EXPECTED FISCAL POLICY
AND THE RECESSION OF 1982

William H. Branson

Arminio Fraga

Robert A. Johnson

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ABSTRACT

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ment that includes such announced and anticipated policy action.

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a stimulus to the economy when the tax cuts actually appear. But the finan-
cial markets could look ahead to the stimulus and the shift in the
high-employment deficit brought about by the tax cuts, and their implica-
tions 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
future 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, 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.

William H. Branson   Arminio Fraga   Robert A. Johnson
Woodrow Wilson School   Woodrow Wilson School   Board of Governors
Princeton University   Princeton University   Federal Reserve System
Princeton, NJ 08544   Princeton, NJ 08544   Washington, DC 20551

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 announced and 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 future 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 V 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. 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 effects of a pre-announced temporary fiscal expansion in the open-economy context are discussed in section IV. This presents both the dynamics of the open-economy model and rounds out our stylized analysis of the recession. The fiscal expansion must be temporary to keep the government debt from going off to infinity in our stationary model. In section V we see the pattern of a jump up in the long-term interest rate and a jump down (appreciation) in the exchange rate when the fiscal package is announced. Then the exchange rate must depreciate in the long-run equilibrium after the fiscal package is reversed, but U.S. interest rates remain permanently higher than those abroad, due to an increase in the exchange risk premium.

II. <u>Economic Policies and the Unusual Characteristics of the 1982 Recession</u>

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 over-all 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)

Source: Expected Fiscal Policy and The Recession of 1982

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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 three
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	91.7	99.9
2	6.1	12.4	13.7	7.6	82.0	90.8	100.1
3	5.7	9.7	12.0	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 expan-
sion 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) $\widehat{ER} = R - r$:   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. Expenditure 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, the difficulty of increasing construction demand, and
supply, quickly as future returns increase, and uncertainty regarding remaining
years of life (see Blanchard, 1984), we think the neutrality assumption is too

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.

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
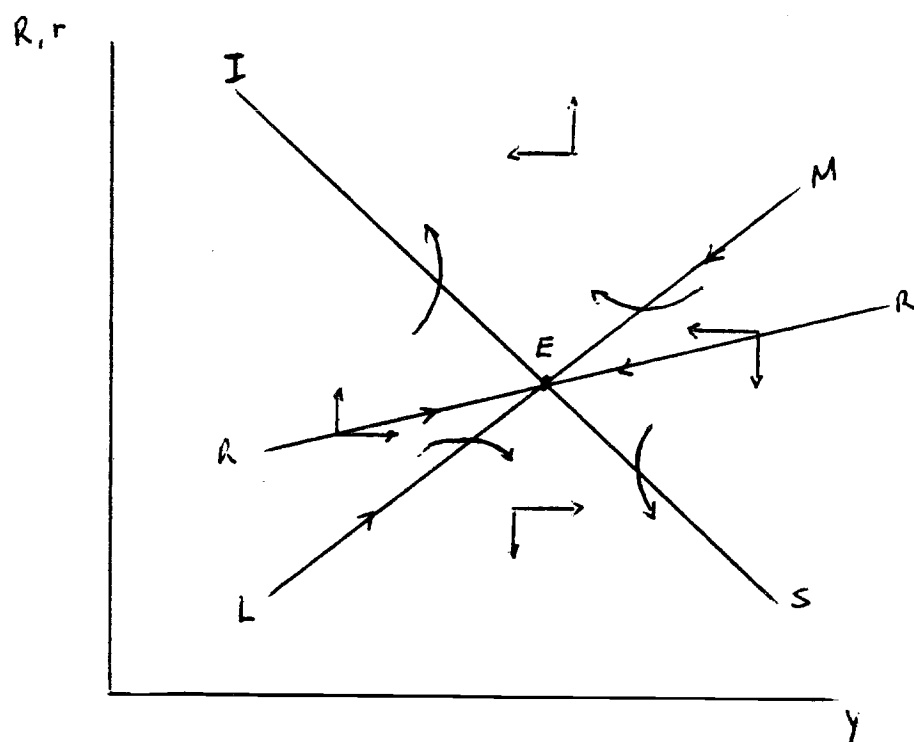
Figure 1: Basic Expectations Dynamics

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, $\hat{ER}$ 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 $\hat{ER} > 0$, R must exceed r. This gives the vertical arrows that show the motion of R. If R is above LM, R > r and $\hat{ER}$ 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, $\hat{ER} = R - r > 0$ 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 ($\hat{ER} = 0$) and explode to the northwest or southeast. These "unstable branches" will play an important role in the analysis of anticipated fiscal policy.

Unanticipated Monetary and Fiscal Policy

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 with
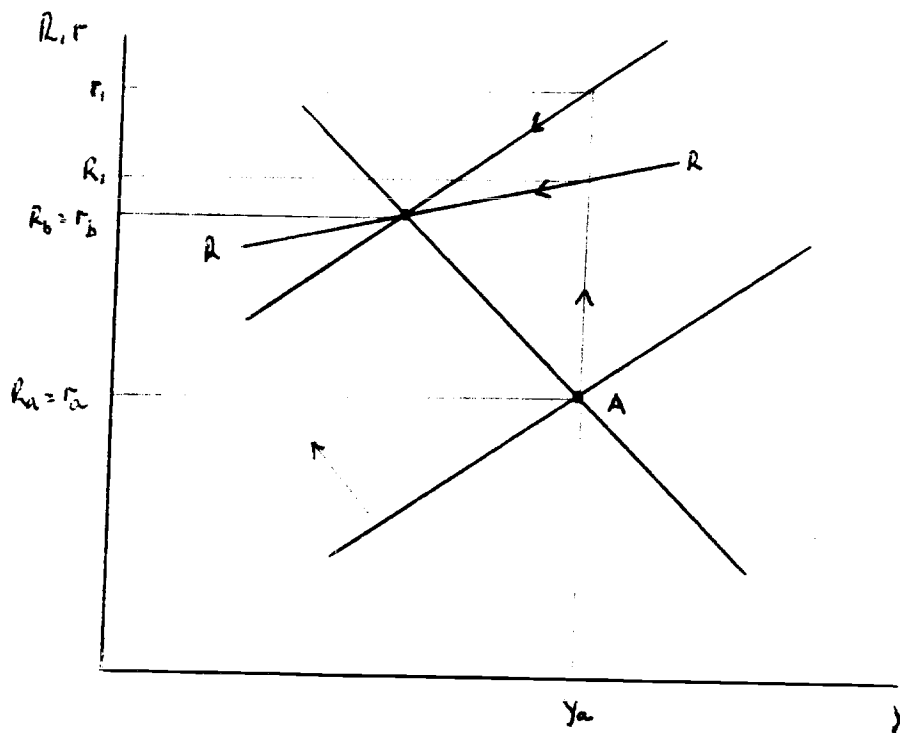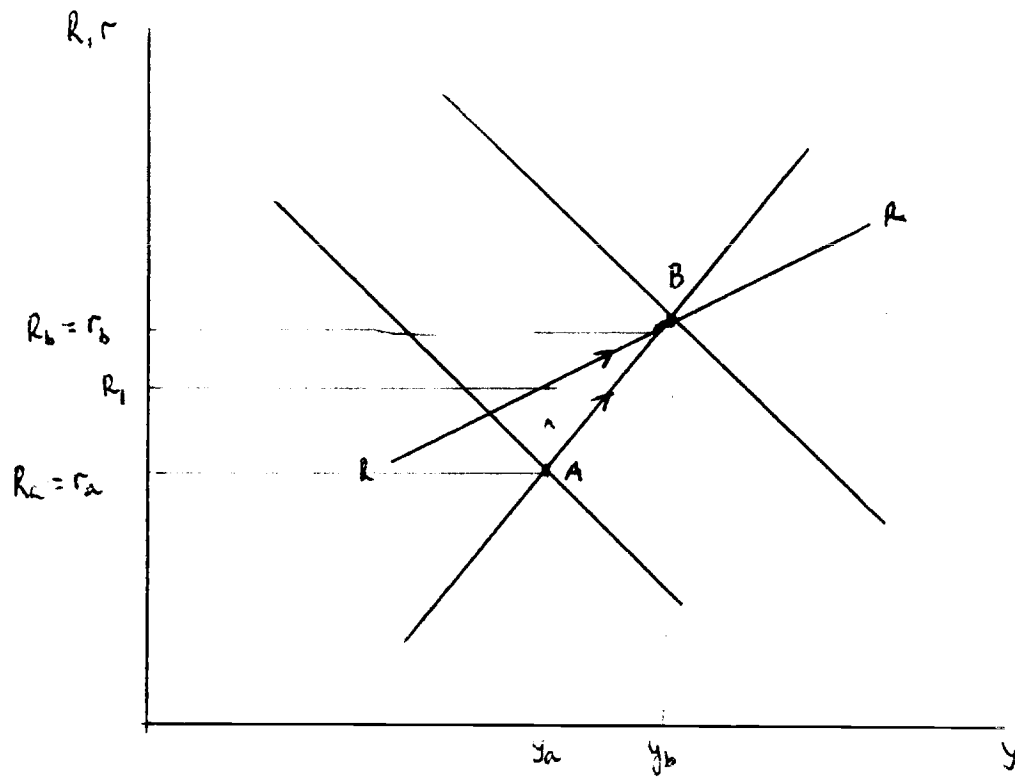
Figure 2: Monetary Contraction

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 exist-

ing 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 equi-

librium 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
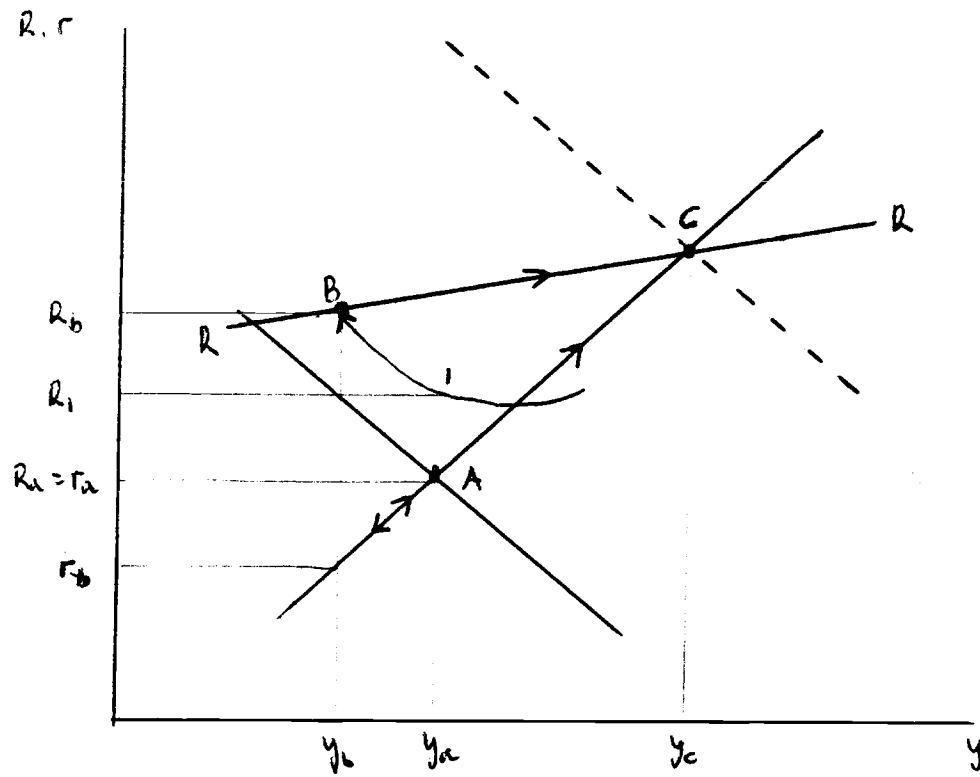
Figure 4: Expected Fiscal Expansion

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 future fiscal expansion raises the present long-term interest rate and throws the economy into an anticipatory recession.

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 Ml 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.
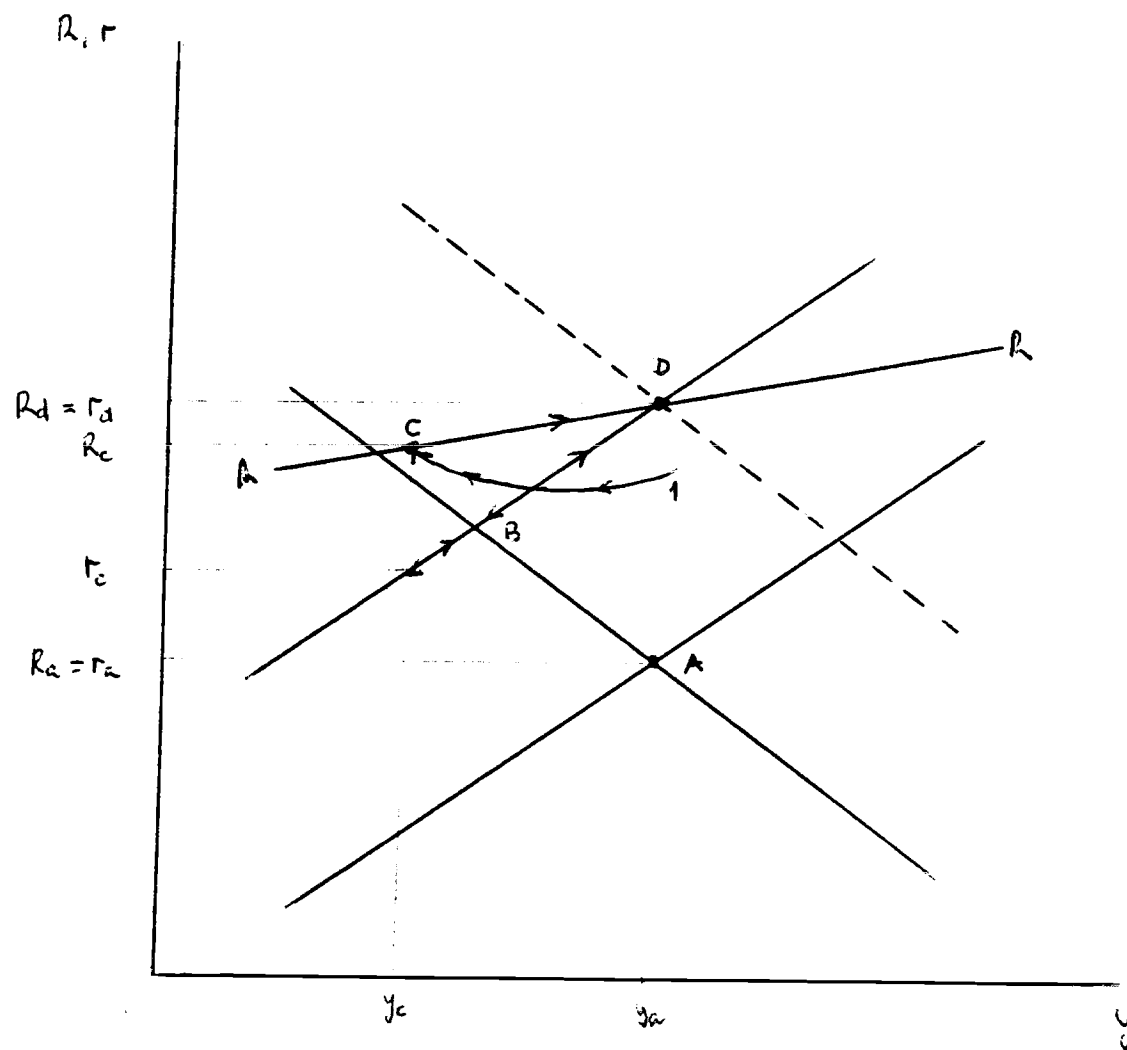
Figure 5:   Actual Monetary and

Expected Fiscal Policy

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 in future research. 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

(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 2. 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 x̃ 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) $\tilde{x} = \jmath\, e/p + \lambda y^* - \omega y$:   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

$$(10) \qquad \dot{b} = f - \dot{m} - m\hat{p},$$

where f is the current real deficit, $\dot{m}$ is the growth rate of real balances, and $m\hat{p}$ is the inflation tax. 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 full open-economy model is summarized in Table 4. 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.

V. Dynamics of an Anticipated Temporary Fiscal Expansion

To study the dynamics of the open-economy model, we can use the example of a pre-announced temporary fiscal expansion. This example, supplemented at the end of this section by a reduction in money growth, will also allow us to present our open-economy analysis of the recession of 1982 and the subsequent recovery. The fiscal expansion must be temporary so the real bond stock reaches a new long-run equilibrium value rather than going off to infinity. So initially we consider the

Table 4: THE COMPLETE MODEL

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

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

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

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

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

$$(6) \qquad \hat{p} \ = \ h + \phi(y - \bar{y})$$

$$(7) \qquad \tilde{x} \ = \ \sigma e/p + \lambda y^* - \omega y$$

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

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

$$(10) \qquad \dot{b} \ = \ f - \dot{m} - m\hat{p}$$

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

example of a temporary pre-announced increase in f that creates a per-
manent increase in b, with no change in money growth.

Long-run Equilibrium

First we consider the effects on the long-run equilibrium, then
shorter-run dynamics. The assumption of no change in money growth fixes
long-run nominal growth rates $\hat{e} = \hat{p} = h = \hat{M}$. With a larger real bond
stock and no change in the equilibrium $\hat{e}$, r and R must rise, from (9)
and (4). It is useful to note that from equation (9) with $\hat{e}$ fixed the
long-run increase in r is equal to $\rho \Delta b$. Thus in the long-run equilibrium
there is no change in the integrand in equation (11). This implies that
if r rises above its long-run equilibrium value during the shorter-run
period of dynamic adjustment, the integral in equation (11) will be nega-
tive, implying a fall in e(t), an appreciation of the dollar, initially.

This rise in long-run equilibrium r means, from (2), that 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, while in the short run interest
rates will rise even more, and the exchange rate will appreciate.

Announcement Effects and the Recession

We now shift the focus to the effects of the announcement of the
fiscal expansion. Essentially, we want to add the open-economy aspects
to the discussion of Figure 4. The announcement of the future fiscal

expansion creates the expectation that interest rates will rise. This means that E$\hat{R}$ in equation (4) becomes positive, and R jumps, as shown in Figure 4.

The expectation that rates will rise to a point like C in Figure 4, and remain high until the fiscal expansion is reversed, creates a negative expected interest integral in equation (11). So in addition to the upward jump in R at the date of the announcement, e jumps down, i.e. the dollar appreciates. We interpret this to be the appreciation shown in Table 2 across the first half of 1981.

The downward jump in e creates a jump appreciation of the real exchange rate e/p, so net exports begin to fall through equations (7) and (8). Thus the rise in the long rate R and the fall in e both contribute to the recession by reducing investment and net exports.

Short-run Equilibrium

Now let us consider the shorter run equilibrium., 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 equi-
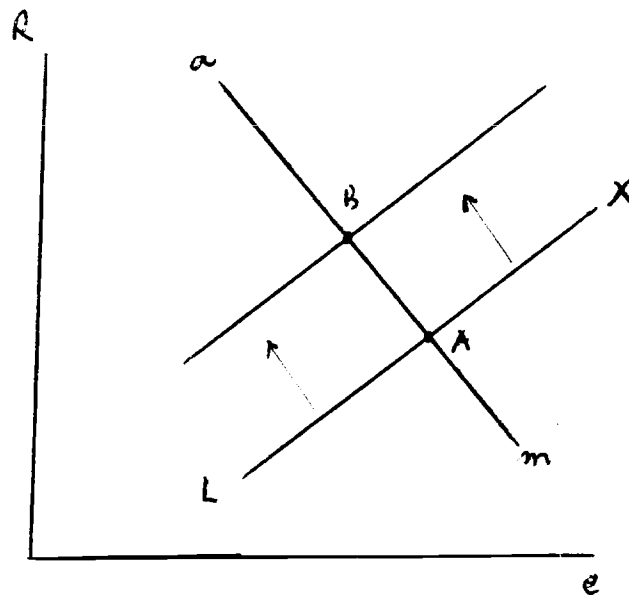
Figure 6: Short-run Adjustment with

Temporary Fiscal Expansion

librium r = R, and equation (11) says that if market participants expect
r to rise above its long-run equilibrium, the exchange rate will imme-
diately 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 explana-
tion 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.

The Role of Slower Money Growth

Finally, let us add the assumption of an unanticipated reduction in
the money growth rate to complete the stylized description of the reces-
sion. An unanticipated discrete reduction in the money stock would give
the term structure inversion shown in Figure 2. But an unanticipated
reduction in money growth does not change the short-run recession
pattern significantly, because it enters the model only gradually via
$\dot{h}$ in equation (5). Eventually, it reduces the nominal growth rates by
the decrease in $\hat{M}$.

In the long-run equilibrium, the addition of slower money growth
adds to the increase in the real bond stock b by reducing the inflation
tax in equation (10). This simply adds to the effect of the temporary
fiscal expansion. These effects all followed from the increase in the
real bond stock.

Thus to understand the pattern of movement of the term structure and
the exchange rate, as well as real output, during the recession, it is

sufficient (but clearly not necessary) to assume that there was a discrete tightening of monetary policy in 1979, pushing short rates above long, and an expectation of the fiscal deficit in 1981, accounting for the reversal of the term structure. This pair of assumptions is sufficient in a model that imposes rational expectations and market clearing in financial markets, but not in goods or, implicitly, labor markets. These are assumptions that we think are consistent with the real world that gave us the recession.

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