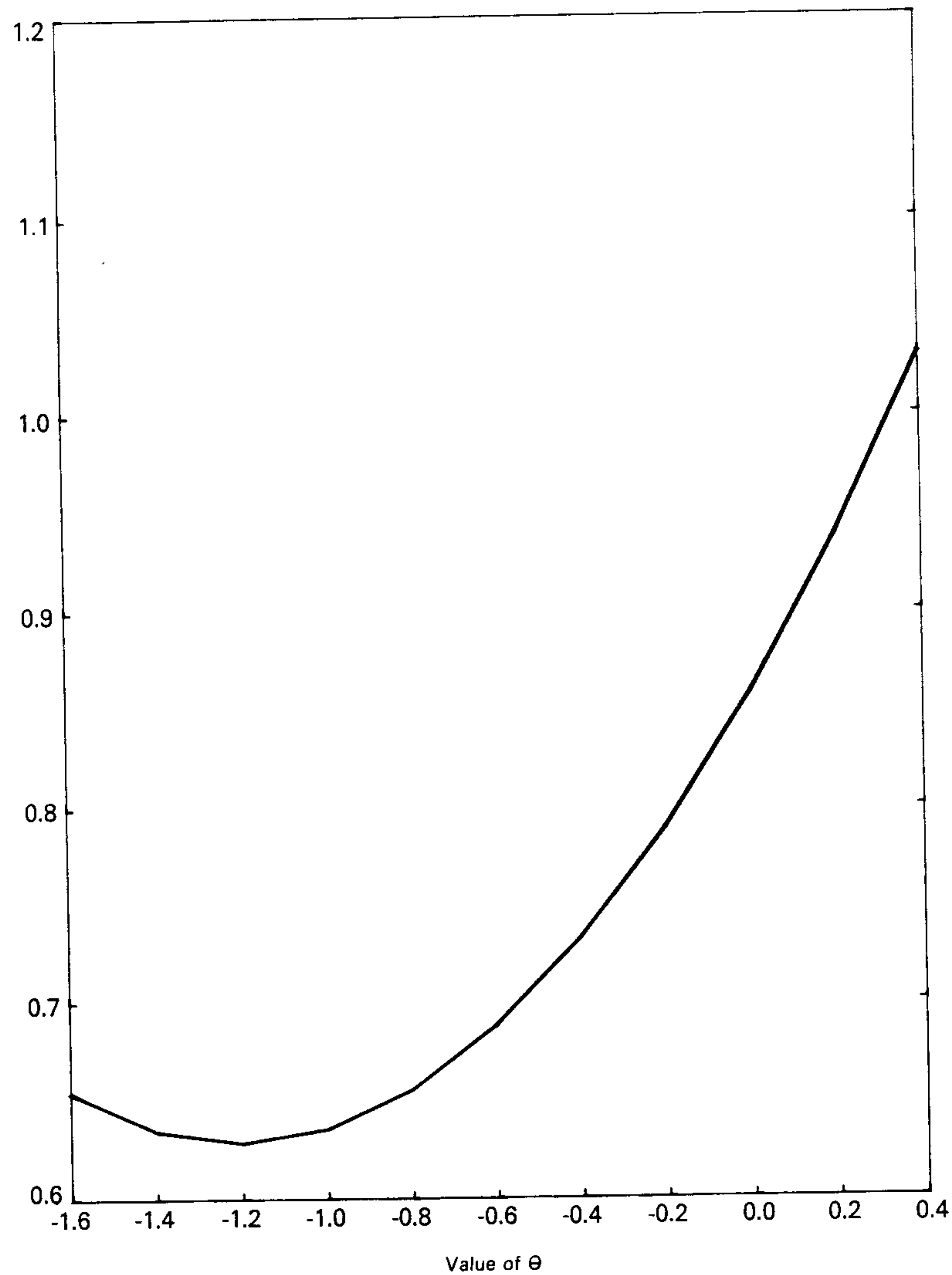


FIGURE 4

LOSS FUNCTION FOR MODEL C



The two simulations of this section emphasize that a decision about the optimal degree of monetary target flexibility must take into account the structure of the economy. Consequently, the choice of exchange rate, monetary, and labor market policies should be treated as a joint problem.

IV. Concluding Remarks

Since the beginning of the 1970s, many industrial countries have announced targets for the growth rates of their monetary aggregates in order to check inflation and inflationary expectations. An interesting policy problem that has arisen in connection with the use of monetary targets is the determination of the optimal degree of flexibility that should be adopted in attaining the targets. Both in the economic policy debate and in the theoretical literature, it is often argued that rigid quantitative money growth rules are suboptimal policies when stochastic disturbances affect the economy. In view of the large real exchange rate movements in the last decade, and the perceived costs associated with them, it has been suggested that monetary targets should aim at smoothing the fluctuations of the rate around the perceived equilibrium level in order to stabilize output and prices at their full employment levels.

In this paper, I develop an aggregated stochastic model which I then simulate in order to assess the optimal degree of monetary policy flexibility in Spain when disturbances mainly originate in labor and financial markets. I show that the model supports the policy choice of the country, namely, the monetary authorities in Spain should adhere rather strictly to their preannounced quantitative targets in the face of domestic disturbances. This conclusion, however, crucially depends on the specification of the authorities' loss function. I also show 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 separately from the characteristics of financial and labor markets.

Two final remarks on the limitations of this study and on possible extensions. First, I neglect the credibility problem. In the model, I 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 to the authorities' loss function along the lines indicated by Barro and Gordon (1983). Second, I assume that the probability of a real or a terms of trade shock is equal to zero. As this probability becomes larger, however, it is likely that the monetary authorities want to opt for a policy that reduces the persistence of wages. This persistence is increased, as I 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 the costs of credibility and the larger the probability that a real shock will occur in the near future.

Footnotes

*I thank Helen Junz, David Folkerts-Landau, Sebastian Edwards, Aris Protopapadakis, and the two discussants, Jeff Frankel and José Perez, for their helpful comments.

[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.

[2]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 the optimal exchange rate intervention (for example, see Turnovsky 1983, Taylor 1983, Aizenman and Frenkel 1984, Fisher 1984 and Marston 1982).

[3]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.

[4]When the real exchange rate appreciates $[(e_t - \bar{e}) - (p_t - \bar{p})]$ becomes negative.

[5]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, I obtain equation (4).

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

7/ The IMF, International Financial Statistics was the source of the data.

8/ Ministerio de Economía y Comercio (1981), contains a description of labor market developments before 1982.

9/ See Bank of Spain, Informe Anual 1982, pp. 121.

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

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

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