International Finance Discussion Papers

Number 286

July 1986

AN EMPIRICAL ANALYSIS OF POLICY COORDINATION IN THE UNITED STATES, JAPAN AND EUROPE

by

Hali J. Edison and Ralph Tryon

ABSTRACT

Coordination of macroeconomic policy has been a major topic at recent summit meetings, and has been the subject of a number of theoretical studies. However, relatively little empirical research exists on policy coordination. This paper is an attempt to help fill this gap. The paper considers the quantitative importance of the coordination of fiscal and monetary policy under flexible exchange rates. We also evaluate the mechanisms by which the effects of macroeconomic policy are transmitted abroad. The nature of the equilibrium reached in the absence of coordination is also analyzed, and the empirical results are related to the theoretical literature. The analysis is based on simulations with the Multicountry Model (MCM) developed at the Federal Reserve Board.

An Empirical Analysis of Policy Coordination in the United States, Japan and Europe

by

Hali J. Edison and Ralph Tryon*

In the postwar period, trading and financial ties have increased dramatically among the industrialized countries. These ties imply that one country's economic policies have spillover effects on other countries' welfare and consequently have implications for their economic policies. This interdependence suggests that coordination of economic policy between countries is important. However, as Oudiz and Sachs (1984) put it, "the advocacy of international coordination has been far more plentiful than its actual implementation." This paper aims to shed some light on the potential gains from coordination.

Several important theoretical papers have been written on policy coordination, but there is relatively little empirical work in the area. Jeffrey Sachs and Gilles Oudiz, in the paper just referred to, made a pathbreaking effort to measure the potential welfare gains that could be realized from policy coordination among Japan, Germany, and the United States.[1] In our paper we work within the general framework of Oudiz and Sachs, but we use a somewhat simpler empirical methodology, and focus on a different aspect of the gains from policy coordination.

Over the past five years, U.S. policy has been subject to much criticism by our major trading partners. One of the major sources of friction has been the "mix" of U.S. fiscal and monetary policies. The United States has been running a large government deficit, the inflationary effects of which have been offset domestically by a restrictive monetary policy. It is generally argued that the result has been higher real interest rates in the United States, a stronger dollar,

and a large U.S. current account deficit. The authorities have been under substantial pressure both at home and from abroad to change the policy mix, and recent months have indeed seen several steps in this direction.

However, if the U.S. government lowers spending there would be a significant tendency to lower real income in the United States, and through lower U.S. imports, in the rest of the world. This could potentially lead to a world-wide recession. On the other hand, part of this recession could be offset by the expansion of other OECD economies, Japan and Germany in particular. An important question is how other OECD economies can act effectively in response to changes in U.S. economic policy. In this paper we consider this as a problem in the empirical analysis of policy coordination.

We examine the impact of the U.S. Balanced Budget and Deficit Act of 1985 (also referred to as the Gramm-Rudman Act) on the U.S. economy and on Germany and on Japan. The paper seeks to evaluate different policy responses to this change in U.S. policy. In particular, we consider first an independent response by Germany and Japan, made in the absence of complete information about the extent of U.S. monetary accommodation, and a similar response for the United States. We then analyze some of the implications of a fully coordinated response. The aim of the paper is to provide an empirical evaluation of the gains from coordination using simulations with the Federal Reserve Board's Multicountry Model (MCM).

The plan of the paper is as follows: Section I gives a brief overview of the MCM model properties. Section II describes the basic features of the Gramm-Rudman Act, and Section III discusses our framework for the analysis of coordination. Section IV presents and

analyzes the empirical results from our model simulations; the conclusions follow in Section V.

I. The FRB Multicountry Model

The Multicountry Model (MCM) is a system of five quarterly national macroeconomic models, at the center of which is a medium-sized model of the U.S. economy.[2] Linked to this U.S. model and to each other are models of Canada, West Germany, Japan, and the United Kingdom.[3] The single models vary in size from 150 to 250 behavioral equations and identities; also included in the system is an abbreviated sector representing the rest of the world.

The system has three salient features relating to the international scope of the MCM. The first is the endogeneity of the bilateral dollar exchange rates. In the current version of the model, exchange rates are determined by the open interest parity condition with the expected exchange rate a function of relative price differentials.[4] The second noteworthy feature of the model is the use of bilateral, rather than aggregate, goods trade equations. These bilateral import demand equations are used to explain each country's imports from each of the other countries. The third feature of interest is the oil sector: the MCM models explicitly the consumption of and trade in oil; oil also enters the supply side, as a factor of production.

In the typical MCM country model, prices and quantities are determined by the behavior of four classes of economic agents: the monetary authorities, the government, commercial banks, and firms and households. The actions of these agents are modelled in the goods market, the labor market, and the asset market. Each country is assumed

to produce a composite consumption-investment commodity. By assumption, goods produced in the different countries are imperfect substitutes.

Aggregate demand is divided into six major components: personal consumption, fixed investment, inventory investment, government spending, exports, and imports. Consumption depends upon private disposable income and net worth following the life cycle hypothesis. The fixed investment equations are based on neo-classical investment theory, being positively related to changes in income and negatively to changes in the user cost of capital. Inventories act as a buffer stock and absorb any discrepancy between production and sales. Real government spending is assumed to be exogenous. Imports and exports of goods and services are broken down into merchandise trade, investment income, and other services.

The supply side of the prototype country model treats potential GNP as a function of the capital stock and labor force using a Cobb-Douglas production function. Capacity utilization is identified by the ratio of actual to potential GNP. The labor market is assumed not to clear completely in any one period, allowing for the existence of labor unions and minimum wage laws. The wage equation follows the familiar Phillips-Lipsey-Friedman approach: the change in wages is a function of unemployment and the expected inflation rate. The expected inflation rate is represented by a distributed lag on past price changes. Prices themselves are determined by a markup over average costs, which include wage costs adjusted for changes in labor productivity, and the cost of imports (including oil).

In the prototype model, the money market focuses on the role of reserves in the system. For a given level of base money the

short-term interest rate adjusts to clear money market. Money demands by the public (currency, demand deposits, and time deposits) and by the banking sector (free reserves) are modelled explicitly. Long-term interest rates are modelled as distributed lags on the short-term rate.

The MCM is in many ways a conventional demand-oriented macroeconometric model -- the innovations are chiefly in the modelling of trade and exchange rates, and in the multicountry structure. In particular, the treatment of expectations and aggregate supply is quite conventional, which does raise some questions about the appropriate way to model policy regime changes. Expectations of future prices and exchange rates are both modelled explicitly in the MCM country model; however, expectations are determined by an adaptive structure, and are not "forward-looking". Exchange rate expectations are used in the determination of the spot exchange rate, while price expectations offset nominal wages and the real interest rate, which appear throughout the model.

To provide a rough indication of the importance of expectations and supply effects in the MCM for the sorts of policy exercises reported in this paper, we present some summary multipliers in Table 1. The table shows the effects on real GNP and prices of standardized fiscal and monetary shocks, for the U.S. and foreign countries. The results can be interpreted as a measure of the degree of crowding out and neutrality of money in the model. The results also show the extent of foreign linkages in the MCM.

The table shows that crowding out of a U.S. fiscal shock is virtually complete after six years. Money is not neutral in the United States over this simulation period, but the positive effects of the

Table 1. Fiscal and Monetary Multipliers in the MCM

(amounts are cumulative percentage deviations from baseline)

year:	1	2	3	4	5	6
U.S. fiscal shock[1]						
U.S. GNP	1.6	1.8	1.4	0.9	0.5	0.1
U.S. prices	0.1	0.4	0.9	1.4	1.9	2.3
foreign GNP	0.3	0.7	0.9	0.9	1.0	1.0
foreign prices	0.2	0.4	0.6	0.7	1.0	1.2
U.S. monetary expansion[2]						
U.S. GNP	0.4	1.5	2.2	2.0	1.4	0.9
U.S. prices	0.1	0.4	0.8	1.4	2.1	2.6
foreign GNP	-.2	-.7	-.8	-.8	-.9	-1.1
foreign prices	-.4	-.6	-.7	-.7	-.9	-1.1
foreign fiscal shock[3]						
U.S. GNP	0.3	0.5	0.4	0.2	0.1	0.0
U.S. prices	0.0	0.2	0.3	0.4	0.6	0.7
foreign GNP	1.1	1.4	1.3	1.2	1.1	1.1
foreign prices	0.0	0.3	0.6	0.9	1.2	1.6
foreign monetary expansion[4]						
U.S. GNP	0.0	0.0	0.0	0.1	0.1	0.0
U.S. prices	-.1	-.2	-.2	-.1	-.1	0.0
foreign GNP	0.3	1.5	2.3	2.2	1.8	1.5
foreign prices	0.5	0.6	0.7	1.1	1.5	2.0

This table is adapted from the results presented at the recent Brookings Institution Conference on Empirical Macroeconomics for Open Economies (March 1986). (Money growth rates are held exogenous in all countries unless noted.)

1 Permanent increase of U.S. real government expenditures of one percent of baseline GNP.

2 One-time increase in U.S money growth rate of four percentage points.

3 Permanent increase in foreign real government expenditures of one percent of baseline GNP.

4 One-time increase in foreign money growth rate of four percentage points.

temporary increase in money growth are substantially reduced. The foreign models, taken together, exhibit noticeably less crowding out and neutrality of money than does the U.S. model. Finally, the spillover effects of U.S. policy on foreign economies are very strong, but foreign policy has much smaller effects on the United States. (The transmission effects are primarily through exchange rate changes, which affect foreign economies more than the United states.)

II. The Gramm-Rudman Act

This section briefly outlines some of the institutional aspects of the Balanced Budget - Deficit Reduction Act of 1985, also known as the Gramm-Rudman Act. In addition, it gives some indication how this will impact government spending. The Gramm-Rudman Act targets are now binding on the U.S. administration and congressional budget proposals. Table 2 shows what these limits are. Under the new law the administration may not propose a budget with deficits that exceeds these specific limits nor may Congress adopt a budget resolution which proposes higher deficits.

Table 2

Gramm-Rudman Deficit Limits

(Fiscal years, billions of current dollars)

	1986	1987	1988	1989	1990	1991
Maximum allowable deficit (in budget deliberations)	172	144	108	72	36	0
Trigger for automatic outlay cut mechanism	172	154	118	82	46	0

The Gramm-Rudman Act utilizes two mechanisms to enforce its deficit targets. First, it amends the regular congressional budget process. This has included making the reconciliation process earlier in the budget cycle and the provision for only one annual congressional budget resolution. Other changes mandate new procedures that are designed to make enforcement of budget targets stricter and more certain.

The second mechanism that the Gramm-Rudman Act uses to enforce deficit targets is a procedure for automatic outlay cuts called sequestration. This process is triggered if the estimate of the deficit for the coming fiscal year prepared by the Congressional Budget Office and the Office of Management and Budget just before the fiscal year begins exceeds the limit for that year specified in the Act. Even after this process is triggered, Congress is given the opportunity to assert priorities other than those embodied in the automatic formula provided that the Congressional alternative brings the deficit within the required limits.

In modelling the Gramm-Rudman Act in this paper, it is assumed that U.S. macroeconomic authorities surrender control over one of their policy instruments, namely government spending. (It is assumed that tax rates do not change, in accord with current administration policy.) Thus government spending is effectively predetermined because the government deficit is limited by the Gramm-Rudman Act. We assume that the constraint imposed by the act is always binding. U.S. government spending is forced to be cut from the baseline in accordance with the numbers in Table 2.

III. Strategic Considerations in Economic Policy-Making

The term "coordination" can refer to several aspects of the way in which countries jointly formulate their economic policies. Here we consider three possibilities.

The first concerns the timing of joint policy actions. Suppose, for example, that two countries agree to intervene in the foreign exchange markets to support a particular currency. The outcome might be different depending on whether or not the intervention occurred simultaneously (that is, was coordinated). It is entirely conceivable that nonlinearities in the system could cause the exchange rate to respond more if both countries intervened together, than if each intervened, by the same amount, a month apart. (The G-5 intervention in September 1985 might be an example of such a case.)

A second type of coordination involves exchanging information among countries about the policy stance of each. Following, say, an unexpected change in oil prices, individual countries would face the problem of determining the appropriate policy response. The best policy for one country might depend on what action was taken by another. For example, if one country responded by easing its monetary policy, that country's trading partners might want to ease its monetary policies to keep real exchange rates unchanged.

Finally, countries might engage in cooperative policy "trading" in which one country undertakes a policy action which lowers its own welfare but helps others, in return for similar concessions by foreign countries. An obvious example is in negotiating tariff reductions, where one country might agree to stop protecting an important domestic industry in return for access to a foreign market.

Or, as in the cases analyzed by Oudiz and Sachs, the trade might occur in macroeconomic policy. One country might inflate its own economy slightly past the optimal point, raising income but at the cost of a deterioration of the exchange rate. The expansion would, however, benefit foreign economies by raising demand for their exports. In exchange for this, the foreign economies could inflate their own economies, offsetting the exchange rate change and raising income in the first country.

For clarity we term these three types of policy interaction "synchronization", "coordination", and "cooperation" respectively. In this paper we focus on the gains from coordination, as defined here. This is in contrast to much of the recent work in this area, which considers the question of policy cooperation, as we use the term. Our interest in this aspect stems not from any presumption that the exchange of information is either more or less important than policy trading, but rather from our desire to explore another side of the question.

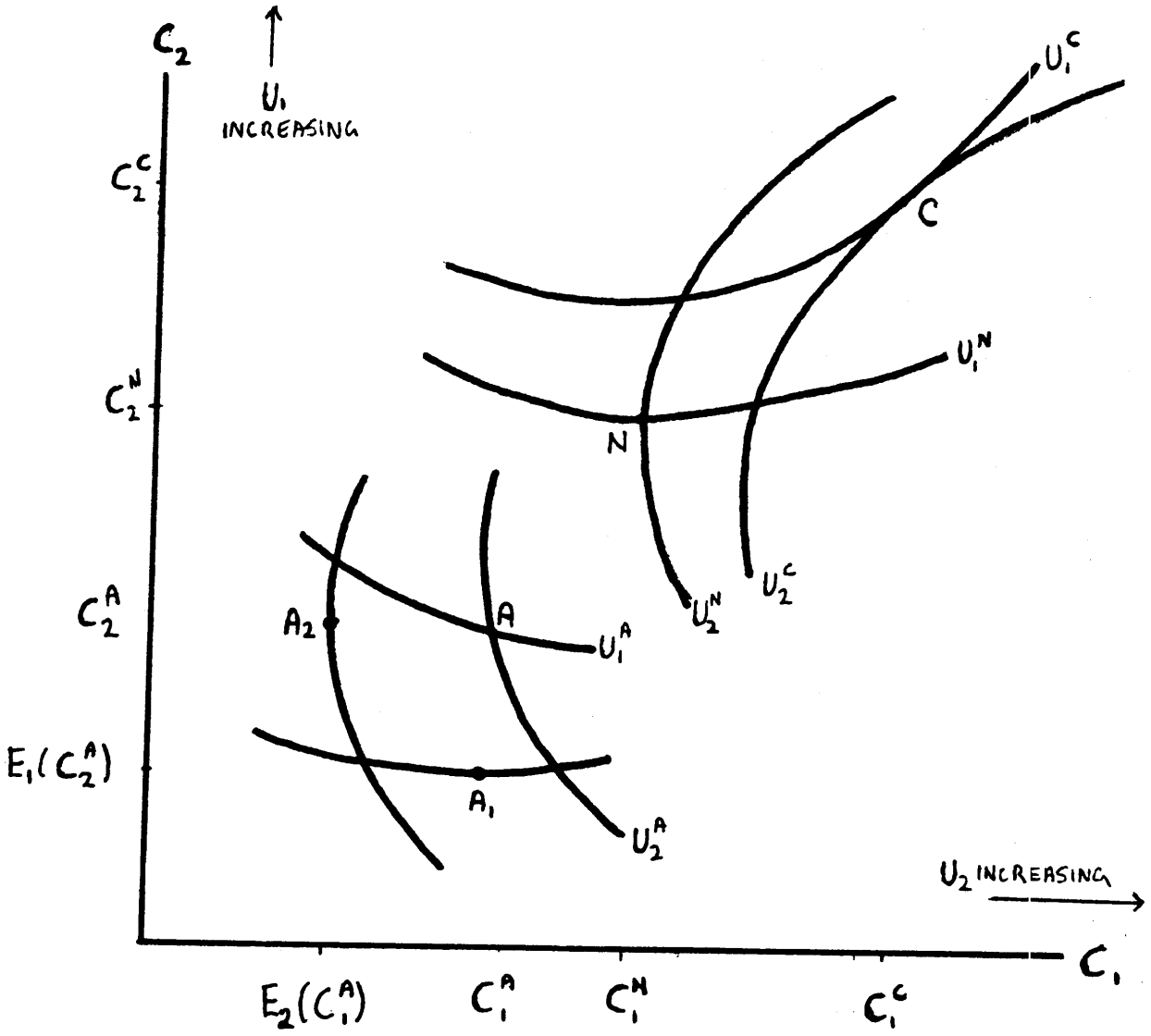
The basic theoretical framework we use adopts the classical convention of Tinbergen of targets and instruments in a multicountry environment (see Oudiz and Sachs (1984))[5]. In the general framework an n country world economy is considered in which each country has k targets. For each country i there is a vector of targets $T^i = (T^i_1, \ldots, T^i_k)$. The i^{th} country has m controls or policy instruments $P^i = (P^i_1, \ldots, P^i_m)$. The macroeconomic authorities of each country choose P^i in a way which will maximise their own utility, $U^i(T^i)$. In an interdependent world the T^i will be a function of all n countries' controls. Therefore, to maximize its utility, country 1's authority will have to condition on what the other n-1 countries are doing.

In this paper three equilibria are considered. In the first policymakers must form expectations under uncertainty about what foreignpolicy is. The second is a Nash equilibrium, or the uncoordinated policymaking equilibrium. In this instance no trades are being made; rather country 1 formulates its policy taking the actions of the n-1 countries as known and given. In the Nash equilibrium each country knows what every other country is doing and that they all know and use the 'true' model. The last equilibrium considered is a cooperative one in which some form of explicit cooperation takes place, moving some or all countries to a higher level of utility.

These concepts can be illustrated for the case of two countries, each with one policy instrument, using the standard indifference curve framework, as shown in Figure 1. On the horizontal axis the control variable is measured for country 1 and the vertical axis depicts that for country 2. The curves in the diagram represent the utility for each country -- actually a family of these curves could be drawn.

Suppose country 1 expects country 2 to set its control variable at $E_1(C_2)$, where E_1 denotes expectations by country 1. Then country 1 chooses policy C_1, expecting to reach point A_1. Country 2 does likewise, expecting to reach A_2. The actual point reached by both countries is A. In this example each country sets a higher value for the control variable than expected by the other, so utility in each country is higher than expected. But point A is clearly suboptimal -- each ccuntry, had it known the other would select a higher value for its control, would have selected a still higher value for its own.

FIGURE 1


C_2
U_1 INCREASING
C_2^C
C_2^N
C_2^A
$E_1(C_2^A)$
U_1^C
C
U_1^N
N
U_2^C
U_2^N
A_2
A
U_1^A
A_1
U_2^A
U_2 INCREASING
C_1
$E_2(C_1^A)$
C_1^A
C_1^N
C_1^C

At the Nash equilibrium, point N, country 1's expectation for country 2's policy, $E_1(C_2^N)$, is equal to that policy, C_2^N, and similarly, $E_2(C_1^N)=C_1^N$. At this point each side is optimizing given the actual policy of the other player -- this is not true at point A. The difference between the two points is that at A, expected foreign policy is not equal to actual foreign policy. Because countries must act without knowledge of actual policy abroad, welfare is reduced.

In other words, while the Nash equilibrium N is not a cooperative equilibrium, it is coordinated in the sense that each side has full knowledge of what the other is doing. (This knowledge might be communicated directly, or it might be obtained by predicting foreign behavior given knowledge of the underlying economic structure.)

Of course, the Nash equilibrium is not optimal either, because welfare could still be improved by a trade. Raising C_1 above its Nash value would change U_1 only slightly, because U_1 is maximized with respect to C_1 at N. But U_2 would clearly rise. A similar argument applies for C_2, and by raising both C_1 and C_2 an efficient point such as C can be reached. Notice that reaching C requires more than an exchange of information -- it requires an agreement in which each party agrees to make a sacrifice for the good of the other. This is what we term policy "cooperation".

In their pioneering article, Oudiz and Sachs make use of the properties of the Nash equilibrium (together with other assumptions) to infer the policymakers' utility functions. This, together with the parameters of the structural model, enables them not only to find an efficient point such as C but to measure the welfare gain from moving

from N to C. The major difficulty with this analysis is that it requires some very stringent assumptions. One needs to be able to identify a particular period in time as a Nash equilibrium and to specify the exact form of the policymakers' utility functions.

In this paper we use a less rigorous but, we think, equally informative approach to study the difference between points such as A and N, and N and C. We assume first that following a particular event (or "shock") each country's expectation about the stance of foreign policy remains unchanged, and we consider various policy responses in this case. We then consider the same type of policy response when policymakers assume that a foreign policy reaction occurs. Finally, we give a simple example of explicit policy cooperation, as defined above. In order to evaluate gains and losses we offer a description of the changes in income, prices, and the real exchange rate, rather than trying to compute a single measure of utility.

IV. Empirical Simulations of Economic Policy Coordination

This section presents the results of a series of simulations of the Gramm-Rudman law in the United States. The simulations were performed using the FRB Multicountry Model (MCM) over the period 1986Q1-1990Q4. In the empirical implementation of our analysis of policy coordination we make several simplifying assumptions. First, it is assumed that economic structure of the MCM is the true model of the world, and that policymakers believe this. Second, we consider policy coordination among only three countries in the MCM: the United States, Japan, and Germany. Finally, each country is assumed to have two policy

instruments - monetary and fiscal policy - and three targets -- GNP, inflation, and the real exchange rate.

We start by describing the underlying baseline projection used in the analysis. The baseline used for these simulations is essentially similar to that used for the Brookings Conference on Empirical Macroeconomics (March 1986). The common elements in the baseline are the components of GNP, prices, exchange rates, and interest rates in each country. For the most part, these paths are extrapolations of forecasts obtained from the OECD Economic Outlook for December 1984. For the period beyond which forecasts have been prepared by the OECD, we extrapolated at the growth rates projected by the OECD for the first half of 1986. Exchange rates and interest rates are held constant over the projection period using 1985Q4 data. This baseline path is treated as the initial Nash equilibrium. That is, each country is assumed to have achieved its optimal policy mix given the other countries' policy actions, prior to the passage of the Gramm-Rudman Act.

The initial effects

Table 3 summarizes the effects of the Gramm-Rudman law in the absence of any other policy reaction either in the United States or abroad. (All countries are assumed to keep their money supplies unchanged.) In this model, the reduction of government spending in the United States leads directly to a reduction in real income. With a fixed path for the money supply, interest rates fall leading to a depreciation of the dollar. (The reduction in real income tends to reduce imports and therefore to cause the dollar to depreciate; this effect is offset by the lower interest rates). Prices fall (relative to the baseline) as output falls because excess capacity in the economy

TABLE 3: US FISCAL CONTRACTION WITH NO MONETARY ACCOMMODATION

	1986Q4	1987Q4	1988Q4	1989Q4	1990Q4
UNITED STATES					
Real GNP (%).....	-1.5	-2.3	-2.5	-1.6	-1.9
growth rate.....	-1.5	-0.8	-0.3	0.9	-0.3
Price level (%).....	-0.1	-0.6	-1.3	-2.1	-3.0
infl rate (+/-).....	-0.1	-0.4	-0.7	-0.8	-0.9
Interest rate (+/-)....	-1.2	-2.3	-3.2	-3.4	-4.5
Money supply--M1 (%)...	0.0	0.0	0.0	0.0	0.0
growth rate.....	0.0	0.0	0.0	0.0	0.0
Trade balance ($B).....	9.3	16.9	24.1	24.1	32.7
Current account ($B)...	11.2	26.1	45.4	59.8	92.7
Exch rate--FX/$ (%)....	-1.8	-3.6	-5.2	-5.5	-6.8
Government deficit ($B)	-8.9	-22.6	-47.6	-72.6	-114.9
GERMANY					
Real GNP (%).....	-0.4	-0.9	-1.3	-1.4	-1.8
growth rate.....	-0.4	-0.4	-0.5	-0.1	-0.3
Price level (%).....	-0.3	-0.7	-1.2	-1.7	-2.4
infl rate (+/-).....	-0.3	-0.4	-0.5	-0.5	-0.7
Interest rate (+/-)....	-0.5	-0.8	-1.1	-1.2	-1.8
Money supply--CBM (%)..	0.0	0.0	0.0	0.0	0.0
growth rate.....	0.0	0.0	0.0	0.0	0.0
Trade balance ($B).....	-1.8	-3.9	-7.0	-9.1	-12.9
Current account ($B)...	-1.3	-2.9	-5.3	-7.2	-11.3
Exch rate--DM/$ (%)....	1.7	3.6	5.2	5.4	6.4
JAPAN					
Real GNP (%).....	-0.7	-1.5	-2.1	-2.2	-2.8
growth rate.....	-0.7	-0.8	-0.6	-0.1	-0.5
Price level (%).....	-0.1	-0.2	-0.4	-0.6	-0.9
infl rate (+/-).....	-0.1	-0.1	-0.2	-0.2	-0.3
Interest rate (+/-)....	-0.2	-0.4	-0.6	-0.6	-0.7
Money supply--M2 (%)...	0.0	0.0	0.0	0.0	0.0
growth rate.....	0.0	0.0	0.0	0.0	0.0
Trade balance ($B).....	-4.2	-8.8	-13.2	-14.8	-20.4
Current account ($B)...	-4.1	-9.7	-15.4	-19.0	-26.9
Exch rate--$/yen (%)...	2.1	3.6	5.1	5.4	7.3

NOTE: Amounts shown are deviations from baseline
(%) = percent, (+/-) = absolute deviation
Dollar values converted at baseline rates

reduces profit margins. Again, this effect offsets the inflation caused by the dollar depreciation.

All of these factors tend to cause the U.S. current account position to improve. Falling income lowers goods imports, while the reduction in interest rates reduces investment income payments. The dollar depreciation and the fall in prices tend to increase exports although on balance exports fall because foreign income is reduced. The net result is a substantial improvement in the U.S. current account. We might note that because the United States has a large net external debt in the baseline simulation changes in U.S. interest rates have an important direct effect on the current account. This effect cumulates as current account improvements reduce the stock of liabilities to foreigners.

In general, the effects on the U.S. economy appear to be of moderate magnitudes. Real income falls by 1-1/2 percent in the first year and by 2-1/2 percent after three years before recovering somewhat. (In the long run these decreases would be almost completely reversed.) The inflation rate falls slightly, by 0.5-0.9 percent, and the exchange rate depreciates by only 5-7 percent. Nominal interest rates fall substantially, by 1.2 percentage points after four quarters and by 4.5 percentage points at the end of the simulation. As noted, the current account improvesquite substantially by the end of this period.

In Germany and Japan the effects of the U.S. fiscal contraction are felt on a direct reduction in demand for exports and as an appreciation of their exchange rates which further lower exports. Prices and interest rates fall, as in the United States but the current account in both countries goes into deficit.

Initially, the impact on real income is smaller abroad than in the United States, but over time the effects of the dollar depreciation

reduce exports sharply. In Japan the percentage fall in output actually exceeds that in the United States by the end of the period. Nevertheless, the magnitude of the effects are in general moderate -- the growth rate of real income is reduced by about 1/2 percent per year, while the inflation rate falls by a little less. Interest rates decline by less than one percentage point in Japan, and somewhat more in Germany; the two countries' exchange rates appreciate by only 5-7 percent against the dollar.

Foreign response

Table 4 shows the results from a second simulation in which foreign countries respond to the U.S. fiscal contraction by using monetary policy to hold their real exchange rates constant. This expansionary policy offsets one of the major sources of deflationary pressure abroad, with the result that the fall in foreign income is greatly reduced. In Germany, real GNP falls by 0.9 percent at the end of the period, instead of 1.8 percent, while in Japan output actually rises slightly. In contrast, during the first two years of the two simulations the output paths are very similar for both countries, since at that point the chief influence is the loss of exports to the United States.

The inflationary price paid for these gains is very modest, which reflects in part the "stickiness" of the price determination mechanism in the MCM. The increase in the money growth rate required to maintain constant real exchange rates is about 1/2 percent per year in Germany (for central bank money), and 1 to 2-1/2 percent per year in Japan (for M2). Interest rates fall by 2 to 3 percentage points.

What is striking about this policy response is that it has essentially no effect on the U.S. economy: the paths for income,

TABLE 4: US FISCAL CONTRACTION WITH FOREIGN MONETARY ACCOMMODATION

	1986Q4	1987Q4	1988Q4	1989Q4	1990Q4
UNITED STATES					
Real GNP (%).....	-1.5	-2.3	-2.5	-1.6	-1.9
growth rate.....	-1.5	-0.8	-0.3	1.0	-0.3
Price level (%).....	-0.2	-0.6	-1.4	-2.2	-3.1
infl rate (+/-).....	-0.2	-0.5	-0.7	-0.8	-0.9
Interest rate (+/-)....	-1.3	-2.3	-3.3	-3.5	-4.6
Money supply--M1 (%)...	0.0	0.0	0.0	0.0	0.0
growth rate.....	0.0	0.0	0.0	0.0	0.0
Trade balance ($B).....	9.3	16.5	23.4	23.2	32.0
Current account ($B)...	11.1	26.0	45.5	60.6	94.4
Exch rate--FX/$ (%)....	-1.1	-2.3	-3.2	-3.3	-3.8
Government deficit ($B)	-9.0	-23.0	-48.7	-74.8	-118.6
GERMANY					
Real GNP (%).....	-0.4	-0.7	-0.9	-0.7	-0.9
growth rate.....	-0.4	-0.3	-0.2	0.2	-0.2
Price level (%).....	-0.1	-0.4	-0.7	-1.1	-1.6
infl rate (+/-).....	-0.1	-0.3	-0.3	-0.4	-0.5
Interest rate (+/-)....	-0.9	-1.5	-2.2	-2.3	-3.1
Money supply--CBM (%)..	0.3	0.8	1.4	1.8	2.3
growth rate.....	0.3	0.5	0.6	0.4	0.5
Trade balance ($B).....	-1.9	-3.6	-5.5	-5.8	-8.2
Current account ($B)...	-2.0	-3.7	-5.9	-6.8	-10.5
Exch rate--DM/$ (%)....	0.7	1.4	1.8	1.7	1.9
JAPAN					
Real GNP (%).....	-0.5	-0.7	-0.6	0.2	0.7
growth rate.....	-0.5	-0.2	0.1	0.7	0.5
Price level (%).....	-0.0	-0.1	-0.2	-0.2	-0.1
infl rate (+/-).....	-0.0	-0.1	-0.1	0.0	0.1
Interest rate (+/-)....	-0.8	-1.4	-1.9	-2.0	-2.6
Money supply--M2 (%)...	0.9	2.0	3.5	5.0	7.7
growth rate.....	0.9	1.1	1.6	1.4	2.8
Trade balance ($B).....	-3.5	-6.5	-9.4	-9.3	-11.9
Current account ($B)...	-3.7	-8.3	-13.7	-17.2	-24.5
Exch rate--$/yen (%)...	0.6	1.1	1.2	0.7	0.3

NOTE: Amounts shown are deviations from baseline
(%) = percent, (+/-) = absolute deviation
Dollar values converted at baseline rates

prices, interest rates, and the current account are virtually identical in the two simulations. The implication of this result is that, at least for policy changes of this order of magnitude, the United States can effectively ignore the foreign response in calculating its own optimal policy. We will return to this theme later in the paper.

U.S. response

In Table 5 we show the results of the opposite case, in which the United States does ease its monetary policy to accommodate the fiscal contraction, but foreign countries do not. We assume that the U.S. monetary reaction is aimed at stabilizing real GNP, rather than the real exchange rate. This choice of target is motivated by the commonplace observation that the United States is a less open and outward-looking economy than is Germany or Japan.

We should note that in our model it is not generally possible to use monetary policy to hold real GNP in the United States to an arbitrary path in the face of a shock. (This is because of the nature of the lagged response of demand to interest rate changes.) Therefore, we have selected a path for monetary growth which substantially reduces the decline in U.S. GNP, without trying to eliminate the decline entirely.

In this simulation, U.S. GNP returns (approximately) to the baseline path after the first two years. The monetary expansion reduces nominal interest rates, which fall by about 4-1/2 percentage points. This leads to a depreciation of the dollar of 12 percent by the end of the period. Despite the dollar's depreciation, the inflation rate is slightly lower throughout the simulation.

These benefits come, however, at the expense of the other countries. The additional depreciation of the dollar (as compared with

TABLE 5: US FISCAL CONTRACTION WITH US MONETARY ACCOMMODATION

	1986Q4	1987Q4	1988Q4	1989Q4	1990Q4
UNITED STATES					
Real GNP (%).....	-1.0	-0.9	-0.3	0.7	-0.1
growth rate.....	-1.0	0.1	0.7	1.0	-0.8
Price level (%).....	-0.0	-0.2	-0.4	-0.6	-0.8
infl rate (+/-).....	-0.0	-0.1	-0.2	-0.2	-0.2
Interest rate (+/-)....	-2.0	-4.4	-4.4	-4.6	-4.7
Money supply--M1 (%)...	1.5	3.5	4.5	4.5	4.0
growth rate.....	1.5	2.0	1.0	-0.0	-0.5
Trade balance ($B).....	6.9	11.6	16.0	18.0	27.3
Current account ($B)...	8.1	26.3	45.0	64.1	93.1
Exch rate--FX/$ (%)....	-2.7	-8.0	-9.5	-11.3	-12.0
Government deficit ($B)	-20.7	-56.8	-104.9	-137.6	-168.8
GERMANY					
Real GNP (%).....	-0.3	-0.5	-0.9	-1.2	-1.7
growth rate.....	-0.3	-0.2	-0.5	-0.2	-0.5
Price level (%).....	-0.5	-1.2	-1.7	-2.1	-2.6
infl rate (+/-).....	-0.5	-0.7	-0.6	-0.3	-0.5
Interest rate (+/-)....	-0.6	-1.2	-1.2	-1.4	-1.8
Money supply--CBM (%)..	0.0	0.0	0.0	0.0	0.0
growth rate.....	0.0	0.0	0.0	0.0	0.0
Trade balance ($B).....	-1.0	-2.4	-5.8	-7.4	-12.0
Current account ($B)...	-0.4	-0.2	-2.4	-2.6	-7.3
Exch rate--DM/$ (%)....	3.2	8.6	10.9	12.5	12.6
JAPAN					
Real GNP (%).....	-1.0	-2.2	-2.9	-3.1	-3.4
growth rate.....	-1.0	-1.3	-0.7	-0.2	-0.3
Price level (%).....	-0.1	-0.4	-0.6	-0.9	-1.2
infl rate (+/-).....	-0.1	-0.3	-0.2	-0.3	-0.3
Interest rate (+/-)....	-0.3	-0.6	-0.7	-0.7	-0.7
Money supply--M2 (%)...	0.0	0.0	0.0	0.0	0.0
growth rate.....	0.0	0.0	0.0	0.0	0.0
Trade balance ($B).....	-6.3	-11.1	-17.2	-17.6	-24.1
Current account ($B)...	-6.3	-12.4	-20.6	-22.6	-31.0
Exch rate--$/yen (%)...	3.4	9.2	10.3	12.6	13.8

NOTE: Amounts shown are deviations from baseline
(%) = percent, (+/-) = absolute deviation
Dollar values converted at baseline rates

the first simulation with no policy response) leads to a further reduction in exports. In Germany this is offset by the positive effects of stronger income in the United States, but in Japan exports and output both fall sharply. Japanese real GNP falls by over 3 percent by the end of the simulation period. Clearly, U.S. policies do affect foreign countries.

Joint policy response

Finally, we consider a simulation in which both the United States and the foreign countries use monetary policy to offset the effects of the initial fiscal contraction. The United States is assumed to follow the same monetary growth path as in the previous simulation, while Germany and Japan again use monetary policy to fix their real exchange rates. Table 6 presents the results.

As in the earlier example, the foreign expansion maintains GNP roughly unchanged in the face of the U.S. contraction, except in the last two years for Japan, when income actually rises. Again, the foreign policy response has only minor effects on U.S. income, prices, interest rates, and current account. Thus we still conclude that U.S. policies can be set independently of the foreign response.

However, the foreign monetary policy needed to stabilize real exchange rates is very different in the last simulation (with U.S. monetary accommodation) from the earlier simulation (without U.S. accommodation). The foreign money growth rates shown in Table 6 are more than twice as large as those in Table 4. Therefore, we conclude that in responding to a given event, foreign economic policymaking should, in general, take into account the response of U.S. economic policy to the same event.

TABLE 6: US FISCAL CONTRACTION WITH US AND FOREIGN MONETRY ACCOMMODATION

	1986Q4	1987Q4	1988Q4	1989Q4	1990Q4
UNITED STATES					
Real GNP (%).....	-1.0	-1.0	-0.3	0.7	0.0
growth rate.....	-1.0	0.0	0.7	1.0	-0.7
Price level (%).....	-0.1	-0.3	-0.6	-0.8	-1.0
infl rate (+/-).....	-0.1	-0.2	-0.3	-0.2	-0.2
Interest rate (+/-)....	-2.0	-4.5	-4.6	-4.7	-4.8
Money supply--M1 (%)...	1.5	3.5	4.5	4.5	4.0
growth rate.....	1.5	2.0	1.0	-0.0	-0.5
Trade balance ($B).....	6.9	10.6	14.4	15.5	25.5
Current account ($B)...	7.8	25.4	45.2	64.9	96.0
Exch rate--FX/$ (%)....	-1.0	-4.8	-5.9	-7.3	-7.9
Government deficit ($B)	-20.9	-57.3	-106.9	-141.4	-175.5
GERMANY					
Real GNP (%).....	-0.2	-0.1	-0.0	0.3	-0.0
growth rate.....	-0.2	0.1	0.1	0.3	-0.3
Price level (%).....	-0.2	-0.5	-0.8	-1.0	-1.2
infl rate (+/-).....	-0.2	-0.3	-0.3	-0.1	-0.3
Interest rate (+/-)....	-1.6	-3.0	-3.3	-3.5	-3.6
Money supply--CBM (%)..	0.7	1.7	2.8	3.5	4.0
growth rate.....	0.7	1.1	1.1	0.7	0.5
Trade balance ($B).....	-1.9	-2.5	-3.0	-1.7	-2.7
Current account ($B)...	-2.5	-2.9	-3.9	-2.6	-4.5
Exch rate--DM/$ (%)....	0.6	3.2	3.8	4.6	5.1
JAPAN					
Real GNP (%).....	-0.3	-0.3	0.5	1.8	2.5
growth rate.....	-0.3	0.0	0.8	1.3	0.8
Price level (%).....	-0.0	-0.1	-0.0	0.1	0.5
infl rate (+/-).....	-0.0	-0.1	0.1	0.2	0.3
Interest rate (+/-)....	-1.4	-2.8	-3.0	-3.0	-3.1
Money supply--M2 (%)...	2.1	5.4	8.0	10.7	13.4
growth rate.....	2.1	3.3	2.5	2.8	2.7
Trade balance ($B).....	-3.7	-6.7	-9.5	-9.8	-12.7
Current account ($B)...	-4.3	-10.2	-17.2	-22.2	-29.8
Exch rate--$/yen (%)...	0.4	2.7	3.0	3.5	3.3

NOTE: Amounts shown are deviations from baseline
(%) = percent, (+/-) = absolute deviation
Dollar values converted at baseline rates

This result is an example of an important, and obvious, asymmetry in the present-day world economy, that the United States is a much larger and substantially less open economy than its major trading partners. Therefore other countries must take into account U.S. policy actions, but the United States need not take theirs into account. (Of course, we have given an analysis of only one possible policymaking problem -- it does not follow that in response to any shock the United States could ignore the actions for foreign countries.)

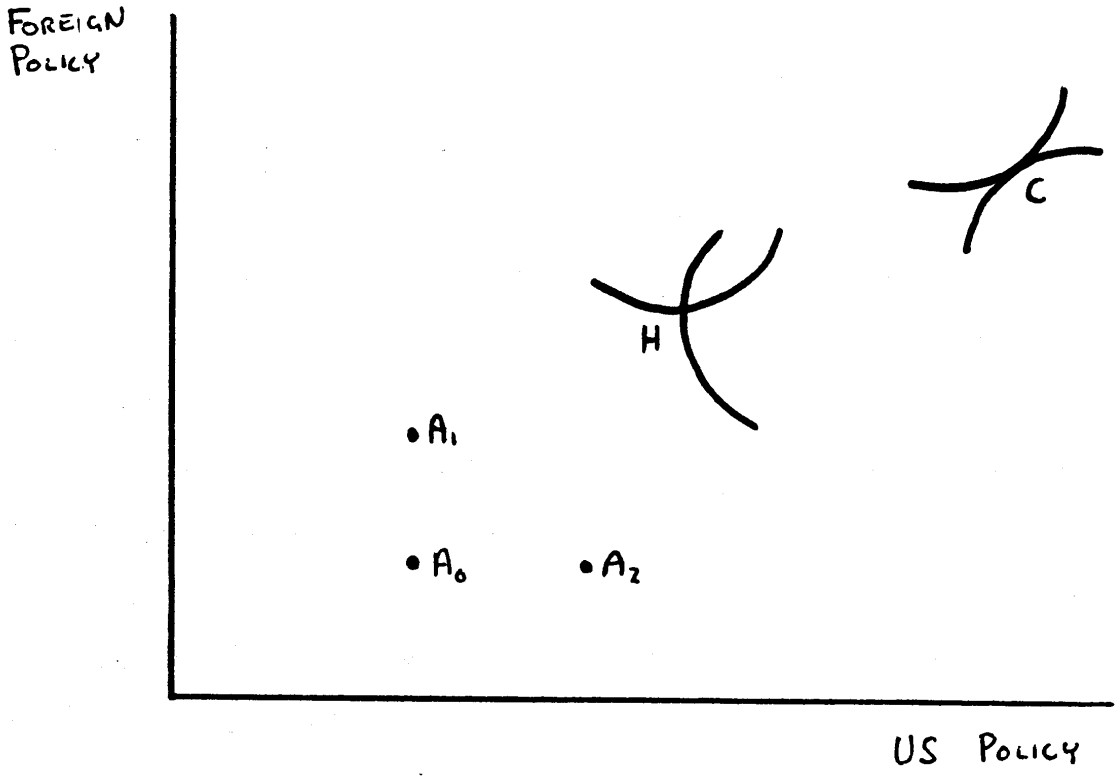
This example also illustrates the scope for gains from sharing information about foreign economic policy responses. In the terms of our earlier discussion, the Nash equilibrium (loosely) corresponds to the last simulation, in which all parties optimize given full knowledge of other countries policies.

V. Conclusion

We can represent these simulations in terms of our theoretical framework using Figure 2. After the implementation of the Gramm-Rudman Act the world economy finds itself at a point such as A_2, which corresponds to our first simulation (Table 3). At this point policy in all countries is suboptimal given the changed conditions, which we model as the imposition of a constraint on U.S. fiscal policy.

We assume that foreign fiscal policy remains unchanged throughout, so that each country has only one policy instrument, namely the money supply. We have further simplified the problem by assuming that each country has only one target -- real GNP in the United States, and the real exchange rate abroad. This assumption allows each country

FIGURE 2



to hit its target exactly, which greatly simplifies the task of computing the optimal policies.

We first suppose that policymakers do not know where the new Nash equilibrium (point N) is. Indeed, they naively assume that policy abroad will remain unchanged while their own countries take action. This gives us points A_1 (corresponding to Table 4) and A_2 (Table 5). The Nash equilibrium is the point at which countries optimize given full knowledge of others' responses. This is shown at point N, which corresponds to the simulation in Table 6. Our results suggest that for U.S. policy, there is only a slight difference between A_2, where the foreign response is ignored, and the Nash equilibrium, where the foreign reaction is taken into account. This is shown by drawing point A_2 on a vertical line beneath N. On the other hand, the optimal foreign policy response changes considerably depending on whether or not the U.S. action is taken into account. Thus, point A_1 is well below N on the vertical axis.

With this framework we are not able to obtain any explicit measures of the welfare gain associated with obtaining information about foreign policy. However, the difference in real income corresponding to the difference between points N and A_1 is of the order of one percent, and the implied monetary policy differ by a factor of two. Therefore, it seems fair to describe the differences as important.

With our framework we are also unable to say much about the location of the cooperative point C. (Indeed, when we reduce the policy problem to one target and one control the Nash equilibrium is pareto-efficient and there are no further gains from cooperation to be

realized.) Sachs and Oudiz analyze the gains to be realized in money from N to C, and find them to be surprisingly small.

We conclude from our analysis that the information about other countries' policies needed to support a Nash equilibrium is quantitatively important. Another way of putting this is that the Nash equilibrium appears to differ significantly from other possible equilibria in the world economy, (for example, one in which countries hold static expectations about foreign policy). The implication for the modeller is that the choice of solution concept is quantitatively important in doing policy analysis. The implication for the policymaker is that institutions which ensure the interchange of information about economic policy are an important form of policy coordination, perhaps at least as important as explicit bargaining over joint policy actions.

Footnotes

* Both authors are Economists in the Division of International Finance at the Board of Governors of the Federal Reserve System. The views expressed herein are solely those of the authors and do not necessarily represent the views of the Federal Reserve System or any members of its staff.

1 Their paper also contains a good list of references to the theoretical literature. See for example Hamada (1974, 1976) Canzoneri and Gray (1983), Miller and Salmon (1985) and Buiter and Marston (1985).

2 For complete details on the theoretical basis of the MCM see Stevens et al. (1984). For an update on the MCM theoretical basis see Edison, Marquez, Tryon (1986).

3 Henceforth we refer to West Germany as Germany.

4 For more detail on the exchange rate in the MCM see Hooper (1986).

5 See references cited in note 1.

References

Buiter, W.H. and R.C. Marston (1985) International Economic Policy Coordination, Cambridge University Press, Cambridge, 1985.

Canzoneri, M.E. and J. Gray (1983) "Two Essays on Monetary Policy in an Interdependent World," forthcoming in International Economic Review.

Edison, H.J., J. Marquez and R. Tryon (1986) "The Structure and Properties of the Multicountry Model of the Federal Reserve Board," forthcoming in Economic Modelling.

Hamada, K. (1974), "Alternative Exchange Rate Systems and the Interdependence of Monetary Policies," in R.Z. Aliber ed. National Monetary Policies and the International Financial System, University of Chicago Press, Chicago pp 13-33.

Hooper, P. (1986) "Exchange Rate Simulation Properties of the MCM," European Economic Review, 30, pp. 121-198.

Hamada, K. (1976) "A Strategic Analysis of Monetary Interdependence," Journal of Political Economy, vol 84, August pp 77-99.

Miller, M. and M. Salmon (1985) "Dynamic Games and Time Inconsistency of Optimal Policies in Open Economies," in W. Buiter and R. Marston edited International Economic Policy Coordination, Cambridge University Press, Cambridge, 1985.

Oudiz, G. and J. Sachs (1984), "Macroeconomic Policy Coordination Among Industrial Economies," Brookings Papers on Economic Activity, No. 1 pp 1-76.

Stevens, G.V.G., R.B. Berner, P.B. Clark, E. Hernandez-Cuta, H.T. Howe and S.Y. Kwack (1984), The U.S. Economy in an Interdependent World: A Multicountry Model, Washington, Board of Governors of the Federal Reserve System.

International Finance Discussion Papers

IFDP NUMBER	TITLES	AUTHOR(s)
	1986	
286	An Empirical Analysis of Policy Coordination in the United States, Japan and Europe	Hali J. Edison Ralph Tryon
285	Comovements in Aggregate and Relative Prices: Some Evidence on Neutrality	B. Dianne Pauls
284	Labor Market Rigidities and Unemployment: the Case of Severance Costs	Michael K. Gavin
283	A Framework for Analyzing the Process of Financial Innovation	Allen B. Frankel Catherine L. Mann
282	Is the ECU an Optimal Currency Basket?	Hali J. Edison
281	Are Foreign Exchange Forecasts Rational? New Evidence from Survey Data	Kathryn M. Dominguez
280	Taxation of Capital Gains on Foreign Exchange Transactions and the Non-neutrality of Changes in Anticipated Inflation	Garry J. Schinasi
279	The Prospect of a Depreciating Dollar and Possible Tension Inside the EMS	Jacques Melitz
278	The Stock Market and Exchange Rate Dynamics	Michael K. Gavin
277	Can Debtor Countries Service Their Debts? Income and Price Elasticities for Exports of Developing Countries	Jaime Marquez Caryl McNeilly
276	Post-simulation Analysis of Monte Carlo Experiments: Interpreting Pesaran's (1974) Study of Non-nested Hypothesis Test Statistics	Neil R. Ericsson
275	A Method for Solving Systems of First Order Linear Homogeneous Differential Equations When the Elements of the Forcing Vector are Modelled as Step Functions	Robert A. Johnson
274	International Comparisons of Fiscal Policy: The OECD and the IMF Measures of Fiscal Impulse	Garry Schinasi

---

Please address requests for copies to International Finance Discussion Papers, Division of International Finance, Stop 24, Board of Governors of the Federal Reserve System, Washington, D.C. 20551.

International Finance Discussion Papers

IFDP NUMBER	TITLES	AUTHOR(s)
	1985 (partial listing)	
273	An Analysis of the Welfare Implications of Alternative Exchange Rate Regimes: An Intertemporal Model with an Application	Andrew Feltenstein David Lebow Anne Sibert
272	Expected Fiscal Policy and the Recession of 1982	William H. Branson Arminio Fraga Robert A. Johnson
271	Elections and Macroeconomic Policy Cycles	Kenneth Rogoff Anne Sibert
270	Assertion Without Empirical Basis: An Econometric Appraisal of Monetary Trends in ... the United Kingdom by Milton Friedman and Anna J. Schwartz	David F. Hendry Neil R. Ericsson
269	Canadian Financial Markets: The Government's Proposal for Reform	Garry J. Schinasi
268	Was It Real? The Exchange Rate Interest Differential Relation, 1973-1984	Richard Meese Kenneth Rogoff
267	The U.K. Sector of the Federal Reserve's Multicountry Model: The Effects of Monetary and Fiscal Policies	Hali J. Edison
266	Optimal Currency Basket in a World of Generalized Floating: An Application to the Nordic Countries	Hali J. Edison Erling Vardal
265	Money Demand in Open Economies: A Currency Substitution Model for Venezuela	Jaime Marquez
264	Comparing Costs of Note Issuance Facilities and Eurocredits	Rodney H. Mills
263	Some Implications of the President's Tax Proposals for U.S. Banks with Claims on Developing Countries	Allen B. Frankel
262	Monetary Stabilization Policy in an Open Economy	Marcus H. Miller
261	Anticipatory Capital Flows and the Behaviour of the Dollar	Arnold Kling