International Finance Discussion Papers

Number 291

Revised: July 1986

ANTICIPATED FISCAL CONTRACTION: THE ECONOMIC CONSEQUENCES OF THE ANNOUNCEMENT OF GRAMM-RUDMAN-HOLLINGS

by

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ABSTRACT

The announcement of a plan to cut the U.S. federal budget deficit through the Gramm-Rudman-Hollings legislation provides an excellent opportunity to examine the influence of expectations on economic behavior. This paper presents a small forward-looking macroeconomic model and simulates the effects of the announcement of a multistaged reduction in the fiscal deficit. Open and closed economy specifications are compared and contrasted to highlight the importance of international transmission mechanisms in macroeconomic adjustment. The results of the simulations are compared with the stylized facts of the U.S. macroeconomy over the period surrounding the passage of the Gramm-Rudman-Hollings legislation.

Anticipated Fiscal Contraction: The Economic Consequences of the Announcement of Gramm-Rudman-Hollings

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In recent years macroeconomic analysis has placed great emphasis on the influence of expectations. While arguments about the relative importance of expectational phenomena are complicated by the fact that it is difficult to assess precisely when and how expectations of a future event are formed as well as to assess the ex-ante weight placed on any of a variety of possible scenarios, it is clear that the influence of expectations of future developments may be a significant determinant of economic behavior.

Unfortunately, the influence of expectations can rarely be observed directly. Two episodes, both associated with recent changes in U.S. fiscal policy, provide economists with a rare opportunity to assess the importance of expectational effects and to refine our understanding of their influence on macroeconomic outcomes. The first episode was associated with the Economic Recovery Tax Act of 1981, the so-called Kemp-Roth tax cut. In the middle of 1981 a three-stage tax cut was announced that would be implemented 2, 6, and 10 quarters after the announcement. The second episode is associated with the Budget Balance and Deficit Control Act of 1985, better known as the Gramm-Rudman-Hollings bill (henceforth GRH), which was enacted on December 11, 1985. The GRH bill announces a five-stage fiscal contraction to be implemented over the period from 1986 to 1991.

Although there is currently considerable variation in the degree of market participants' confidence that the executive and legislative branches of the federal government will adhere to the GRH deficit reduction schedule, the bill appears to reflect a serious effort to reduce the fiscal deficit in the years ahead. It is as clear-cut an example of an announcement of future policy at specified dates as we have ever observed in the United State. It therefore seems appropriate, in light of the announcement of GRH, to investigate the macroeconomic consequences of anticipated fiscal contraction, or at very least the short-run macroeconomic consequences of announced fiscal contraction.

This paper examines the implications of an anticipated fiscal contraction in a forward-looking open economy simulation model of the U.S. macroeconomy and to compare the predictions of the model with the stylized facts surrounding the announcement of the GRH bill. The analysis presented here is similar to that contained in a companion paper by Branson, Fraga and Johnson (1985) on the implications of the Economic Recovery Tax Act of 1981, in which an anticipated change in fiscal policy was also the focus of analysis.

The paper is organized as follows. Section I discusses the buildup to the GRH bill, the provisions of the legislation, its timing, and the stylized facts characterizing the reaction of financial markets and foreign exchange markets to the bill's announcement in the fourth quarter of 1985. Section II presents a simple closed economy simulation model with a term structure of interest rates and examines a variety of policy experiments including both an unanticipated and an anticipated fiscal contraction, an increase in the growth rate of money, and an increase in the level of the money stock. Section III extends the model to take account of the foreign sector and then compares the simulation of closed and open economies in response to: 1) an anticipated fiscal contraction and 2) an increase in the growth rate of money, to illustrate the influence of the international economy on the macroeconomic adjustment process. Section IV then uses the open economy model to simulate two scenarios which have been discussed in conjunction with the GRH bill; an anticipated staged reduction in the fiscal deficit and an anticipated fall in the fiscal deficit coupled with a temporary increase in the rate of money growth. The concluding section discusses the shortcomings of the model developed in this paper and suggests possibilities for future research.

I. THE GENESIS OF GRAMM-RUDMAN-HOLLINGS

The basis for the enactment of the GRH legislation, and the reaction of financial markets to its announcement, can be illuminated by an examination of the recent behavior of the U.S. economy. Tables 1 and 2 give some background on U.S. economic developments since the beginning of the decade. From Table 1 one can observe the steep increase in real interest rates and the substantial real appreciation of the dollar over that period. At the same time, the government budget grew to over 5 percent of GNP and the current account deficit increased steadily, ultimately exceeding $100 billion in 1985. Table 2 highlights the dispersion in the performance of several sectors in the economy through the end of 1984. The general pattern reveals reasonable aggregate growth over the period but wide variation across sectors as tradeable goods and interest-sensitive sectors were adversely affected.

The difficulties associated with divergent sectoral performance in the U.S. economy may have combined with several other influences to raise the costs of maintaining a policy mix that perpetuated the U.S. external imbalance. As dissatisfaction grew in some sectors, protectionist pressures and pressure for greater monetary accommodation appeared to increase. While the U.S. Treasury sought to minimize the costs of borrowing large sums by introducing innovations designed to make U.S. securities more attractive abroad, such as special foreign targeted issues and the elimination of the withholding tax on interest payments to foreigners, concern mounted within the policymaking community over the willingness of foreign residents to continue to accumulate dollar-denominated securities and the possible consequences

TABLE 1
NATIONAL INCOME FLOWS, INTEREST RATES, AND EXCHANGE RATES

YEAR	CURRENT ACCOUNT DEFICIT (billions) $	EXCESS DOMESTIC SAVINGS (billions) $	TOTAL BUDGET DEFICIT (billions) $	REAL LT INTEREST RATE (%)	REAL EXCHANGE RATE ($/composite)	RATIO BUDGET DEF. TO GNP (%)
1979:1	-3.4	-15.4	-22.2	0.5	1.01	0.4
1979:2	4.3	-17.4	-20.1	-.2	0.99	0.2
1979:3	-2.7	-14.6	-12.9	0.3	1.03	0.7
1979:4	4.6	-15.6	2.1	1.6	1.01	1.1
1980:1	2.9	-7.3	7.5	3.6	1.00	1.5
1980:2	-7.9	43.0	38.1	2.1	0.99	2.5
1980:3	-21.5	61.3	43.3	1.9	1.02	2.8
1980.4	-3.5	37.1	33.9	3.0	0.99	2.5
1981:1	-13.6	9.5	9.7	2.5	0.95	1.6
1981:2	-1.8	5.1	11.4	2.9	0.88	1.7
1981:3	-2.9	19.5	23.3	5.1	0.83	2.0
1981:4	-9.3	69.0	62.4	4.4	0.87	3.2
1982:1	-2.5	84.6	73.8	5.3	0.83	3.5
1982:2	-11.1	91.8	77.6	6.4	0.80	3.6
1982:3	18.9	112.4	122.5	5.8	0.76	5.3
1982:4	20.9	147.8	166.8	5.2	0.76	6.8
1983:1	4.1	140.1	150.0	6.6	0.78	5.8
1983:2	30.9	83.5	123.8	6.4	0.76	5.1
1983:3	41.5	96.7	127.0	8.1	0.74	5.4
1983:4	59.1	75.0	122.2	8.4	0.74	5.2
1984:1	77.7	25.5	93.8	8.3	0.73	4.5
1984:2	85.0	5.3	97.3	9.6	0.72	4.4
1984:3	119.4	20.9	116.0	9.0	0.68	4.8
1984:4	81.5	24.1	126.8	7.8	0.66	5.1
1985:1	97.0	20.1	99.4	7.8	0.63	2.8
1985:2	110.8	50.8	151.9	7.2	0.64	4.3
1985:3	121.8	15.7	144.5	7.2	0.68	4.0

Data from Citibase and IFS tapes. The real long term interest rate is the net of the long term (20 year) bond rate and inflation. The real exchange rate series (IFS) is based on relative normalized unit labor costs. A decrease in the real exchange rate represents an appreciation. The Total Budget Deficit series include the federal balance as well as the state and local balances. The CAB is from the National Income and Products Accounts and is constructed when net foreign investment is added to net capital grants received by the U.S. Domestic Investment in the U.S.

Table 2

Percent Change in Production, Imports, and Exports for Selected Sectors[1]

	Industrial Production		Imports [2]	Exports [2]
	80/4 to 84/4	82/4 to 84/4	82/4 to 84/4	82/4 to 84/4
Total Manufacturing	12.5	24.3	59.6	16.0
Ordinance	36.8	19.3	n.a.	n.a.
Motor vehicles and parts	33.6	61.2	57.1 [3]	-4.5 [3]
Electrical Machinery	29.5	35.1	76.4	18.3
Nonelectrical Machinery	14.2	33.8	79.0	6.2
Textile mill Products	0.1	9.5	57.5	-3.0
Leather and Products	-18.1	-1.0	57.0	n.a.
Iron and Steel	-27.4	48.4	50.5	-16.1
Mining	-7.3	7.0	n.a.	n.a.
Real GNP	12.4	12.3		

1 I would like to thank Peter Isard for letting me use this chart which comes from his work at the Federal Reserve Board.

2 Imports and exports are measured in current dollars; unit value deflators are not available by industry. From 1982Q4 to 1984Q4, the unit values of non-oil imports and nonagricultural exports each increased by about 2 percent.

3 Excludes trade with Canada

of an abrupt change in confidence in the dollar. At the same time, a gradual consensus appeared to emerge among policymakers, academics and businessmen that the high real interest rates and the overvalued dollar were related to the unprecedented federal budget deficit.[1] Foreign governments also urged the United States to reduce its fiscal dissaving in order to alleviate the interest burden associated with developing country debt and to stimulate growth in other industrial countries, particularly in Europe where unemployment has been quite substantial and capital formation has been sluggish.

By the end of the third quarter of 1985, the multiple pressures for fiscal reform came to a head. The meeting of finance ministers and central bank governors from the Group of Five countries in late September emphasized the desirability of coordinating fiscal policies among leading industrial countries, with particular emphasis on the desirability of fiscal contraction in the United States. At the same time it was announced that efforts would be made by the monetary authorities of the G5 countries to reduce the foreign exchange value of the dollar. Shortly thereafter, legislation was proposed in Congress by Senators Gramm, Rudman, and Hollings to reduce the federal government deficit over a period of 6 years. On December 11, 1985 Congress passed the GRH bill, which set out the following schedule for reduction of the budget deficit:

Fiscal Year	Target Deficit ($ billion)
1986	172
1987	144
1988	108

1989	72
1990	36
1991	0

The movements in asset prices during the period of buildup to and enactment of GRH can be seen in charts 1a, 1b, and 2, which exhibit U.S. short-term and long-term interest rates, the term structure of interest rates, and the weighted average exchange value of the dollar from the beginning of 1985 through the early part of 1986. It is here in the asset markets that many economists believe that new information is most quickly incorporated into pricing decisions. Chart 1a shows that the long rate of interest fell substantially in the fourth quarter of 1985 and the first few weeks of 1986. This is also reflected in chart 1b, which shows the term structure, measured here as the difference between the 30-year and 6-month rates on U.S. government securities. The 30-year U.S. government bond rate fell nearly 150 basis points between late July 1985 and January 1986. In particular, the bond rate fell 66 basis points during December while the short rate rose 8 basis points.

Chart 2 shows that the reduction in the exchange value of the dollar began in late February of 1985 and continued through the first few weeks of 1986. The G5 announcement on September 22 produced the largest single drop in the exchange rate but the tendency was for the dollar to fall throughout the period. It might be argued that the need to bring the dollar down to diffuse protectionist pressures was well known in early 1985 but the method of inducing depreciation was still uncertain. Under that scenario, interest rates, particularly long-term

INTERESTING RATES IN 1985 AND EARLY 1986

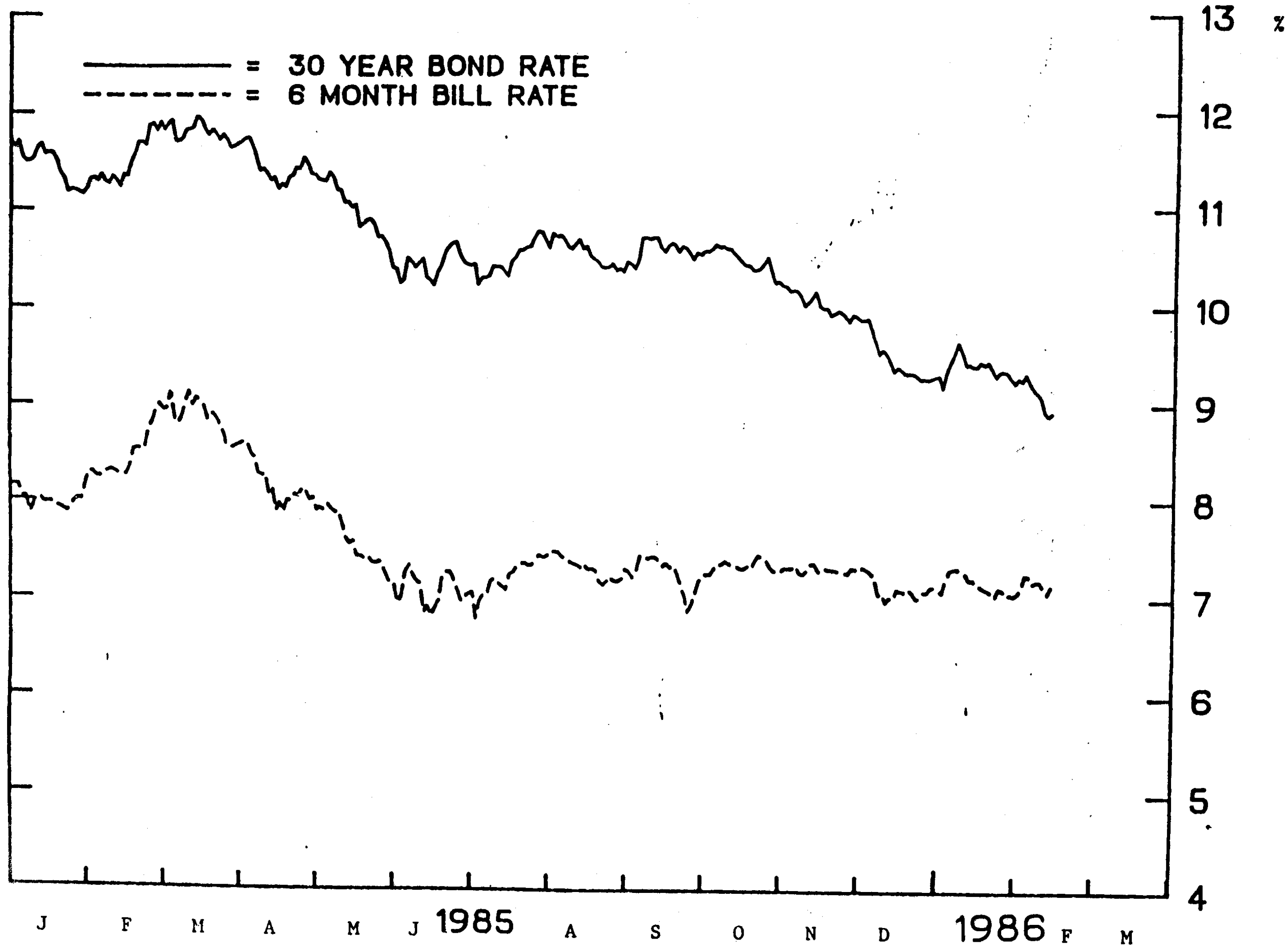


CHART 1A

TERM STRUCTURE IN 1985 AND EARLY 1986

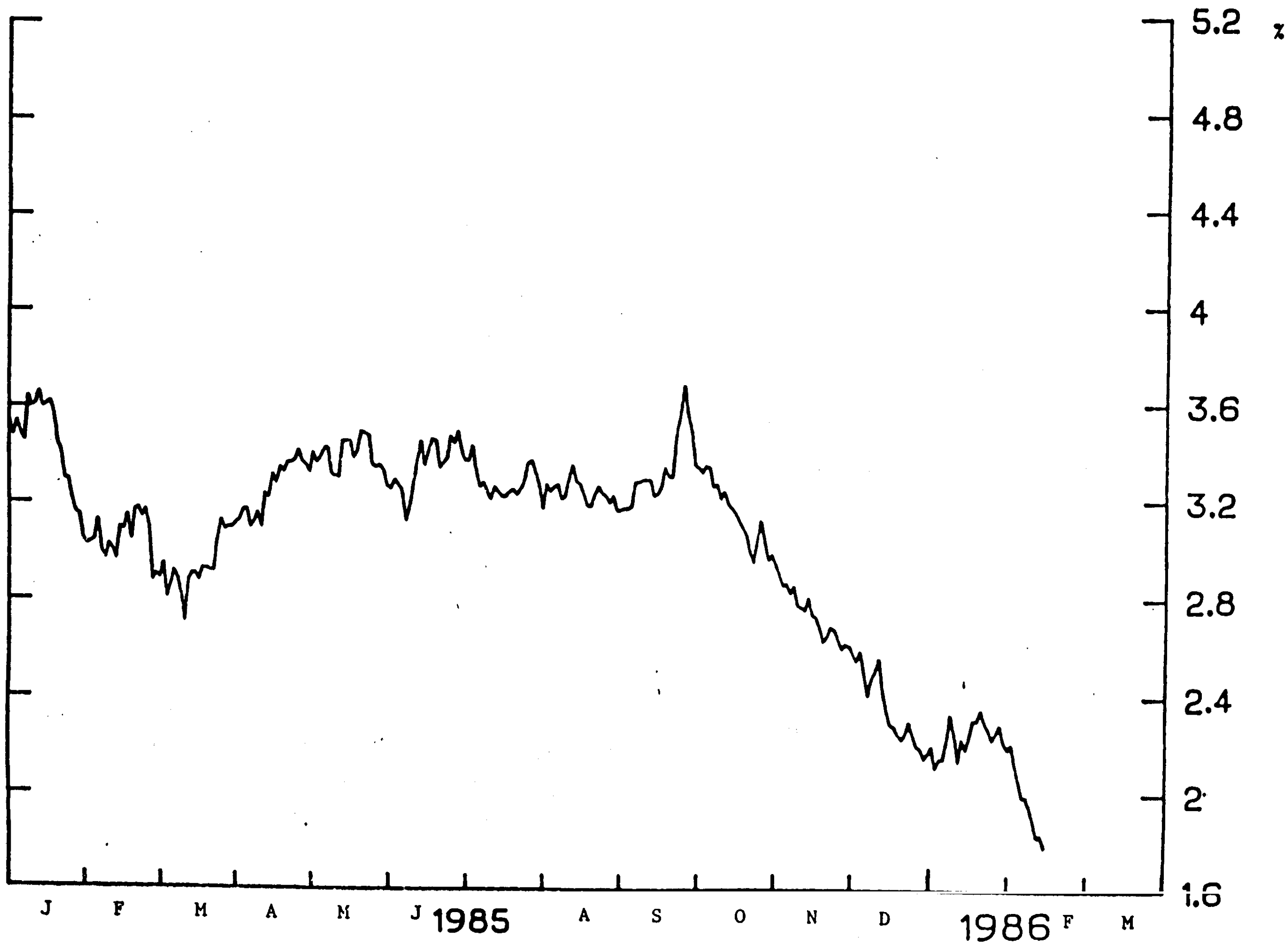


CHART 1B

WEIGHTED AVERAGE EXCHANGE RATE
(INCREASE IS AN APPRECIATION)

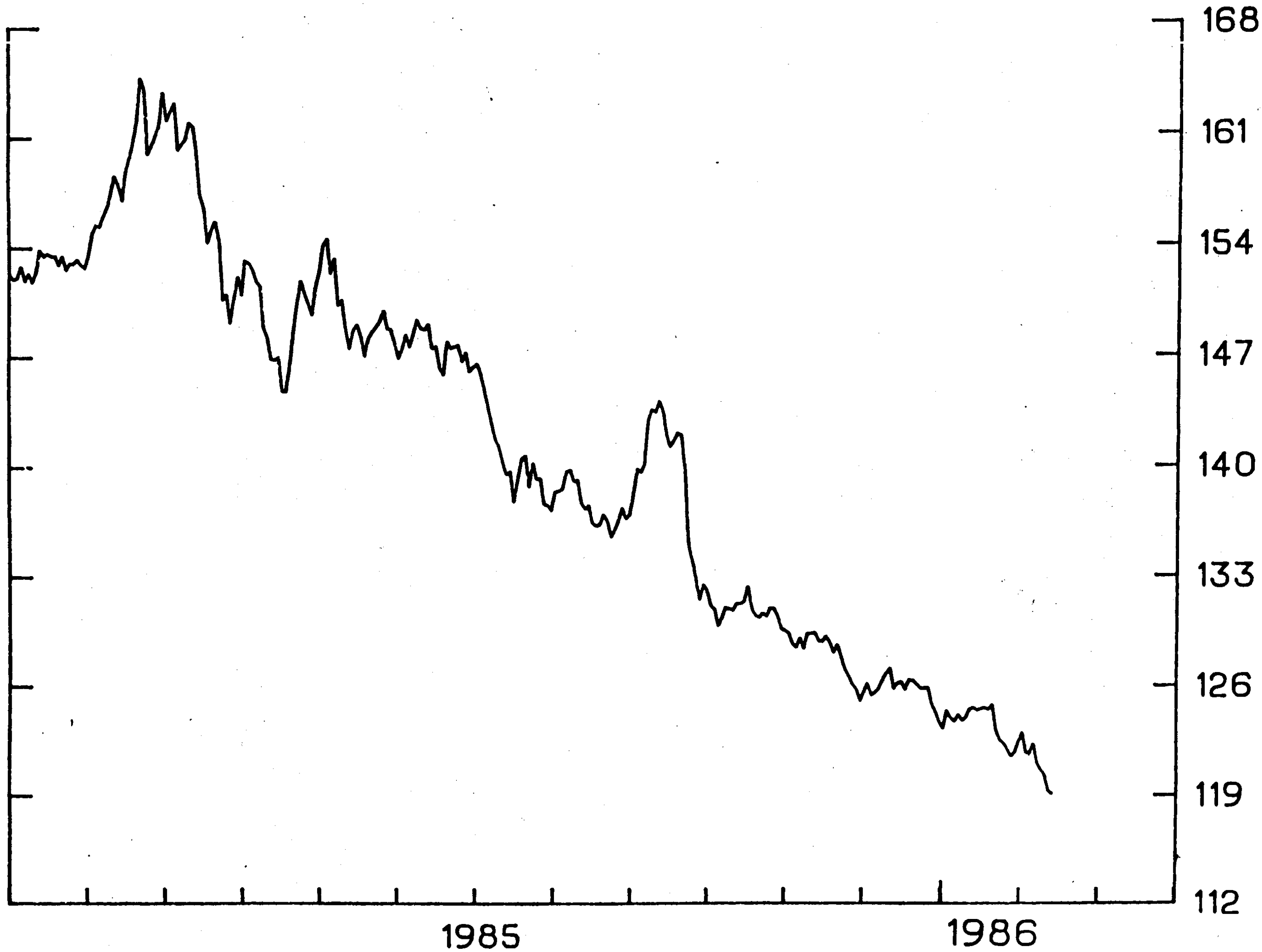


CHART 2

interest rates, might have remained high as the risk premium associated with the expected future supply of government bonds was replaced by an expected inflation premium by those investors fearing that an increase in the rate of money growth would be the instrument chosen to bring the dollar down. Following this line of argument, it was only after the G5 announcement and the passage of GRH that market participants were convinced that fiscal contraction, rather than an increase in money growth, would be the instrument chosen to bring the dollar down in order to avert an escalation of impediments to international trade. At that time, interest rates could fall along with the dollar as it was no longer necessary to fear renewed inflation as the inevitable cost of stemming the tide of protectionist pressure.

In the simulation exercises that follow, the announcement of a multistage future fiscal contraction will take place at one particular moment. In other words, GRH will be treated as an unanticipated shock to expectations about future policy, where all participants in financial markets and foreign exchange markets will be assumed instantly to comprehend the entire future of fiscal policy and its implications for asset prices. This is clearly an oversimplification of the way in which information diffuses through the economy. While the G5 meeting in September and the passage of GRH may have been the most important events that convinced the markets of the altered trajectory of U.S. macroeconomic policy, debate over budget reform was ongoing throughout the period and most likely affected the price of financial instruments well before these two key events.

In summary, the stylized facts of the period surrounding the GRH legislation are: 1) a sharp flattening of the term structure of interest rates, principally because of a fall in the long-term rate of interest, during the fourth quarter of 1985 when the term structure declined from 320 basis points to 210 basis points; and 2) an acceleration in the rate of decline of the dollar following the G5 announcement and the enactment of GRH. Let me now turn to a small macroeconomic model to illustrate the logic of what I believe underlies the behavior revealed by the data above.

II. THEORETICAL BACKGROUND

Before turning to the simulation exercises below I will present a description of the model. This specification envisions a macroeconomic environment where financial markets respond very quickly to new information and clear very quickly while goods and factor markets adjust to disequilibrium more gradually. In what follows I will make the extreme assumption that financial markets, including foreign exchange markets, adjust to new information instantaneously, while the price setting behavior in goods markets is governed by slow adjustment. First I will present a theoretical model that incorporates this behavioral hypothesis and then illustrate the implications of monetary and fiscal policy changes under this specification in a simple IS-LM framework that draws extensively on the work of Miller (1984) and the joint work of Branson, Fraga, and Johnson (1985). In the next section I will shift to a simulation analysis using this model and examine a variety of policy changes and their macroeconomic consequences.

Consider the system shown in equations 1-6 below.

<u>Equations</u>	<u>Steady State Values</u>
(1) $d = ay + \mu f - \delta(R-h)$	$d = y = \bar{y}$
(2) $r = (\tau y - m)/\varepsilon$	$r = R = \hat{M} + ((a-1)\bar{y} + \mu f)/\delta$
(3) $\mathring{y} = \phi(d - y)$	$h = \mathring{p} = \hat{M}$
(4) $E\hat{R} = R - r$	$\bar{m} = \tau\bar{y} - \hat{M} - ((a-1)\bar{y} + \mu f)/\delta$
(5) $\mathring{h} = \pi(\hat{M} - h)$	
(6) $\mathring{p} = h + \Phi(y - \bar{y})$	

y is defined as the log of real aggregate output.

d represents the log of real demand.

R represents the rate of interest on consols.

r is the short-term rate of interest.

h represents inflationary expectations.

f represents a measure of the real fiscal deficit as a fraction of private demand.

m represents the log of real balances.

p is the log of the price level.

$\bar{y}$ is the log of full employment output.

M is the nominal money stock.

E is the expectations operator.

"$\mathring{x}$" denotes the derivative with respect to time of variable x.

"$\hat{x}$" denotes the percentage change in variable x.

"$\bar{x}$" denotes the steady state value of variable x.

$\tau, \varepsilon, \pi, \phi, \Phi, \delta, \mu,$ and a are parameters.

Equation 1 shows demand as a function of the long-term real interest rate, fiscal stimulus, and income.[2] The constituents of demand, whether they represent consumption or investment, are modeled as a function of current income rather than as a function of wealth or some other forward-looking proxy for purchasing power. This is clearly an important assumption for the analysis of fiscal policy changes. If consumers were assumed to take into account all future tax liabilities, then a shift from tax financing to debt financing, which would increase f in this model, would be fully offset by increased saving to provide for future tax payments. This case is developed by

Barro (1974). For several reasons, including informational imperfections, liquidity constraints, and uncertainty regarding the remaining years of life (see Blanchard (1985)), I believe that the neutrality assumption is too strong.

The specification of the long-term real interest rate in the aggregate demand relationship is of great importance in evaluating the simulation results below. The basis for this specification is that many projects are of an extended duration, and the cost of borrowing for durable goods should either reflect the expected sequence of short-term rates that would be applicable to a continuous rollover of the debt or it should be a rate that is applicable for the term of the project. Secondly, the applicable borrowing cost is the real rate rather than the nominal rate of interest. R-h is one measure of the real rate and its specification as the expected long-term real rate is constructed to be consistent with the vision that goods markets are myopic. Projections of expected inflation, h are conditioned on past rates of money growth and R is assumed to be determined in financial markets. An important implication of this specification is that "news" will change the real long rate of interest as the long-term nominal rate jumps and the expected rate of inflation does not change instantaneously.

Equation 2 is an inverted LM equation in log form solved for the short-term rate of interest. It shows the short rate to depend positively on transactions demand, which is represented by output, and negatively upon the supply of the real transactions medium, n. The short rate represents the opportunity cost of holding the transaction medium, and ε represents the semi-elasticity of the demand for real money balances with respect to the short-term rate of interest. τ

represents the income elasticity of the demand for real balances. It will be assumed throughout the analysis that the short rate clears the money market continuously so that, for any given level of real balances and economic activity, r will be instantaneously determined.

Equation 3 is the differential equation governing the gradual adjustment of output in response to an excess of demand over output. A more elaborate specification would reflect the consumer's problem of the optimal adjustment of desired spending, d, to actual spending, y, or would be developed from the microeconomic foundations of inventory dynamics.[3] But for the sake of simplicity and to preserve the focus on expectational aspects of multi-market behavior I have chosen to rely on this simple specification.

Equation 4 is an arbitrage relation between the holding period return on long-term bonds and the short-term interest rate. It is derived as follows:

Let p_b be the consol bond price per dollar of coupon payment.

$$p_b = 1/R.$$

Then the holding period yield = capital gain + yield.

$$= (d(p_b)/dt)/p_b + R.$$

$$d(p_b)/dt = d(1/R)/dt$$

$$= (-1/R^2)*dR/dt.$$

Thus, equating the holding period yield on the long bond to the yield on short-term instruments, r, implies;

$$r = R - (dR/dt)/R.$$

Or equivalently, $\hat{R} = R - r$.

Equation 5 represents an adaptive adjustment mechanism for normal or long-run inflationary expectations depending upon the difference between the rate of money growth and the current expected rate of inflation. It reflects an assumption that inflationary expectations are only significantly altered by a change in the growth rate of money after the altered rate of money growth has persisted for some time (See Dixit (1980)). As money growth increases, $\hat{M}$ rises above h and $\mathring{h}$ becomes positive. The sensitivity of economic agents to changes in the rate of money growth is governed by the parameter π. In the simulations that follow I will assume that π is large so that changes in money growth induce a rapid, but not instantaneous, adjustment in inflationary expectations. Note that this assumption implies that financial market participants, who have perfect foresight, incorporate goods markets participants' systematic errors in predicting expected inflation in the short run into their expectation formation when jumping onto asset price saddlepaths. Equation 6 is an expectations-augmented Phillips curve.

Also shown are the steady state solutions to the system. In the steady state, real balances are constant so inflation, $\mathring{p}$, is equal to the rate of money growth, $\hat{M}$. Inflationary expectations, h, are equal to the rate of money growth according to equation 5. Output is equal to $\bar{y}$, and both the long and short rates of nominal interest are equal to $\hat{M} + (\mu f - (1-a)\bar{y})/\delta$.

Before examining the simulation results produced by the model, let us use graphical methods to illustrate its workings in response to an anticipated fiscal contraction. First I will examine the stability of the system in R-y space and then conduct the policy exercise. This analytic apparatus, which was developed through joint efforts by Miller (1984) and Branson, Fraga, and Johnson (1985), is adapted for use in this paper to provide a more intuitive grasp of the workings of this model than can be seen through simulation results alone.

Figure 1 shows a dynamic IS-LM diagram with the directions of motion as indicated by the arrows. The IS curve is defined as the $\mathring{y}$=0 locus in R-y space and has slope $-(1-a)/\delta$. Above the IS curve, at a given level of y, the higher interest rate reduces demand and d is less than y. This causes output to fall.

The LM curve defines the equilibrium in r-y space according to equation 2 and also defines the $\hat{R}$=0 locus since it is assumed that the economy is always on the LM curve and that the $\hat{R}$=0 locus in R-Y space coincides with the r-y locus because $\hat{R}$=0 only when R=r, according to equation 4. Above (below) the LM curve R is greater (less) than r and $\hat{R}$ is therefore increasing(decreasing).

Let us now turn to the graphical analysis of an anticipated fiscal contraction. For the moment let us suspend the use of equations 5 and 6 and hold $\mathring{p}$, the rate of inflation, and h, the expected rate of inflation, constant at rate $\hat{M}$.

In figure 2, an anticipated fiscal contraction is shown. At time $t=t_0$ the fiscal contraction is announced for implementation at a later time $t=t_1$. At $t=t_0$ the long rate jumps downward from R_0 to R_1. Thereafter the long rate of interest continues to fall and output rises along an unstable branch which will intersect the new saddlepath, RR, at the time $t=t_1$ when the fiscal contraction is implemented.[4] Thus the anticipated fiscal contraction produces an anticipatory expansion between t_0 and t_1 prior to the decline in output that accompanies the

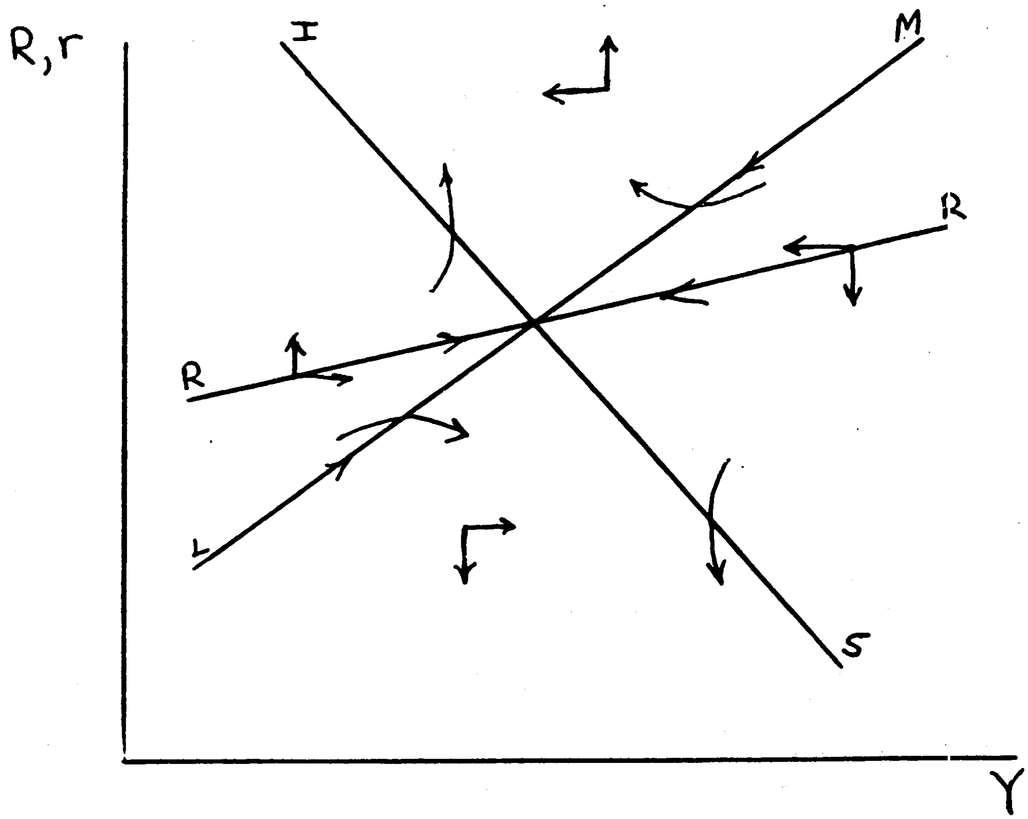


Figure 1 : Dynamics and Stability

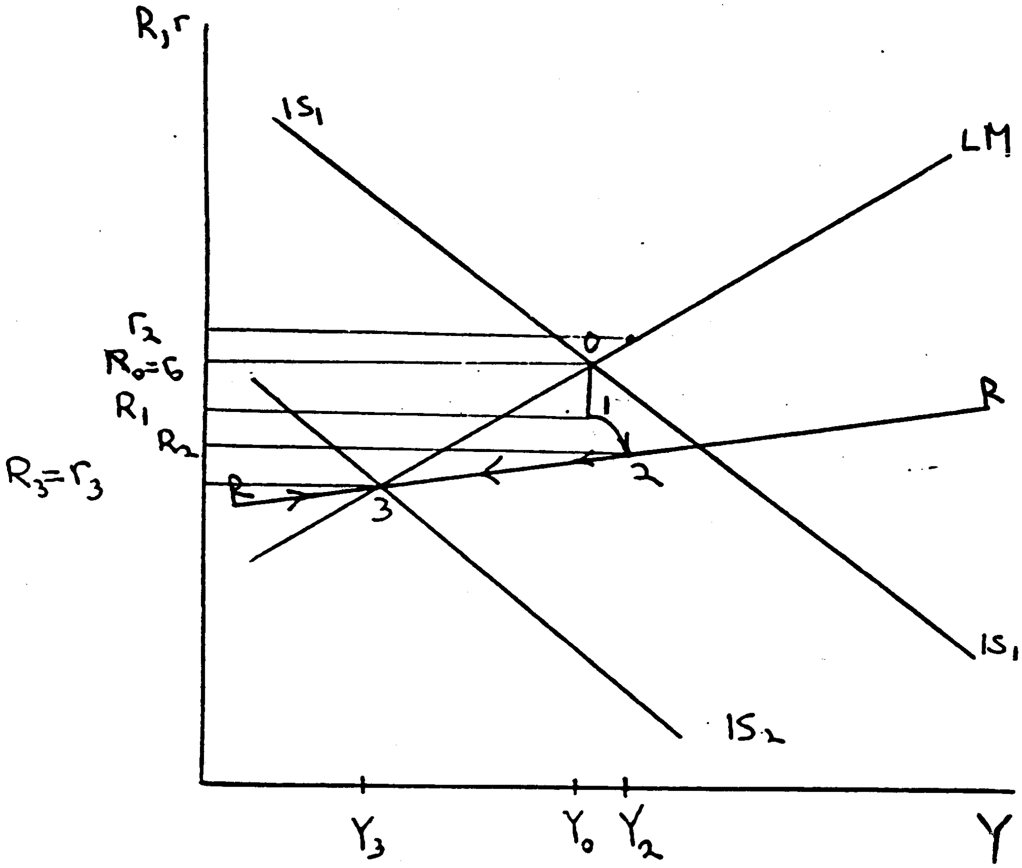


Figure 2 : Anticipated Fiscal Contraction

future decline in fiscal stimulus. At the same time, the short-term rate moves along the LM curve at all times as y and m determine the value of r, which clears the money market as shown by equation 2 above. Upon announcement r does not move because output and real balances are fixed. It then rises to point r_2 before falling back towards the equilibrium interest rate $r_3(=R_3)$. Thus the term structure, as measured by the difference between the long and short rates of interest, inverts upon the announcement of the fiscal contraction, at time t_0. It then becomes more steeply inverted until time t_1 when the fiscal cutback is implemented, before narrowing back to zero in the steady state.

The peculiar "anticipatory expansion" produced by the anticipated fiscal contraction in this model is the result of the assumption that goods markets are not forward-looking and therefore do not react to the future implications of a reduction in the fiscal deficit while financial market participants do react to the information instantly and incorporate the information into their pricing decisions.[5] In this example of an anticipated fiscal contraction in a closed economy, the realization that the fall in the fiscal deficit will reduce interest rates in the future informs financial market participants that the yield on consols which prevailed at the instant just prior to the announced fiscal contraction is higher than the yield that will be available on a perpetual sequence of short-term bonds. As a result, the consol price is bid up instantly upon announcement of the fiscal contraction. The goods market then receives the information that the cost per dollar of borrowing for projects of any duration has fallen as R drops. At the same time that demand increases because one moves along the demand schedule as the interest rate falls, goods demand does not shift in response to the future implications for firms and consumers of the upcoming reduction in fiscal stimulus. Thus the reduction in interest rates stimulates demand and causes economic expansion prior to the reduction in fiscal stimulus. It is only after the fiscal contraction is implemented at time t_1 that the goods demand function falls, reflecting the effects of the fiscal contraction on income that in turn affects consumption and investment spending.

This preliminary exercise may yield a more tangible feel for the underlying logic of the modeling approach used here. Let us now turn to simulation methods to examine the effects of several types of policy changes before broadening the model to include the elements of structure that reflect the influences of international trade in both goods markets and financial markets.

SIMULATION ANALYSIS OF THE CLOSED ECONOMY

This section reports the results of the simulation of equations 1-6 under a variety of different policy experiments, including a change in the money growth rate, a change in the money stock, and both an anticipated and an unanticipated change in fiscal stimulus. Before turning to those results let us discuss the values of the parameters chosen for the simulations.

The parameters fall into two groups. First are the structural parameters. These include the estimates of the magnitudes of the sensitivity of the various economic variables to one another, and plausible values can be chosen with some confidence through reference to econometric evidence. The second group consists of adjustment speeds in equations 3 and 5. Choosing them can be aided by the following procedure.

For an equation of the form $\mathring{x} = -\sigma(x-\bar{x})$, the solution is of the form,

$$x(t)-\bar{x} = (x(t_0)-\bar{x})*e^{-\sigma(t-t_0)},$$

where $\bar{x}$ is the steady state value of x.

If one desires to set an adjustment speed so that in a period of time equal to $t-t_0$ the initial disequilibrium is reduced to the fraction z of its initial value, where $z = (x(t)-\bar{x})/(x(t_0)-\bar{x})$, then the adjustment speed, σ becomes

$$\sigma = -\ln(z)/(t-t_0).$$

For example, when one half of the initial disequilibrium is closed the relationship becomes

$$\ln(.5) = -\sigma(t-t_0).$$

As a result, in an annual model one could decide that one half of the initial disequilibrium would be eroded by market adjustment in a year. Setting $t-t_0=1$ yields

$$\sigma = -\ln(.5) = .69$$

While this does not give one an ironclad scientific means to derive adjustment speeds it does facilitate choosing parameters that are within a reasonable range.

The adjustment speed parameters chosen for this section's simulation exercises are: $\phi=1$, and $\pi=8$. A value of 8 for π implies rapid adjustment of inflationary expectations to changes in the rate of money growth. It implies that market participants adjust their expectations of inflation in response to a change in the growth rate of money by ninety percent of the difference between the former and new rate of money growth in a little over a quarter. The "half life" of a disturbance to aggregate demand is set to slightly less than three quarters;

$$t-t_0 = -\ln(.5)/1 = .69$$

The income elasticity of the demand for money, τ, is set to unity and the semi-elasticity of money demand with respect to the short-term rate of interest, ε, is set to 2. The sensitivity of aggregate demand to changes in the fiscal deficit, μ, is set to unity and the semi-elasticity of aggregate demand with respect to the long-term real rate of interest, δ, and the sensitivity of aggregate demand to variations in income are both equal to .80. The parameter Φ, which measures the sensitivity of the rate of inflation to a deviation of output from its steady state level, is set equal to .5.

Using the model outlined above in conjunction with the computer program "JAB" (See Johnson (1985), and Austin and Buiter (1982).) we can conduct a series of simulation experiments to illustrate the response of the system to a variety of exogenous policy changes. In this section I will examine the dynamic response of the model to the following policy experiments: 1) An unanticipated increase in the rate of money growth, 2) an unanticipated increase in the money stock. 3) an unanticipated fiscal expansion, and 4) an anticipated fiscal expansion.

Figures 1.1 and 1.2 illustrate the results of an unanticipated increase in the rate of money growth from 6% to 10%. The model is assumed to be in steady state equilibrium with 6% money growth at time t_0 when the increase is implemented. Figure 1.1 exhibits the behavior of interest rates and inflation. When the money growth rate change is announced and implemented the long rate jumps up nearly 250 basis points reflecting the eventual incorporation of a four percent inflation premium into the steady state interest rates. The short rate does not jump because neither real balances nor output change discontinuously with a money growth rate change. The short rate begins declining gradually, reflecting a diminished transactions demand for money resulting from the decline in interest-sensitive expenditure following the jump in long rates. The sharp initial increase in real long-term rates does not persist because economic agents quickly revise their inflationary expectations according to equation 5. In the longer term both the long and short rates rise from 8 to 12 percent reflecting the increase in inflation produced by faster money growth. Figure 1.2 shows that after the abrupt decline

INTEREST RATES AND INFLATION
CLOSED ECONOMY: MONEY GROWTH RATE INCREASE

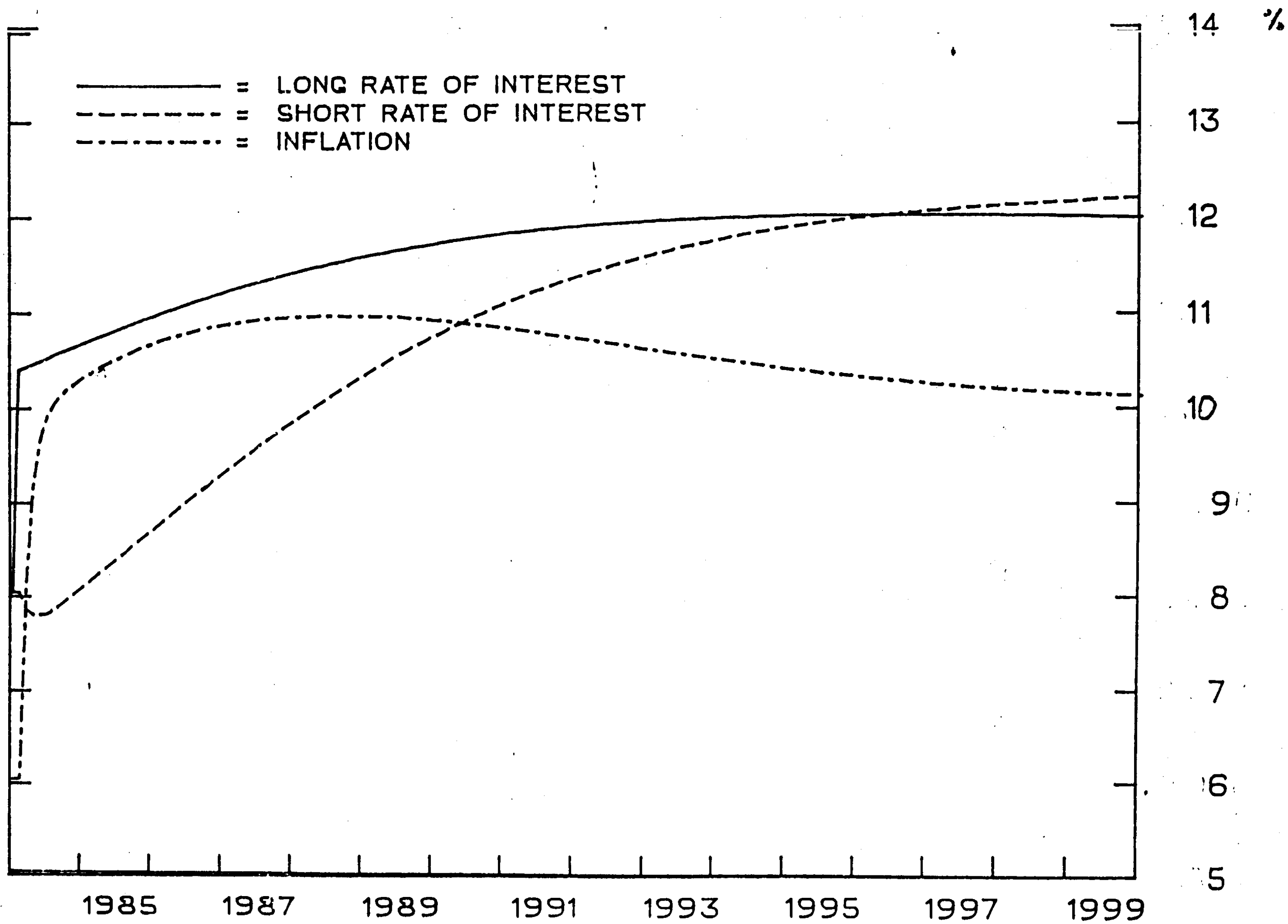


FIGURE 1.1

OUTPUT AND AGGREGATE DEMAND

CLOSED ECONOMY: MONEY GROWTH RATE INCREASE

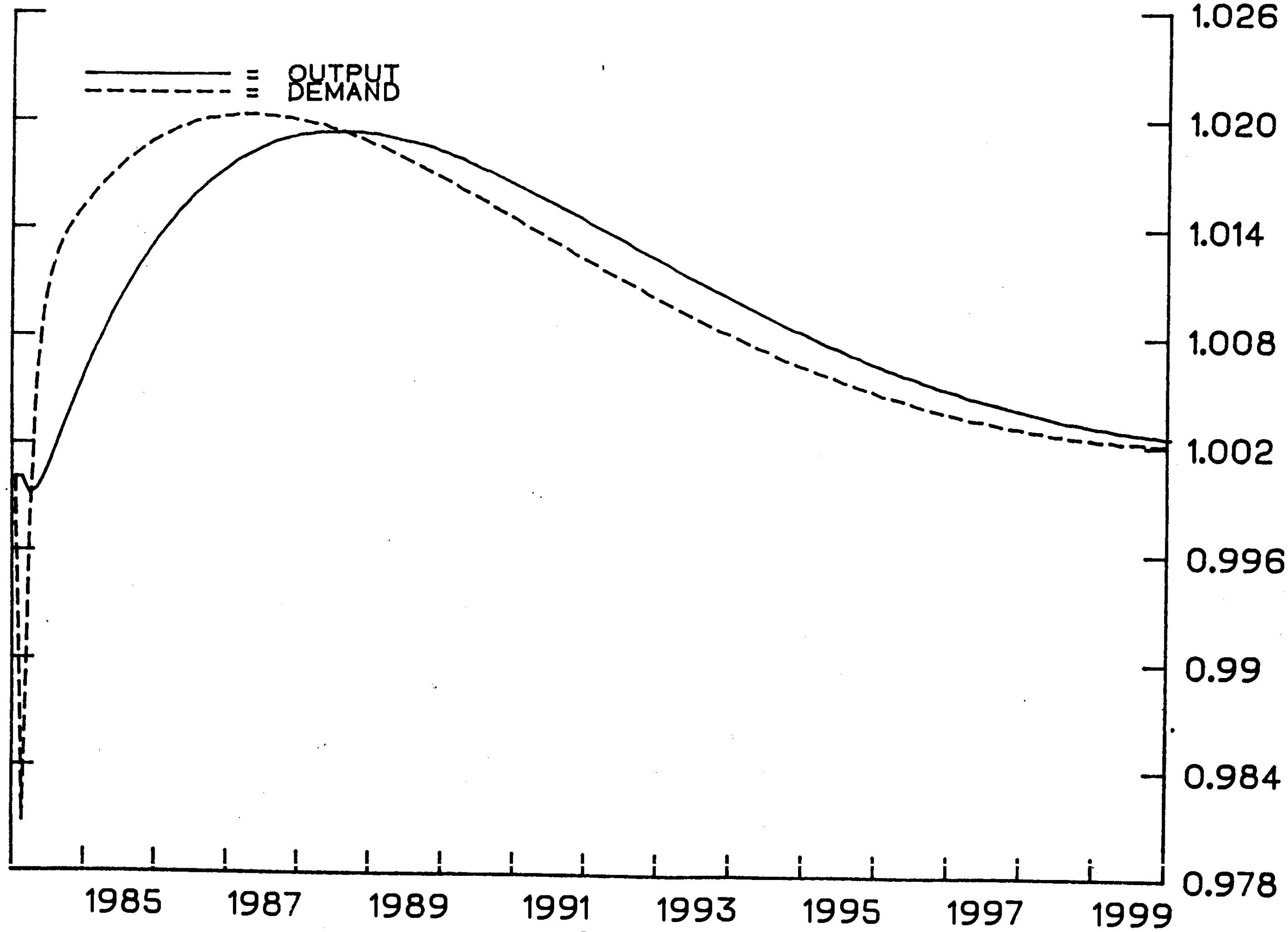


FIGURE 1.2

in demand upon announcement output rises rapidly for nearly 12 quarters as real long-term rates fall. Thereafter real long-term rates increase gently as economic activity eases back to its steady state level.

A second characterization of a monetary policy change is a change in the stock of money that leaves the growth rate of money unaltered. Figures 2.1 and 2.2 exhibit the results of a one time 5% unanticipated increase in the money stock. Figure 2.1 shows that unlike the case of a money growth rate change, an increase in the money stock causes the short rate to jump as the change is implemented. In addition the long rate jumps downward reflecting the lower expected sequence of short term rates resulting from the higher quantity of real balances. In the longer term both the short and long rates return to their steady state level of 8%. Inflation increases transitorily because of the excess demand generated by the initial fall in interest rates. Figure 2.2 shows the jump in demand resulting from the fall in long rates and the transitory increase in economic activity.

Figures 3.1, 3.2, 4.1 and 4.2 show the results of an unanticipated and an anticipated fiscal contraction of the same size. The two experiments differ only in that the anticipated fiscal contraction is implemented three years after it is announced whereas the unanticipated fiscal contraction is implemented immediately. A comparison of Figures 3.1 and 4.1 reveals that the fall in the long rate of interest is much greater when the fiscal contraction is unanticipated. This is not surprising. The more striking result is the qualitative difference in the behavior of short-term interest

INTEREST RATES AND INFLATION
CLOSED ECONOMY: MONEY STOCK INCREASE

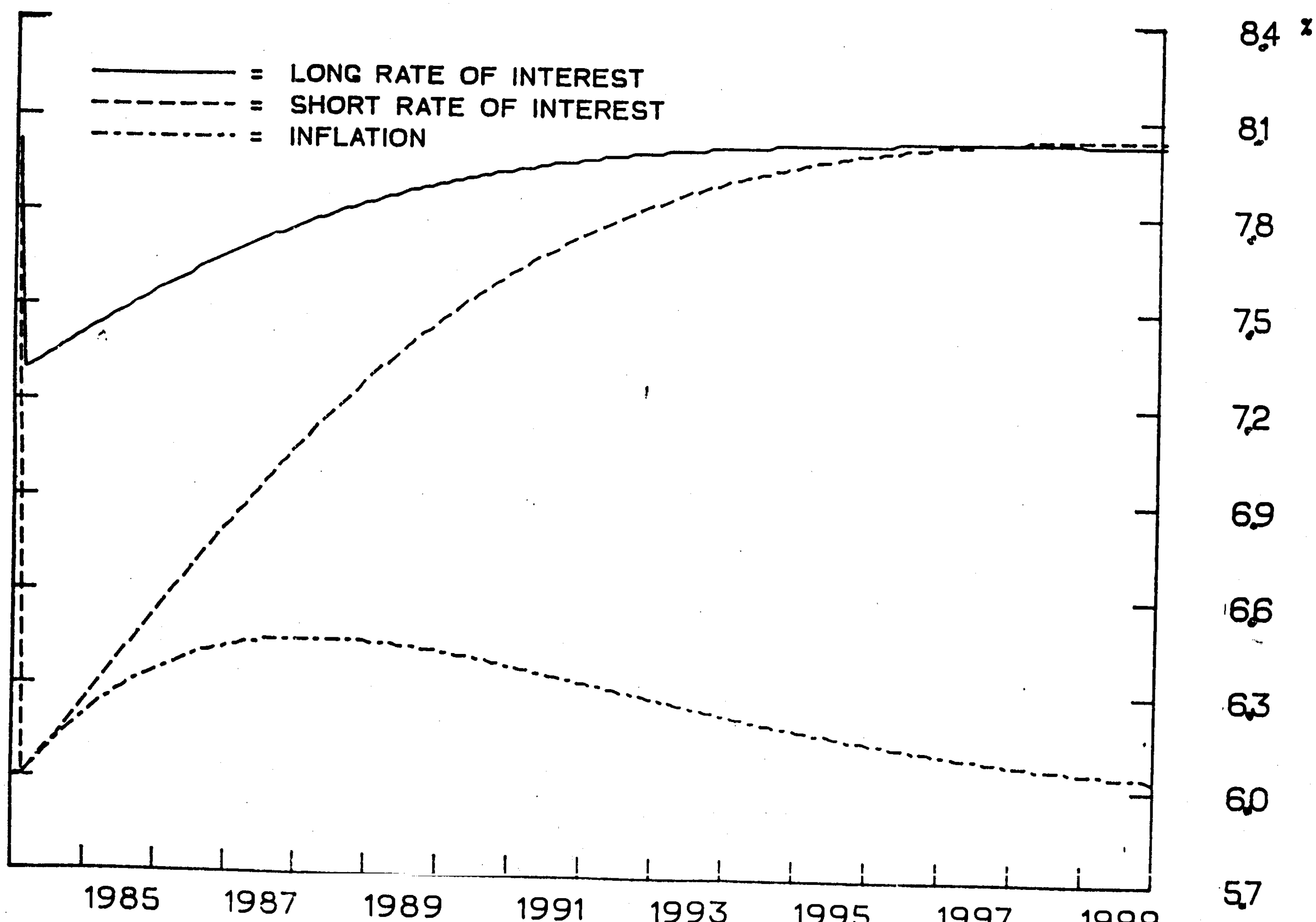


FIGURE 2.1

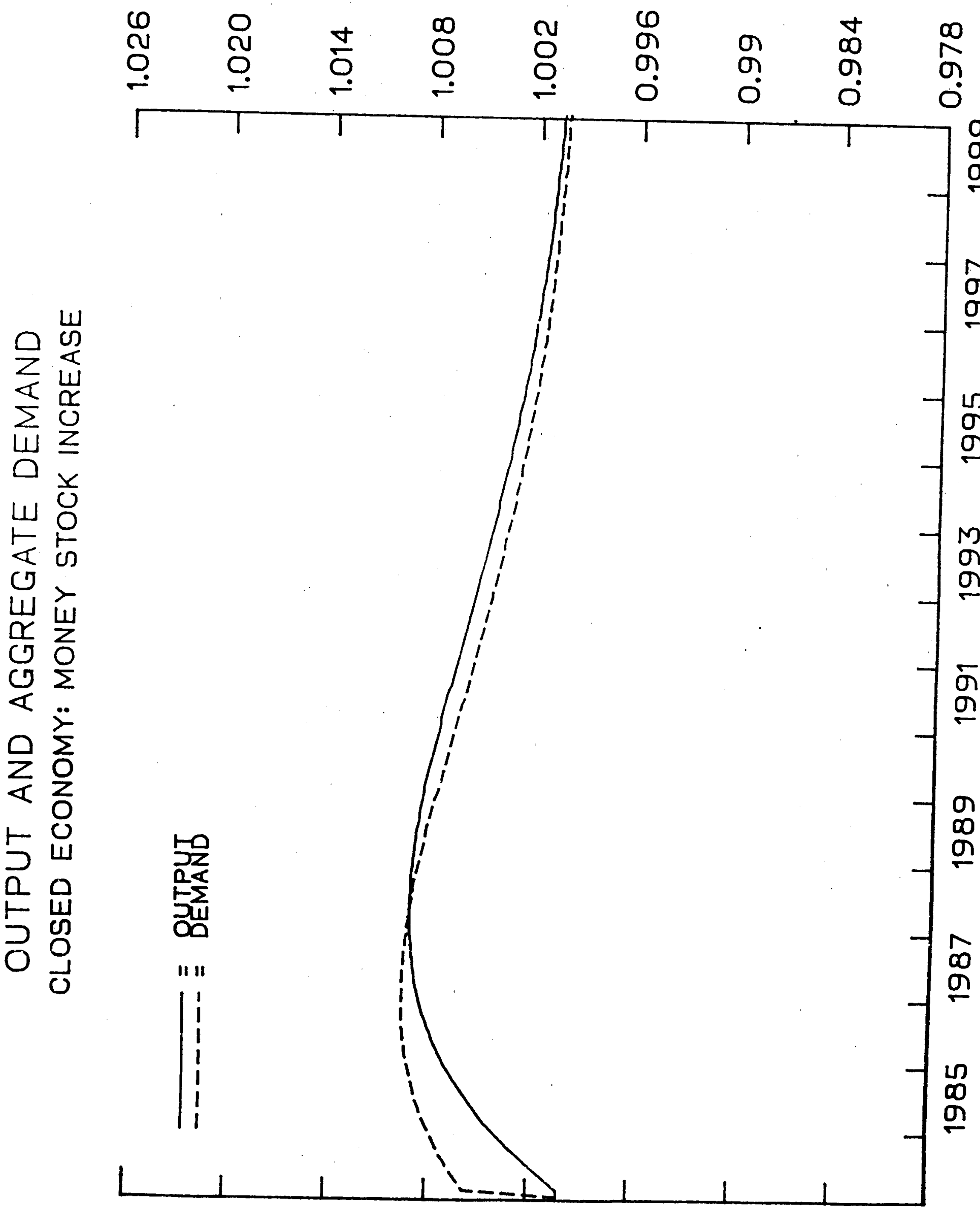

OUTPUT AND AGGREGATE DEMAND
CLOSED ECONOMY: MONEY STOCK INCREASE
= OUTPUT
= DEMAND
1.026
1.020
1.014
1.008
1.002
0.996
0.99
0.984
0.978
1985
1987
1989
1991
1993
1995
1997
1999

FIGURE 2.2

INTEREST RATES AND INFLATION

CLOSED ECONOMY: UNANTICIPATED FISCAL CONTRACTION

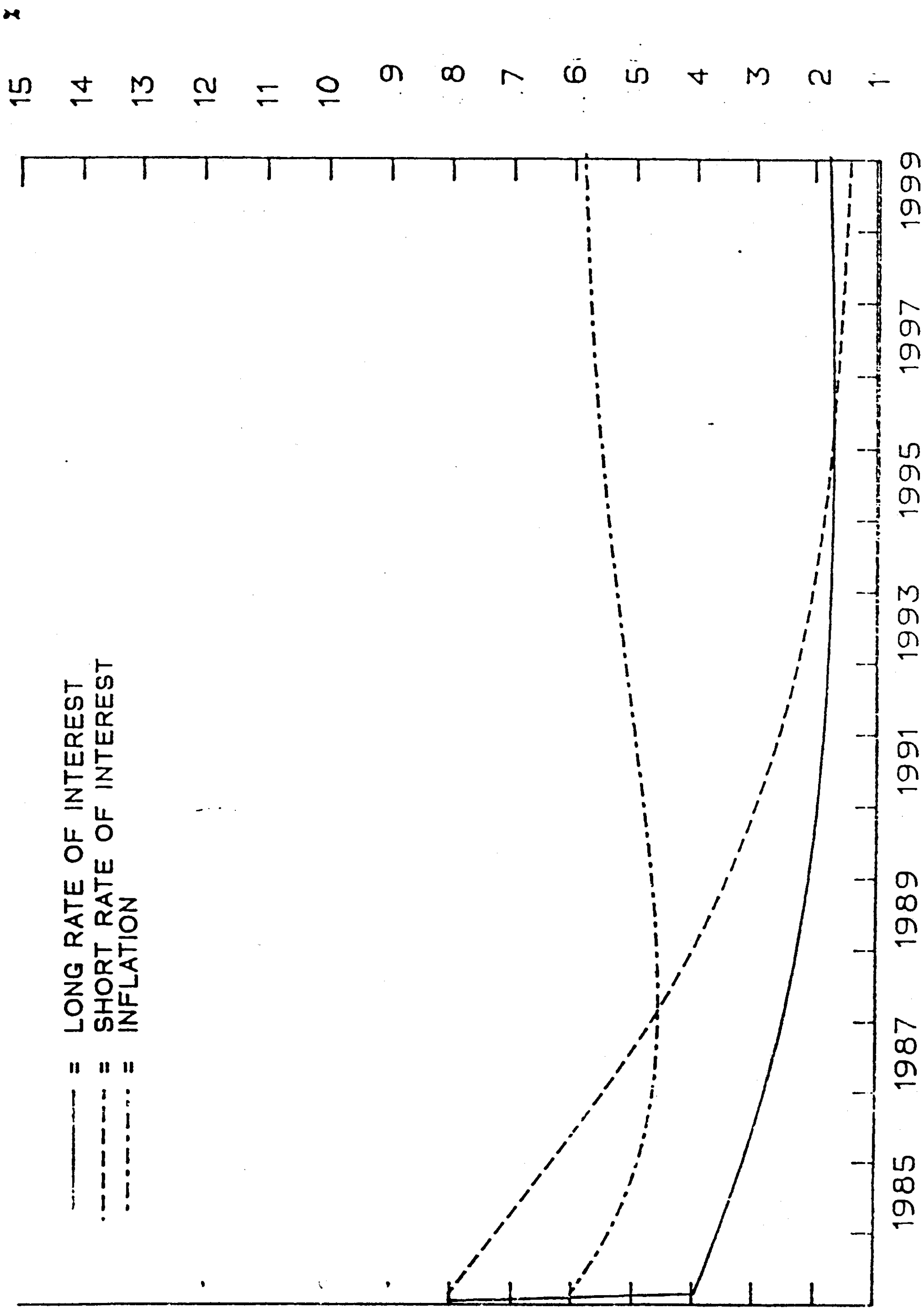


FIGURE 3.1

OUTPUT AND AGGREGATE DEMAND

CLOSED ECONOMY: UNANTICIPATED FISCAL CONTRACTION

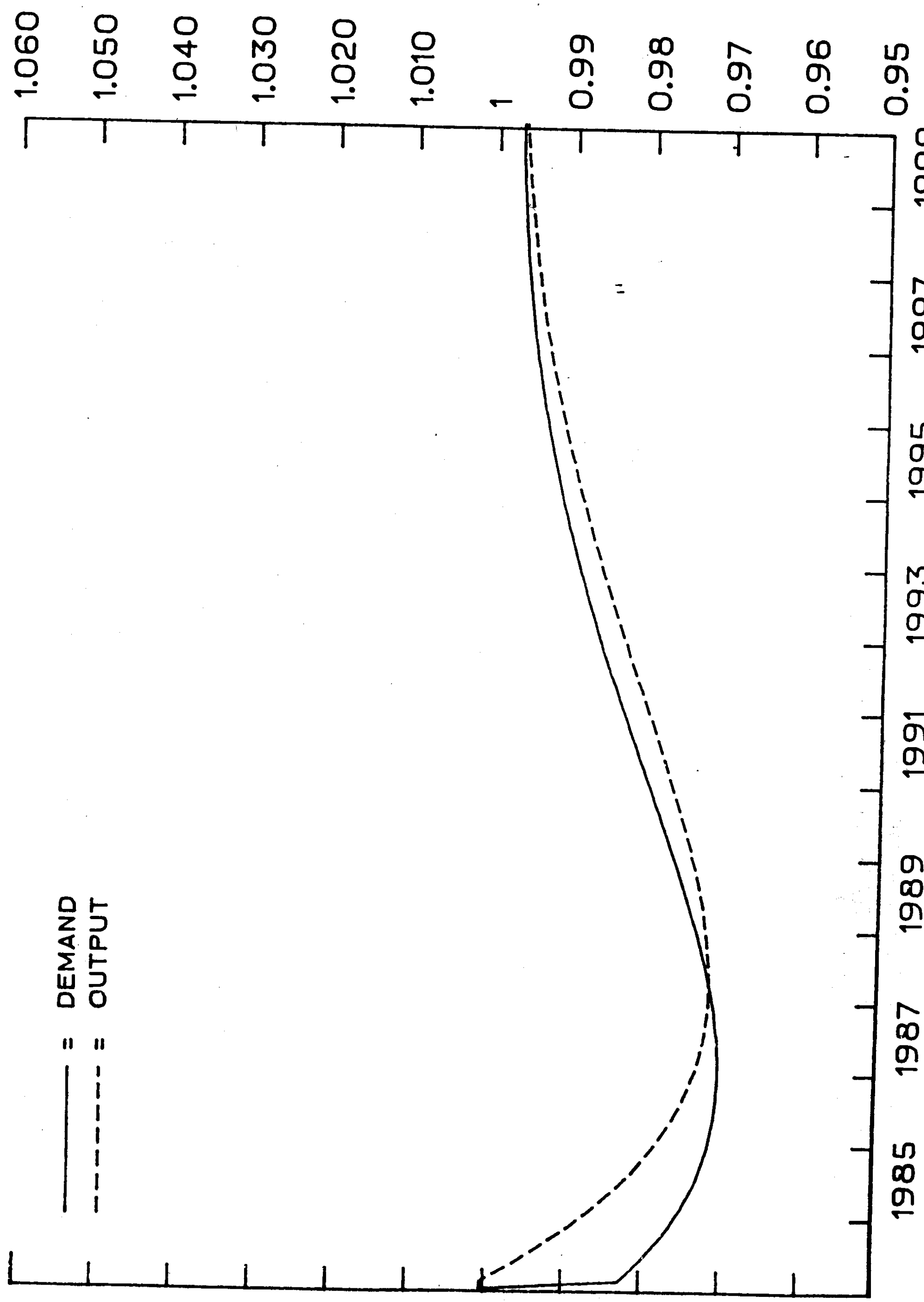
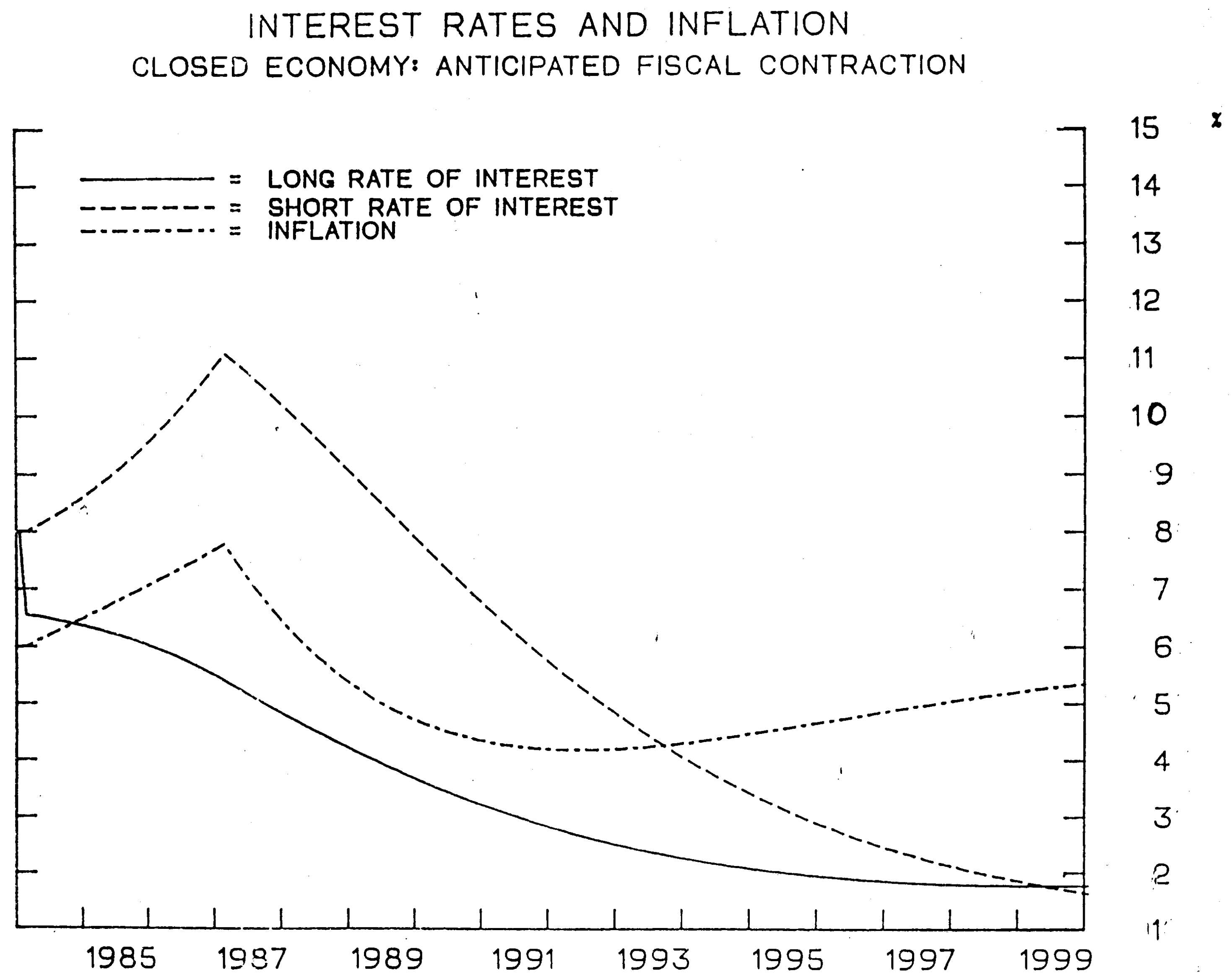


FIGURE 3.2



INTEREST RATES AND INFLATION
CLOSED ECONOMY: ANTICIPATED FISCAL CONTRACTION
= LONG RATE OF INTEREST
= SHORT RATE OF INTEREST
= INFLATION
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
%
1985
1987
1989
1991
1993
1995
1997
1999

FIGURE 4.1

OUTPUT AND AGGREGATE DEMAND
CLOSED ECONOMY: ANTICIPATED FISCAL CONTRACTION

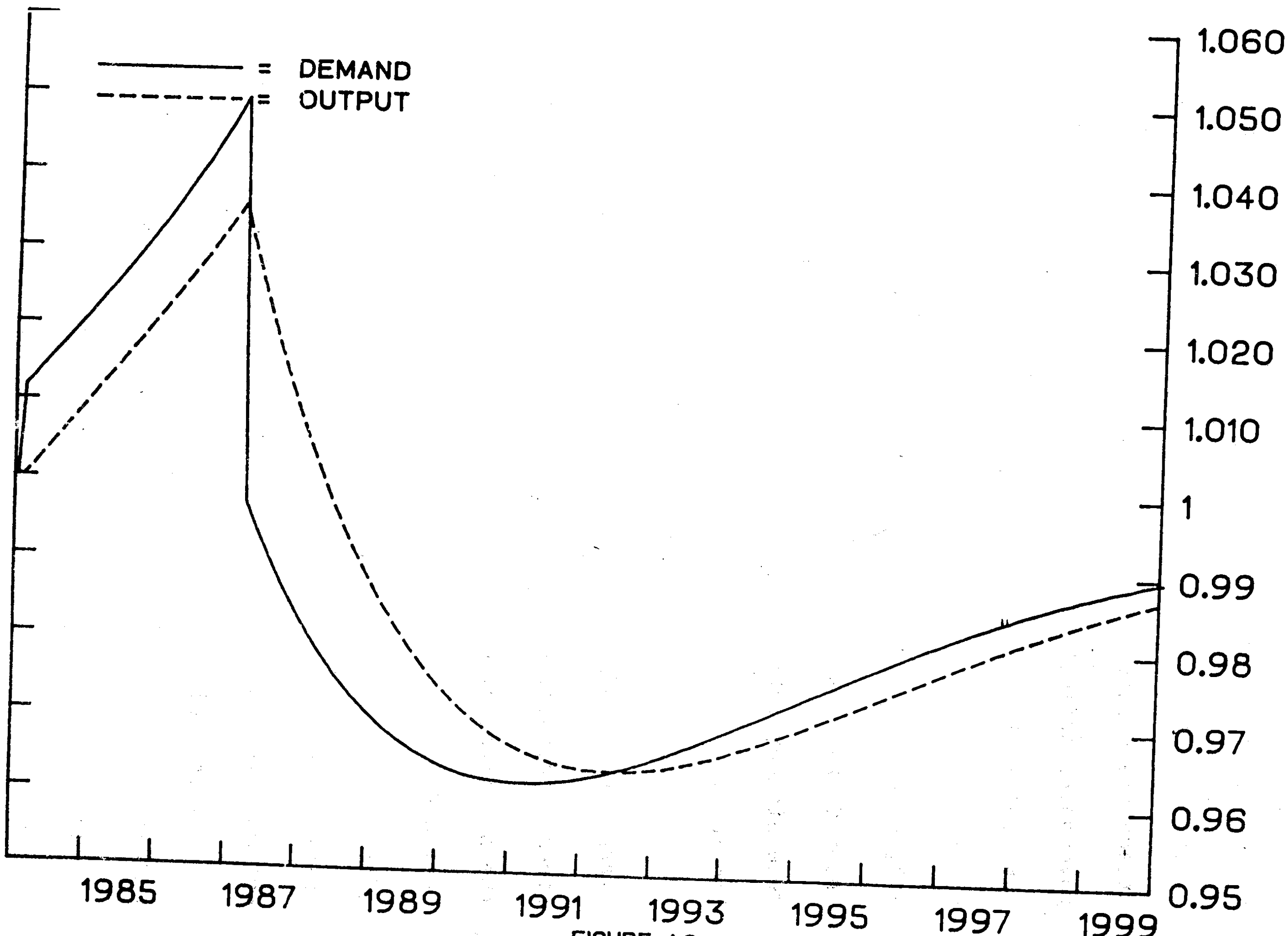


FIGURE 4.2

rates and inflation in the two cases. When the fiscal policy is anticipated, economic activity expands in the period between the announcement and the implementation of the cuts in government dissaving because of the fall in the long-term rate. This in turn increases the pressure on the price level and the transactions demand for money. After the fiscal cut takes place, the pressure of economic activity recedes and the interest rate declines to a new, lower, steady state level that reflects the diminished crowding out by the government deficit. In contrast, the larger initial fall in the long rate initially when the fiscal contraction is unanticipated is not, by itself, stimulative enough to offset the direct contractionary effects of the cut in the fiscal deficit. In that case short-term interest rates and inflation fall from the outset, reflecting the recessionary influence on both inflation and the transactions demand for money.

A comparison of figures 3.2 and 4.2 reveals the markedly different trajectories of output in the two cases. The anticipated fiscal contraction induces wide variation in output beginning with the anticipatory expansion produced by the fall in interest rates and followed by a steep contraction in output after the decline in government stimulus sets in. The unanticipated fiscal contraction creates a recession from time t_0 and the variations in output growth are much less extreme.

This series of policy experiments serves to illustrate the essential operation of the model in response to a variety of policy changes. But to address the question of the influence of the GRH bill on the U.S. economy it is vital to broaden the analysis to incorporate the influences of the international economy and to assess the qualitative differences in the adjustment mechanism that "openness" creates.

III. COMPARATIVE ADJUSTMENT: OPEN VERSUS CLOSED ECONOMIES

Before turning to an examination of the effects of the GRH bill on the U.S. economy, I will introduce the international influences into the goods and asset markets of the model used in the previous section. I will describe how the steady state behavior of the new model differs from the closed economy model. Then simulation experiments will be shown comparing the open and closed economy adjustment mechanisms in response to: 1) an anticipated fiscal expansion, and 2) an increase in the growth rate of money.

The open economy extension of the model, variable definitions, and the steady state behavior of the model are shown in tables 3, 4 and 5 respectively. Equation 1 is identical to equation 1 in the previous section, with the exception of the addition of the trade balance as a fraction of total domestic demand, x (henceforth "the trade balance"). The trade balance is assumed to adjust gradually to deviations of the equilibrium trade balance, $\tilde{x}$, from the actual trade balance as in equation 8. This specification is intended to reflect the initial "J curve" effects of the exchange rate on trade. It is consistent with the perspective embodied in most recent work on open economy macroeconomics which emphasizes the role of asset markets in the determination of the exchange rate coupled with the slow adjustment of goods markets to changes in the exchange rate. The equilibrium trade balance, $\tilde{x}$, is shown in equation 7 to depend upon both domestic and exogenous foreign income as well as on the real exchange rate, c. The foreign price level is assumed to be fixed at 1. Equation 9 represents the open interest parity condition augmented by a term which allows for the emergence of a risk premium in

Table 3.: The Complete Model

(1) $d = ay + \mu f - \delta(R-h) + x$

(2) $r = (\tau y - m)/\varepsilon$

(3) $\dot{y} = \varphi(d - y)$

(4) $E\hat{R} = R - r$

(5) $\dot{h} = \pi(\hat{M} - h)$

(6) $\dot{p} = h + \Phi(y - \bar{y})$

(7) $\tilde{x} = \sigma c + \Gamma y^* - \Omega y$

(8) $\dot{x} = \Theta(\tilde{x} - x)$

(9) $E\dot{e} = r - (r^* + \alpha b)$

(10) $\dot{b} = f - \hat{M}\bar{L}(1-\bar{m}) - \hat{M}\tilde{L}m$

(11) $\dot{c} = \dot{e} - \dot{p}$

(12) $\dot{m} = \hat{M} - \dot{p}$

Parameter Values

$a = .80$	$\bar{R} = .10$	$\delta = .80$
$\mu = 1$	$\sigma = .15$	$\Theta = .80$
$\pi = 8.0$	$r^* = .02$	$\Omega = .20$
$\alpha = .02$	$\Phi = .50$	$\Gamma = 0.0$
$\tau = 1.0$	$\varepsilon = 2.0$	$\varphi = 1.0$

Table 4: Definitions

y = the log of aggregate output

h = inflationary expectations

m = the log of real balances

f = real budget deficit

R = long term interest rate

r = short term interest rate

x = trade balance

$\tilde{x}$ = equilibrium trade balance

M = money supply

p = the log of the price level

e = the nominal exchange rate

b = stock of real bonds

L = the level of real balances

c = the real exchange rate

E = conditional expectations operator

Note: a bar over a variable denotes the steady state value, a hat denotes proportional rate of change, a dot the time derivative, and a star the foreign variable.

Table 5 Steady State Open Economy

(a) $h = \dot{p} = \dot{e} = \hat{M}$

(b) $y = d = \overline{y}$

(c) $\overline{r} = \overline{R} = \hat{M} + r^* + \alpha b$

(d) $\overline{m} = \tau\overline{y} - \varepsilon(\hat{M} + r^* + \alpha b)$

(e) $\hat{c} = ((1 - a - \Omega)\overline{y} \quad -\mu f + \delta(r^* + \alpha b) - \Gamma y^*)/\sigma$

(f) $\dot{b} = f - \hat{M}L$

response to increases in the outstanding real stock of government bonds, b. This term can also capture the effect on world interest rates, r^*, of an increase in b.

For example, if $r^*(b)$ is expanded using a first order Taylor series approximation around the value b_0 the equation would look like;

$$r^*(b)=r^*(b_0)+(dr^*(b_0)/db)*(b-b_0)$$

Setting r^* in equation 9 to $r^*(b_0)$ and b_0 to 0 will yield the result equation 9 above provided that $\alpha=dr^*(0)/db$. One would then interpret equation 9 as an open interest parity condition where the difference between the home interest rate, r, and the world interest rate, r^W, which equals $r^*+\alpha b$, would be the expected rate of depreciation of the home currency.

Equation 10 is a linearization of the identity relating the rate of change of the real bond stock to the rate of money growth and the stock of real balances. Equation 11 and 12 are the identities relating the rate of change of both the real exchange rate and real balances to their components. Note once again that the foreign price level is not included in the measure of the rate of change of the real exchange rate because it is assumed to be constant.

The steady state behavior of the system of equations in table 3 is shown in table 5. The inflation rate, the nominal exchange rate, and the expected rate of inflation are all equal to the rate of growth of money, $\hat{M}$. Output and demand are both equal to $\bar{y}$ in the steady state. The short and long rates of interest are both equal to the rate of money growth plus the foreign real interest rate and the risk premium. Note that r^* is both the real and nominal foreign rate of interest under the assumption that the foreign price level is constant. Real balances in the steady state are a function of steady state output, and the nominal interest rate, which in turn depends on the rate of money growth. The steady state real exchange rate, $\bar{c}$, depends upon full employment output, the fiscal deficit, and the real interest rate, $r^* + \alpha b$. Note that a reduction in the deficit will tend to depreciate the real exchange rate, as pressure in the goods market is relieved, but it will also lower the expected risk premium as the expected future stock of real bonds is reduced. This latter effect will tend to appreciate the steady state real exchange rate, for lower real interest rates imply greater demand and necessitate an appreciation of the real exchange rate to equilibrate the goods market. The final equation of table 5 shows that the real bond stock will remain stationary only if $f=\hat{M}L$. An increase in the rate of money growth has two effects on the rate of growth of the real bond stock. The term $\hat{M}L$ will increase because of the increased rate of money growth but at the same time the equilibrium level of real balances, L, falls because of the non-superneutrality of money. On net, the rate of growth of the real bond stock will fall provided that $\hat{M}\varepsilon$ is less than 1, where ε is the semi-elasticity of real balances with respect to the short-term interest rate. With $\hat{M}$ less than or equal to .10 and $\varepsilon=2$ the real bond stock will fall when money growth increase in the simulations presented here.

Additional parameter values must also be chosen for the simulation exercises. These values are shown along with those used in the previous section at the bottom of Table 3. In particular, α, the sensitivity of short-term interest rates to changes in the real bond stock is set to .02, which implies that a doubling of b from an initial value of 1 will increase interest rates by 2 percentage points. Other parameters added in this open economy specification are σ, which measures the sensitivity of the trade balance to the exchange rate; Ω, the sensitivity of the trade balance with respect to home income; and γ, the speed of adjustment of the trade balance in response to changes in income and relative international prices. In the simulation exercises, σ is set to .15, Ω is set to .2, and γ is set to .80 so that the "half life" of a disturbance is slightly under one year.

With the open economy version of the model one can conduct simulations of policy experiments of the type performed with the closed economy version in the previous section. A direct comparison of the dynamic behavior of the variables in response to the same policy change can be made, beginning from the same initial conditions and using the same parameter values, in order to illuminate the differences in the adjustment processes for the two models.

Before turning to the simulation results it is instructive to compare the differences between the steady state solutions of the two systems.

Closed Economy	Open Economy
$\bar{r} = \bar{R} = \hat{M} + ((a-1)\bar{y} + \mu f)/\delta$	$\bar{r} = \bar{R} = \hat{M} + r^{*} + \alpha b$
	$\bar{c} = ((1-a-\Omega)\bar{y} - \mu f + \delta(r^{*} + \alpha b))/\sigma$

In both closed and open economy specifications the growth rate of money plays a role by contributing a direct inflation premium to the steady state interest rates. In addition, in the open economy, provided that $\hat{M}\varepsilon$ is less than unity, the increase in the growth rate of money will reduce interest rates by decreasing the real stock of bonds through an inflation tax as well as through increased monetization of the debt.

Fiscal policy can have quite different effects in the two models when the risk premium, α is small. In the closed economy the steady state interest rate is raised by an increase in the real budget deficit f. The magnitude of the increase depends upon the ratio of μ/δ. The larger the response of aggregate demand to changes in fiscal policy the greater will be the rise in interest rates necessary to equilibrate the goods market. A larger semi-elasticity of aggregate demand with respect to the real long term rate of interest necessitates a smaller rise in interest rates to accomplish the necessary crowding out to clear the goods market in the steady state. In the open economy, both the tradeable goods and interest sensitive sectors can be crowded in or out in the steady state in order to clear the goods market. At one extreme, if the risk premium, α, is equal to zero then all steady state adjustment will be done by the tradeable goods sector. In that case it is the ratio of μ/σ which determines the extent of the adjustment of the real exchange rate. The greater the sensitivity of demand to the real exchange rate the smaller will be the necessary change in the exchange rate required to clear the goods market. If α is nonnegligible an unanticipated increase in the fiscal deficit will directly raise demand in the goods market by $\mu\partial f$, but at the same time the real stock of government bonds will increase by at least $\partial f^*(T-t_0)$, where $T-t_0$ is the duration of the fiscal expansion.[6] This will in turn raise real interest rates by at least $\alpha\partial f^*(T-t_0)$ and reduce demand by not less than $\delta\alpha\partial f^*(T-t_0)$. Thus the longer the fiscal deficit increase persists, the greater will be bond accumulation and the greater will be the crowding out of interest sensitive expenditure relative to the crowding out of tradeable goods. For example with $\delta=.8$, $\mu=1$, and $\alpha=.02$, a fiscal shock lasting 10 years will increase demand at year 10 by ∂f but the bond accumulation effects on interest rates will reduce demand by at least $1.6^*\partial f$. This will necessitate depreciation of the real exchange rate to clear the goods market.

Figures 5.1-5.5 and 6.1-6.5 exhibit the results of two policy simulation experiments corresponding to two policy changes which are discussed in conjunction with the GRH legislation. The first, of course, is the anticipated fiscal contraction. The second is an increase in the growth rate of money, a policy change often mentioned as a likely complement to fiscal contraction so as to lean against the recessionary wind. Ironically, if the analysis of this paper is correct, the monetary stimulus, if implemented prior to the implementation of the fiscal cuts, would serve to exacerbate the anticipatory expansion rather than attenuate the effects of a recession.

The behavior of interest rates in both the closed and open economies in response to an anticipated fiscal contraction is shown in figure 5.1. Most noticeable is the much greater fall in long-term interest rates in the closed economy upon announcement, which

INTERESTING RATES: CLOSED VERSUS OPEN ECONOMY MODELS

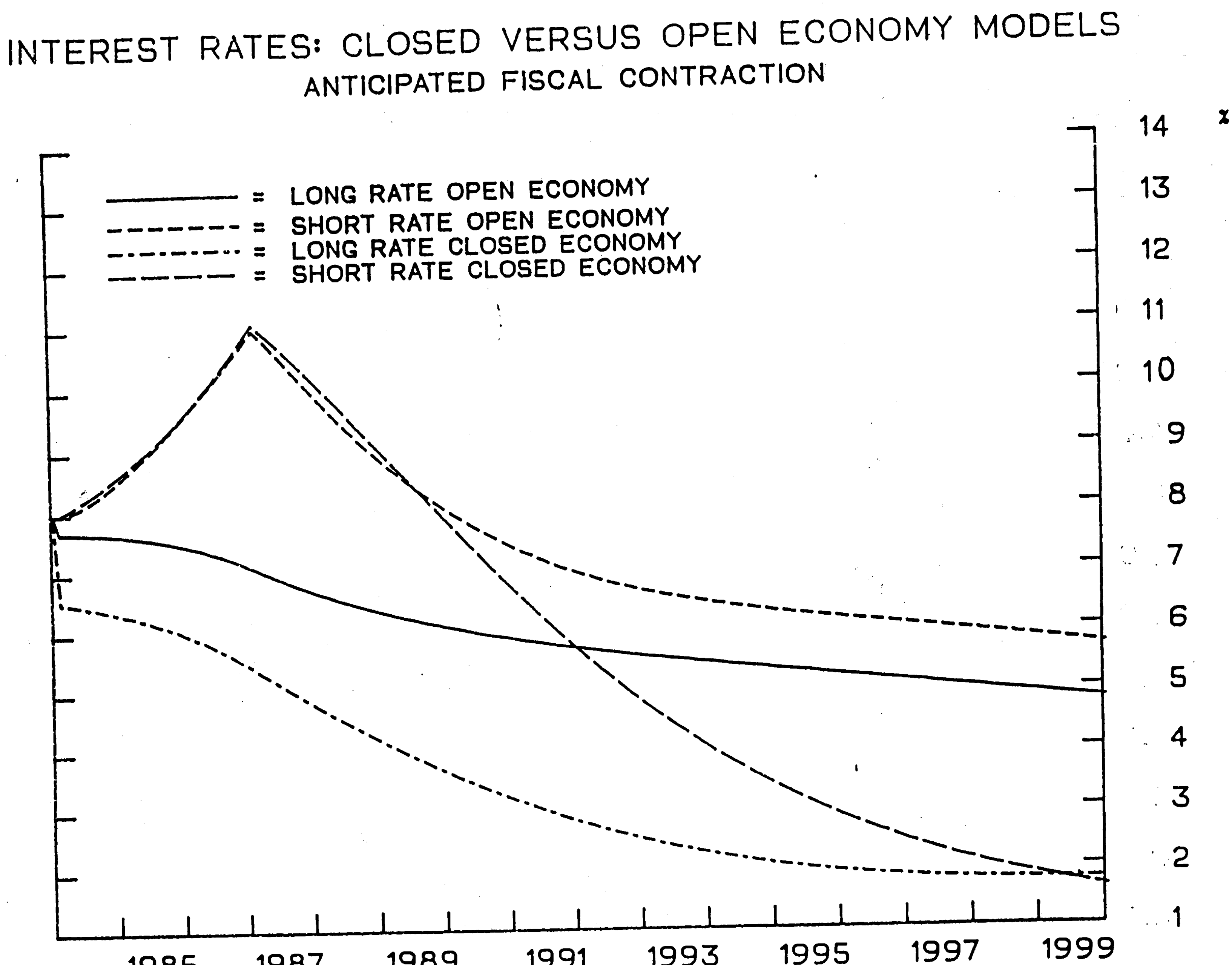


FIGURE 5.1

INFLATION: OPEN VERSUS CLOSED ECONOMY
ANTICIPATED FISCAL CONTRACTION

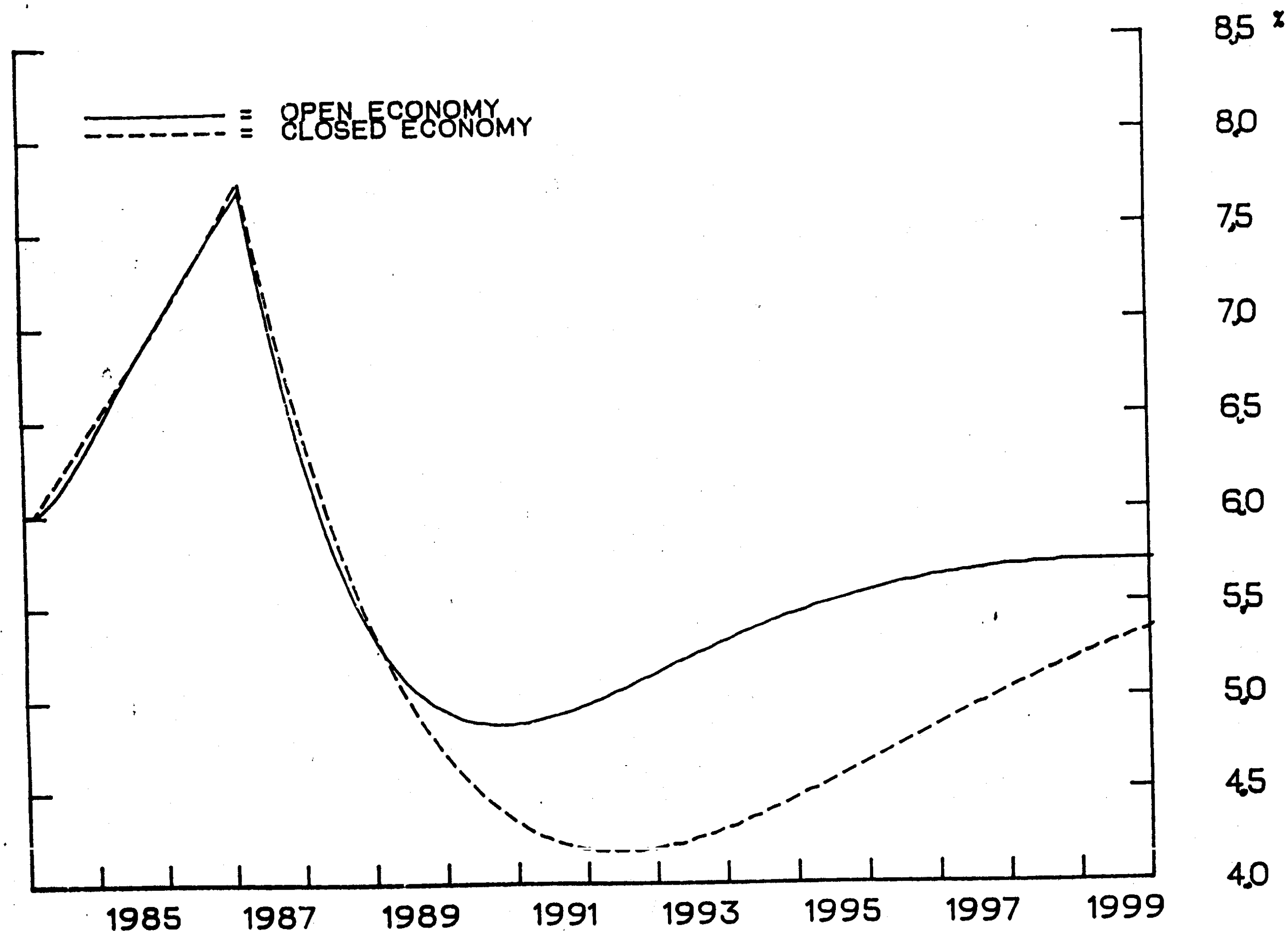


FIGURE 5.2

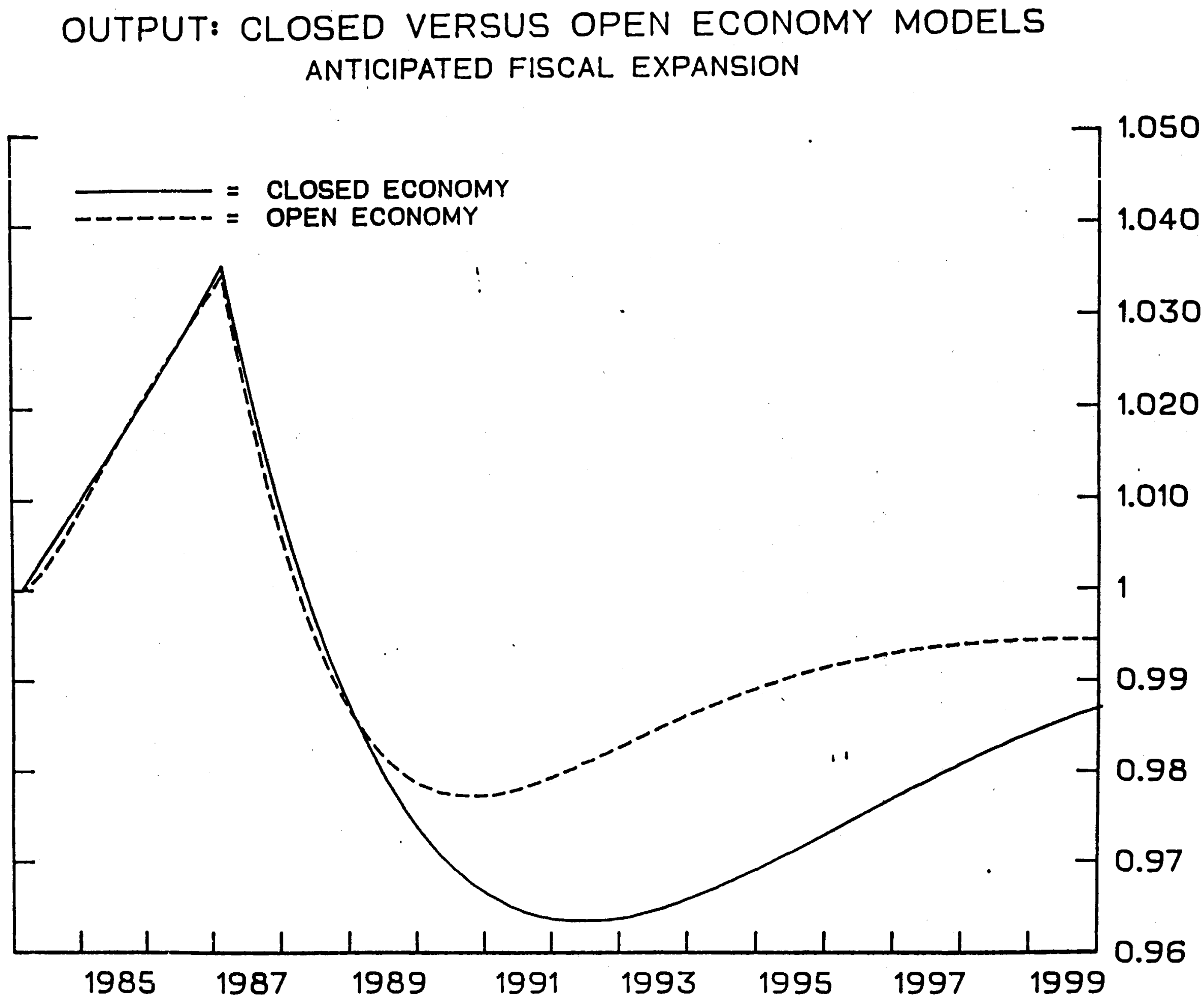

OUTPUT: CLOSED VERSUS OPEN ECONOMY MODELS
ANTICIPATED FISCAL EXPANSION
= CLOSED ECONOMY
= OPEN ECONOMY
1.050
1.040
1.030
1.020
1.010
1
0.99
0.98
0.97
0.96
1985
1987
1989
1991
1993
1995
1997
1999

FIGURE 5.3

REAL EXCHANGE RATE: ANTICIPATED FISCAL CONTRACTION
(UP EQUALS DEPRECIATION)

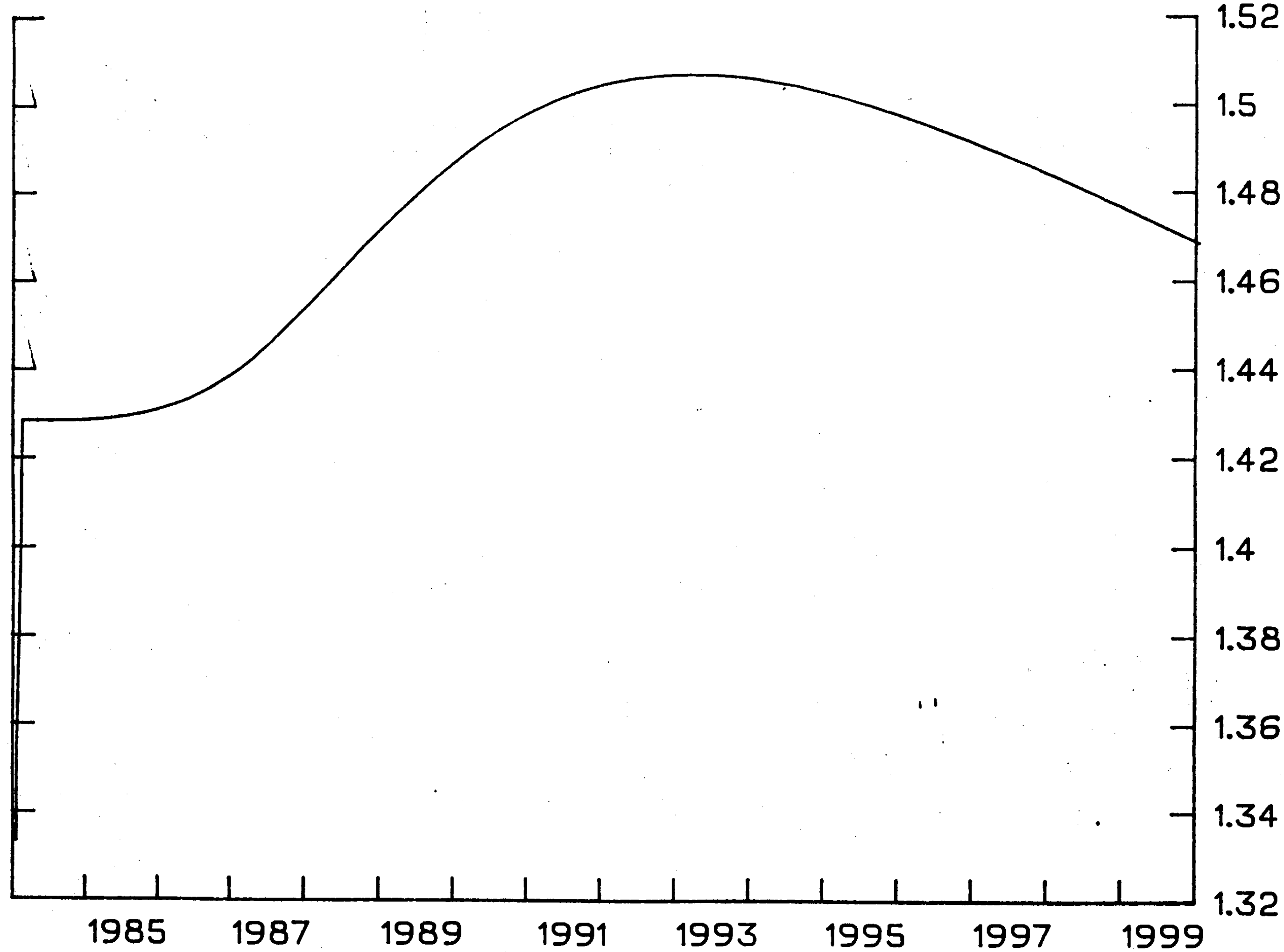


FIGURE 5.4

EXTERNAL BALANCE: ANTICIPATED FISCAL CONTRACTION

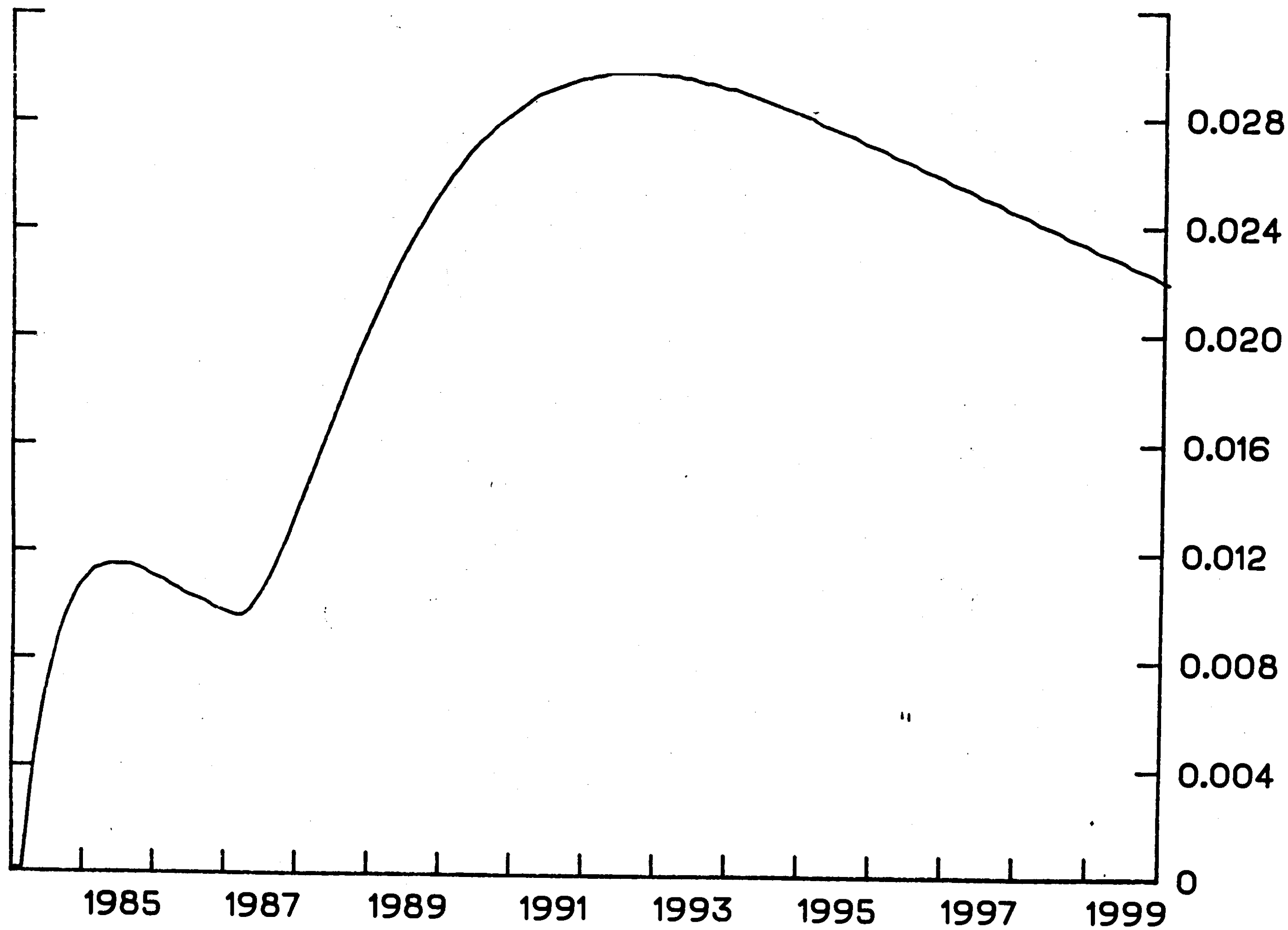


FIGURE 5.5

reflects the fact that the interest rate is used to clear the goods market in the steady state in a closed economy and will therefore fall as fiscal dissaving diminishes. In contrast, in the open economy the interest rate does not fall as far because the depreciation of the exchange rate sustains demand, and therefore short rates, through an increased transactions demand for money. The evolution of the exchange rate is shown in figure 5.4. The trade balance improves following the exchange rate depreciation but backslides a bit because the anticipatory expansion increases absorption transitorily before the fiscal cuts are implemented. Note that in response to this anticipated fiscal contraction the path of output over the first five years is strikingly similar, as shown in figure 5.3. While interest rates fall much further in the closed economy at the time of announcement, the improvement in the trade balance resulting from the depreciation of the exchange rate compensates for the relatively milder response of interest-sensitive sectors in the open economy.

Figure 6.1 shows long-term and short-term interest rates in response to an unanticipated increase in the rate of money growth. Surprisingly, the open economy long rate jumps up further upon announcement than does its closed economy counterpart, even though the steady state long rate is lower in the open economy than it is in the closed economy (because the monetization of the debt due to faster money growth reduces the real bond stock). Despite the higher long rate, initially the open economy's output rises more rapidly than does output in the closed economy, as is shown in figure 6.3. The difference arises because the exchange rate depreciates in the open economy and produces an additional source of stimulus to

MONEY GROWTH RATE INCREASE

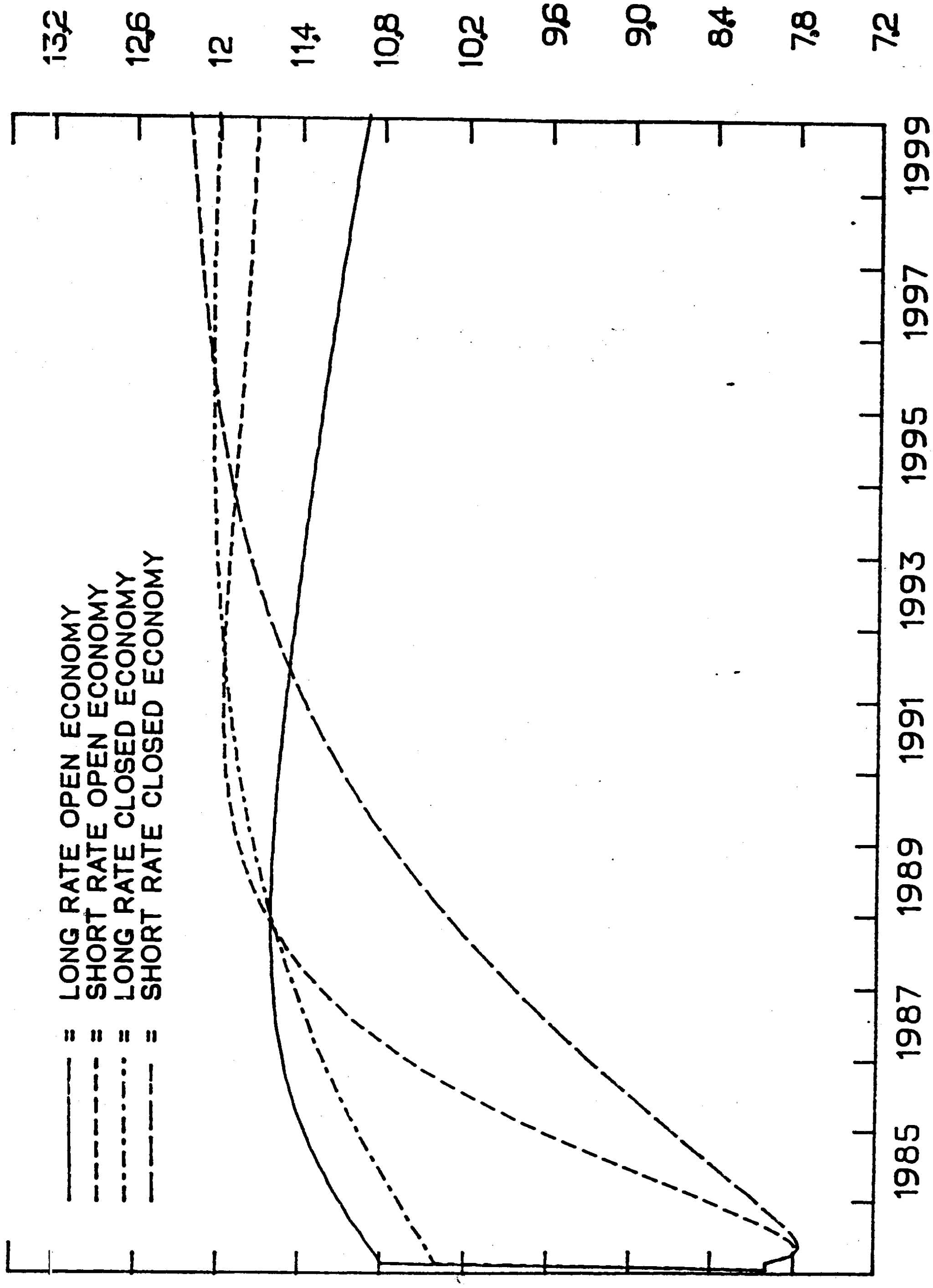


FIGURE 6.1

INFLATION: OPEN VERSUS CLOSED ECONOMY
MONEY GROWTH RATE INCREASE

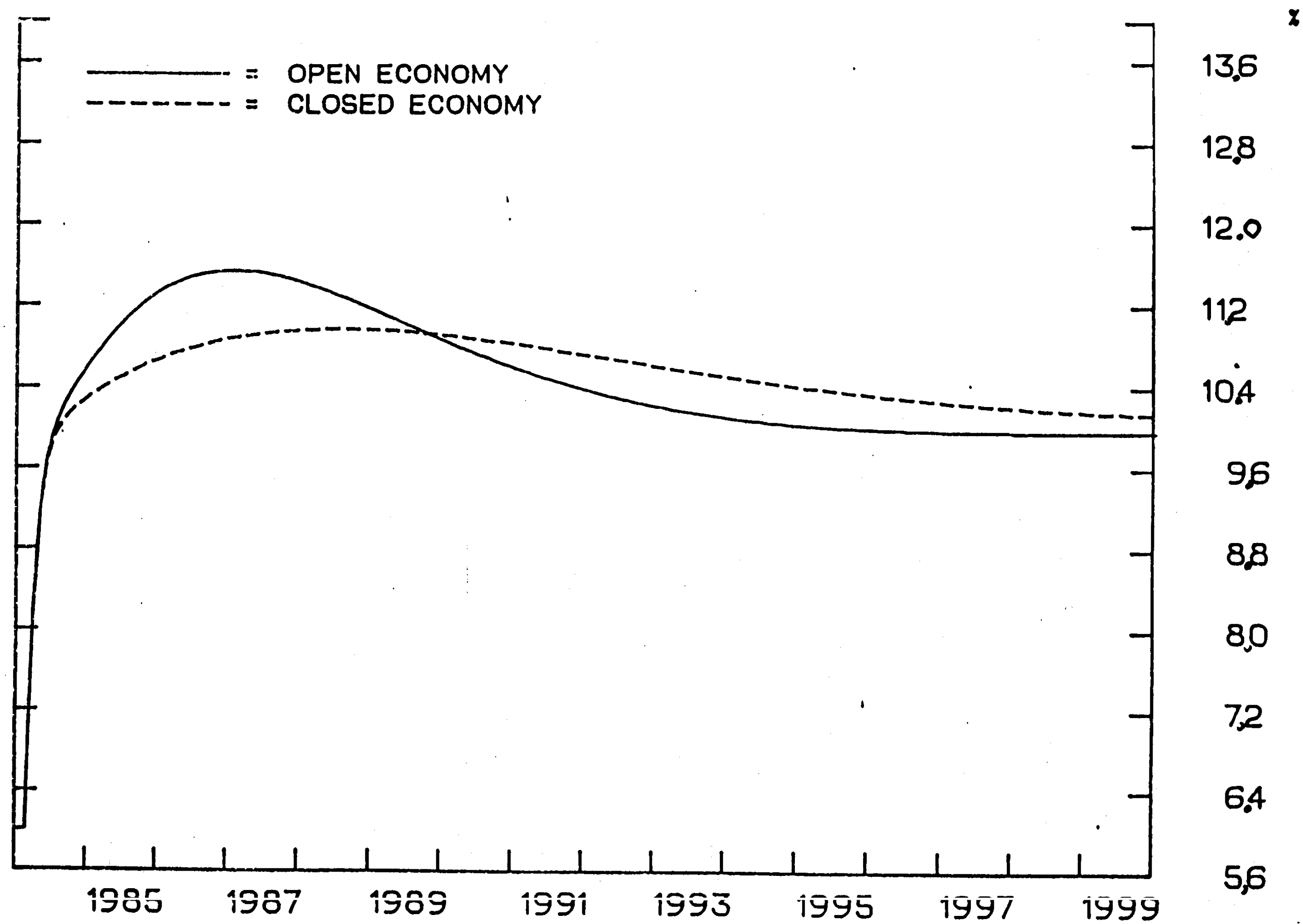


FIGURE 6.2

OUTPUT: CLOSED VERSUS OPEN ECONOMY MODELS

INCREASE IN THE RATE OF MONEY GROWTH

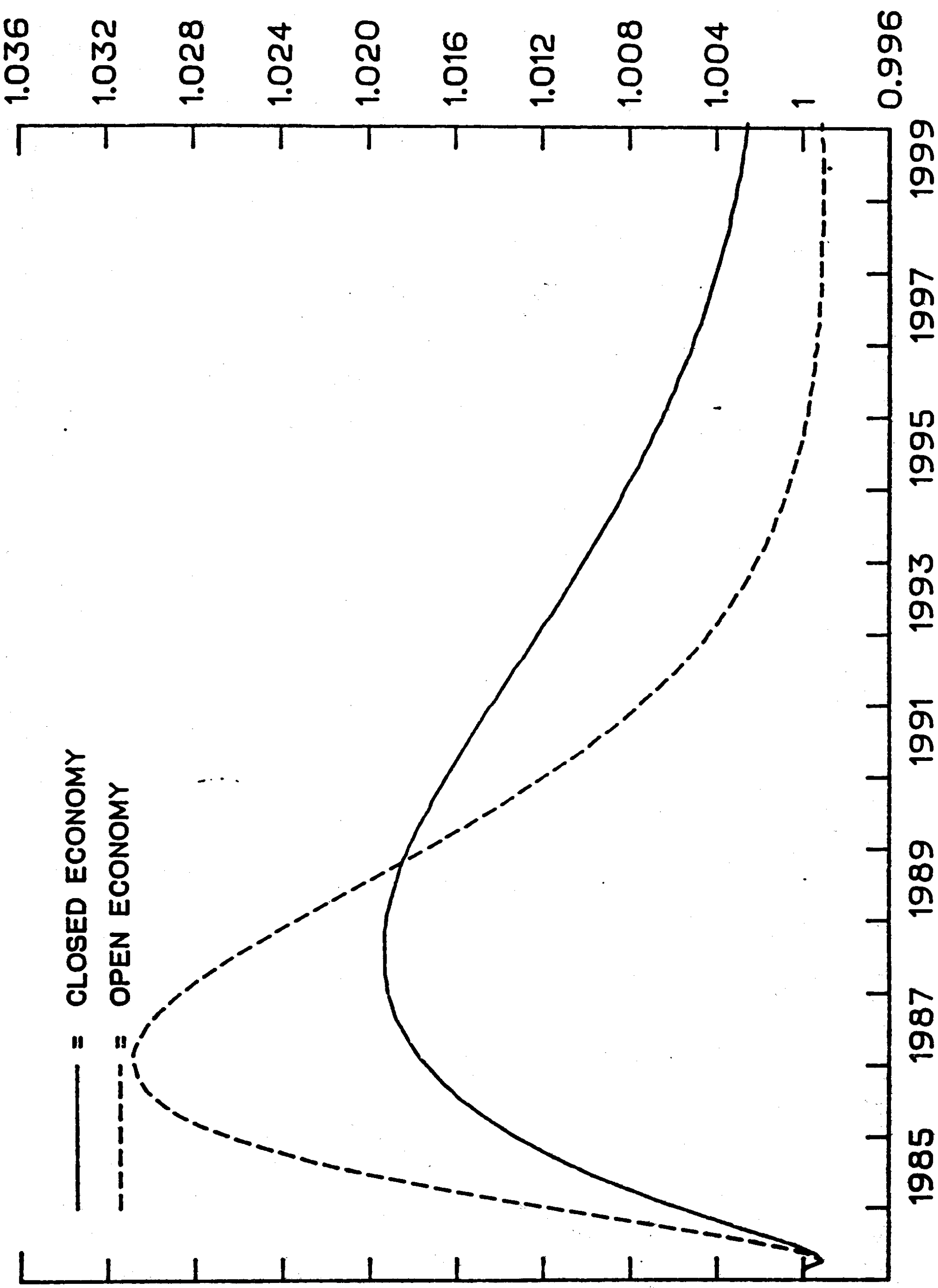


FIGURE 6.3

REAL EXCHANGE RATE: MONEY GROWTH RATE INCREASE
(UP EQUALS DEPRECIATION)

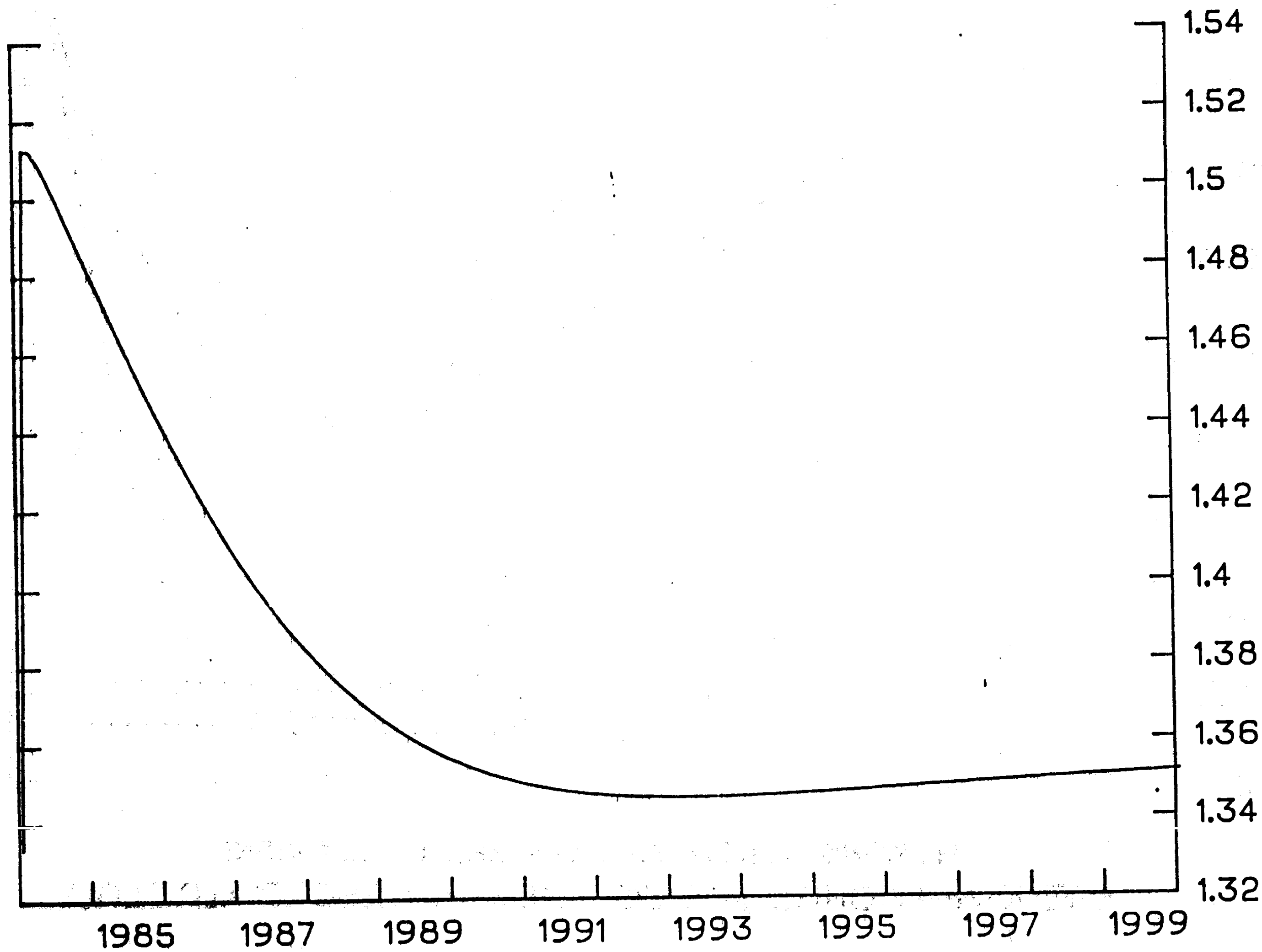


FIGURE 6.4

EXTERNAL BALANCE: MONEY GROWTH RATE INCREASE

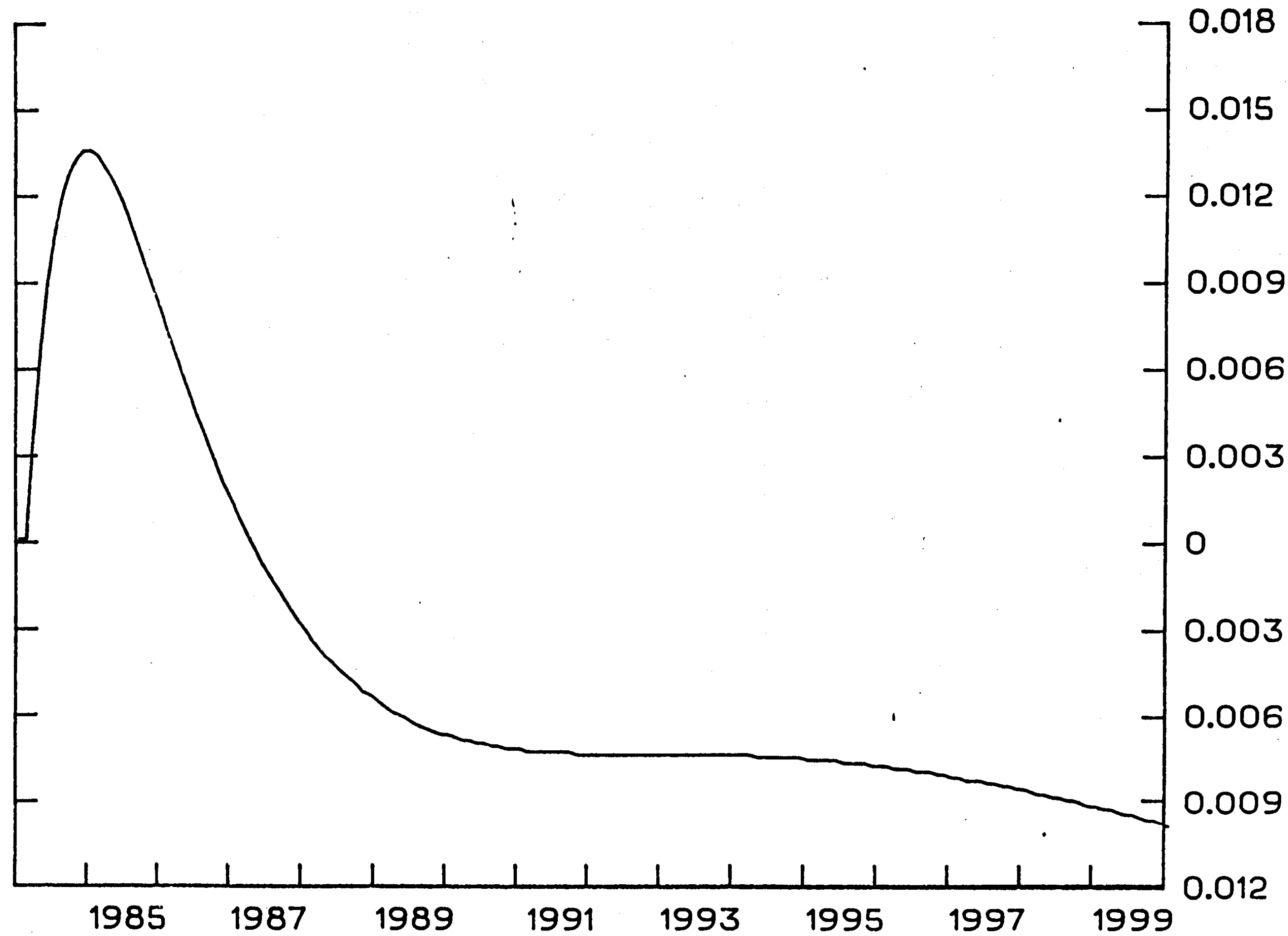


FIGURE 6.5

aggregate demand and concomitantly a higher transaction demand for money.

The response of the real exchange rate and the trade balance are shown in figures 6.4 and 6.5. The increase in the rate of money growth produces an initial sharp depreciation in the real exchange rate, that results entirely from a depreciation of the nominal exchange rate, which overshoots the long-term level of the real exchange rate. The trade balance improves markedly in the short run and then returns to zero in the steady state. In figure 6.3 the peak difference in output between the closed and open economy models occurs early in the fourth year and the expansion of the tradeable goods sector accounts for more than all of that difference.

A comparison of open and closed economy adjustment patterns reveals the following. Monetary policy changes produce a wider swing in the long-term rate of interest in the open economy than in the closed economy because the change in monetary policy produces an exchange rate effect which reinforces the effect of monetary policy on interest-sensitive expenditure. The higher demand from the tradeable goods sector supports the transactions demand for money and raises the short rate. Fiscal policy changes produce less-wide variation in the long rate of interest in the open economy because the exchange rate adjusts to offset the effect of fiscal policy on aggregate demand and therefore dampens the demand for money and the magnitude of the changes in the short rate necessary to clear the money market. Overall, the response to fiscal policy changes in the open economy appears to rely heavily on adjustments to the tradeable goods sector and less so on the crowding in and crowding out of interest sensitive sectors than does the closed economy. Monetary changes tend to have an amplified effect on output because of the added stimulus to the traded goods sector because of real exchange rate overshooting, despite greater volatility of the long rate of interest in the short run.

IV. SIMULATION OF FISCAL CONTRACTION IN THE OPEN ECONOMY

Using the model of the open economy I will present two simulation exercises corresponding to two policy scenarios that have been discussed recently. The first consists of a fiscal contraction, announced today and implemented over five years to eliminate the fiscal deficit in stages, in essence an approximation of the GRH bill. The second simulation exercise consists of the same five-year fiscal contraction but this time accompanied by a temporary increase in the rate of money growth of 2% during the five years of fiscal contraction.

Figures 7.1-7.3 portray a simulation of deficit reduction which is announced at the beginning of 1986 and implemented in five steps beginning one year later. As initial conditions I have assumed that output is slightly higher than trend but is decelerating, that the trade balance is in substantial deficit, and that the term structure, as measured by the difference between the short and long rates, is nearly 500 basis points. These initial conditions are consistent with the simulation runs produced in Branson, Fraga and Johnson (1985) and correspond to the conditions that would have prevailed in early December 1985 as a result of the policies of the late 1970s and early 1980s modeled in that paper. Figure 7.1 shows the behavior of interest rates and inflation. Upon announcement of the fiscal contraction, the long rate of interest jumps downward by nearly 100 basis points, reflecting the expected reduction in the real bond stock. The short rate does not jump because neither y, nor, p, nor m, jumps in the short run. As time proceeds, the term structure inverts as both the short rate and inflation rise, reflecting an increase in the transactions demand for money and excess goods demand, respectively. These increases

SIMULATED INTEREST RATES AND INFLATION
GRAMM-RUDMAN-HOLLINGS

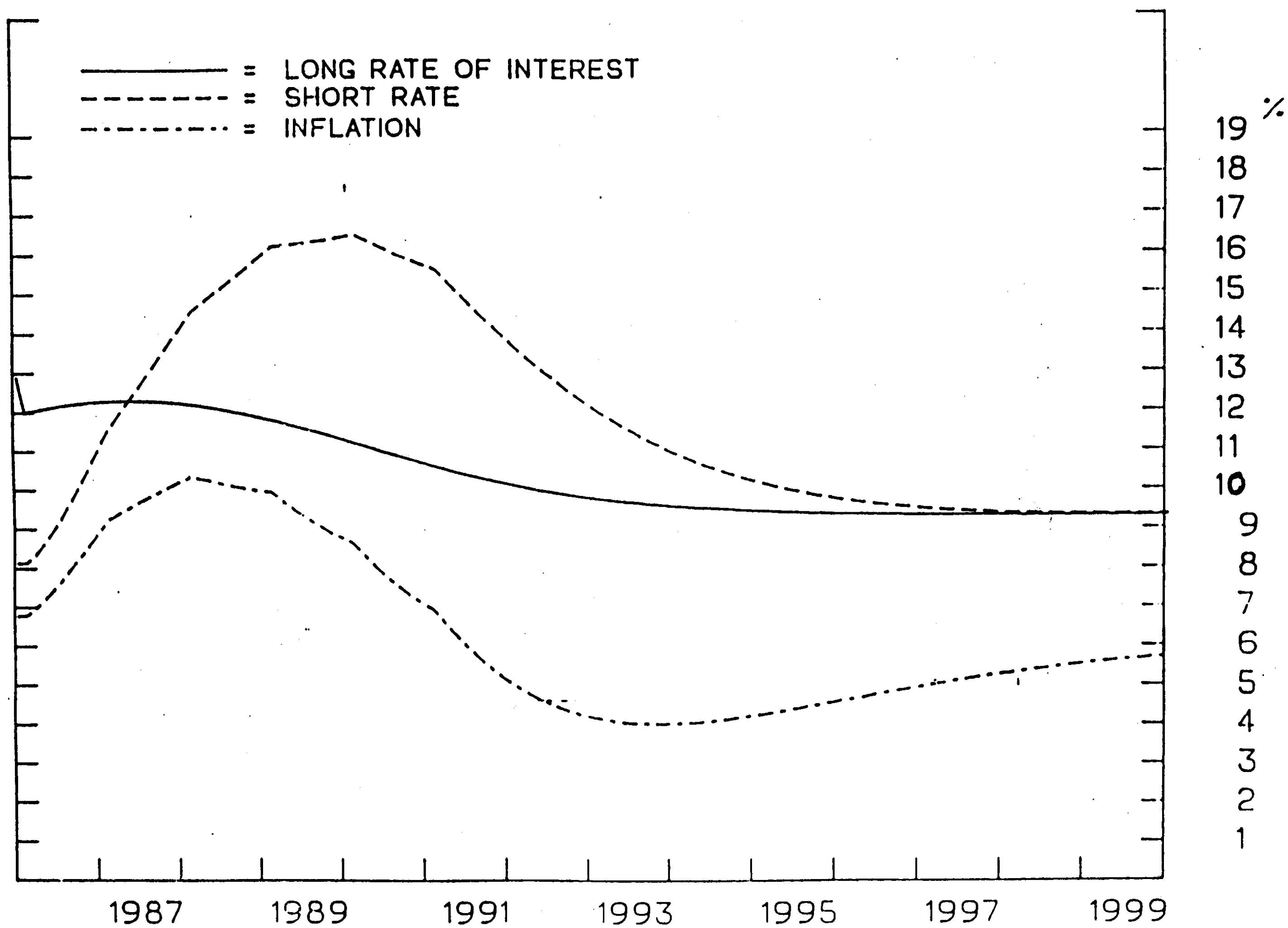


FIGURE 7.1

SIMULATED REAL EXCHANGE RATE
GRAMM-RUDMAN-HOLLINGS

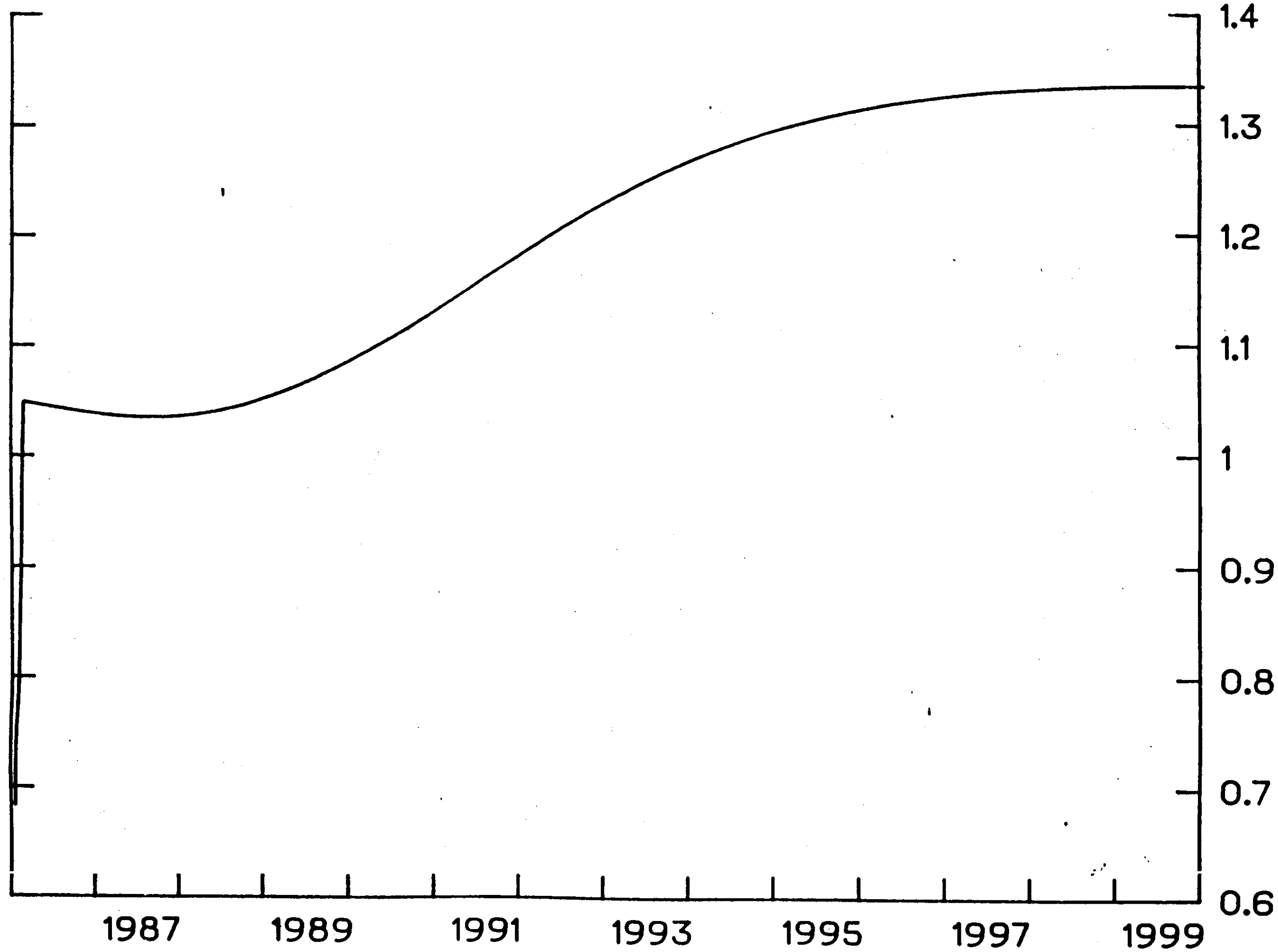


FIGURE 7.2A

SIMULATED TRADE BALANCE
GRAMM-RUDMAN-HOLLINGS

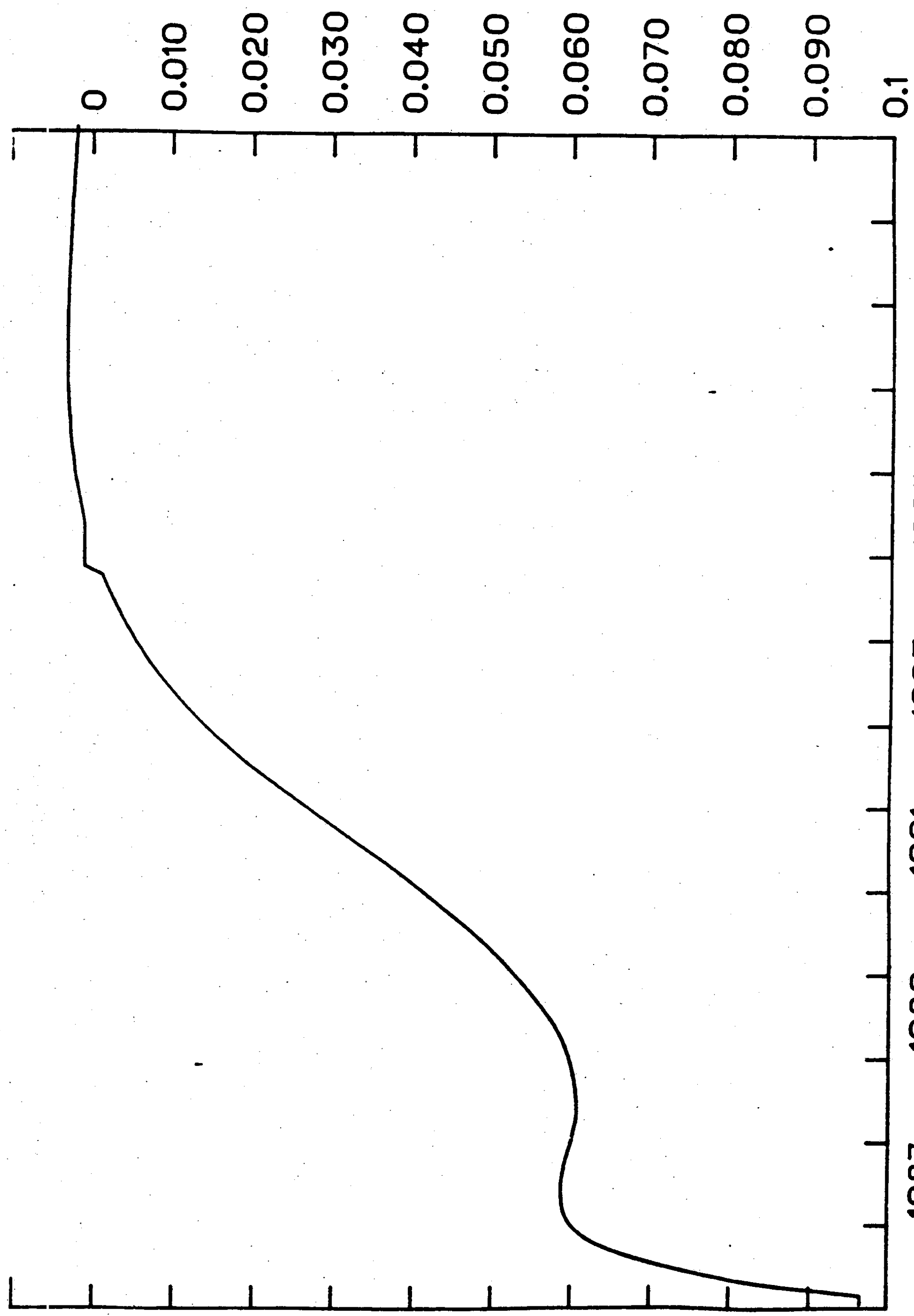


FIGURE 7.2b

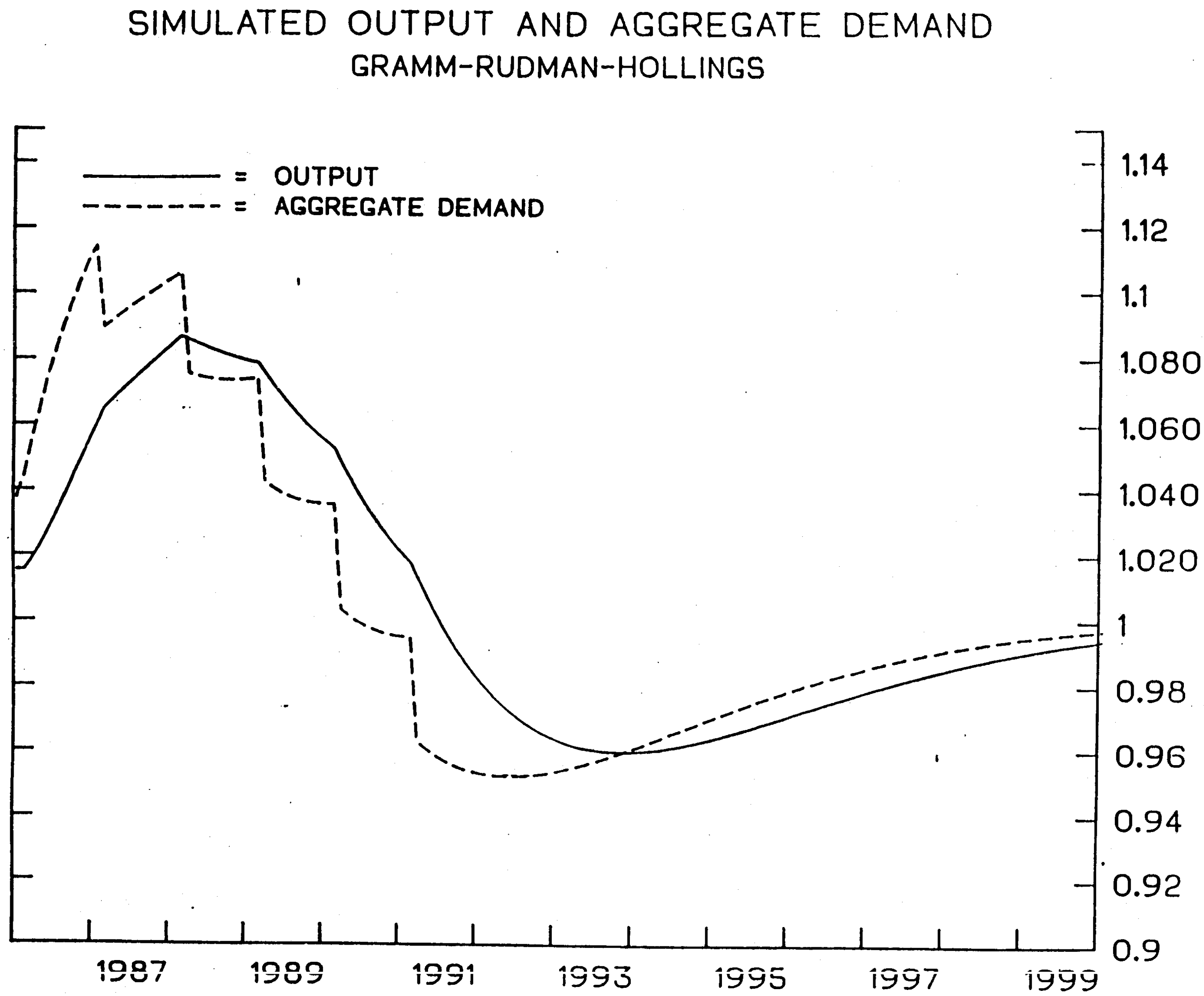

SIMULATED OUTPUT AND AGGREGATE DEMAND
GRAMM-RUDMAN-HOLLINGS
= OUTPUT
= AGGREGATE DEMAND
1.14
1.12
1.1
1.080
1.060
1.040
1.020
1
0.98
0.96
0.94
0.92
0.9
1987
1989
1991
1993
1995
1997
1999

FIGURE 7.3

are both results of the anticipatory expansion of economic activity that stems from the announcement of the fiscal contraction. The real exchange rate also depreciates upon announcement as shown in figure 7.2a. This leads to a gradual improvement in the trade balance as shown in figure 7.2b.

Figure 7.3 shows the results of the various changes in prices on demand and output. The announcement of fiscal contraction reduces the instantaneous real long-term interest rate, R-h, and causes an immediate jump in demand leading to an expansion of interest-sensitive sectors. The subsequent implementation of fiscal contraction in five stages reduces demand and produces a downturn in 1988 which persists into the early 1990s.

The second experiment includes the same fiscal experiment shown in the first set of figures but also includes an announced increase in the rate of money growth from 6% to 8% introduced in 1987, when the fiscal cuts begin, and lasting until 1991 when the reduction of the fiscal spending is complete. At that time the money growth rate returns to 6%. Note that the entire trajectory of this temporary monetary expansion is announced at the time of fiscal announcement so that all surprises come at the beginning of 1986 for forward-looking sectors. The behavior of the economy in the second exercise is qualitatively similar to that in the first simulation, but there are some quantitative and timing differences in the trajectories of macroeconomic variables shown in figures 8.1-8.3 when compared with figures 7.1-7.3.

First, comparing figures 7.1 and 8.1, one can observe that the fall in the consol rate is smaller with monetary accommodation, reflecting the greater eventual rise in the short rate because of the

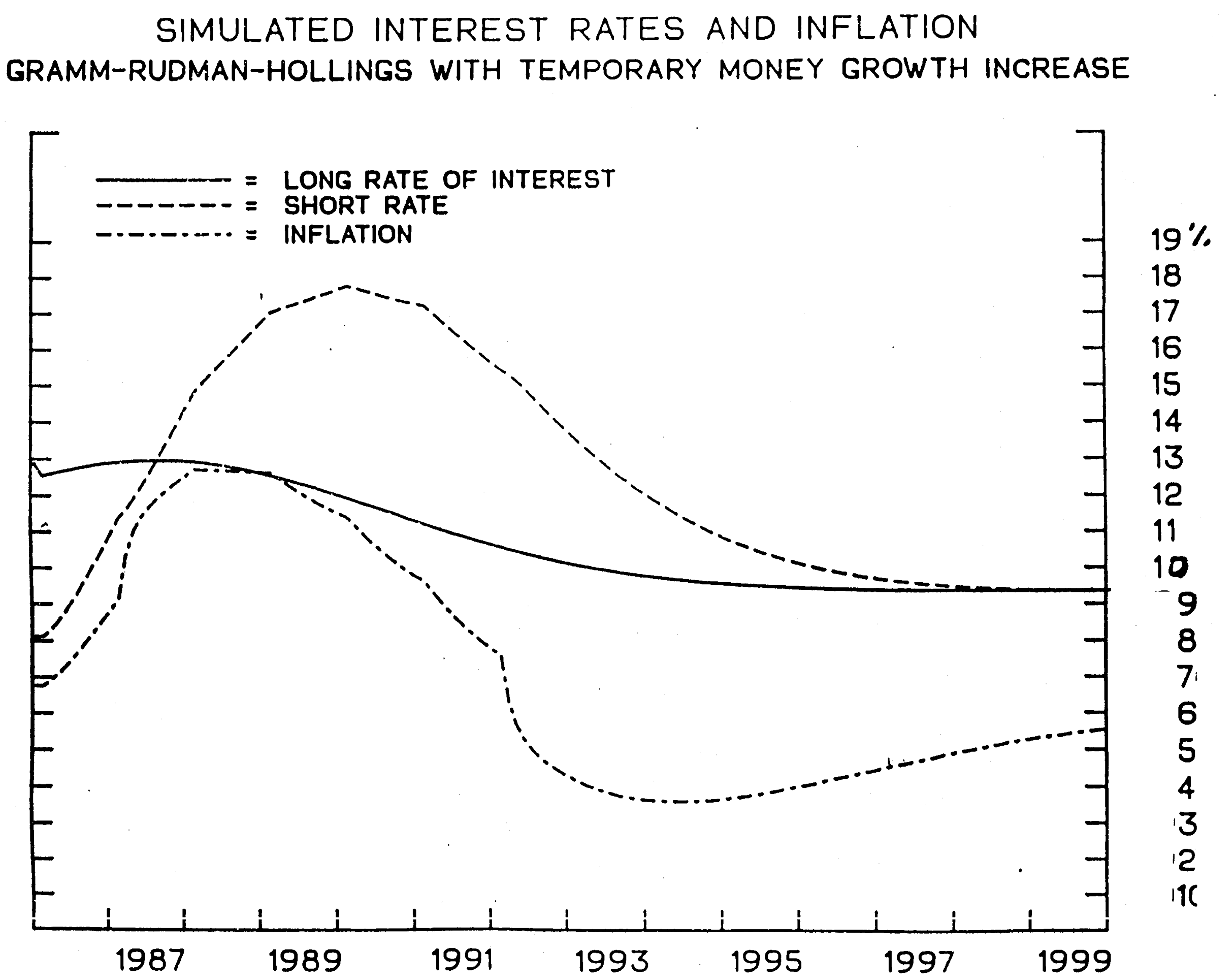

SIMULATED INTEREST RATES AND INFLATION
GRAMM-RUDMAN-HOLLINGS WITH TEMPORARY MONEY GROWTH INCREASE
= LONG RATE OF INTEREST
= SHORT RATE
= INFLATION
19%
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1987
1989
1991
1993
1995
1997
1999

FIGURE 8.1

SIMULATED REAL EXCHANGE RATE

GRAMM-RUDMAN-HOLLINGS WITH TEMPORARY MONEY GROWTH INCREASE

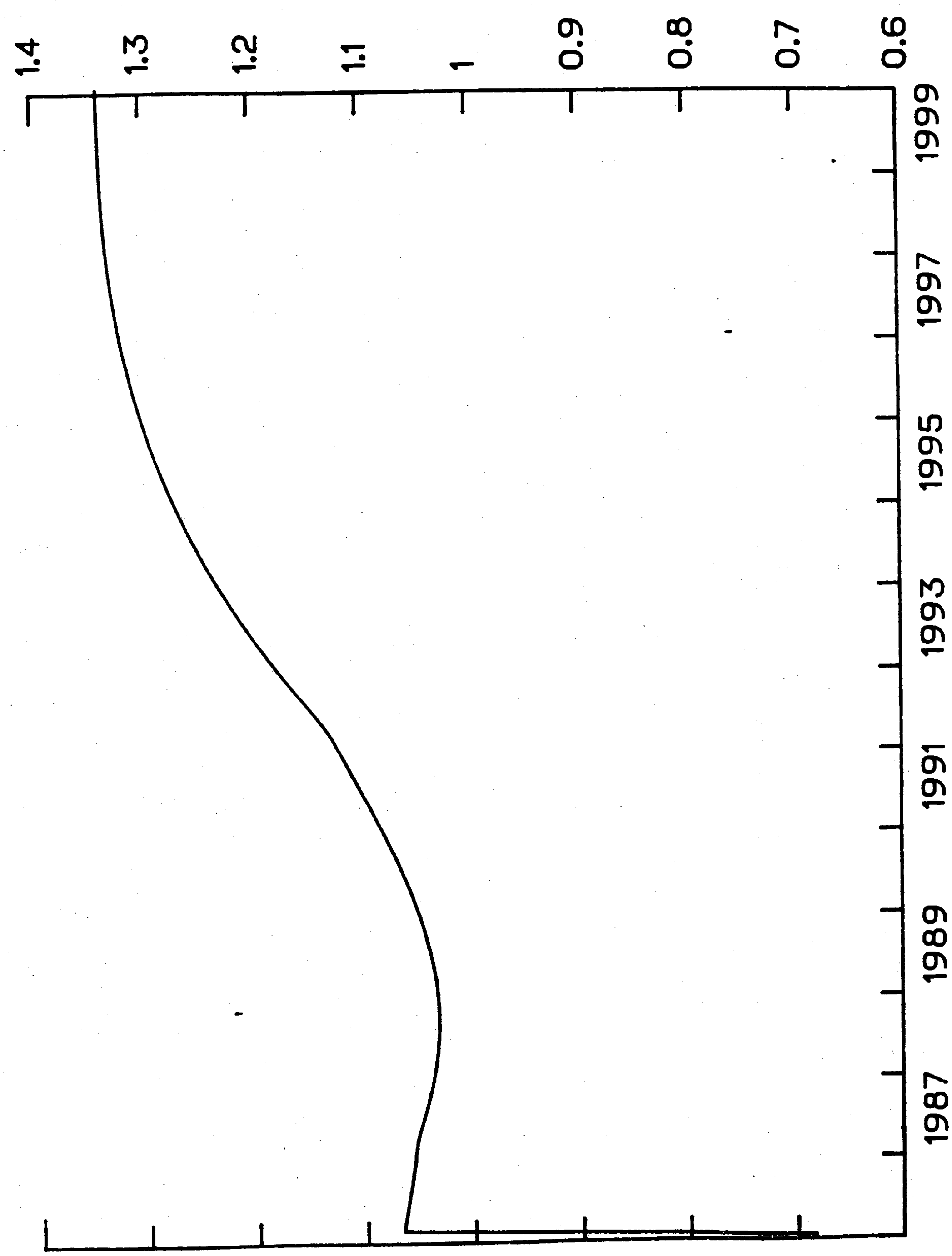


FIGURE 8.2A

SIMULATED TRADE BALANCE
GRAMM-RUDMAN-HOLLINGS WITH TEMPORARY MONEY GROWTH INCREASE

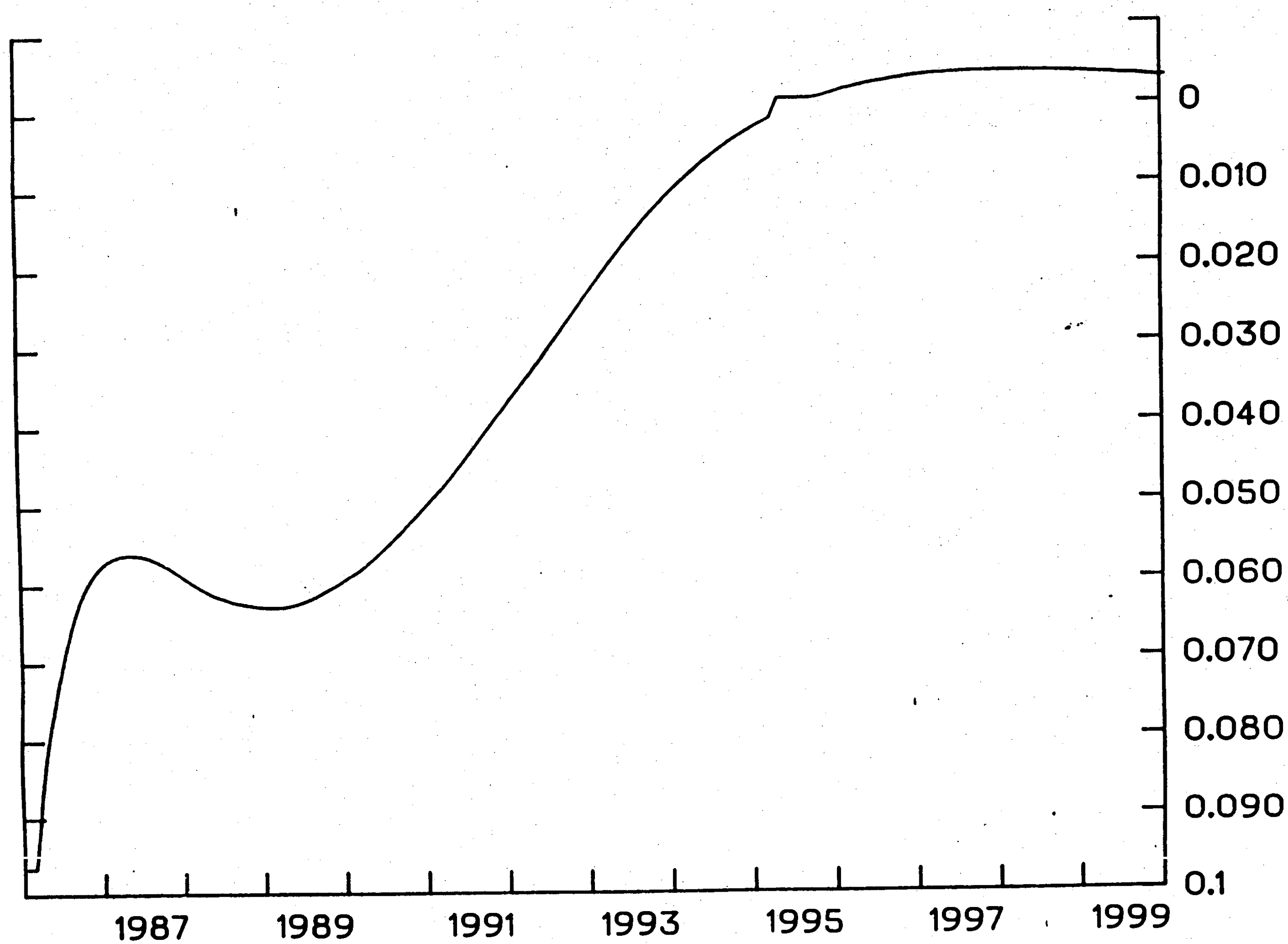


FIGURE 8.2B

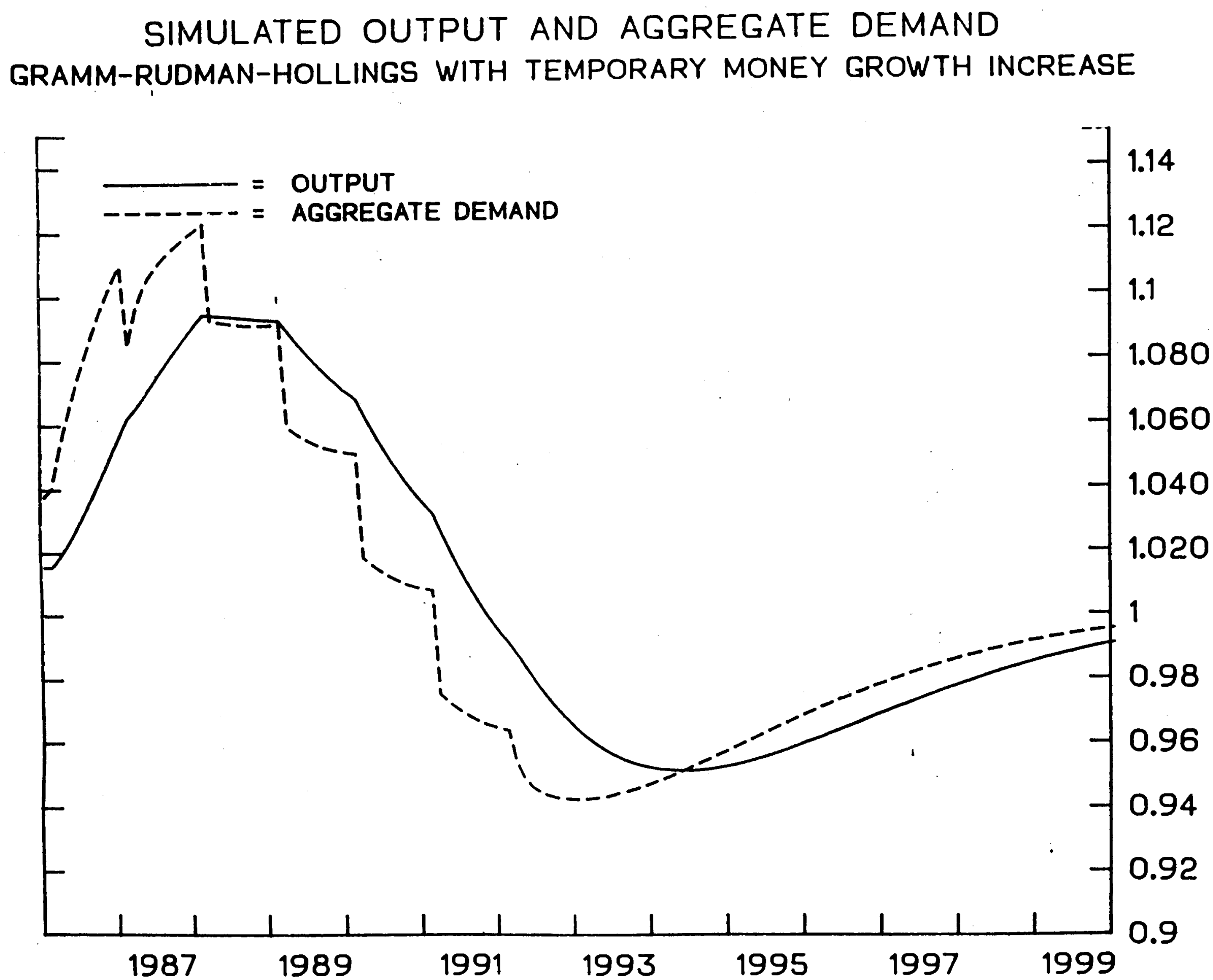

SIMULATED OUTPUT AND AGGREGATE DEMAND
GRAMM-RUDMAN-HOLLINGS WITH TEMPORARY MONEY GROWTH INCREASE
= OUTPUT
= AGGREGATE DEMAND
1.14
1.12
1.1
1.080
1.060
1.040
1.020
1
0.98
0.96
0.94
0.92
0.9
1987
1989
1991
1993
1995
1997
1999

FIGURE 8.3

expected inflation premium and the expansionary impact of eventual reductions in the real interest rate as h, the expected rate of inflation increases. Secondly, beginning in 1987 the rate of inflation increases with monetary accommodation, reaching a peak difference relative to the non-accommodation scenario of nearly 3% in 1988-89. Comparing figures 7.2a and 8.2a one finds that the instantaneous jump in the real exchange rate, which is solely attributable to a jump in the nominal exchange rate, is slightly higher with monetary accommodation. The higher equilibrium price level in the steady state resulting from the increased money growth necessitates a greater nominal depreciation to obtain a comparable steady state real exchange rate; the real exchange rate in each case will differ slightly because of the differential effect on the steady state real bond stock produced by the differences in inflation.

The real exchange rate is not depreciated in figure 8.2a relative to figure 7.2a over the entire simulation period because the increase in inflation resulting from faster money growth in the former case appreciates the real exchange rate after 1988. A comparison of the relative trade balances in the two simulations reveals a slight improvement relative to the non-accommodation case in 1987 and early 1988 because of the transitory increase in competitiveness, but by 1989 the greater domestic absorption of imports and the decline in competitiveness combine to produce a slower improvement in the U.S. trade balance with monetary accommodation than without it (see figures 7.2b and 8.2b). Finally, a comparison of figures 7.3 and 8.3 reveals that the anticipatory expansion will be of very similar size with a slightly greater stimulation of interest-sensitive sectors and a smaller initial expansion of traded goods in the absence of monetary accommodation. As the higher money growth rate persists, one can observe that aggregate output reaches a higher peak and the downturn in economic activity is less severe through 1992 with easier money. Thereafter, as the disinflation begins in the early 1990s, output falls relative to the case when money growth is held constant throughout.

In summary, monetary accommodation that is transitory affords greater levels of output during the fiscal contraction at the expense of both a greater subsequent recession as inflation is wrung out of the economy and greater inflation in the interim.

V. CONCLUSION

The simulation exercises presented above were conducted to illustrate the behavior of an open economy in response to an announced fiscal contraction, with and without a temporary increase in the rate of money growth. The predictive value of these experiments, even in a qualitative sense, hinges on several assumptions about economic behavior which are embedded in the model specification and the simulation technology used. I would like to reflect for a moment on some of these considerations.

First, the assumption that financial markets see everything instantly and that announcements are immediately believable is quite strong. It begs the issue of the predictability of fiscal policy in an environment of legislative uncertainty, which may be a serious omission in the case of the GRH bill. Moreover, questions concerning struggles over the constitutionality of GRH and the fight over where the cuts will fall provide sufficient reason to proceed somewhat cautiously in betting on policy outcomes, at least in the short run. Perhaps a specification which permitted some adjustment of the real sector in response to expected future developments while preserving a relatively more rapid, but not instantaneous, adjustment to information in the financial markets would acknowledge the spirit of the analysis presented above and at the same time diminish the hard corners of discrete jumps upon announcement.

A second omission which is of considerable importance in the current policy environment is the suppression of factor markets in the particular model specification used. The disinflationary consequences of the recent fall in oil prices is of central importance to any assessment of the outlook for inflation over the next several years. In addition, capital accumulation is not considered. The consequences of fiscal policy changes for investment and hence output capacity in the medium and long run is certainly an important consideration when weighing the relative merits of alternative policy actions.

A third aspect of the model used above that is not wholly satisfactory is the rather crude specification of fiscal policy. A more disaggregated specification which allows for discrimination between tax changes and expenditure changes and which includes the endogenous changes in the deficit that result from change in aggregate income, and the interest burden of federal indebtedness, would enhance the analysis. For instance, the analysis of the relative merits of monetary accommodation could be altered if prolonged expansion were to reduce the deficit and therefore reduce the risk premium which is associated with increases in the supply of bonds. This is only one of many such possibilities. Similarly, a more elaborate specification of the current account which considers the interest payments to foreigners and the wealth effects of prolonged current account imbalance would also be desirable.

Finally, this modeling apparatus would be improved by efforts to endogenize the behavior of the rest of the world and to make the U.S. the large country that it most surely is in the current international commercial system. In particular, wide variations in the behavior of exchange rates could result from simply modifying the reaction of foreign interest rates to a change in the interest rate at home. It would also be useful to analyze the consequences of alterations in the matrix of policy variables in several countries simultaneously and to trace the effects of these changes on the external position of developing countries. These issues were clearly presented in a prescient study of the current period produced by a panel of economists in conjunction with the Institute for International Economics; see IIE(1982). Recent work by Buiter(1985), McKibbin and Sachs (1985) and Kenen (1985) has made significant progress in this direction.

In conclusion, the announced fiscal contraction in December of 1985 was associated with a reduction of long-term interest rates and a fall in the exchange value of the dollar. The agreement between this set of stylized facts and the results generated by the simulations above suggests that a specification emphasizing the role of forward-looking asset markets is of great value in explaining the macroeconomic effects of policy changes in the short to medium term.

Footnotes

*The author is a staff economist in the International Finance Division. This paper represents the views of the author and should not be interpreted as reflecting those of the Board of Governors of the Federal Reserve System or other members of its staff. I would like to thank Alan Blinder, William Branson, Michael Gavin, Bonnie Loopesko and Dwight Jaffee for comments and helpful suggestions.

1. The emerging consensus described in the text finds its intellectual foundations in the Mundell-Fleming model developed in the early 1960s. More sophisticated dynamic descendants in that tradition have been developed since. See Dornbusch(1976), Sachs(1980), and Branson and Buiter(1984). Also note that the relationship between fiscal policy and interest rates in an open economy with a high degree of capital mobility may depend upon global fiscal dissavings rather than just U.S. fiscal deficits. For the argument that an increase in global fiscal dissavings did not cause high real interest rates because foreign fiscal contraction offset U.S. fiscal expansion in recent years, see Blanchard and Summers(1984).

2. The fiscal stimulus is measured as a fraction of total private demand. Consider $Y=A+F$, where A is total private sector demand. This is equal to $Y=A(1+F/A)$. Converting this expression into logs reveals,

$$y=\ln(A) + \ln(1+F/A).$$

Provided that F/A is small a Taylor approximation would yield,

$$y=\ln(A) + F/A.$$

Similarly, if $Y=A+F+X$, where X represents the trade balance, one can construct, $Y=A(1+F/A)(1+(X/(A+F)))$. Converting to logs and using the Taylor approximation yields,

$$y=\ln(A) + F/A + X/(F+A).$$

In the open economy section developed below I make use of this in specifying the trade balance. I would like to thank Alan Blinder for suggesting this method to me.

3. Consider a simple specification with $y=\Phi(N)$ and $\mathring{N}=-\lambda(d-y)$, where N=inventories and $\Phi'$is less than zero. Then $\mathring{y}=\Phi' * (-\lambda)(d-y)$. A more sophisiticated specification would also include some influence of demand on desired inventories.

4. For a proof of the result that the non-predetermined variable will intersect the saddlepath into the terminal equilibrium at the time of implementation of the changes which create the terminal saddlepath see Rogoff(1980).

5. The specification utilized here is not necessary to generate an anticipatory recession. Other examples of anticipatory expansions in

response to a fiscal contraction, or similarly, an anticipatory recession in response to an announced fiscal expansion are found in Blanchard(1981) and Gavin(1985). In those papers the stock market falls in response to an announced fiscal expansion when the interest rate effects dominate the output effects on profitability. This is the so-called "bad news" case.

6. This relationship is similar to the results developed in Sachs and Wyplosz(1984). In that paper they showed that imperfect substitutability between domestic and foreign securities could lead to a depreciation of the real exchange rate upon announcement of a fiscal expansion. In this paper if α is very large or the deficit runs for a long period of time then the indirect interest rate effect could outweigh the direct effect of government spending and lead to a depreciation upon announcement of fiscal expansion.

Consider an unanticipated permanent increase in f which begins at time t_0 and is evaluated at time T. Integrating (10), the bond accumulation equation, reveals that;

$$b(T)=\int_{t_0}^{T}[f(s)-\hat{M}(s)L(s)]ds \quad +b(t_0).$$

Assuming that $\hat{M}$ is constant and that f is constant between t_0 and T at f_0+df. One obtains;

$$b(T)= [f_0+df]*[T-t_0] -\hat{M}\int_{t_0}^{T}[L(s)-L_0]ds -\hat{M}L_0[T-t_0] +b(t_0).$$

Presuming that $\mathring{b}$=0 before t_0, then the increment to the bond stock equals

$$b(T)-b(t_0)= df*[T-t_0] - \hat{M}\int_{t_0}^{T}[L(s)-L_0]ds.$$

The relationship of L(s) to L_0 will depend upon the evolution of r and y between t_0 and T. An increase in f will increase d on impact and increase y. The increase in output will cause real balances to fall. This can be seen from equations (6) and (12) of table 3. Note that m=ln L.

$$\mathring{m}=\hat{L}=\hat{M}-\mathring{p}=-\phi(y-\bar{y})\leq 0.$$

Thus if L(s) is less than L_0, the increment in the bond stock will exceed df*[T-t_0]. The case of an anticipated fiscal shock is more difficult to analyze because the anticipatory effects of the announcement of future policy will produce variations in L before the implementation of the fiscal change. But as T, the point of examination, gets sufficiently large the results will be similar to the those in the case of an unanticipated change in fiscal policy.

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