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EXPECTED FISCAL POLICY AND THE RECESSION OF 1982

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I. Introduction

The Economic Recovery Tax Act of 1981 had one aspect that is unusually useful for economic analysis. It provided an example of a clear-cut announcement of future policy actions at specified dates. This provides an opportunity to apply recent advances in the analysis of expectations dynamics to data that have been generated in an environment that includes such anticipated policy action.

A three-stage future tax cut was announced in the Tax Bill in March 1981. In a Keynesian model with liquidity-constrained consumers or investors, or with uncertainty, this would normally be expected to provide a stimulus to the economy when the tax cuts actually appear. But the financial markets could look ahead to the stimulus and the shift in the high-employment deficit brought about by the tax cuts, and their implications for bond prices and interest rates. In this paper we argue that this happened during the first half of 1981. As market participants came to understand that the tax and budget actions of March 1981 implied a <u>future</u> shift of the high-employment—now "structural"—deficit by some 5 percent of GNP, they revised their expectations of future real interest rates upward. This caused a jump in real long-term rates then, in 1981. And, we argue in section IV below, it also caused a sudden and unanticipated real appreciation of the dollar at the same time. The jump in real long-term interest rates and the dollar appreciation in the first half of 1981 were essential features of the recession that began in July 1981.

This paper points out the possibility of a purely anticipatory recession. If the only policy action had been the fiscal announcement, and if goods markets are "Keynesian" but financial markets are forward-looking, the announcement can cause a recession, which will end when the actual fiscal action begins to stimulate the economy. In the actual context of 1981, a shift toward monetary tightness also contributed to the recession.

The models we use to analyze these policy changes have many antecedents. Wilson (1979) analyzed the effect of anticipated policies in Dornbusch's (1976) model of expectations and exchange rate dynamics. Buiter and Miller (1984 and references therein) have used similar models to analyze the theoretical effects of disinflation policies, as well as the actual events of the Thatcher period (1981, 1984). Miller (1980) and Blanchard (1981) have constructed closed-economy models which include an expectational term-structure of interest rates, and are simple enough to be treated analytically. In particular, the initial model of section III begins with Marcus Miller's (1980) four-equation closed-economy model, and we have benefitted greatly from discussions with him on this topic (and many others). The paper is structured as follows.

In section II we begin with some "stylized facts" about the recession. The important things to notice are the sharp rise in real long-term interest rates and the real appreciation of the dollar in early 1981, and the subsequent split of financing of the budget deficit between domestic saving and foreign borrowing--the current account balance.

Section III begins by incorporating a term structure based on expectations of future movements in interest rates into a standard fixed-price closed-economy IS-LM model. This is the model of Miller (1980). In it the short-term rate moves along the LM curve, but the long-term rate follows a positively-sloped saddle path. This framework shows clearly the principles involved in analyzing expectations dynamics. We then proceed to add a model of core inflation and a short-run Phillips curve in order to incorporate price dynamics.

The open-economy version of the model is presented in section IV, with equations for the current account and an "open interest parity" condition with exchange-rate expectations and a risk premium that depends on the stock of government debt. This reflects our assumptions that dollar-dominated and foreign-exchange assets are imperfect substitutes so that U.S. interest rates can move relative to foreign rates. The open-economy model shows how the anticipated fiscal package could cause a jump in the real long-term rate and the dollar, splitting the financing between domestic investment and the current account.

The simulation version of the model is presented in section V. There we illustrate the dynamic effects of a variety of monetary and fiscal policies, and then combine them to produce a simulated view of the U.S. economy from 1980 to 1983. The results of this final simulation experiment are then compared with the stylized facts presented at the outset. Finally, we conclude with a discussion of the strengths and shortcomings of our approach, highlighting a number of policy events which occurred during this period, but are not integrated into this exercise.

II. Economic Policies and the Unusual Characteristics of the 1982 Recession

The 1982 U.S. recession coincided with major shifts in monetary and fiscal policies. In this section we will present a brief description of the main policy changes, as well as of the corresponding movements in some key endogenous variables. In particular, we will focus on the financing of the deficit, and on the behavior of prices, production, interest rates, and the exchange rate.

In March of 1981 the new budget and tax package was announced. It included a major increase in defense spending to be phased in over several years, a three-stage tax cut to begin in 1982, and some cuts in non-defense spending. The package as a whole implied a growing "structural" deficit in the Federal Government's budget from $40 billion in the first half of 1981 to about $180 billion by the end of 1984. The financing of the overall government deficit can be seen in Table 1. As required by the national income identity, a budget deficit must be financed by a combination of excess domestic saving over domestic investment, and a current account deficit (net foreign saving). Until the third quarter of 1982 most of the deficit was financed by net domestic saving. Investment fell from a peak of $495.8 billion in 1981:3 to $377.4 billion in the last quarter of 1982. In 1983, however, as the recovery gained momentum and the dollar continued to appreciate, a larger share of the deficit began to be financed by foreign saving.

Unlike fiscal policy, it is harder to characterize monetary policy in this period of financial innovation and deregulation. Even though the monetary authorities made explicit their intention of reducing inflation, the main monetary indicators did not exhibit signs of larger policy shifts.

Table 1: U.S. NATIONAL INCOME ACCOUNTS, 1979.1 - 1984.2

	Government Deficit	Net Foreign Saving	Net Domestic Saving	Private Investment	Private Saving
1979.1	-22.1	-2.3	-15.4	415.1	399.7
2	-20.1	5.4	-17.4	428.3	410.9
3	-12.9	-1.6	-14.6	431.9	417.3
4	-2.1	5.7	-15.6	416.3	401.2
1980.1	7.5	4.1	-7.3	422.0	414.7
2	38.1	-6.7	43.0	394.3	437.3
3	43.3	-20.3	61.3	379.5	440.8
4	33.9	-2.3	37.1	411.7	448.3
1981.1	8.1	-11.3	13.3	455.5	468.8
2	10.6	0.5	13.1	472.1	485.2
3	25.2	0.3	37.8	495.8	531.6
4	63.7	-5.5	76.6	476.2	552.8
1982.1	79.7	-4.8	91.2	422.9	514.1
2	81.2	-8.7	88.2	432.5	520.7
3	127.0	24.8	99.6	425.3	524.9
4	175.3	21.9	149.2	377.4	526.6
1983.1	142.9	6.7	137.4	404.1	541.5
2	114.4	33.0	84.9	450.1	535.0
3	133.5	41.5	96.7	491.9	588.6
4	129.3	59.1	75.0	540.0	615.0
1984.1	107.4	77.7	27.5	623.8	651.3
2	n.a.	83.5	n.a.	631.5	n.a.

Source: CITIBASE

Net Domestic Saving = Gross Private Saving (GPS) minus
Gross Private Domestic Investment (GPI)

The growth rate of the money supply (M1 as currently defined) decreased from an annual rate of 8.3% between 1976.3 and 1979.3 to 6.1% between 1979.4 and 1982.3. In particular, from the second quarter of 1981 to the third quarter of 1982 M1 grew at an average annual rate of 5.4%. Finally, if we correct the money supply for the introduction of NOW accounts on December 31, 1980, we find that for the year 1981 the adjusted figure drops from 6.4% to 2.3%, indicating a severe monetary squeeze.

The behavior of the main macroeconomic variables in this period is summarized in Table 2. By mid-1981 nominal short-term interest rates had risen by about 5 percentage points over mid-1980, and long-term rates by 3.5 points, even as the inflation rate began to decline. In the third quarter of 1981 the recession began, and short rates dropped slightly. Long rates, however, remained high, a fact that we will discuss at length below. Almost simultaneously with the announcement of future fiscal policy and the rise in interest rates, the dollar started its appreciation, which has continued to the end of 1984. The recession began in the third quarter of 1981 and ended in the fourth quarter of 1982, with a decline in industrial production of about 11.5%.

If tight money were the sole cause of the recession, we would have expected to see the short-term interest rate remain above the long-term rate. However, since the fourth quarter of 1981, the short rate has been below the long rate. The severity of the recession, the inversion of the term structure of interest rates, and the appreciation of the dollar in recession are the puzzle that we attempt to solve in the next two sections, focusing on expectations dynamics and future fiscal policy.

Table 2: ECONOMIC INDICATORS, 1979.1 - 1984.2

	INFL	SR	LR	RLR	RER	IP	GNP
1979.1	8.7	9.4	9.0	0.3	101.9	100.5	99.0
2	8.7	9.4	9.1	0.4	99.6	100.0	98.8
3	9.1	9.6	9.0	-0.1	101.9	100.0	100.0
4	9.5	11.8	10.2	0.7	100.1	99.8	100.1
1980.1	10.0	13.5	11.8	1.8	100.0	99.6	100.6
2	10.2	10.0	10.6	0.4	100.0	91.6	98.3
3	10.3	9.2	10.9	0.6	102.9	94.5	98.4
4	10.2	13.7	12.1	2.0	98.2	98.4	99.4
1981.1	9.5	14.4	12.7	3.2	92.6	99.6	101.5
2	8.9	14.5	13.5	4.6	85.8	100.1	101.7
3	8.4	15.1	14.5	6.1	81.8	99.2	102.6
4	7.8	12.0	14.1	6.3	85.9	93.9	101.3
1982.1	7.0	12.9	14.3	7.3	83.7	92.7	99.9
2	6.1	12.4	13.7	7.6	82.0	90.8	100.1
3	5.7	9.7	12.9	7.2	78.6	89.9	99.9
4	4.9	7.9	10.7	5.8	78.0	88.5	99.6
1983.1	4.0	8.1	10.9	6.9	80.4	91.6	100.2
2	4.1	8.4	10.8	6.7	79.1	95.8	102.5
3	3.5	9.2	11.8	8.3	76.2	100.7	104.4
4	3.0	8.8	11.7	8.7	75.7	102.4	105.7
1984.1	3.5	9.2	11.9	8.4	75.4	105.2	108.3
2	3.0	9.7	13.2	10.2		107.3	110.2

Sources: GNP: CITIBASE
Others: IFS Data tape, IMF.

INFL = % increase in PCE deflator over the same quarter a year earlier.

SR = T-bill 3-month.

LR = T-bond 20-year.

RLR = real long rate (LR - INFL).

RER = index of real effective exchange rate using WPIs (down = $ appreciation); this is the inverse of the IMF index.

IP = industrial production, indexed to 1979.3 = 100.

GNP = GNP at 1972 prices, indexed to 1979.3 = 100.

III. The Basic Model, Closed Economy

We begin the exposition with the simplest fixed-price IS-LM model of a closed economy. The basic idea of how expectations dynamics in financial markets can generate a recession from an expected fiscal expansion can be easily outlined in this framework. Then we will go on to price dynamics and open-economy aspects of the model.

IS-LM with Short- and Long-Term Interest Rates

The basic model can be stated in four equations

(1) $d = ay + i + \mu f - \delta(R - h)$: IS Curve,

(2) $r = (\tau y - m)/\varepsilon$: LM Curve,

(3) $\dot{y} = \psi(d - y)$: Gradual Output Adjustment,

(4) $E\hat{R} = R - r$: Path of Long Rate, or Term Structure.

Variable definitions are given in Table 3. Equation (1) gives aggregate demand d as a function output y, autonomous investment i, the exogenous component of fiscal policy f, and the real long-term (actually consol) bond rate. Consumption is assumed to be a function of current income, in Keynesian fashion. This is clearly an important assumption for our analysis of fiscal policy. If infinitely-lived consumers take into account fully all future tax liabilities, including those related to debt service, then a shift from tax-financing to debt-financing of government spending will have no effect on aggregate demand. See Barro (1974) for a discussion of this case. For a variety of reasons such as liquidity constraints and uncertainty regarding remaining years of life (see Blanchard, 1984), we think the neutrality assumption is too strong.

The expected, or "core" inflation rate h is given exogenously in equation (1), and set at zero for the time being. It will be endogenized later. Equation (2) is the LM curve normalized on the short-term interest rate r. The short rate is assumed to clear the money market at all times. In the LM curve m is real balances M/P, and ε is the semi-elasticity of the demand for money with respect to r. Equation (3) gives the change in output over time as a partial adjustment to the excess of demand over output. A more precise model would include inventory dynamics, but the specification here is sufficient to maintain a focus on expectations.

Equation (4) specifies the term structure of interest rates, providing one link with the future, and thus bringing expectations dynamics into the model. Aside from a risk premium, which we set to zero, any long-short differential must be equal to the expected rate of change of the long rate. If $R - r > 0$ in equation (1), then the long rate must be expected to rise (i.e. consol price to fall) to generate a capital loss that offsets the rate differential, for the bond market to be in equilibrium.

The dynamics of the model are described in the IS-LM diagram of Figure 1. The short-term rate r and the long-term rate R are measured on the vertical axis; output is on the horizontal axis. The stationary equilibrium is at point E, where $R = r$ and $d = y$. Away from equilibrium, y and R move along the "saddle path" RR, and r moves along the LM curve.

The innovation in Figure 1 is the RR saddle path. This comes from the combination of equation (4) and the assumption of rational expectations in financial markets. In this non-stochastic model, rational expectations is the same as perfect foresight. Output adjusts toward the

IS curve, following equation (3). This gives the horizontal arrows in Figure 1. The short-term rate clears the money market, so it moves along the LM curve following output.

The RR saddle path can be derived as follows. If the long rate R were to adjust along the LM curve, $E\hat{R}$ would be zero throughout, from equation (4) with $R = r$. This is inconsistent with rational expectations; to the left of E, r and R are expected to rise and to the right of E to fall. Therefore, to the left of E, for example, with $E\hat{R} > 0$, R must exceed r. This gives the vertical arrows that show the motion of R. If R is above LM, $R > r$ and $E\hat{R}$ must be positive for equilibrium between short and long rates; vice versa below LM. There is then only one saddle path RR that is consistent with a rational expectations equilibrium. It is positively shaped but flatter than LM. Along it, to the left of point E, $E\hat{R} = R - r > 0$ and to the right of E, it is negative. Other paths of R,y are "bubble" paths that cross IS vertically ($\dot{y} = 0$) or LM horizontally ($E\hat{R} = 0$) and explode to the northwest or southeast. These "unstable branches" will play an important role in the analysis of anticipated fiscal policy.

<u>Unanticipated Monetary and Fiscal Policy</u>

As a prelude to an analysis of the 1982 recession, we can use the diagram of Figure 1 to characterize the effects of unanticipated monetary or fiscal policy on demand and the term structure of interest rates. This is the usual textbook case. Consider first the effects of a contractionary monetary policy (dM 0), illustrated in Figure 2. The LM curve shifts up, so the equilibrium moves from point A to point B. At the initial level of income y_a, the two interest rates rise to r_1, R_1

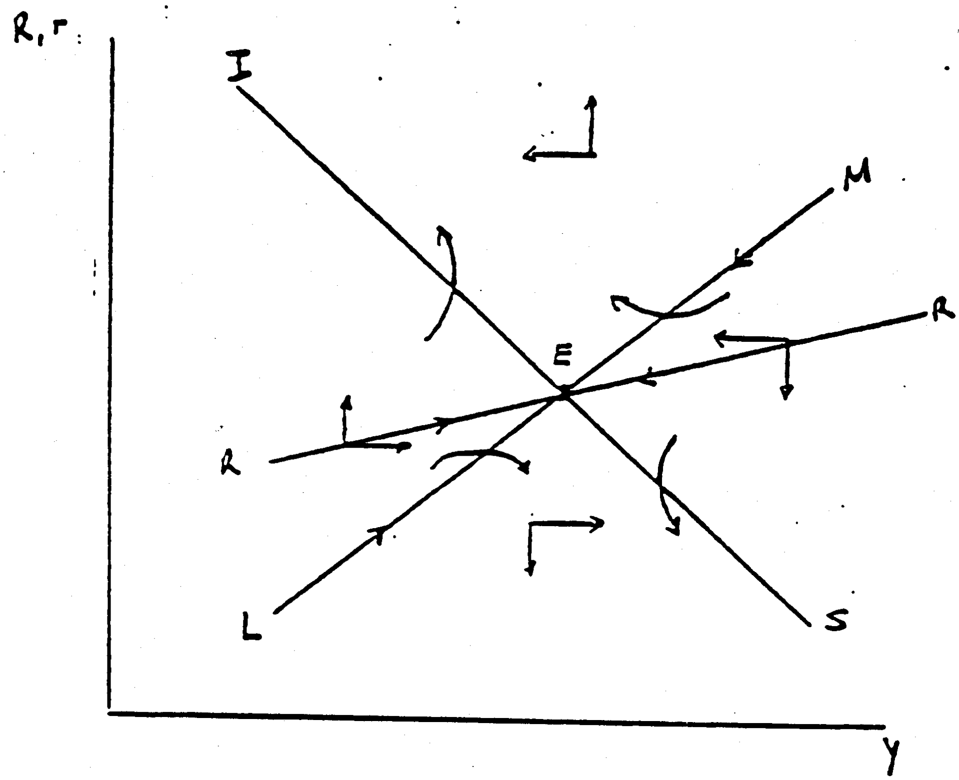

Figure 1: Basic Expectations Dynamics

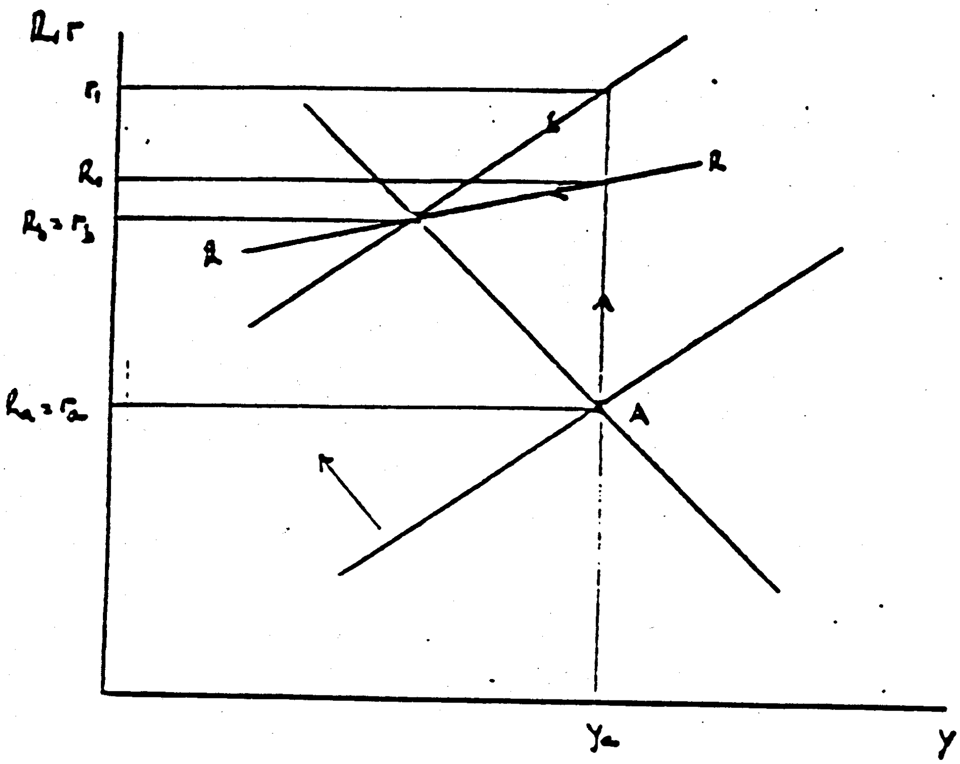

Figure 2: Monetary Contraction

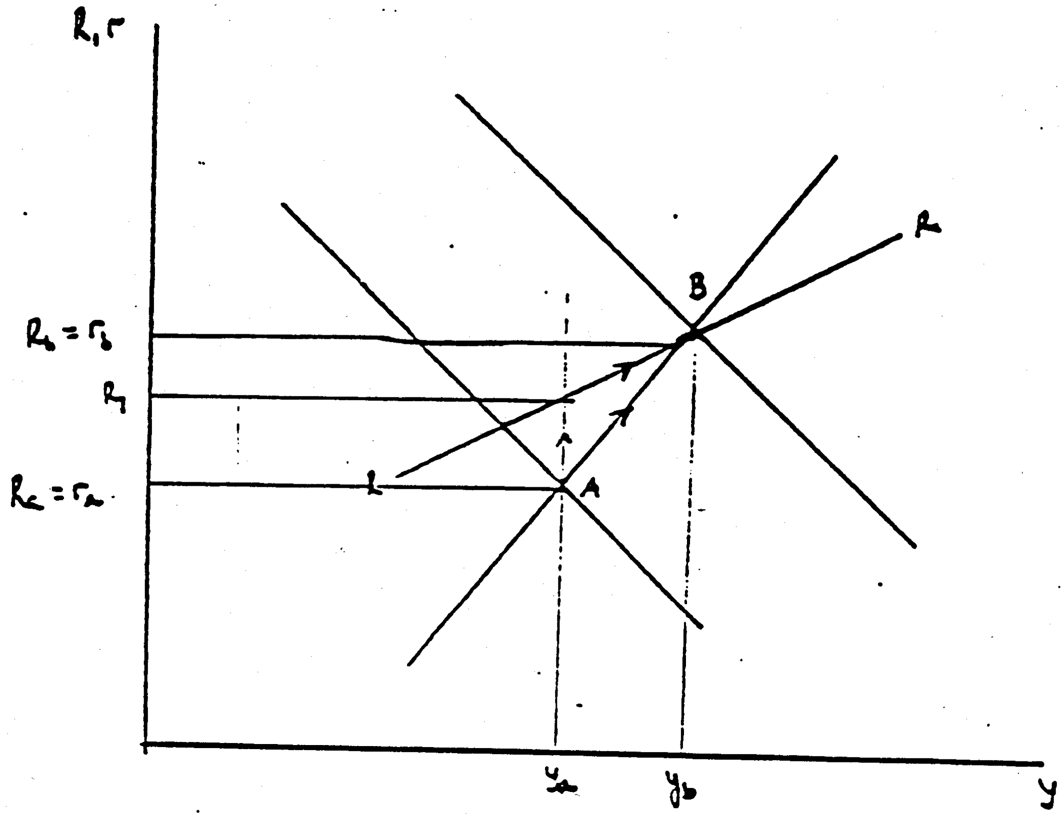

Figure 3: Expansionary Fiscal Policy

with the short rate above the long. As y falls, the two interest rates also fall, converging to point B.

The effect of an unanticipated fiscal expansion is shown in Figure 3. Again the equilibrium point moves from A to B. With y at y_a, initially the short rate remains at r_a. But in anticipation of the future rise in both rates, the long rate jumps to R_a. As output then rises to y_b, both interest rates rise to R_b, r_b.

Expected Fiscal Policy

The Reagan Administration's future budget package, which implied a rising structural deficit, was announced in March 1981. The potential recessionary effects of an announcement of a future fiscal expansion are illustrated in Figure 4. With the economy at point A, a future fiscal expansion is announced. The financial markets come to understand that the future equilibrium is at point C, with higher interest rates. This means the long rate will jump immediately. But onto what path? The future saddle path will be RR at the time of the actual fiscal expansion. The long rate will rise seeking an unstable branch relative to the existing equilibrium A that has the following property: as the economy moves along that unstable branch, it will reach the new saddle path at the time the announced fiscal expansion actually takes place, i.e., when equilibrium C comes into existence.

Thus the long rate jumps to R_1 in Figure 4 with output at y_a. This depresses investment and sends the economy into recession along the unstable branch from point 1 to point B. Output and the short rate fall to y_b, r_b, while the long rate rises to R_b. When the actual fiscal expansion occurs, the recovery begins. Output increases from y_b to y_c, with the short and long rates rising to converge to C. The financial market's anticipation of the <u>future</u> fiscal expansion raises the <u>present</u> long-term interest rate and throws the economy into an <u>anticipatory recession</u>.

Anticipation of the future effects of the 1981 budget and tax package cannot be the only cause of the 1982 recession, however. In Figure 4, the long rate rises and the short rate falls in the recession, and the short rate is below the long rate throughout. However, in the data of Table 2 we see that the short rate rose above the long rate in late 1979 and again from the fourth quarter of 1980 to the third quarter of 1981, after which it has remained below the long rate. So current tight monetary policy in 1980-81 must also be part of the story.

Tight Money and Anticipated Fiscal Ease

To explain the movements in the term structure in 1980-84, as well as the recession and recovery, we need a scenario that combines a monetary policy tightening in 1981 with the effects of anticipated fiscal ease. In fact, growth of M1 slowed to 5½ percent, annual rate, from December 1980 to July 1982, so this may be a fairly accurate scenario.

The combination of an actual tightening of monetary policy and an anticipated easing of fiscal policy is illustrated in Figure 5. For expositional convenience, we assume there that the two policies have an offsetting effect on demand in the final equilibrium, that is, that after the recession and recovery, real GNP is back to its initial level relative to trend.

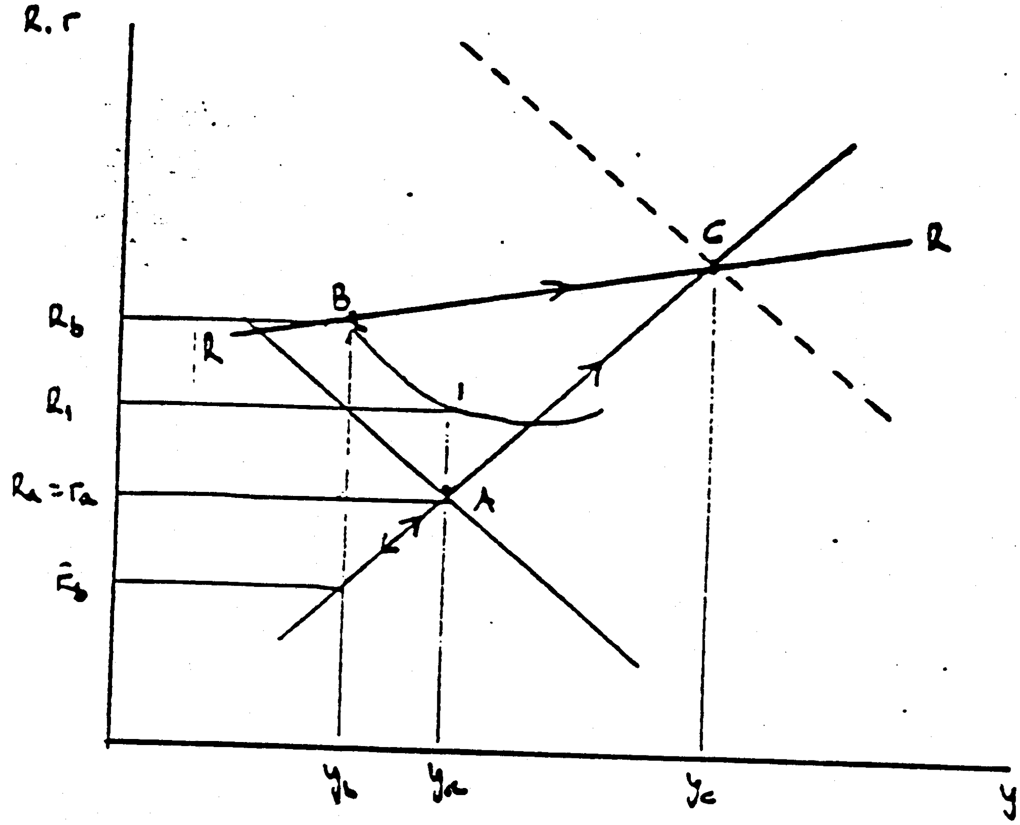

Figure 4: Expected Fiscal Expansion

In Figure 5, the shift of the LM curve is current and unanticipated, while the IS shift is announced for the future. This creates a new current equilibrium at point B, and a future equilibrium at point D with a saddle path RR into it. At the initial level of income y_a, the short rate jumps to r_d on the new LM curve. The long rate rises, seeking the unstable branch relative to the new equilibrium B that will take the economy to RR when the IS curve actually shifts. So the long rate rises to point 1 to put the economy on the recessionary path from 1 to C.

Now we see that initially the short rate moves above the long rate. In the recession, as y falls from y_a to y_c the short rate falls along the LM curve to r_c, moving below the long rate at the bottom of the latter's path from 1 to C. The economy bottoms at point C when the actual fiscal stimulus comes on line. During the recovery period the two rates rise, converging to point D.

The essential feature of this scenario is the reversal of the term structure. At first short rates rise above long rates, and then fall below them, bottoming when the recession bottoms. Then in the recovery both rise with the long rate above the short. This is essentially the pattern of the data of Table 1. In the fourth quarter of 1980 the short rate jumped above the long rate. The crossover came in the first quarter of 1982, and the short rate remained below the long rate after that, bottoming with the recession in the fourth quarter of 1982. Both rates rose after that. Thus the scenario of an actual monetary tightening combined with anticipated fiscal ease is consistent with the broad movements of the term structure and GNP.

Price Dynamics

The next step is to add price dynamics to the model. We adopt a model of "core inflation," in which inflation adjusts gradually to monetary disturbances and is also sensitive to output disturbances. We use this model to reflect the idea that inflationary expectations are adaptive, rather than forward-looking. In our specification, the inflation rate is a geometric average of past money growth rates. This can be taken to represent a credibility effect, where a policy change is not immediately assumed to be permanent, as well as an element of stickiness on the supply side, such as would be implied by staggered wage contracts. People believed in the early 1980s that inflation was coming down only when they saw it come down.

The inflation equations are two:

(5) $\dot{h} = \pi(\hat{M} - h)$: Adjustment of Core Inflation,

(6) $\hat{p} = h + \phi(y - \bar{y})$: Phillips Curve.

Equation (5) has the core inflation rate h adapting to deviations of money growth from h. Equation (6) says the actual inflation rate is the core rate plus a Phillips-curve term for deviations of output from its natural level $\bar{y}$.

For solutions of the dynamic model we will turn to computer simulation after introducing open-economy aspects in section III. But the solution algorithm for the dynamic closed-economy model is clear. The ISLM equilibrium is on a trend inflation rate given by $\hat{M}$. Core inflation is $\hat{M}$ so $\dot{h}$ in (5) is zero. Equilibrium output is $\bar{y}$, so $\hat{p}$ in (6) is equal to h. Demand and output are equal so $\dot{y}$ in (3) is also zero. With R = r from

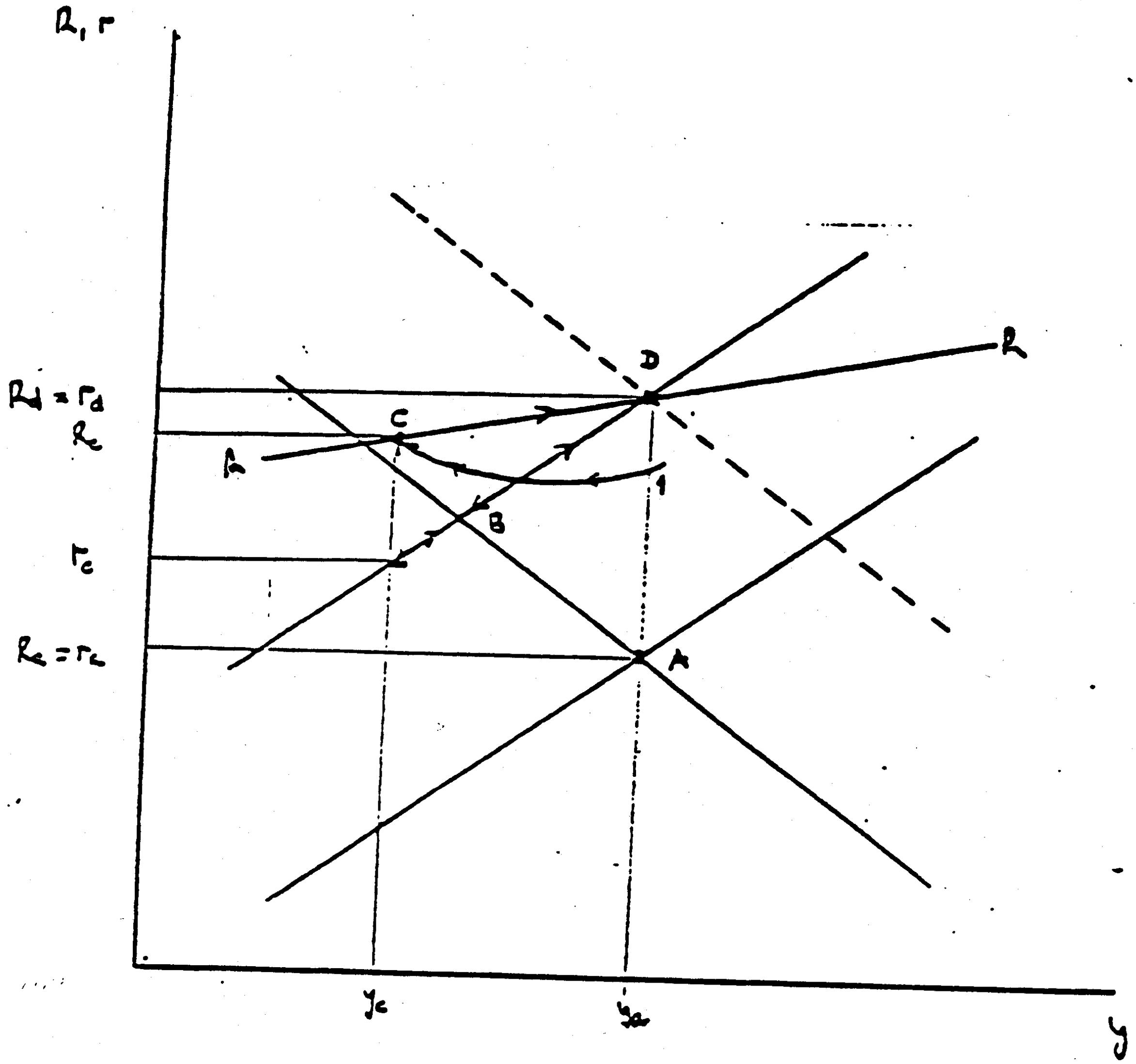

Figure 5: Actual Monetary and

Expected Fiscal Policy

(4), we can solve (1) for R and then (2) for P. The saddle path into this solution gives the motion of the real long-term interest rate R - h. The jump in the long-term real interest rate over the first half of 1981, and its continued upward movement since the bottom of the recession in the fourth quarter of 1982 can be seen in the data in Table 1. The is consistent with an interpretation of Figure 5 as showing the path of the real long-term interest rate.

IV. The Open Economy

In addition to the historically high level of long-term real interest rates since the first half of 1981, the economy has experienced an appreciation of the dollar, in real effective terms, of some 30 percent since then. The data, using the IMF's index, are shown in the fifth column of Table 2. Since we define the exchange rate as U.S. dollars per unit of foreign exchange, an appreciation means the real effective rate in Table 2 goes down. Again, the major movement in the exchange rate comes across the first half of 1981, consistent with the movement of real interest rates. To build this into the model, we have to open it up.

Trade Flows

We assume gradual adjustment of real net exports x toward an equilibrium level $\tilde{x}$ that is a function of competitiveness, domestic income, and foreign income. Competitiveness is measured by the exchange rate relative to the domestic price level (e/p), with the foreign price level fixed at unity. The equations for trade flows are:

(7) $\tilde{x} = \sigma\, e/p + \lambda y^* - \omega y$: Equilibrium Trade Balance,

(8) $\dot{x} = \gamma(\tilde{x} - x)$: Gradual Trade Adjustment.

The partial adjustment model is used to reflect the assumption that adjustment of trade flows to changes in competitiveness takes time. Equation (1) should be rewritten to include the trade balance:

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

Asset Markets

The central aspect of our model of exchange-rate determination is imperfect substitutibility between assets denominated in U.S. dollars and in foreign exchange. With imperfect substitutability, an accumulation of U.S.-government debt can increase U.S. interest rates relative to "world" interest rates by increasing the risk premium on U.S. bonds. With rational expectations, financial markets can look ahead to this implication of a shift in the full-employment deficit, and move the interest rate and exchange rate at the time when the implication becomes clear.

Imperfect substitutability and a risk premium that is positively related to the bond stock are given by

(9) $E\hat{e} = r - (r^* + \rho b),$

where $\hat{e}$ is the rate of change of the exchange rate, r and r^* are the U.S. and world short-term interest rates, and b is the real bond stock. This is the standard open interest parity condition with a flexible exchange rate and a risk premium.

The real bond stock accumulates as the non-monetized part of the budget deficit, following

$$(10) \qquad \dot{b} = f - \hat{M}L$$

where f is the current real deficit, $\hat{M}$ is the growth rate of money, and L is real balances. Agents in financial markets are assumed to look ahead to the consequences of shifts in f or b through equation (10).

With perfect foresight, equation (9) says that the current level of the exchange rate must reflect the integral of future expected interest differentials, adjusted for the risk premium. In the solution of the open-economy model, agents look ahead to the path of $r - r^* - \rho b$. Throughout the analysis, we hold r^* constant. If this integral is positive, the expected value of $\hat{e}$ must be positive, so the current exchange rate must fall below its equilibrium value given the current fundamentals. Thus for sufficiently small ρ, the announcement of a future fiscal deficit combined with a current shift to tighter monetary policy, by increasing the expected future short-term interest rate, will yield an appreciation of the dollar, at the time of the announcement. Buiter and Miller (1983) give the forward integral of (9) as

$$(11) \qquad e(t) = \bar{e}(t) + \int_t^{\infty} E_t(r^* + \rho b(s) - r(s))ds,$$

where $\bar{e}(t)$ is the current long-run equilibrium exchange rate. When the expected integral becomes negative, e(t) falls relative to $\bar{e}(t)$ so the expected rate of increase of the exchange rate, $\hat{e}(t)$, is positive.

Long-run Equilibrium

The long-run equilibrium of the open-economy model can be solved as follows. From equation (5) with $\dot{h} = 0$, the core inflation rate is $h = \hat{M}$, which is fixed exogenously. From (6) with $y = \bar{y}$, $\hat{p} = h$ also, and $m = M/p$ is constant. From (3) with $\dot{y} = 0$, $d = y$. In long-run equilibrium the real exchange rate e/p will be constant, so $\hat{e} = \hat{p} = h = \hat{M}$. Combined with the long-run bond stock b, this gives us the equilibrium value of the short rate r from (9), and from (4) with $\hat{R} = 0$, the long rate and the short rate are equal. With M given exogenously, and y and r determined, the price level P comes from money-market equilibrium (2), and the IS equation (1) can be solved for net exports x. With $\dot{x} = 0$ in (8), $\tilde{x} = x$, and finally equation (7) can be solved for the level of the nominal exchange rate e that yields a real exchange rate (e/p) consistent with equilibrium x. This completes the long-run equilibrium solution.

Intuitive Dynamics of a Temporary Fiscal Expansion

The dynamics of fiscal and monetary policy will be studied using a simulation version of the model in section V. Here we will outline the intuition behind the results using the example of an unanticipated and temporary fiscal expansion. It must be temporary so that the real bond stock reaches a new long-run equilibrium value rather than going off to infinity. So consider a temporary increase in f that creates a permanent increase in b, with no change in money growth. This fixes long-run nominal growth rates $\hat{e} = \hat{p} = h = \hat{M}$.

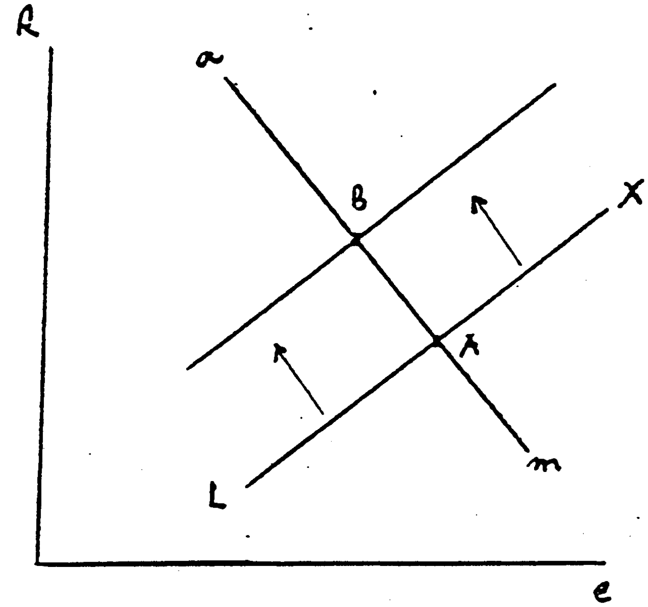

Figure 6: Short-run Adjustment with

Temporary Fiscal Expansion

First we consider long-run equilibrium. With a larger bond stock and no change in the equilibrium $\hat{e}$, r and R must rise, from (9) and (4). The rise in long-run equilibrium r means the entire price path must rise to reduce real balances. With a higher real interest rate R - h, net exports must rise, so e/p must rise. This implies that the e path rises more than the p path. So in the long run interest rates rise and the exchange rate depreciates.

Now let us consider the shorter run, while the budget is in deficit, but $y = d = \bar{y}$. In this short-run equilibrium, some combination of an increase in the real interest rate (R - h) and decrease in (e/p) are required in order to reduce investment and net exports to make room for the increase in f. Total differentiation of equation (1) with y and d given, p set at unity, and (7) for x results in

$$(12) \qquad \mu df - \delta dR + \sigma de = 0.$$

In the R,e space of Figure 6, equation (12) is the LX curve with slope σ/δ and an upward shift when f increases. But in the short-run equilibrium r = R, and equation (11) says that if market participants expect r to rise, the exchange rate will immediately fall. This gives the negatively-sloped am (for asset markets) line in Figure 6. The two conditions together give the increase in R and decrease in e that split the financing of the f deficit between investment and net exports in the short run. This is a partial explanation of the increase in real interest rates and appreciation of the dollar that was shown in Table 2, in order to obtain the shift in the private saving-investment balance and net exports that was shown in Table 1.

V. Dynamic Policy Simulations

In this section we will examine the results of a variety of dynamic simulation experiments using the model developed in the previous sections. For convenience, this model and the parameter values we have used are reproduced in Table 4. The simulations will be performed using the computer program of Austin and Buiter (1983), as modified by Johnson (1985). The program simulates linear, dynamic, perfect-foresight models applying the methods developed by Dixit (1980) and Buiter (1984).

First we will compare and contrast the impact of anticipated versus unanticipated fiscal stimulus. We will then explore the implications of monetary contraction, alternatively modelled as an unanticipated fall in the rate of growth of money and as an unanticipated fall in real balances. Finally, we will combine the elements of unanticipated monetary contraction followed by anticipated fiscal stimulus and compare the dynamic paths of the variables in our model with the data series which were discussed in section II above.

Unanticipated Fiscal Stimulus

Figures 1.1 -1.3 illustrate the result of a fiscal expansion which is unanticipated. The stimulus to aggregate demand and the concomitant increase in the future supply of bonds to finance the deficit lead to an immediate jump in the long rate of interest as the policies are announced. The short-term rate of interest rises as the increase in demand increases the transaction demand for money. Figure 1.2 shows that the nominal

Table 3: VARIABLE DEFINITIONS

d	aggregate demand
y	output
i	autonomous investment
f	budget deficit
R	long-term interest rate
r	short-term interest rate
h	expected or "core" inflation
x	trade balance
$\tilde{x}$	equilibrium trade balance
m	real balances
M	money supply
p	price level
e	exchange rate
b	stock of real bonds
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 a foreign (and exogenous) variable.

Table 4: THE COMPLETE MODEL

		Parameter values
(1)	$d = ay + i + \mu f - \delta(R - h) + x$	$a = .80$
(2)	$r = (\tau y - m)/\varepsilon \quad + r^d$	$\delta = .80$
(3)	$\dot{y} = \psi(d - y)$	$\mu = 1$
(4)	$E\hat{R} = R - r$	$\psi = 1.00$
(5)	$\dot{h} = \pi(\hat{M} - h)$	$\gamma = .80$
(6)	$\hat{p} = h + \phi(y - \bar{y})$	$\sigma = .15$
(7)	$\tilde{x} = \sigma e/p + \lambda y^* - \omega y$	$\lambda = 0$
(8)	$\dot{x} = \gamma(\tilde{x} - x)$	$\omega = 0.2$
(9)	$E\hat{e} = r - (r^* + \rho b)$	$\hat{R} = .10$
(10)	$\dot{b} = f - \widehat{\overline{ML}}(1-\overline{m}) - \widehat{\overline{ML}}m$	$\tau = 1$
		$\varepsilon = 2$
		$\rho = .02$
		$\phi = .50$
		$\pi = 8.0$
		$r^* = .02$

Note: For simulation purposes, equation (10) in the text was linearized to obtain equation (10) here.

exchange rate and, because of sticky prices, the real exchange rate jump appreciates upon announcement of the fiscal stimulus and then depreciates continuously. The trade balance deteriorates following the real exchange appreciation and gradually offsets the impact of fiscal stimulus upon aggregate demand. Output y is shown in figure 1.3. Initially output rises as the direct fiscal effect dominates reduced demand in the interest sensitive and foreign sectors. Thereafter the latter two effects predominate and the economy slackens.

Anticipated Fiscal Stimulus

Figures 2.1 - 2.3 exhibit the results of the simulation of a fiscal expansion announced one year before its actual implementation. Figure 2.1 shows that, just as when the fiscal stimulus is unanticipated, the long rate of interest jumps in anticipation of future bond supply increases. A comparison of figures 1.1 and 2.1 reveals that when economic agents anticipate the fiscal expansion one year before implementation, the resulting jump in the long-rate is smaller upon announcement. Similarly the appreciation of the real exchange rate is smaller initially when the announcement precedes the implementation of the policy. This can be seen by comparing figures 1.2b and 2.2b.

The impact of the announcement of future fiscal stimulus upon current output is shown in figure 2.3. Unlike the immediate fiscal expansion shown in figure 1.3, anticipated expansion produces an "expectations recession" with output initially falling in response to both the rise in interest rates and the deterioration of international competitiveness. It is only after the implementation of the expansionary fiscal policies that output begins to recover. This trajectory of output in response to expected future fiscal expansion is attributable to the contrasting assumptions employed in modelling the behavior of financial markets with actions in the goods and factor markets.

We have assumed in our specification that agents in the real economy "believe what they see" whereas in the financial markets, participants "see what they believe." Thus an anticipated fiscal expansion may produce movements along a demand function as the cost of capital increases but the expected policy does not produce a shift in demand prior to the implementation of the policies either because of increased expected profitability or, in the case of consumption, because of expected increases in future income.

We will now turn to the examination of the impact of monetary contraction upon the variables in our model before attempting to compare our fiscal experiments with the time series data discussed above. Following that, we will model the combined influence of monetary and fiscal policies with a better understanding of how each policy instrument contributes to our simulated view of the causes of the recession of 1982.

<u>Reduction in the Growth Rate of Money $\hat{M}$</u>

The simulation of an unanticipated permanent reduction in the rate of growth of money from 5.3percent to 2 percent is plotted in figures 3.1 - 3.3. Figure 3.1 reveals that upon announcement the long rate R jumps downward, reflecting the expectation of falling interest rates in the long run, as some of the inflation premium is "wrung out" of nominal interest rates. The short-term rate does not move discontinuously from the initial position of 8 percent, reflecting the fact that a change in the rate of money growth does not imply an instantaneous change in the stock of money and that prices and income adjust gradually. As the new lower growth rate of money translates into a smaller nominal money stock while prices adjust sluggishly, the short rate is driven up as real balances decline.

The magnitude of the rise in short rates is also increased because aggregate demand is stimulated by the fall in long interest rates and produces a greater transactions demand for money in the short run.

Figure 3.2b reveals that the real exchange-rate jump appreciates in response to the announcement of reduced money growth. This jump appreciation corresponds to a jump in the nominal exchange rate to a new dynamic path because of the expected lower path of prices.

Figure 3.3 plots the path of output after the fall in the growth rate of money. Initially output is stimulated by the jump decline in the long rate of interest. Thereafter the downward adjustment of inflationary expectations increases the perceived long real rate of interest and at the same time the trade balance deteriorates following the initial exchange-rate appreciation. In the long run the real rate of interest is restored to its equilibrium value and the trade balance improves following a depreciation of the real exchange rate.

Fall in the Level of Real Balances M/P

A second characterization of a monetary contraction consists of an unanticipated fall in the level of the money stock without altering the steady-state rate of money growth. Figures 4.1 - 4.3 exhibit the results of an experiment where the stock of money falls at time $t = 0$ by 3 percent.

In Figure 4.1 we see that the inversion of the term structure, as measured by the difference between the long and the short rates of interest, is primarily attributable to a jump in the short rate though the long rate also moves at the time of the announcement.

On the other hand, the inversion of the term structure of interest rates in figure 3.1 was primarily attributable to a fall in the long rate of interest in anticipation of falling inflation. In this simulation steady-state inflation does not decline.

Figure 4.2b once again reveals that the real exchange-rate jump appreciates due to the expectation of a lower price level brought about by transitory disinflation resulting from the money stock decline. Thereafter the real exchange rate depreciates back toward its initial level.

The trade balance, shown in figure 4.2A, follows the exchange rate with a lag. Figure 4.3 shows that, unlike a money-growth rate decline, the drop in the stock of real balances produces an unambiguous immediate decline in aggregate demand as both the real exchange appreciation and the rise in interest rates depress expenditure.

Policy Simulation and the Recession of 1982

In this section we combine the various monetary and fiscal policy influences in a manner which we feel roughly corresponds to the macroeconomic policies which influenced the U.S. economy between the third quarter of 1979 and the end of 1984. The principal policy events which we try to capture are:

1. A contraction of the money stock in October of 1979.
2. A tendency for the monetary authorities to reduce the growth rate of money over the period.
3. An anticipated three-stage fiscal expansion announced in March of 1981 to be implemented over the years 1982-85.

For the purpose of the simulation experiment we have sought to capture these policy influences as follows. We begin the simulation in October of 1979 by implementing an unanticipated drop in the money stock. Then, in March of 1981 we simultaneously introduce a 2.3 percentage-point reduction in the growth rate of money and a three-stage anticipated fiscal expansion to be implemented in steps, 3, 7, and 11 quarters in the future. The results are shown in figures 5.1 - 5.3 and can be compared with the data for the U.S. economy from Table 2 above.

Initially the short rate of interest increases by over 100 basis points while the long rate rises by 20 basis points. The inversion of the term structure persists until the announcement of a fiscal stimulus produces a rise in the long rate in anticipation of rising interest rates due to bond finance of the prospective deficit.

Figure 5.2b shows the pattern of the real exchange rate and can be compared with the fifth column of Table 2. The marked event is the large real exchange-rate appreciation upon announcement of the fiscal program and monetary deceleration. In our stylized view this event roughly corresponds to the period between the election in the fourth quarter of 1980 and the third quarter of 1981 when the fiscal program of the Reagan Administration was formed and the information diffused into the market-place.

Figure 5.2A shows the deterioration of the trade balance over this period. Figure 5.3 reveals the impact of the simulated policies on output. The money squeeze in 1979 induces some recessionary behavior but the severe "expectations recession" begins with the announcement of the fiscal program in 1981 and reaches bottom at the end of 1982 with particularly deleterious effects on the foreign and interest sensitive sectors.

In the final simulation experiment conducted above we have chosen a particular configuration and timing of changes in monetary and fiscal policy instruments to represent a stylized view of U.S. macroeconomic policy in the early 1980's. The implications of these actions for key simulated variables, given our structural specification, were then compared with the actual historical behavior of those variables, to assess the correspondence between the two series.

The quality of our "fit" in the simulation experiment is affected by several limitations which we would like to stress briefly. They fall into two groups: methodological limitations, and omitted events.

The dynamic simulation methodology utilized here constrains one's modeling of forward-looking events by requiring that upon announcement of a new policy environment, stretching indefinitely into the future, agents have complete and immediate perfect foresight. Thus, new policies are completely credible upon announcement, and there is no time lag between the announcement and "belief," because of lags in the diffusion of information.

In our experiment this methodological restriction implies that changes in such variables as the term structure of interest rates occur in discrete and discontinuous jumps as new information is revealed. For instance, the announcement of the future fiscal expansion in 1981 produced an instantaneous jump in long rates of interest, whereas the historical data on Table 2 show that the rise took place gradually over the second and third quarters of 1981.

While we are comfortable with the assumption that new information propagates through the financial markets relatively more quickly than through goods and factors markets, we feel that the assumption of instantaneous perfect foresight imposed by the methodology introduces distortions into the simulation.

The other source of discordance between simulation and historical variables is the omission of several key aspects of the policy environment over the period under study. In particular, in order to retain simplicity and facilitate exposition we have omitted some important financial events. The Credit Control program of 1980 introduced limitations on the behavior of participants in U.S. financial markets which we have not incorporated into the simulation. Similarly, we have not introduced the deregulation of interest rates on instruments included in money aggregates, nor have we sought to deal with any aspect of what might be termed "financial innovation." Finally, in this version of the paper we have not modeled the so-called "safe-haven effect" or dealt with the rapid growth in the money supply, both of which occurred in the third quarter of 1982. Studies of these additions to our stylized view of policy events constitute an agenda for future research.

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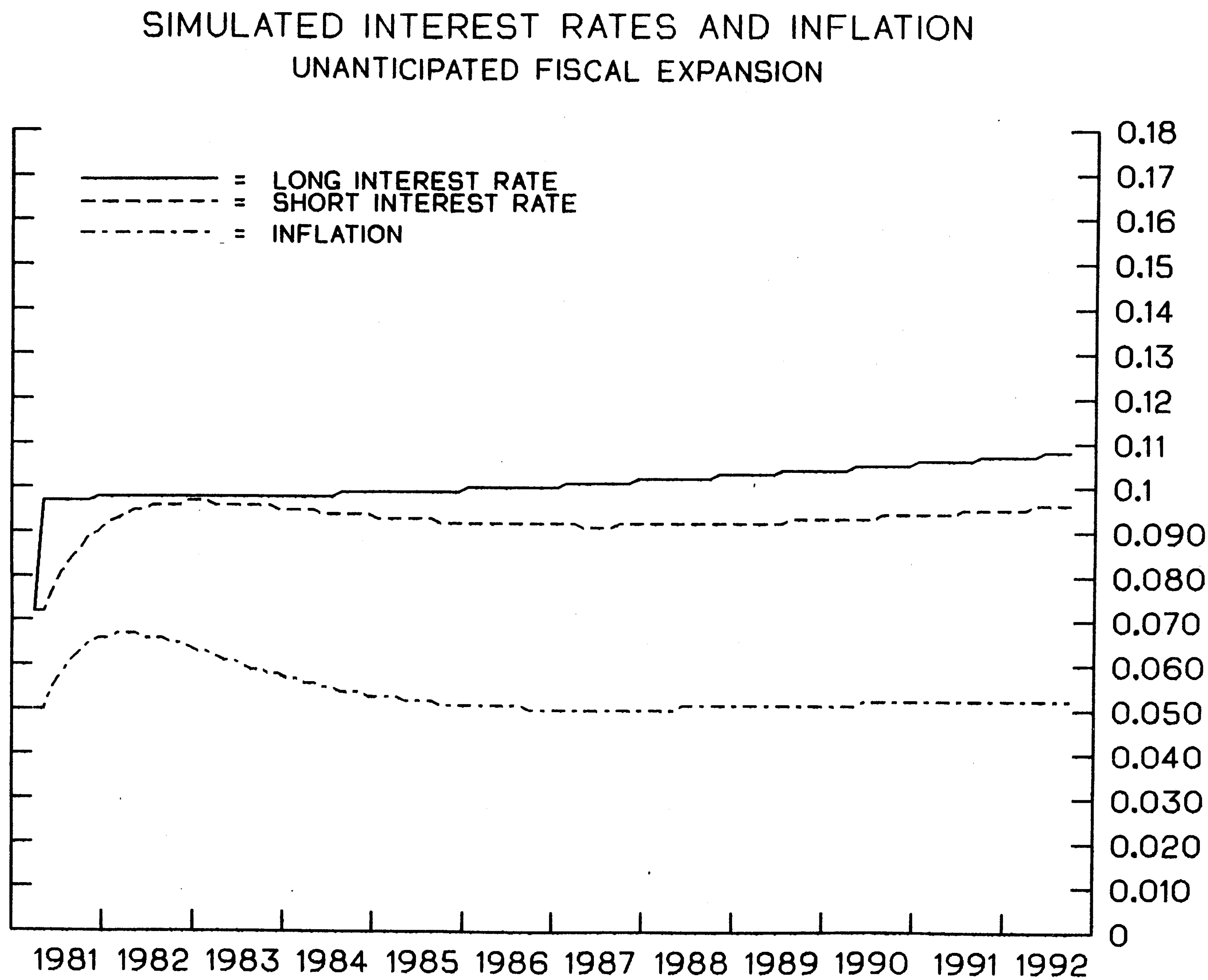


SIMULATED INTEREST RATES AND INFLATION
UNANTICIPATED FISCAL EXPANSION
= LONG INTEREST RATE
= SHORT INTEREST RATE
= INFLATION
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.1
0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992

FIGURE 1.1

SIMULATED EXTERNAL BALANCE

UNANTICIPATED FISCAL EXPANSION

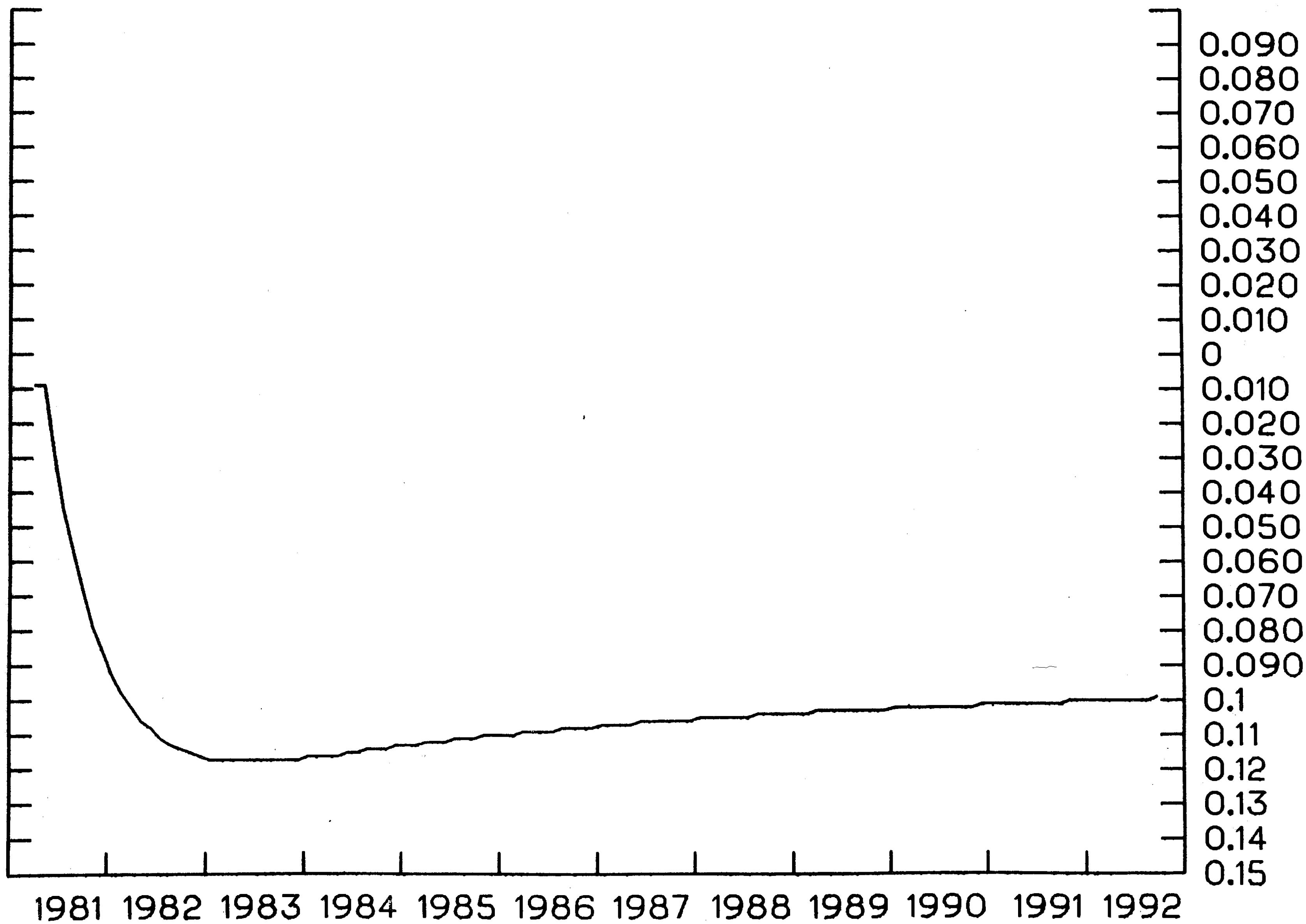


FIGURE 1.2A

SIMULATED REAL EXCHANGE RATE
UNANTICIPATED FISCAL EXPANSION

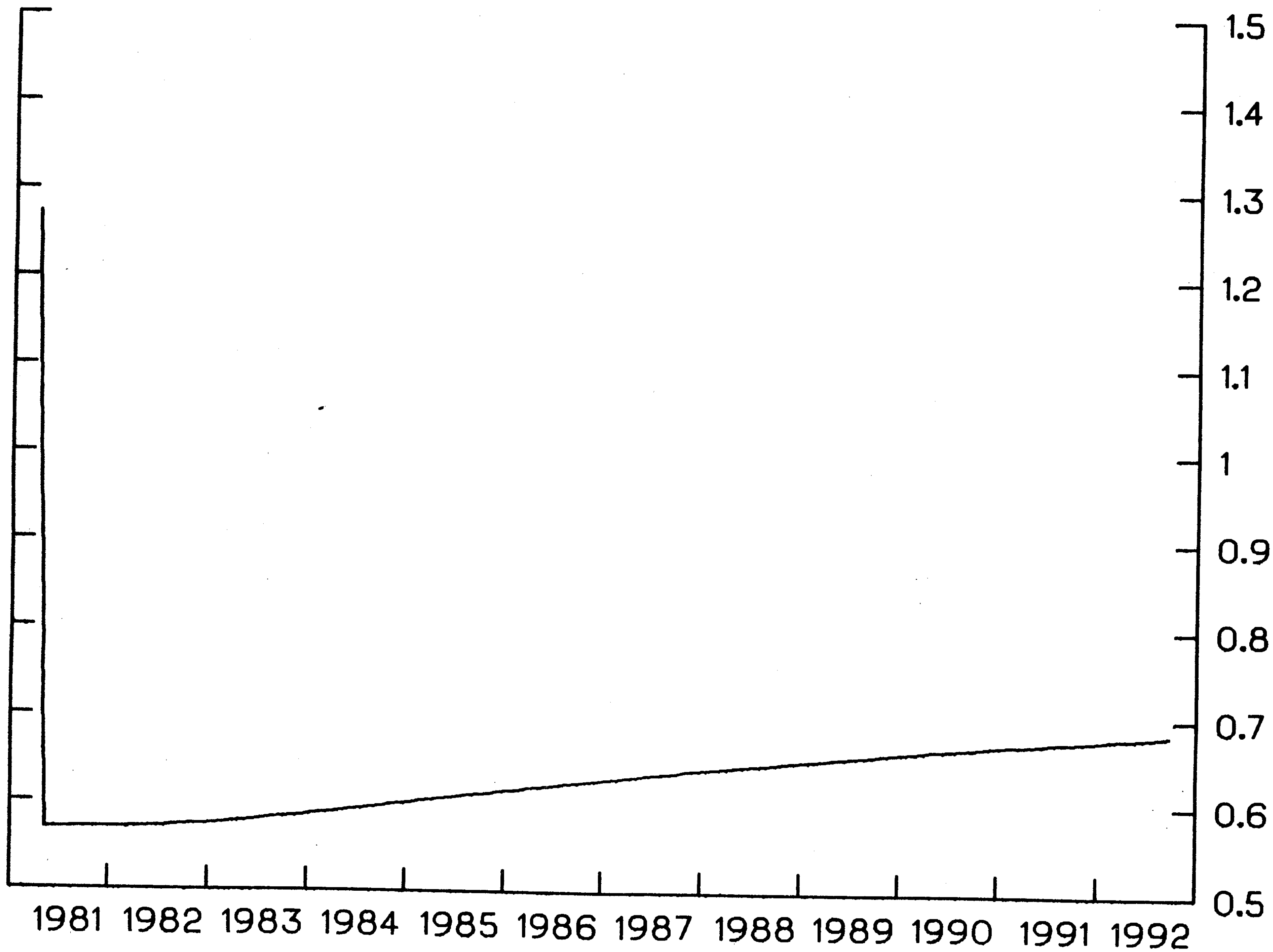


FIGURE 1.2B

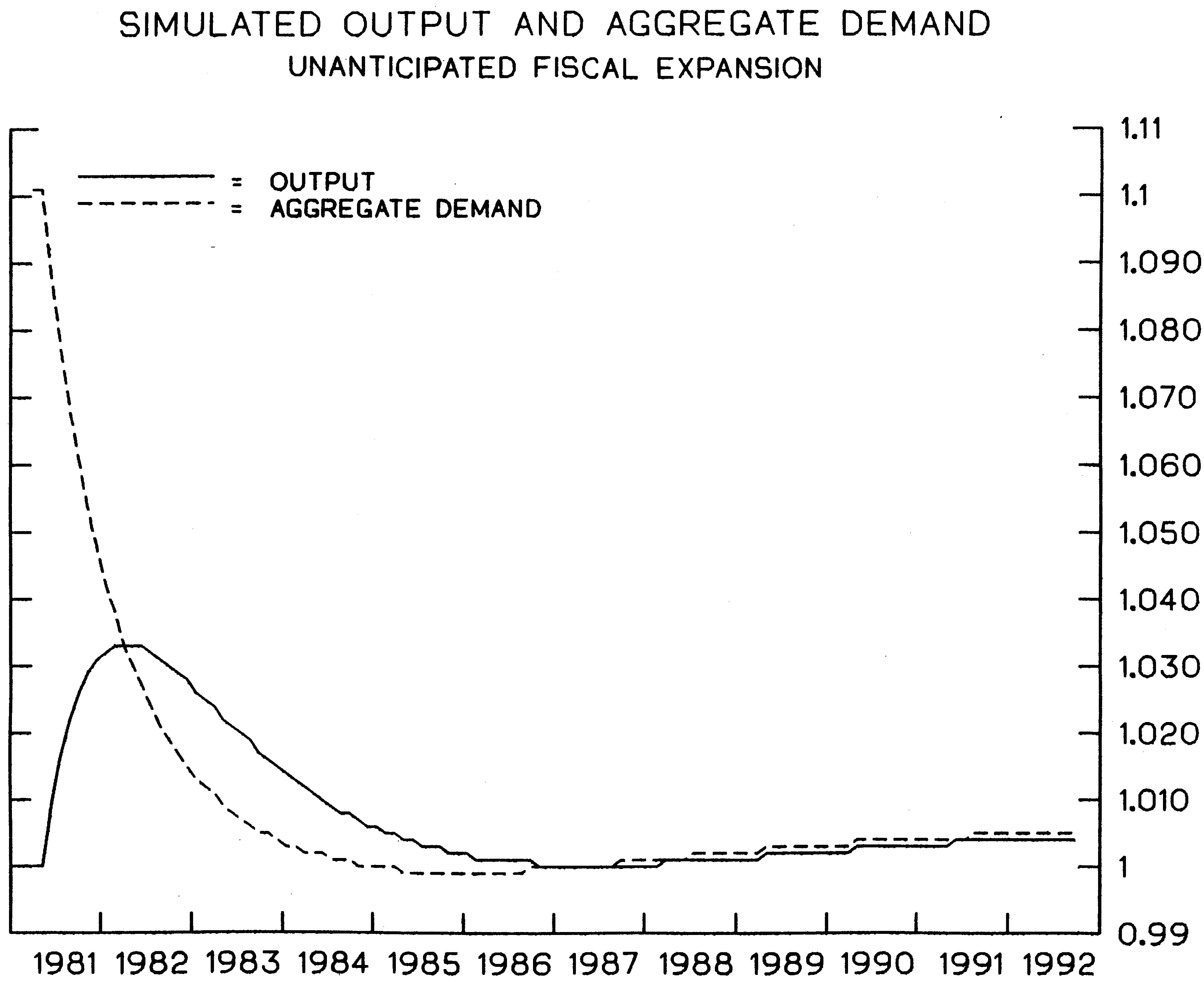
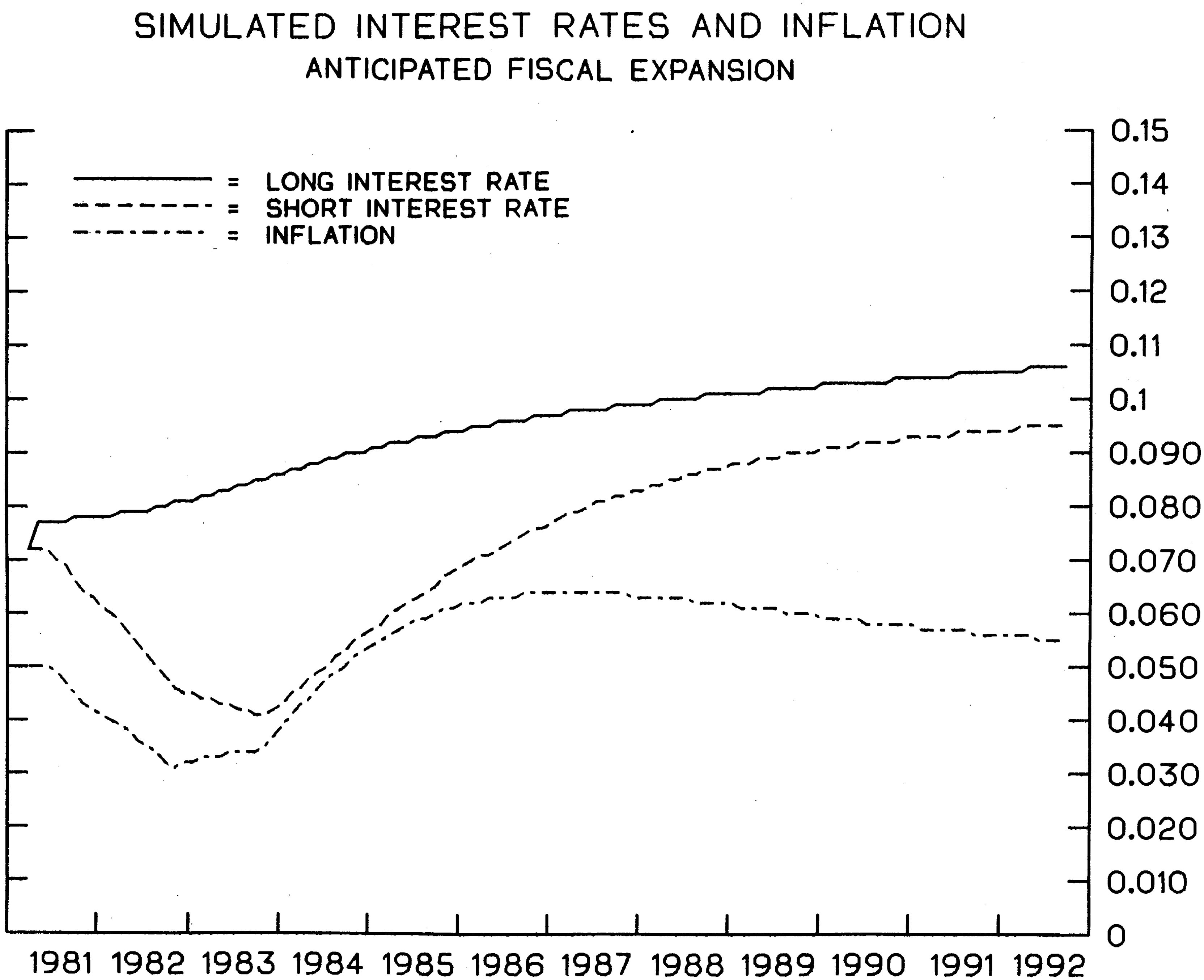
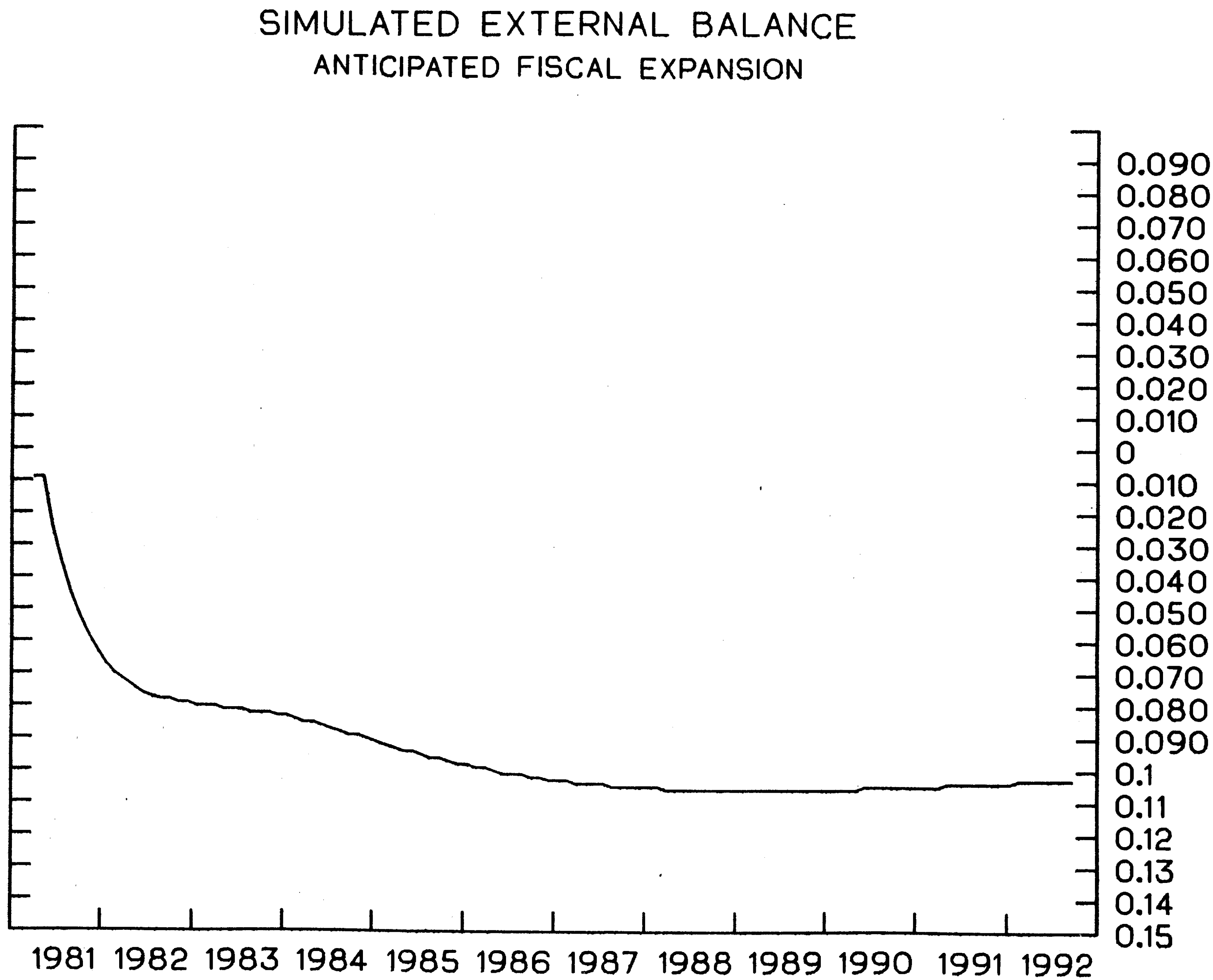

SIMULATED OUTPUT AND AGGREGATE DEMAND
UNANTICIPATED FISCAL EXPANSION
= OUTPUT
= AGGREGATE DEMAND
1.11
1.1
1.090
1.080
1.070
1.060
1.050
1.040
1.030
1.020
1.010
1
0.99
1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992

FIGURE 1.3



SIMULATED INTEREST RATES AND INFLATION
ANTICIPATED FISCAL EXPANSION
= LONG INTEREST RATE
= SHORT INTEREST RATE
= INFLATION
0.15
0.14
0.13
0.12
0.11
0.1
0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0
1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992

FIGURE 2.1


SIMULATED EXTERNAL BALANCE
ANTICIPATED FISCAL EXPANSION
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0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0
0.010
0.020
0.030
0.040
0.050
0.060
0.070
0.080
0.090
0.1
0.11
0.12
0.13
0.14
0.15
1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992

FIGURE 2.2A

SIMULATED REAL EXCHANGE RATE
ANTICIPATED FISCAL EXPANSION

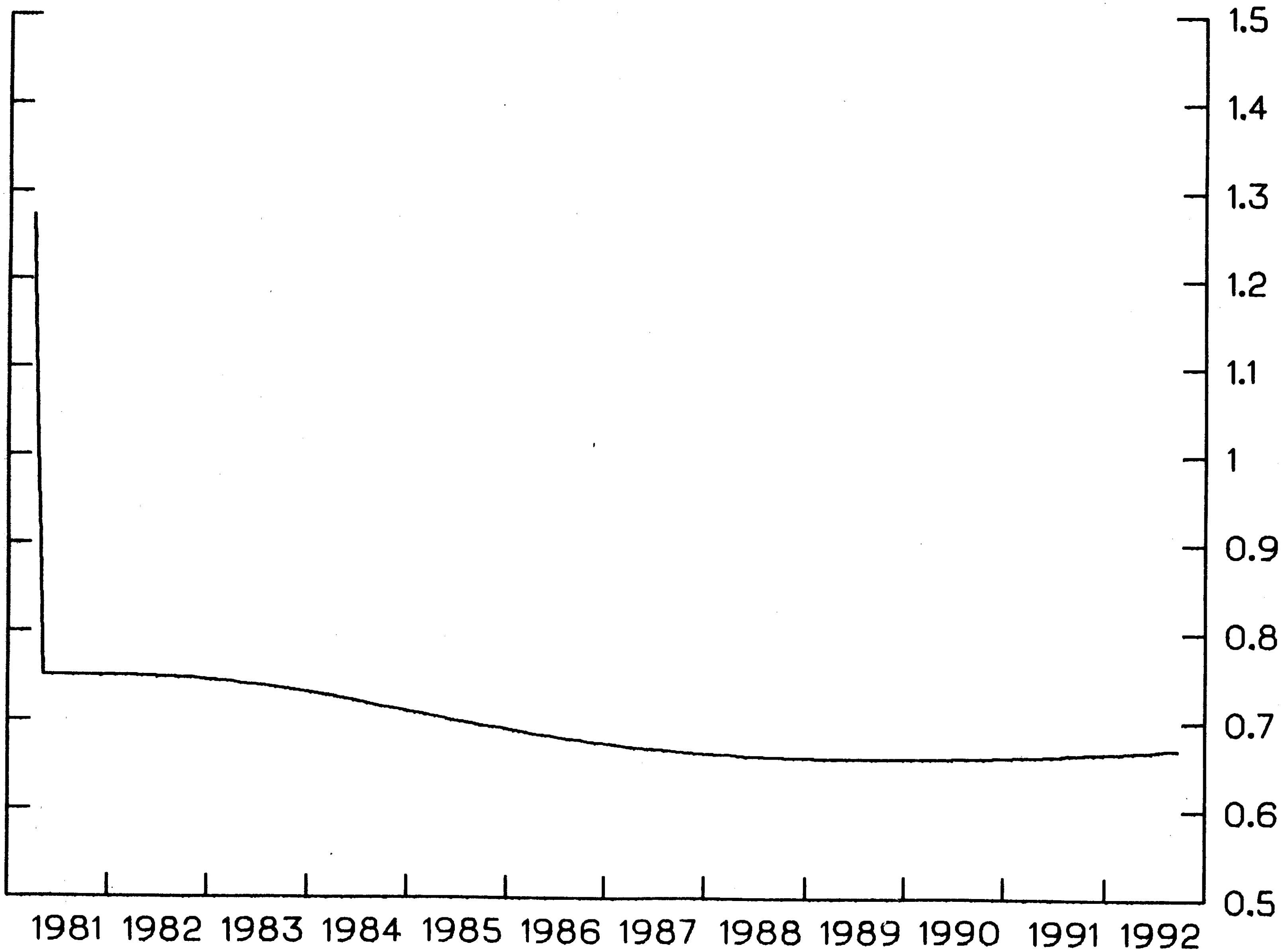


FIGURE 2.2B

SIMULATED OUTPUT AND AGGREGATE DEMAND

ANTICIPATED FISCAL EXPANSION

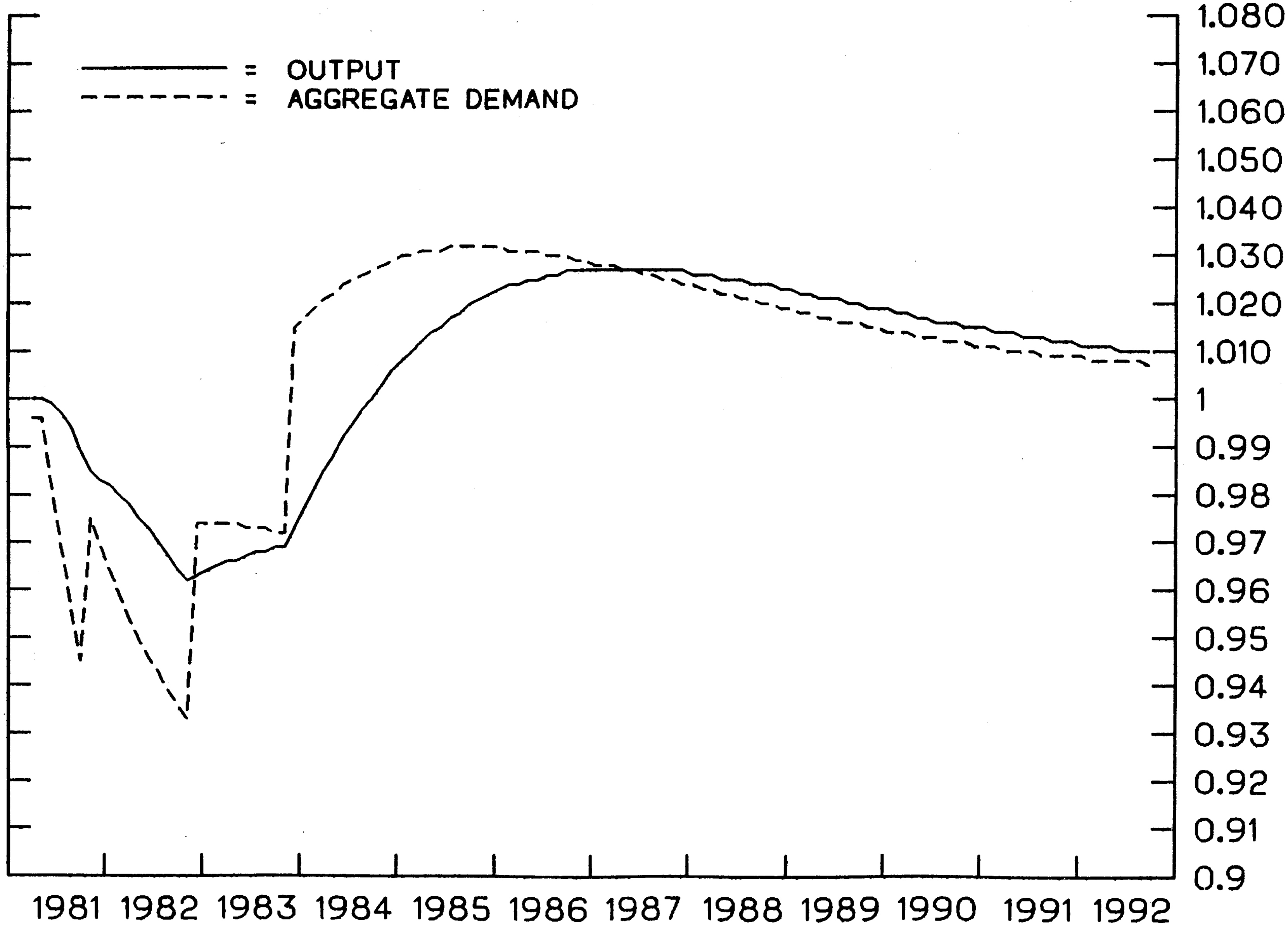


FIGURE 2.3

SIMULATED INTEREST RATES AND INFLATION

UNANTICIPATED DECLINE IN THE RATE OF MONEY GROWTH

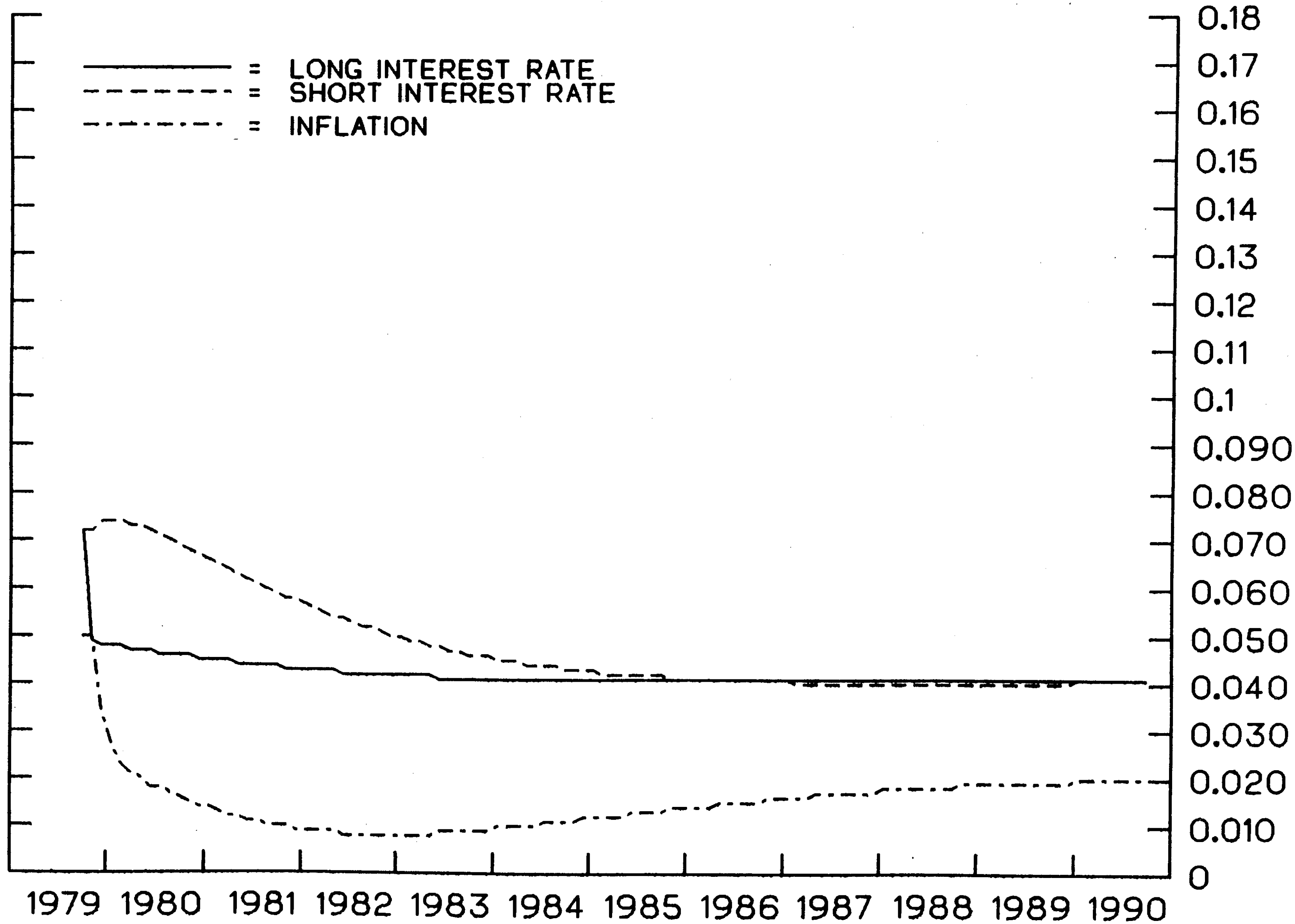


FIGURE 3.1

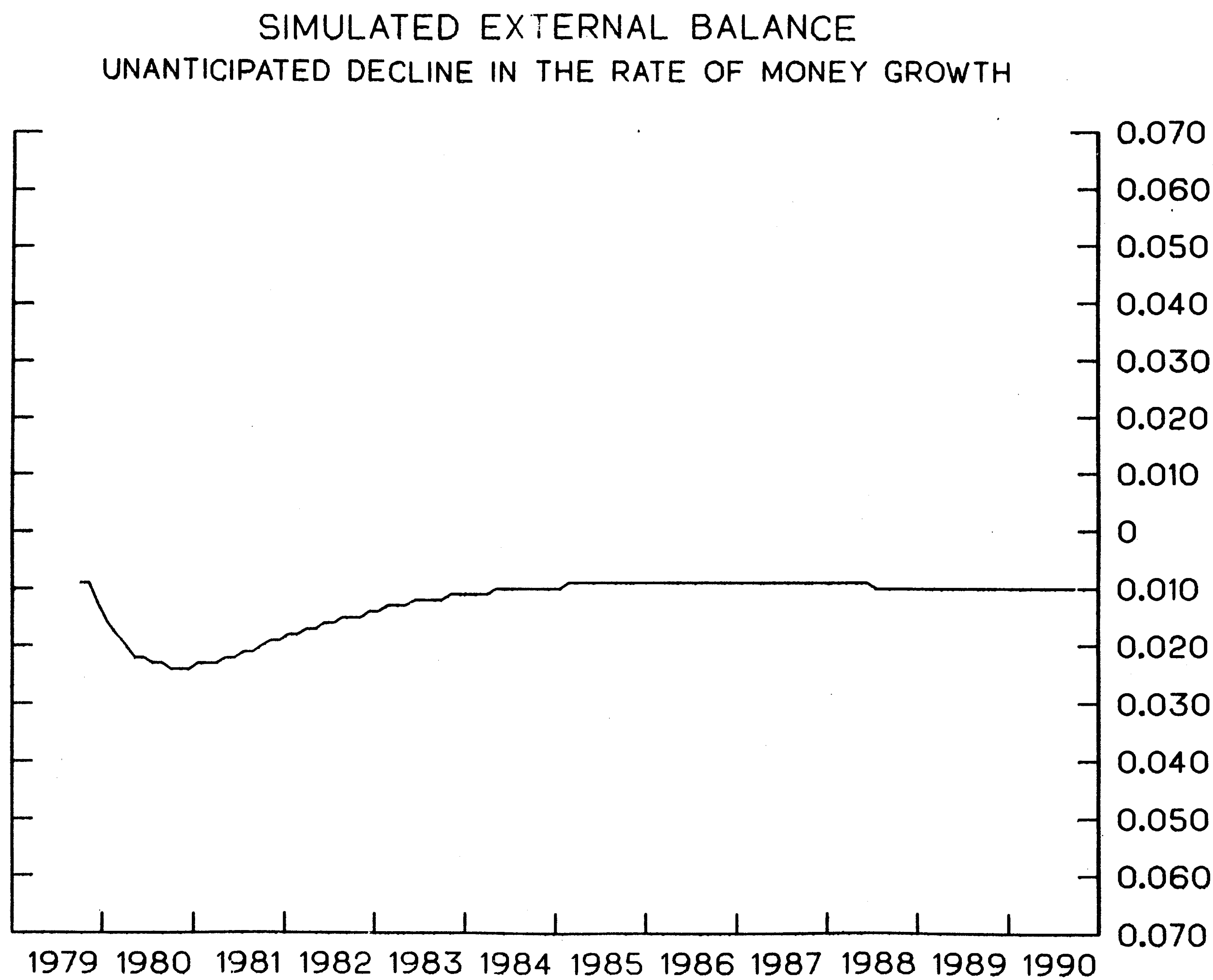

SIMULATED EXTERNAL BALANCE
UNANTICIPATED DECLINE IN THE RATE OF MONEY GROWTH
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0
0.010
0.020
0.030
0.040
0.050
0.060
0.070
1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990

FIGURE 3.2A

SIMULATED REAL EXCHANGE RATE

UNANTICIPATED DECLINE IN THE RATE OF MONEY GROWTH

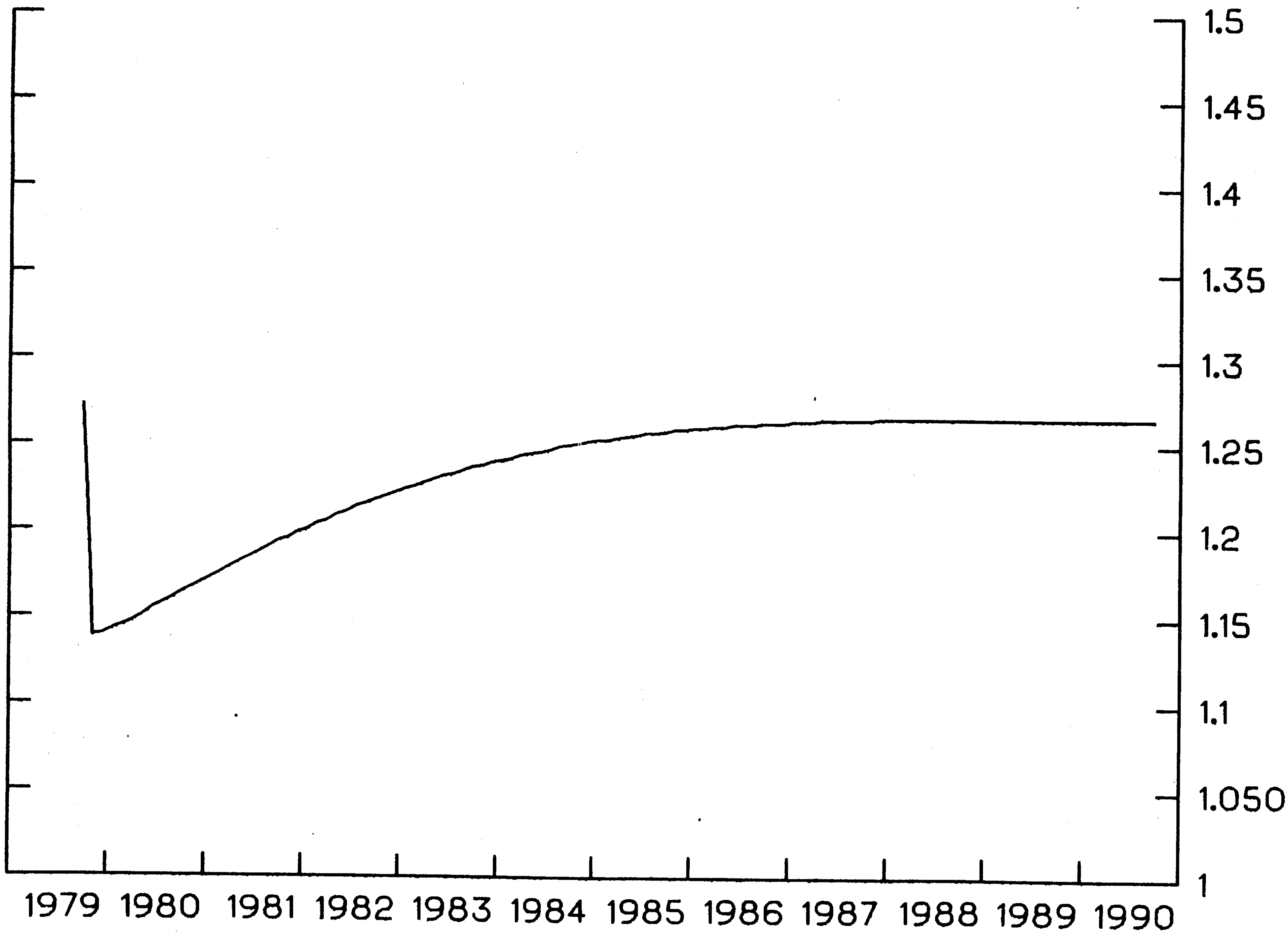


FIGURE 3.2B

SIMULATED OUTPUT AND AGGREGATE DEMAND
UNANTICIPATED DECLINE IN THE RATE OF MONEY GROWTH

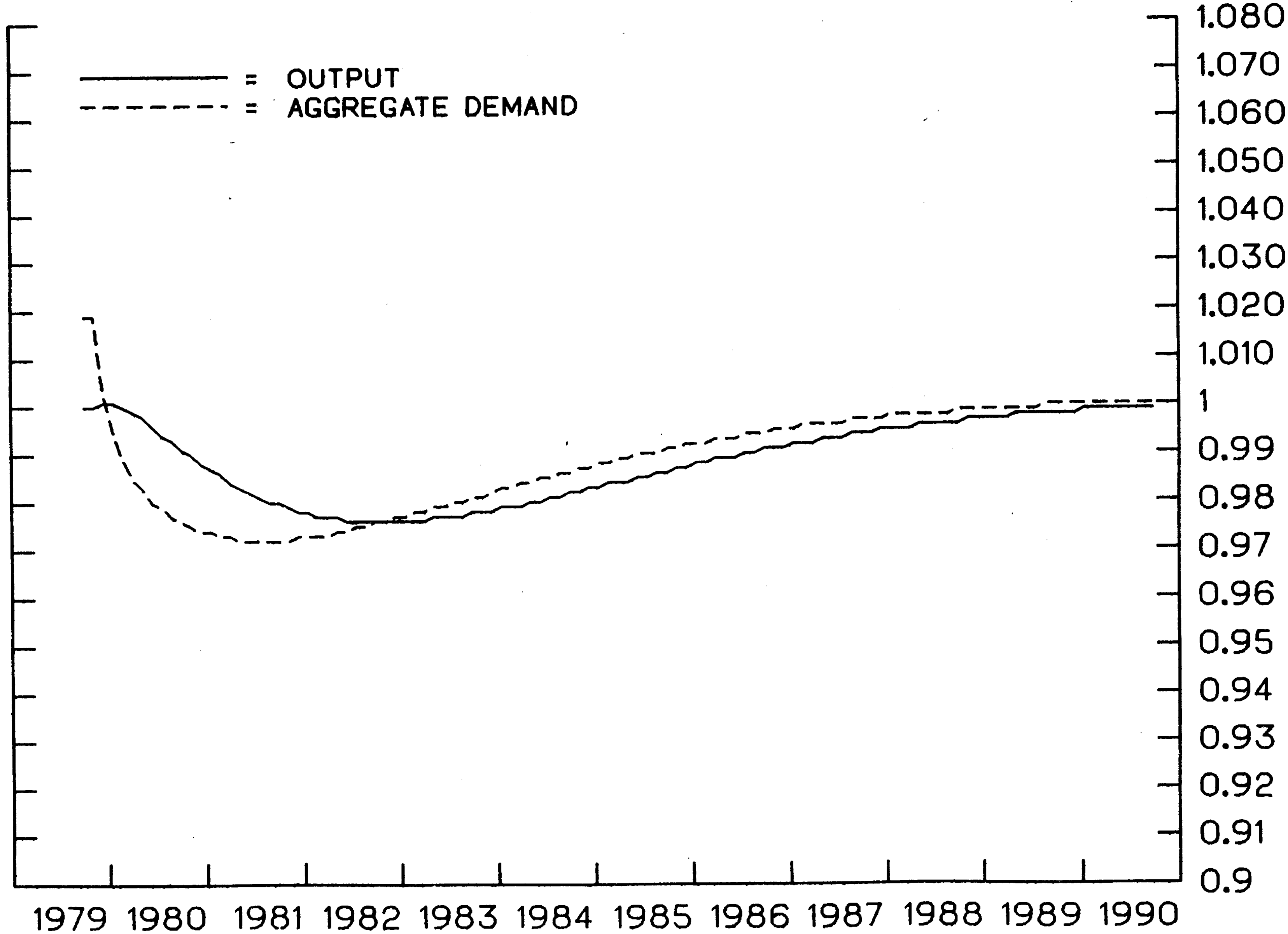


FIGURE 3.3

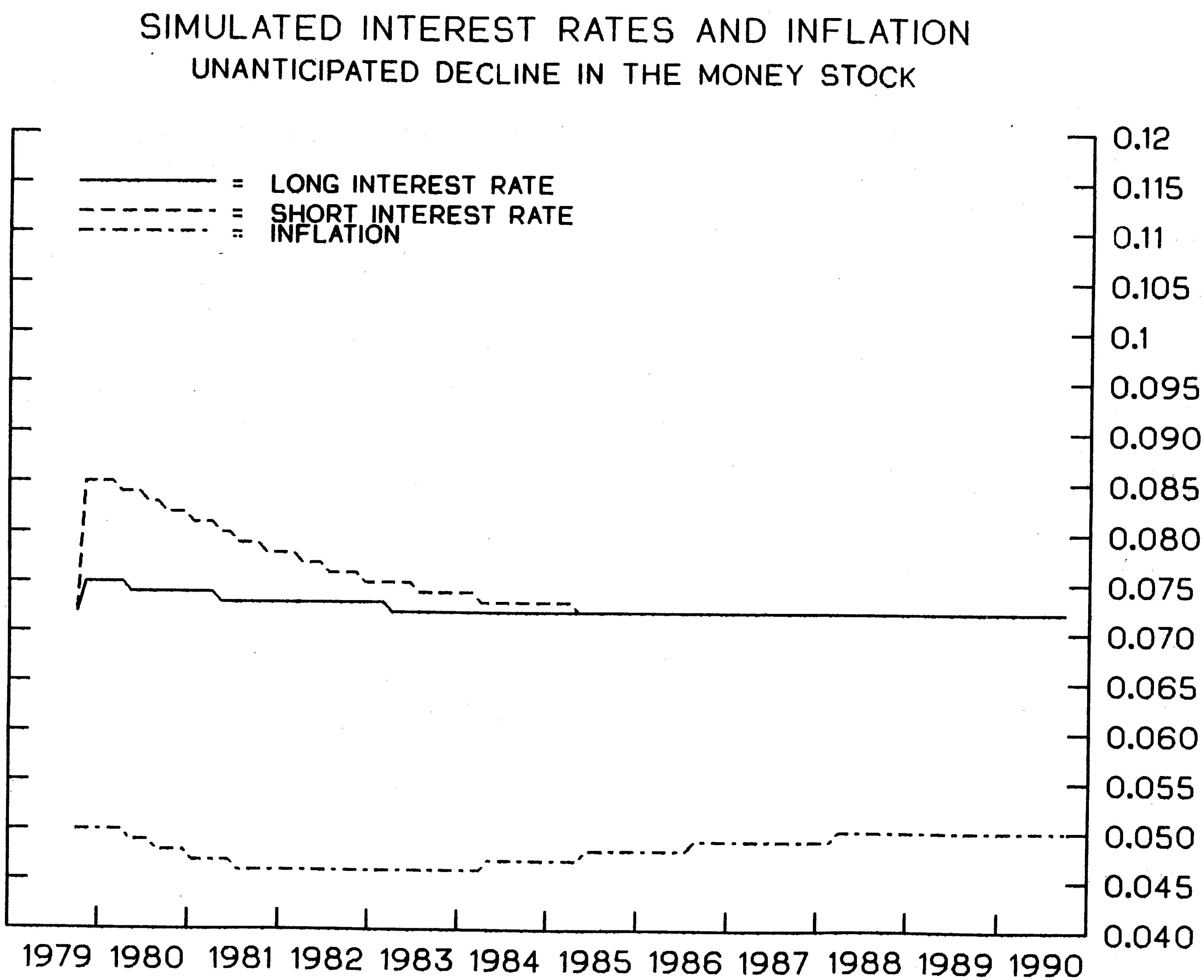

SIMULATED INTEREST RATES AND INFLATION
UNANTICIPATED DECLINE IN THE MONEY STOCK
= LONG INTEREST RATE
= SHORT INTEREST RATE
= INFLATION
0.12
0.115
0.11
0.105
0.1
0.095
0.090
0.085
0.080
0.075
0.070
0.065
0.060
0.055
0.050
0.045
0.040
1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990

FIGURE 4.1

SIMULATED EXTERNAL BALANCE
UNANTICIPATED DECLINE IN THE MONEY STOCK

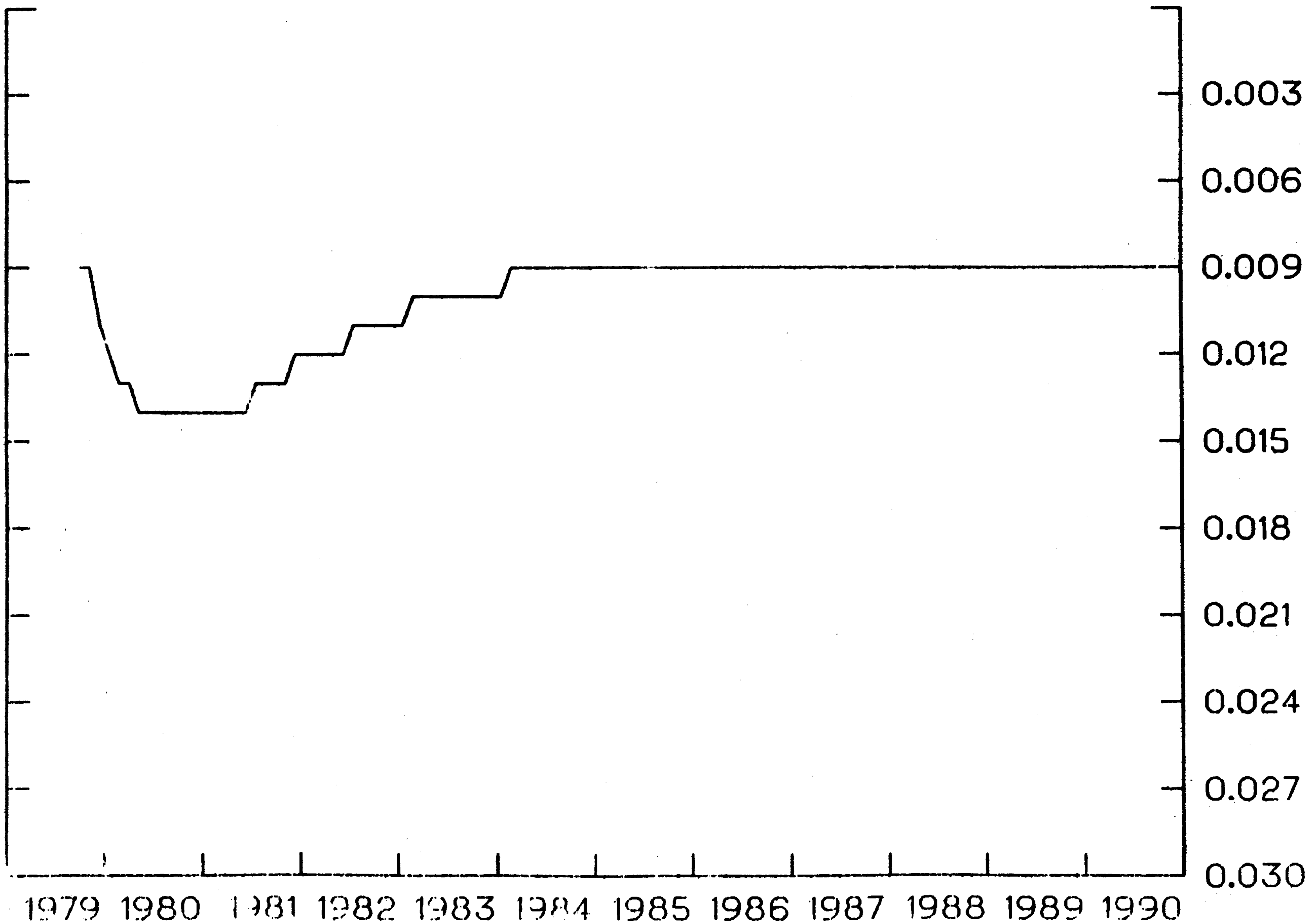


FIGURE 4.2A

SIMULATED REAL EXCHANGE RATE
UNANTICIPATED DECLINE IN THE MONEY STOCK

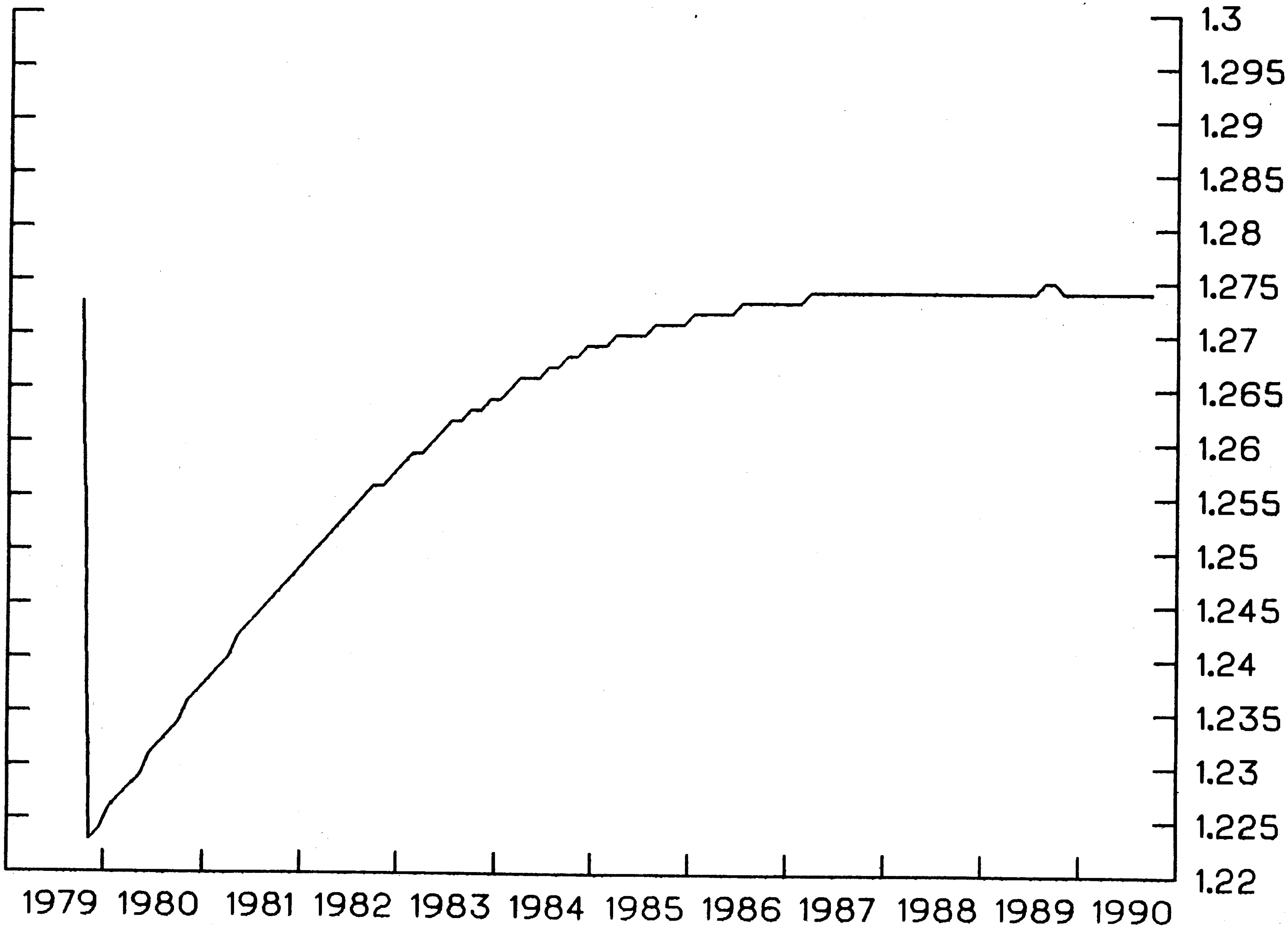


FIGURE 4.2B

SIMULATED OUTPUT AND AGGREGATE DEMAND
UNANTICIPATED DECLINE IN THE MONEY STOCK

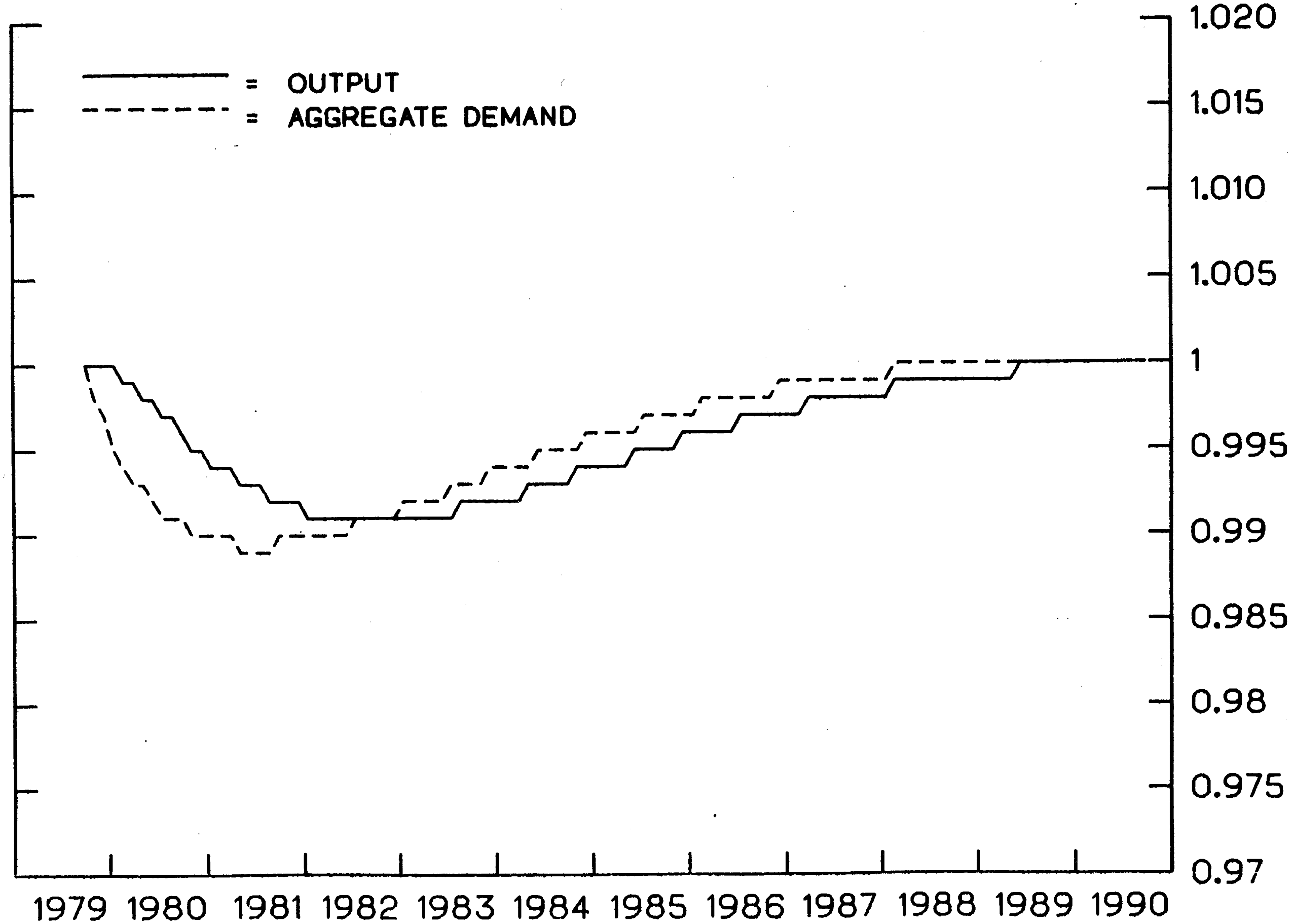
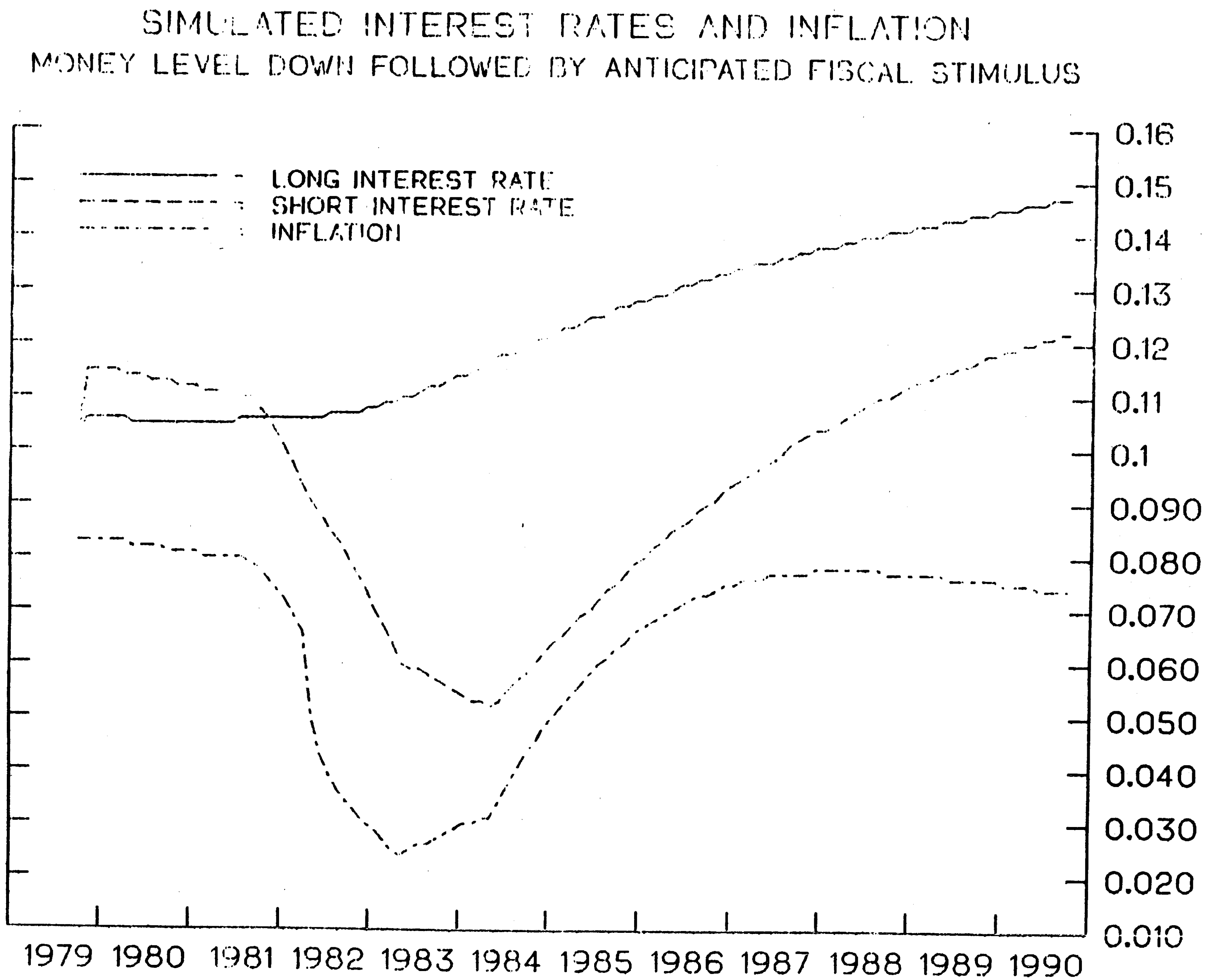


FIGURE 4.3



SIMULATED INTEREST RATES AND INFLATION
MONEY LEVEL DOWN FOLLOWED BY ANTICIPATED FISCAL STIMULUS
LONG INTEREST RATE
SHORT INTEREST RATE
INFLATION
0.16
0.15
0.14
0.13
0.12
0.11
0.1
0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990

FIGURE 5.1

SIMULATED EXTERNAL BALANCE

MONEY LEVEL DOWN FOLLOWED BY ANTICIPATED FISCAL STIMULUS

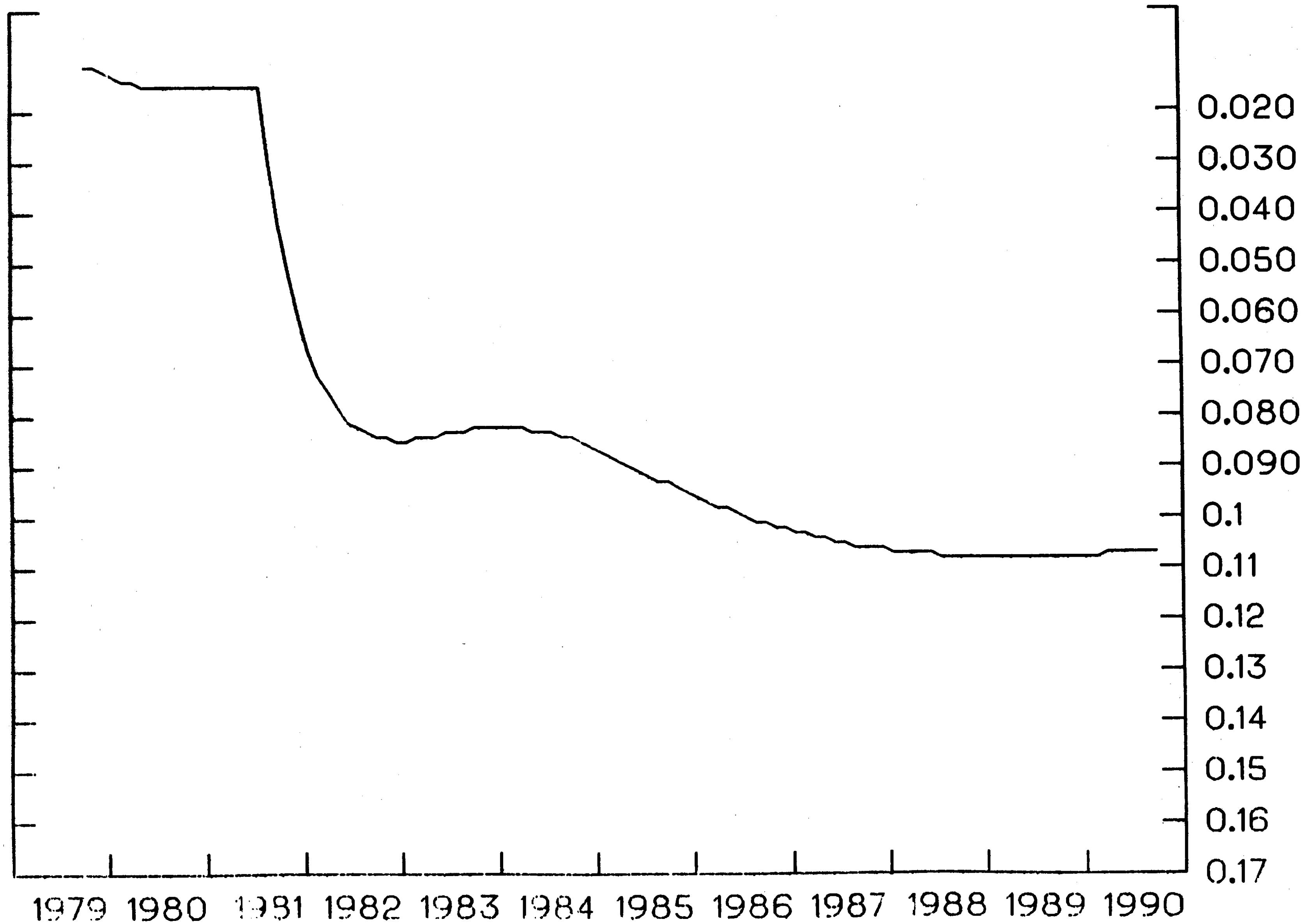


FIGURE 5.2A

SIMULATED REAL EXCHANGE RATE
MONEY LEVEL DOWN FOLLOWED BY ANTICIPATED FISCAL STIMULUS

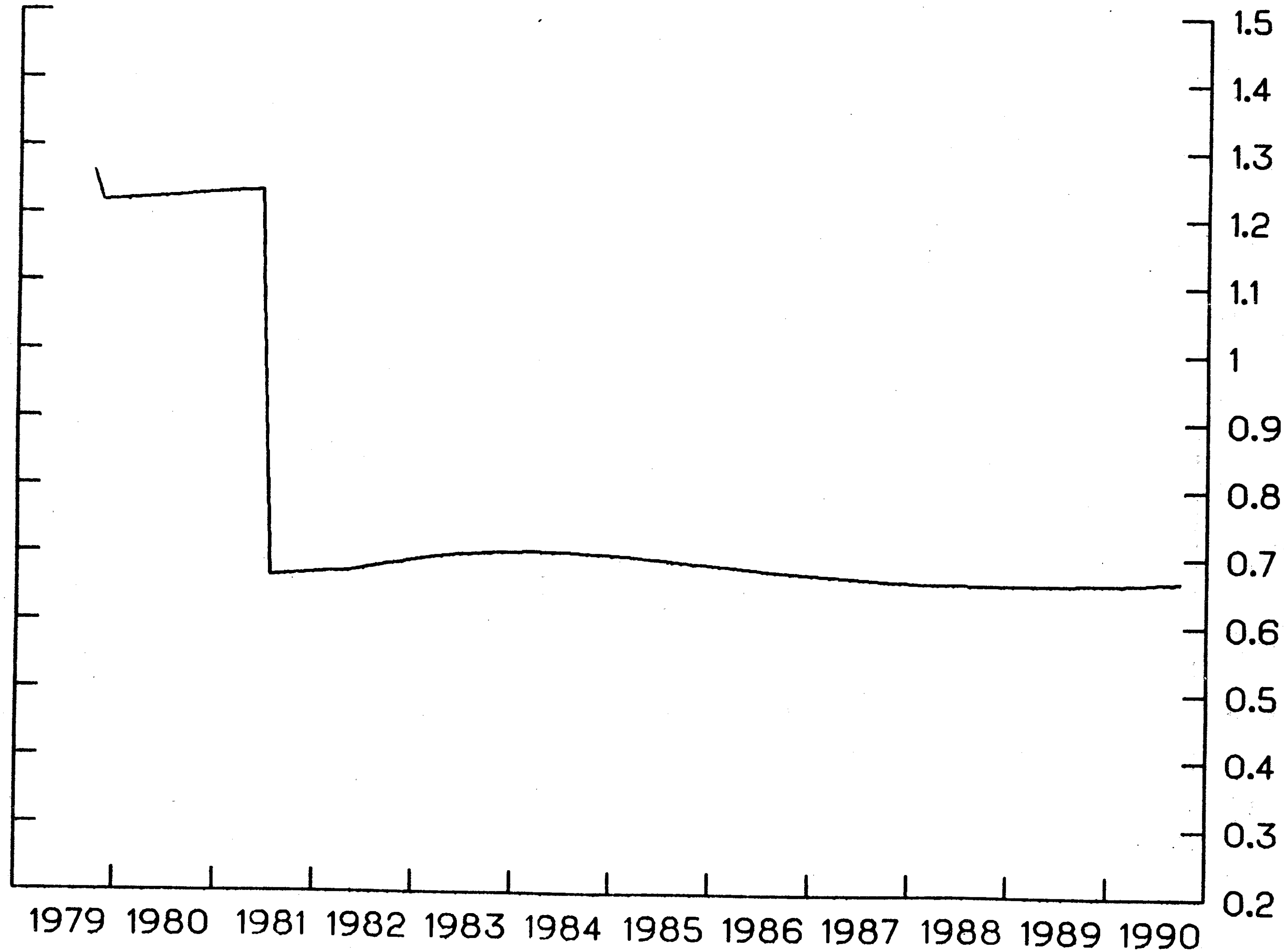


FIGURE 5.2B

SIMULATED OUTPUT AND AGGREGATE DEMAND
MONEY LEVEL DOWN FOLLOWED BY ANTICIPATED FISCAL STIMULUS

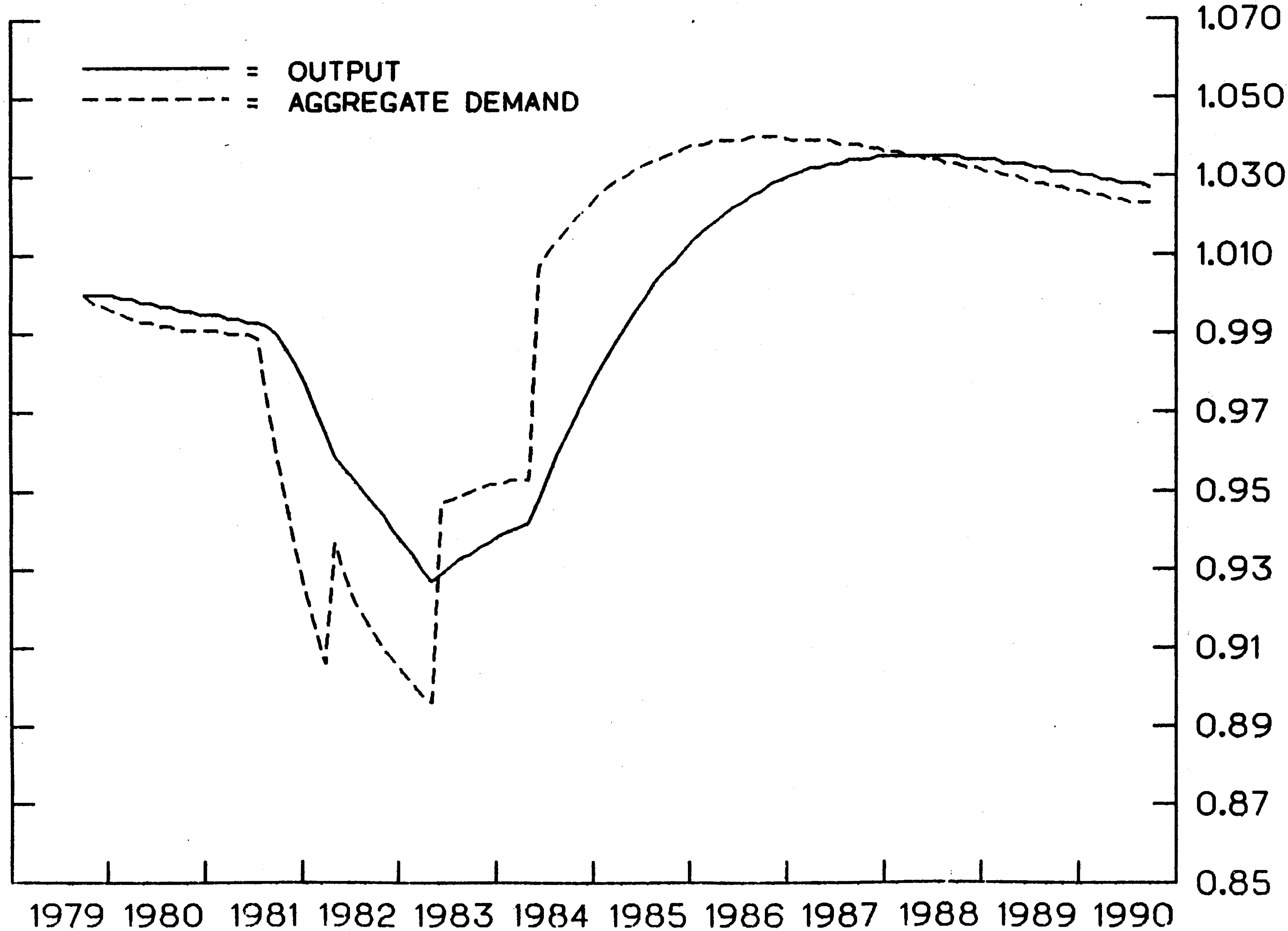


FIGURE 5.3

International Finance Discussion Papers

IFDP NUMBER	TITLES	AUTHOR(s)
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258	Long Memory Models of Interest Rates, the Term Structure, and Variance Bounds Tests	Gary S. Shea
257	Currency Substitution and the New Divisia Monetary Aggregates: The U.S. Case	Jaime Marquez
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