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Monetary Interdependence and Coordination

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I. Introduction

Economists have long debated the merits of international policy coordination. Game theoretic models show that, in the presence of economic policy spill-overs, policy coordination generally leads to Pareto-superior outcomes.[1] Estimates of the theoretical gains to coordination vary widely, and appear to depend on initial conditions and the degree of economic interdependence.[2] In practice, coordination of monetary and fiscal policies occurs sporadically among the industrialized countries. Some of these coordination episodes have been carefully analyzed,[3] but there are no systematic investigations of the time series of coordination among the industrial countries over the period since the breakdown of the Bretton Woods System.[4]

In this paper I examine international interdependence and coordination of monetary and exchange rate policies between the United States, Germany and Japan since the mid-1970s. Future work will examine the coordination of other economic policies - such as sterilized intervention operations, fiscal policies, and trade policies - over the same period. The first part of the paper describes the monetary and exchange rate

[1] Hamada (1976, 1985), Cooper (1985), Canzoneri and Henderson (1991). Even nonoptimizing governments may coordinate when they believe that they will benefit from collective economic action, as Kenen (1990) notes.

[2] Bryant (1980), Fischer (1988), Frankel and Rockett (1988), Holtham and Hallett (1987) and Oudiz and Sachs (1984, 1985).

[3] For example, Putnam and Bayne (1987) analyze the efforts of the G-7 countries to coordinate economic policy at the yearly Summit meetings from 1975 through 1986; Putnam and Henning (1989) provide a case study of the Bonn Summit of 1978; Von Furstenberg and Daniels (1991, 1992) examine G-7 compliance with the economic policy declarations at the yearly Summit meetings from 1975 to 1989; Funabashi (1988) describes the G-7, G-5 and G-3 coordination efforts between the Plaza Agreement in 1985 and the Louvre Accord in 1987; Dominguez and Frankel (1993) study the intervention operations of the G-3 from 1977 through 1991.

[4] Bryant et al (1988) analyze simulations of monetary and fiscal policy coordination in the context of eight multi-country, macroeconometric models. Chung (1993) tests for Granger causality between the G-3 country's monetary policies using quarterly monetary aggregate data over the period 1960 to 1989. Furman and Leahy (1995) test for monetary policy transmission effects between the US and Canada.

coordination agreements reached at Economic Summits, G-7, G-5, and G-3 meetings between 1975 and 1993.[5] The second part of the paper measures the degree to which monetary policies in the G-3 countries are influenced by international commitments. This assessment is difficult for two reasons. First, official agreements are often written in vague language, and in terms of global objectives rather than specific policies. For example, on occasion the G-3 commits to "vigilance against inflation" but it is not clear exactly how to satisfy such a commitment. Second, it may be that countries honor their international commitments by making changes in their policies, but these policy changes may not achieve the stated objective. In order to honor an "inflation" commitment, countries may pursue contractionary monetary policies, but this may not immediately reduce inflation rates.

International commitments and monetary policy changes are defined broadly in this paper. The goal is not to measure whether countries are able to achieve their stated objectives, but rather, to measure whether countries pursue monetary policies that differ from the ones they would put in place in the absence of international commitments.

The paper also offers new measures of monetary policy changes. It is difficult to separate the effects of central bank policy changes from demand and supply shocks when using data on individual countries' interest rates or monetary aggregates. As a consequence, examinations of cross country interdependence in these time series might erroneously conclude that countries coordinate policies when, in fact, they are subject to correlated economic shocks. In order to identify discretionary policy changes, the paper constructs monetary policy indices using information concerning policy intentions available directly from the G-3 central banks.[6]

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[5] The G-3 consists of Germany, Japan and the United States; the G-5 adds France and the United Kingdom; and the G-7 adds Canada and Italy.

[6] The US monetary index was created by Boschen and Mills (1995) and is based on the minutes of FOMC

The findings indicate that US monetary policy influences German and Japanese monetary policies and that German policies influence Japanese policies. There is little evidence that Japanese monetary policy influences either Germany or the United States. Although the G-3 frequently made public commitments to coordinate exchange rate policies in the late 1970s and mid-1980s, there is, at best, mixed evidence of monetary coordination related to these commitments. However, there is evidence that G-3 monetary policies were influenced by commitments to fight inflation and lower interest rates. The results are surprising for three reasons. First, there seems to be a greater degree of monetary policy interdependence among the G-3 countries than conventional wisdom suggests. Second, the interdependence seems to be related to the public monetary policy commitments made by the G-3 countries. Third, commitments to stabilize and realign exchange rates, which have received quite a bit of attention in the financial press, do not appear to influence G-3 monetary policies or exchange rate behavior.

II. Models of International Coordination

Economic models in which monetary policy influences short-run national output[7] typically have the feature that monetary policy also affects output in other countries. For example, in the Mundell-Fleming model, a monetary expansion in a foreign country reduces that country's real interest rate, depreciates its currency relative to others, raises import prices, and raises inflation and output. Other countries are affected because their currencies appreciate relative to the foreign country's (assuming that they do not match the foreign country's monetary policy), thereby reducing import prices and inflation, and possibly decreasing

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meetings. The German and Japanese indices are created by the author and are described in detail in Dominguez (1996).

[7] Monetary policy influences short-run output if prices are sticky, making the goods market slow to adjust, or if portfolio choices are not instantaneous, making the asset market slow to adjust.

output.[8] It is this terms of trade externality that encourages monetary policy coordination.

At the same time that countries have incentives to coordinate monetary policy changes, they also have incentives to renege on such agreements. Unanticipated events may change the costs and benefits of implementing agreed-upon policies. Once foreign countries have implemented their part of a coordination agreement, it may no longer be in the home country's best interest to also follow through. Policy-makers usually have incentives to maximize national welfare at the expense of global welfare. They are rarely penalized for lowering welfare abroad, or for that matter, rewarded for improving foreign welfare.

The question of whether to coordinate monetary policy with other countries can be modeled using game theory.[9] The Nash (noncooperative) solution to the dilemma (in which policy-makers maximize national welfare, taking other countries' policies as given) is generally inefficient because countries playing Nash do not internalize terms of trade externalities. But cooperative solutions (in which policy-makers maximize weighted averages of national welfares so that no single country can be made better off without making another worse off) may also be inefficient in the presence of third-party effects (Rogoff, 1985), time consistency problems, or uncertainty over the underlying economic model (Frankel and Rockett, 1988). Even in cases in which the cooperative solution leads to an efficient outcome, the economic benefits may be small (Oudiz and Sachs, 1984).

Game theory suggests a range of circumstances in which the probability of policy coordination[10] (or cooperation) is likely to be extremely low. Countries are unlikely to coordinate monetary policies when (1)

[8] In the Mundell Fleming model monetary transmission is unambiguously negative (a monetary expansion abroad reduces home output). Positive monetary transmission could arise if the output effect (a monetary expansion abroad raises foreign demand for home goods) dominates the terms of trade effect.

[9] See Canzoneri and Henderson (1991).

[10] Often there are multiple noncooperative solutions for policymakers to choose among in selecting a policy. In the context of game theoretic models, international coordination (as opposed to cooperation) denotes the process by which policymakers jointly choose the optimal noncooperative solution.

the terms of trade externality is perceived to be small (national welfare is relatively unaffected by adverse exchange rate movements); (2) policy-makers disagree about the underlying economic model; (3) commitments to coordination have not been honored in the past; (4) policy-makers are unable to commit to announced future actions.

The case of the United States, Germany and Japan, exhibits many of the circumstances that theory suggests will reduce the probability of monetary policy coordination. Measures of the degree to which monetary policy influences the terms of trade in the three countries vary widely; the Fed, BOJ and Bundesbank probably do not share a common objective function; and the frequent turnover in the leadership of the three countries makes it difficult for them to make credible long term policy commitments. Yet, as will be described in greater detail below, the three countries have recently made numerous public commitments to coordinate macroeconomic policies.

III. Coordination Agreements Among the G-3 Countries

Policy makers in the G-3 countries convene regularly in the context of Summit, G-7 and G-5 meetings to discuss common economic problems and, occasionally, to coordinate policies.[11] The economic policy commitments made by the participating countries at Summit and other official meetings are generally made public in the form of communiques. Hajnal (1989, p. xxxi) describes Summit communiques as, "scriptures, the central achievement whose creation consumes much of the summit preparatory activity during the preceding year". Table 1 provides a brief summary of communique statements regarding monetary and exchange rate policies agreed upon at various Summit, G-7, G-5 and G-3 meetings.[12] The

[11] See Dominguez (1996) for a description of the history of Summits, G-7 and G-5 meetings.

[12] Monetary policy coordination between the US, Germany and Japan also takes place in the context of meetings at the IMF, the OECD, and the Bank for International Settlements (BIS). However, the

macroeconomic agreements described in the communiques from these meetings can generally be categorized as focussing on (1) inflation, (2) lower real interest rates (economic growth), (3) exchange rate variability, or (4) the level of the dollar. Although the language used in the communiques is often extremely vague, and the policies discussed are not always within the legal jurisdiction of the particular meeting's participants, the communiques provide a time series of public commitments to international coordination. The communiques allow us to test whether these publicly declared commitments to coordination actually influence individual country's policy decisions over time.

The information in table 1 suggests that commitments to, for example, fighting inflation, tend to be episodic and commitments are repeated using similar language in the communiques over time. Unsurprisingly, concern over inflation, and commitments to fight inflation, coincide with periods in which the industrial countries experience relatively high rates of inflation. Commitments to lowering inflation rates were made starting with the first Summit in 1975 continuing through the London Summit in 1984, and again in mid-1988 through April 1989. (Inflation was not mentioned in the 1979 Summit communique, which focused on reducing oil imports, probably because of the uncertainty over possible additional oil price increases and their ramifications for inflation levels.) The focus shifted to economic growth and commitments to lower interest rates in 1986, 1987, 1991, and 1992. Concern over exchange rate stability was mentioned at almost every meeting, with the focus shifting to the level of the dollar in 1978, 1985, December 1987, September 1989 through May 1990, and April 1992.

In order to test whether monetary policy coordination is more likely to occur during periods when countries make public commitments, the information in table 1 is summarized using four dummy variables. The inflation dummy variable takes on the value of 1 during the periods in which commitments to fight inflation are included in the communiques. Likewise, the growth and exchange rate stability dummy

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commitments made at these meetings are generally not made public.

variables take values of 1 during periods in which commitments to these policies are included in the communiques. The exchange rate level dummy variable takes on the value of 1 during periods in which commitments to depreciate the dollar relative to the yen and mark are included in the communiques, and the value -1 during periods in which commitments are made to appreciate the dollar. Table 2 lists the meetings in which policy commitments were made by the G-3, and categorizes the types of commitment.[13]

IV. Identification of Monetary Policies

This study examines the circumstances in which countries coordinate their monetary and exchange rate policies, and the extent to which international agreements influence central bank policies. To do so it is helpful to define monetary and exchange rate policy. A monetary policy is usually defined as a central bank's decision to expand or contract the domestic money supply. In principle it should be possible to quantify changes in monetary policy by examining data on monetary aggregates or interest rates. In practice, however, these data will reflect policy decisions made by the central bank as well as changes in money demand.

Exchange rate policy is defined in this paper as a central bank's decision to use non-sterilized intervention operations to influence currency values. Therefore, a policy decision to depreciate the domestic currency involves an expansion of the domestic money supply. More generally, exchange rate policies, defined in this manner, can be translated one-for-one into corresponding monetary policies.

Monetary policy changes can be identified in a number of ways. Structural models avoid the problem of disentangling the supply and demand by estimating approximations to decision equations for

[13] The coding for Table 2 was done twice by two different assistants. In the two cases in which the codings did not agree, a third reader determined the final coding for the two observations.

both the central bank and the market.[14] The validity of this approach depends critically on the econometrician's ability to fully specify the decision equations. Some of the difficulties that arise in specifying structural models can be avoided by using of vector autoregressive (VAR) techniques. Because VAR equations are inherently reduced-forms, it is difficult to construct structural interpretations of coefficient estimates. But VARs offer the advantage that they estimate historical relationships without imposing structural assumptions.

This paper uses VAR techniques to measure the influence of international agreements on central bank policies. The literature on the domestic effects of US monetary policy suggests that results may be highly sensitive to the method of measuring monetary policy innovations.[15] For this reason, two different approaches to the measurement of monetary policy changes are considered: the narrative approach and the money market variable approach. The narrative approach to measurement of monetary policy, pioneered by Friedman and Schwartz (1963) and used more recently by Brunner and Meltzer (1989) and Romer and Romer (1989), is based on a review of statements made by the central bank regarding its own policy decisions.

The narrative approach to measuring monetary policy is particularly appealing relative to other possible methods when the hypothesis to be tested involves more than one country. Monetary policy decisions are made and implemented differently in Germany, Japan and the United States, making it difficult to find one variable or one structural specification to summarize policy changes across the three countries. For example, non-borrowed reserves provide good measures of U.S. policy over some periods, but such a measure would not be appropriate for Germany or Japan, where open market operations play

[14] See Fair (1989) for a comparison of structural approaches and the Romer and Romer (1989) narrative approach.

[15] See Bernanke and Blinder (1992), Christiano and Eichenbaum (1992), Eichenbaum and Evans (1995),

minimal roles.

The main criticism of the narrative approach is that monetary policy so defined may not be truly exogenous with regard to domestic output and prices. Therefore the monetary index cannot be used to answer the question of whether domestic money influences domestic output. However, in this study the question is not whether domestic monetary policy influences domestic output, but whether domestic monetary policy influences foreign monetary policy.

Another criticism of the narrative approach is that it relies on human judgement. The narrative approach is inherently subjective because it is based on interpretations of descriptions of policy intentions by the three central banks.[16] In order to control for the potential biases inherent in the narrative approach, this study also examines monetary policy changes using traditional money market variables, including monetary aggregates and interest rates.

A. The US Monetary Policy Index

The measurement of US monetary policy intentions is relatively easy because the Fed makes publicly available (with a six week lag) the minutes of the FOMC meetings where policy decisions are made. Romer and Romer (1989) create a dummy variable that takes on the value one during periods in which the minutes from FOMC meetings and related records indicate that the Fed intended to contract the money supply in order to combat inflation.[17] Boschen and Mills (1995) largely follow the Romer and Romer

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and Strongin (1995). Cochrane (1994) provides a survey of this literature.

[16] Boschen and Mills (1995) show that different narrative-based policy indices for the US are highly correlated among themselves and are also correlated with more traditional data-based measures of Fed policy.

[17] The Romer and Romer (1989) index does not identify Fed decisions to expand the US money supply. The reason for this is that the index was created in order to test whether monetary policy influences US output. The authors assume that the Fed does not make monetary contraction decisions based on changes in output (these are assumed to be made on the basis of changes in inflation), but this assumption is not expected to hold for monetary expansions.

(1989) methodology, but include monetary expansions and allow for different degrees of policy intensity. The Boschen and Mills index takes on the value two (or negative two) during periods when the Fed was strongly expansionary (contractionary) and the value one (or negative one) during periods of mild expansion (contraction).[18] A graphical depiction of the Boschen and Mills index is presented in figure 1.

The Bank of Japan and the Bundesbank do not provide public records of their respective monetary policy directives. The next two sections of the paper describe the monetary policy decision process in Germany and Japan, and the methodology used to create monetary policy indices, analogous to the Boschen and Mills index, for each country.

B. German Monetary Policy

The Bundesbank has sole responsibility for German monetary policy. The Directorate, which is comparable to the Federal Reserve Board, is composed of the president and vice-president of the Bundesbank and up to eight additional members with special professional qualifications. The Central Bank Council (Zentralbankrat), which consists of the Directorate and the Presidents of the German Land Banks, is the decision-making body at the Bundesbank. The Council meets biweekly on Thursdays.

The Bundesbank established a regime of monetary targeting in 1975.[19] From 1975 to 1987, the target aggregate was the Central Bank Money Stock (CBM) which is a weighted sum of currency held by nonbanks, and demand, time and savings deposits.[20] In 1988 the Bundesbank switched to targeting M3, the

[18] The Romer and Romer (1989) index differs conceptually from the Boschen and Mills (1995) index in that it is intends to measure US monetary policy innovations directly, while the Boschen and Mills index attempts to describe the current state of monetary policy.

[19] Underlying the Bundesbank's announced monetary target is an explicitly stated goal for inflation. In 1975 the inflation goal was set at 4.5%, over the next several years the target was reduced to 2%, and it has remained at 2% since 1986.

[20] The weight on currency is one and the weights on the other components is equal to their respective historical required reserve ratios in January 1974.

sum of all the components in CBM (without the weighing scheme). The Bundesbank announces a monetary target range in January, and this target range is reviewed and often revised in the early summer. At the mid-year review the Bundesbank also often reduces the effective target range by stating whether it will target in the upper, middle, or lower part of the initial range. These monetary targets are summarized in table 3. As suggested by the "explanation" column in table 3, the monetary targets are often exceeded, and are best viewed as guidelines rather than strict targets.[21]

The main instrument that the Bundesbank uses to implement monetary policy is its lending to banks. Open-market operations are not typically used because the market for short-term government paper in Germany is extremely thin. Banks may borrow from the Bundesbank at three different interest rates: the discount rate, the lombard rate and the repurchase (repo) rate. The discount rate is typically below the market interest rate. Banks are rationed at the discount window according to a pre-set quota, but they are allowed to borrow discount credit upon request up to their quota. The Lombard rate is always above the market interest rate so that there is no need to ration this credit under normal circumstances. Lombard credit can be thought of as a last resort source of funds for banks when there is excess demand for central bank money. Repos are loans to banks that are collateralized by securities. The Bundesbank auctions repos once a week. The auctions can be either volume or interest tenders. In volume tenders the Bundesbank fixes the interest rate and banks bid for quantities. Generally under 50% of bids are successful. The Bundesbank reportedly uses volume tenders as a means of signalling information to the market about changes in interest rates. In interest rate tenders banks bid both quantities and prices (interest rates).

The Bundesbank uses the call-money rate in the Frankfurt interbank market to gauge the influence of its policies. A bank will not borrow from the Bundesbank if it can obtain money more cheaply from the

[21] This point is also emphasized in Clarida and Gertler (1996).

interbank market. Further, the interbank interest rate will react immediately to any change in the interest rates offered by the Bundesbank.

In a period in which the money supply is growing at the target rate, the Bundesbank is likely to offer new repos at rates a bit below the call-money interest rate. If the money supply is growing more quickly than the target, the Bundesbank will push up the repo rate and potentially the discount and Lombard rates. Likewise, if the money supply is growing more slowing than the target, the Bundesbank will push down the repo rate.

Creation of the Bundesbank Monetary Index

The Bundesbank does not publish minutes of the Council meetings where monetary policy decisions are made. Therefore, German monetary policy changes must be inferred from monetary targets, movements in interest rates and monetary aggregates, and from descriptions provided in Bundesbank publications. Creation of the German index requires three steps.

(1) Monetary policy regimes are categorized based on movements in the discount and lombard rates. These rates determine the range within which all other interest rates move. The Bundesbank uses this range to guide rates along a path by slowly moving the band up or down, or they can change the variance of the rates by narrowing or widening the range. Changes in money growth targets (described in table 3) are also examined. This information is mainly useful in determining the level of intensity of policy stances.

(2) Movements of the repo rate identify policy changes (or signals) that occur prior to discount and lombard rate changes.[22] Changes in the repo rate may reflect monetary policy changes or market-determined innovations. The procedure assumes that if the repo rate changes prior to a change in the discount or lombard rate, and if the repo is a volume-tender, then it reflects a change in policy stance.[23]

(3) The third step is to examine the description of interest rate and monetary target changes in the

[22] Repo rates are available after 1983.

[23] An alternative possibility is that the Bundesbank uses volume-tenders to gauge market sentiments. But, this might also be considered a shift in stance. Regardless, there were only a few examples where this was relevant, implying that any error from this assumption is likely to be negligible.

Bundesbank Monthly Report. These descriptions provide information on the magnitudes of the changes in stance and resolve areas of ambiguity. The comments clarify the Bundesbank's perception of the effect of its own actions on growth and inflation, though there is only limited discussion of growth. Finally, newspaper accounts reported in NEXIS resolve cases where the timing or magnitude of policy changes remain ambiguous.

Dominguez (1996) provides a detailed description of the major changes in Bundesbank monetary policy over the period 1978 through 1993, and the ways in which the index reflects these decisions. Figure 2 presents a graphical depiction of the German monetary policy index.[24]

B. Japanese Monetary Policy

The Bank of Japan Law authorizes the Policy Board (Nihon Gink_ Seisaku Iinkai) for the BOJ to formulate, direct and supervise monetary policy. This Board is composed of the Governor of the BOJ, representatives of the Ministry of Finance and the Economic Planning Agency, and four representatives of the private sector with experience in banking, industry, commerce and agriculture. In practice, the Board has an advisory role, since monetary policy is effectively conducted by the Executive Committee (Yakuinkai) which includes only BOJ officials.

BOJ monetary policy has undergone substantial changes in the past twenty years in conjunction with the deregulation of financial markets. The intermediate target of monetary policy employed by the BOJ shifted in mid-1978 from bank lending to a broadly defined money stock. Money market operations also shifted from "window guidance" or moral suasion and direct control of interest rates to controlling the supply of reserves to the banking system and thereby indirectly influencing interbank interest rates. The

[24] The German index takes on the value 1, denoting mildly expansionary policy, over the period April 1985 through May 1988. This is one of the few periods in which data and official statements provide some mixed messages. There is some evidence to suggest that the Bundesbank monetary stance was neutral, rather than expansionary, starting in March 1986. The time series tests presented in the next sections were performed using the index as depicted in figure 2, as well as one which characterizes the period March 1986 to May 1988 as neutral. The qualitative implications of the results did not change with this alternative specification.

BOJ uses three instruments to signal monetary policy intentions to the market and other governments: the discount rate, the reserve progress ratio, and the call money rate. The discount rate in Japan is the rate at which commercial banks can borrow funds from the BOJ and it is always lower than the interbank rate.[25] Consequently, discount window lending is rationed by the BOJ. Further, the level of lending changes at the initiative of the BOJ, rather than at the initiative of private banks (as in the United States). Discount rate changes are typically accompanied by a brief official statement from the BOJ providing reasons for the change.[26]

The reserve progress ratio is the cumulative sum of daily reserves held by commercial banks since the beginning of the current reserve accounting period relative to the required reserves of the period. This ratio is expected to start at zero and to increase by about 3.3% every day to reach 1 at the end of the month. If the BOJ wants to loosen or tighten its monetary policy stance, it can alter the rate of change in the reserve progress ratio by increasing or decreasing its lending to banks.

The call market rate is similar to the Federal Funds market rate in the United States: it is the interest rate that banks offer each other to borrow short term funds. Although the BOJ does not have direct control over the call rate, it is widely believed that, especially prior to 1988, the BOJ exerts strong influence over the call market. "Under the tatene system, that is, until 1979, every day after the close of the market the BOJ and a representative call loan dealer met and discussed the next day's call rate; in effect the BOJ told the dealer the call rate. Under the kehaichi system, between 1979 and 1988, the role of the BOJ in the determination of the call rate was officially weakened but actually remained the same." (Ueda, 1990, p.18). In November 1988, the BOJ liberalized transactions in the interbank market; nevertheless, the continued relative stability of the call market rate suggests that some degree of BOJ control remains in this market.

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[25] The interest charged on discount window loans is calculated on the period of the loan plus one day, so that the effective interest rate exceeds the published discount rate and may exceed the call market rate.

[26] In recent years, discount rate changes have sometimes followed trends in other market interest rates rather than providing a leading indicator. The financial press refers to this as "tsuizui" which translates (roughly) to "following in the wake of".

Creation of the BOJ Monetary Index

The BOJ does not publish minutes of the Executive Committee meetings where monetary policy decisions are made. Therefore, as is the case for Germany, Japanese monetary policy changes must be inferred from movements in interest rates, the reserve progress ratio, monetary aggregates and from descriptions in BOJ publications.

Creation of the Japanese index requires three steps.

(1) Monetary policy regimes are categorized based on movements in the discount rate.

(2) Movements of the call rate and the reserve progress ratio identify policy changes (or signals) prior to discount rate changes. This information is supplemented by press accounts of policy changes during periods when the call rate or the reserve progress ratio changed prior to the discount rate.

(3) Additional information on policy changes appears in discussions in the BOJ Annual Report, the BOJ Annual Review, and the Monthly Economic Review . These publications generally contain formulaic discussions of policy so that when new sentences or phases are included, it is reasonable to infer that a change has occurred. Finally, NEXIS coverage of statements and comments made by BOJ officials provides additional information in cases where the timing or magnitude of a policy change remain ambiguous.

Dominguez (1996) provides a detailed description of the major changes in BOJ monetary policy over the period 1977 through 1993, and the ways in which the index reflects these decisions. Figure 3 presents a graphical depiction of the Japanese monetary policy index.

The Boschen and Mills (1995) index of Fed monetary policy changes is fundamentally an ex ante measure. The index is based on the policy intentions of the FOMC as documented by the minutes of each FOMC meeting. The German and Japanese indices are not directly comparable to the US index because they measure policy intentions with hindsight. These indices are, by necessity, based on after-the-fact accounts of policy in central bank publications and on historical movements in monetary aggregates and interest rates. But the common feature of the three indices is that they are, at least partially, based on descriptive information provided by each central bank. Figure 4 plots the three monetary indices on the same graph to illustrate the empirical correlation between their policies.

V. The Estimation Procedure

This section describes the methodology used to measure the influence of international commitments on the G-3 monetary policies. A first set of tests examines whether there is evidence that G-3 monetary policies are interdependent, ignoring information about the coordination commitments. These initial tests employ 6-variable VARs to examine the dynamic relationships between G-3 monetary policy innovations (defined in numerous different ways).[27] Each country's VAR system includes the standard domestic variables (output, prices and the exchange rate), as well as monetary policy indicators for the other two countries.[28]

A second set of tests directly examines the relationship between domestic monetary policies and the international coordination commitments. Measures of the coordination agreements are added to standard domestic VAR systems in order to test whether innovations in the international agreements significantly influence the G-3 monetary policies. In these tests each country's VAR system includes five variables: the coordination dummy variable, domestic output, prices, monetary policy, and the exchange rate.

Both sets of tests specify monetary policy as a function of domestic policy and non-policy variables, to which the first specification adds foreign monetary policy variables, and the second specification adds the international coordination agreements. The null hypothesis tested in the first specification is that domestic

[27] It is possible that expansionary and contractionary monetary policies have asymmetric effects. This hypothesis will be tested in future work.

[28] Nine-variable VAR systems that include foreign output and prices are also examined; they provide qualitatively similar results, and are available from the author. The advantage of this specification is that it permits examination of the effect of one country's monetary policy on the economies of the other countries. If foreign monetary policies influence domestic output, it is not possible to identify whether this is due to the direct effect of foreign monetary policy, or the influence of foreign monetary policy on domestic monetary policy - which, in turn, affects domestic output. Furman and Leahy (1995) use an identifying assumption (that US monetary policy is not influenced by Canadian monetary policy) to distinguish these

monetary policy does not influence foreign monetary policies. The null hypothesis in the second specification is that the international monetary agreements do not influence domestic monetary policy. The following general model is used to test these hypotheses:

$$Y_t = \sum_{i=0}^{n} \alpha_i Y_{t-i} + \sum_{i=0}^{n} \beta_i mp_{t-i} + \varepsilon_t \qquad 1$$

$$mp_t = \sum_{i=0}^{n} \delta_i Y_{t-i} + \sum_{i=0}^{n} \phi_i mp_{t-i} + \nu_t \qquad 2$$

in which Y is a vector of domestic macroeconomic variables, mp is a vector of indicators of domestic and foreign monetary policies (or international monetary agreements) and e and v are mutually uncorrelated error terms. The structure of the domestic economy (and its possible interdependence with foreign policies) is captured by equation (1) and central bank reactions are described by equation (2). The systems are identified by the assumption that monetary policy shocks (or, in the second specification, international agreements) do not contemporaneously influence the macroeconomic variables ($ß_0$=0).[29] Using this assumption, (1) and (2) can be solved simultaneously to obtain a

standard reduced form VAR system:

$$Y_t = (I - \alpha_0)^{-1} \sum_{i=1}^{n} \alpha_i Y_{t-i} + (I - \alpha_0)^{-1} \sum_{i=1}^{n} \beta_i mp_{t-i} + (I - \alpha_0)^{-1} \varepsilon_t \qquad 3$$

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effects.

[29] Alternatively, one could assume that central banks do not respond to contemporaneous information (d_0=0). The system estimates are not much influenced by the choice of identifying assumption, which suggests that the policy shocks are not highly correlated with other contemporaneous disturbances in the system.

$$mp_t = \sum_{i=1}^{n} [\,\delta_i + \delta_0 (I - \alpha_0)^{-1} \alpha_i\,] Y_{t-i} + \sum_{i=1}^{n} [\,\phi_i + \delta_0 (I - \alpha_0)^{-1} \beta_i\,] mp_{t-i} + [\,\delta_0 (I - \alpha_0)^{-1} \varepsilon_t + \nu_t\,] \qquad 4$$

The impulse response functions implied by estimates of equations (3) and (4) can be used to illustrate the dynamic relationships between the included variables. The impulse responses of the variables in the VAR system, calculated with respect to the orthogonalized[30] policy shock (v), can be interpreted as structural responses to innovations in one country's monetary policy, or innovations in international agreements. The maintained assumption in both VAR systems is that the recursive structure of the identification restrictions hold.[31]

Variance decompositions corresponding to the impulse response functions are also presented. Variance decompositions describe the fraction of the total variance in one variable explained by the other variables in the system. The impulse responses indicate whether particular policy shocks influence other included variables, while the variance decompositions indicate magnitudes of influence relative to other explanatory variables.

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[30] Orthogonalized innovations have the convenient property that they are uncorrelated both across time and across equations. The difficulty with orthogonalization is that it can be accomplished in many ways, and the choice of method is consequential. The most popular method is based on the Choleski factorization, and the impulse response functions presented in this paper rely on this method. An alternative approach is to model the decomposition using structural methods. Bernanke and Mihov (1995) provide a recent example of this approach.

[31] More generally, to interpret v as a policy shock, equation (2) must be the correct specification of the central bank's reaction function, and date t shocks must not affect the variables in Y. For example, if the true central bank reaction function is nonlinear, v will reflect the error involved in approximating a nonlinear function with a linear one. A potential problem with using the indices to measure monetary policy is that they are discrete variables, while the empirical model specification is in terms of continuous variables. The results suggest, however, that bias from this misspecification is negligible, given that inferences do not qualitatively change when monetary policy is measured with continuous variables such as interest rates or monetary aggregates.

The first set of impulse response functions and variance decompositions examine whether the orthogonalized innovation in each country's monetary policy is related to foreign monetary policies. It is possible to address the same question, without reliance on the VAR methodology by examining cross correlations between the residuals from standard central bank monetary policy reaction functions and measures of foreign monetary policy. The final set of tests presented in this paper examine the relationships between G-3 monetary policy innovations (measured using the before-mentioned residuals) and three sets of variables: foreign monetary policy innovations, foreign monetary policy indices, and the international agreements.

A standard monetary policy reaction function relates the movement in short-term interest rates to deviations of inflation and output from their targets. Taylor (1994) and Clarida and Gertler (1996) use this specification to estimate US and German monetary policy reaction functions, respectively. Intuitively this specification suggests that central banks increase short term interest rates when either inflation or output rise above target. The equation is:

$$i_t = \gamma_0 + \gamma_1 [\pi_{t-j} - \pi^T] + \gamma_2 [Y_{t-j} - Y^T] + \sum_{n=1}^{k} \rho_n i_{t-n} + \eta_t \qquad 5$$

where i is the short-term interest rate, p is inflation, Y is industrial production, superscript T denotes the target level, and ? is the error term. Monetary policy innovations are measured using ? .

There are various ways in which target levels of inflation and output can be estimated. In the case of Germany, the Bundesbank provides yearly inflation targets corresponding to their monetary targets (reproduced in Table 3). However, in order for the targets to be consistently estimated for the three countries, Y^T and p^T are measured as the Beveridge-Nelson permanent component of output and prices

derived from the six-variable VAR systems described previously.[32]

The data used in this paper are monthly observations from 1977 to 1993. Interest rate, monetary aggregate, price, and inflation data are available from the IMF's IFS database. The industrial production index is part of the OECD's Main Economic Indicators database. Consumer price and industrial production indices are measured in logarithms, and the monetary aggregates are measured as rates of growth. Log changes in oil prices are included in the VARs to control for major economic shocks to the three countries over the sample period. The VARs include four lags of data. However, inference is robust to the introduction of higher order lags.[33]

Augmented Dickey-Fuller tests for the variables, both with and without deterministic trends, and including seasonal dummy variables and twelve lagged differences, indicate that it is not possible to reject unit roots for most of the series at usual levels of significance. It is then valuable to determine whether the variables share common stochastic trends (are cointegrated). Johansen's (1991) cointegration test applied to the system of nine variables and the Engle-Granger (1987) cointegration tests applied to all bivariate combinations of the variables reveal only marginal evidence of cointegration among the variables. Sims, Stock and Watson (1990) suggest that failing to impose true cointegration or stationarity inducing transformations of the data is unlikely to bias VAR results, while the imposition of false cointegration relationships may introduce serious bias. As a consequence, the variables are included in level form in the VARs.

[32] Gali and Clarida (1994) and Clarida and Gertler (1996) produce Beveridge-Nelson decompositions of output and prices for OECD, and German data, respectively.

[33] Lags lengths of 3, 6, 9 and 12 as well as the following staggered lag structure {1,2,3,6,9,12} were each used to estimate the VAR systems. After the inclusion of the 4th lag, the estimated results differ little across the alternative lag structures.

VI. Results

Figure 5 presents the G-3 dynamic responses to a positive (orthogonalized) shock in each country's monetary policy.[34] Dynamic responses are based on six-variable VAR systems for each country assuming a Wold ordering of $[Y^H, P^H, MP^H, MP^{F1}, MP^{F2}, S]$, where Y is industrial production, P is the consumer price index, MP is monetary policy (measured using the indices)[35], S is the nominal exchange rate (DM/$ or Yen/$), the superscript H denotes home country, and the superscripts F1 and F2 denote the two foreign countries. Intuitively, the VAR ordering assumes that domestic monetary policy is contemporaneously influenced only by domestic output and prices, although the results are robust to alternative recursive orderings. Solid lines represent the point estimates and the dashed lines denote the two-standard deviation bands calculated using the Monte Carlo procedure described in Doan (1992).[36]

The first row of figure 5 displays the dynamic responses of German and Japanese monetary policies to an expansionary shock to US monetary policy. The next two rows display responses to shocks in German and Japanese monetary policy, respectively. Also included in the figures are the nominal exchange rate reactions to the three monetary policy shocks. An expansionary shock to US monetary policy is followed by

[34] G-3 dynamic response functions are also calculated over two subperiods, 1977 to 1984 and 1985 to 1993 (these are available from the author). With the exception of the Japanese case, the results over the subperiods are qualitatively similar to those over the full period. In these subperiods, innovations in Japanese monetary policy influence US policy, but in two different directions, explaining why the effect does not hold over the full sample. In the early subperiod, an expansionary shock in Japanese policy leads to an immediate expansion in the United States which peaks after one year and dies out in two years. But in the later subperiod, a Japanese expansion leads to an immediate (but statistically insignificant) expansion followed by a contraction which peaks after 20 months and dies out in three years.

[35] Analogous figures using interbank interest rates and M3 to measure monetary shocks provide qualitatively similar results and are available from the author.

[36] The monte carlo simulations involved five-hundred draws from the estimated asymptotic distribution of the VAR coefficients and covariance matrix of the innovations. See Furman and Leahy (1995) for a discussion of the potential downward bias of these standard errors.

statistically significant expansions in both German and Japanese monetary policies.[37] The maximal impact of the US shock occurs after about 7 months in Germany, and after one year in Japan. An expansionary shock to German monetary policy also leads to expansions in the United States and Japan, although the influence on US monetary policy is only marginally significant and short-lived. An expansionary shock to Japanese monetary policy does not significantly influence US or German monetary policy over the full sample period. Interestingly, only the US monetary policy shock significantly influences the nominal exchange rate. Theory predicts that, all else equal, a monetary expansion will lead to a depreciation of the domestic currency relative to foreign currencies. Correspondingly, the dollar weakens relative to the mark in reaction to a US monetary expansion, with the maximal impact occurring after approximately nine months.[38]

The variance decomposition point estimates presented in table 4 measure the fraction of the variance of each index that is explained by the other indices and the corresponding t-statistics are based on a monte carlo procedure similar to the one used to calculate confidence bands for the impulse response functions. The impulse responses presented in figure 5 and the corresponding variance decompositions in table 4 together support the hypotheses that US monetary policy influences Germany and Japan, German policy influences Japan, but do not support the hypothesis that Japanese policy influences US or German policy over the full sample period.[39]

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[37] Reactions of domestic industrial production and prices to the monetary policy shocks are not included in Figure 5 to save space. In the U.S. case, both IP and P rise in reaction to an expansionary monetary policy shock. In similar VAR specifications that exclude the foreign monetary policy variables, expansionary US shocks lead to an anomalous, persistent decline in the US CPI. Sims (1992) finds that this "price puzzle" disappears with the inclusion of the exchange rate or a commodity price index. The results in this paper confirm that the exclusion of foreign variables from the US equation results in a serious misspecification.

[38] Similar results are obtained when the nominal exchange rate is the Yen/$ rate. This slow reaction of the dollar to US monetary policy changes is also documented in Eichenbaum and Evans (1995).

[39] Table 4 excludes the variance decompositions for output and prices to save space. In the US case,

In order to determine whether the monetary policy interdependence documented in figure 5 and table 4 is correlated with monetary policy commitments between the G-3 countries, a second set of tests examines the relationship between the dummy variables described in table 2 and the monetary indices. Figures 6, 7, 8 and 9 present the dynamic responses of G-3 macroeconomic variables to the four types of policy coordination commitments, and table 5 presents the corresponding variance decompositions. Each row in these figures represents an individual country's response to the joint commitment. The Wold ordering in the five-variable VAR systems [coordination-dummy,Y,P,MP,S] implies that there is no contemporaneous feedback from the other variables in the system to the coordination dummy variable.[40]

Figure 6 presents G-3 impulse responses to a joint commitment to fight inflation. The individual graphs suggest that the United States, Germany and Japan react consistently, and in tandem, to inflation commitments. The third column in figure 6 presents the G-3 monetary policy reactions to the inflation commitment. In all three countries monetary policy becomes relatively contractionary, although the effect is not statistically significant for Japan. Correspondingly, industrial production (column one) falls in the three countries, and prices (column two) rise initially but fall after about six months. The only apparent difference in macroeconomic variable reactions among the countries to this international commitment is the reaction of the dollar exchange rate. The dollar strengthens in reaction to a monetary contraction in all three countries, again suggesting that U.S. policy dominates movements in the dollar cross rates.

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innovations to monetary policy (measured using the Federal Funds rate) account for 38% of the variance of US industrial production after two years. Using a VAR specification that excludes the foreign monetary policy variables, Strongin (1995) finds that innovations in US monetary policy account for 49% of the variance of industrial production after two years. Strongin (1995) measures US monetary policy as nonborrowed reserves adjusted for reserve demand shocks. Using his measure of US monetary policy in the model, monetary policy innovations account for 41% of the variance of industrial production after two years.

[40] Alternative specifications with the coordination dummy variable ordered last provided qualitatively similar results.

Figure 7 presents G-3 impulse responses to a joint commitment to reduce interest rates. Again all three countries react similarly in terms of monetary policy: they each become relatively expansionary. However, the effects of the monetary expansions on industrial production differ across the countries; output in the United States rises, while it falls in Germany and Japan. Surprisingly, price levels fall in all three countries - although only in Japan is it statistically significant. Again, US monetary policy seems to dominate the DM/$ and Yen/$ exchange rates; the dollar weakens in reaction to policy expansions in all three countries.

Figures 8 and 9 present the G-3 macroeconomic variable reactions to joint commitments to stabilize the dollar, and realign the dollar, respectively. Perhaps unsurprisingly, given the indirect nature of these commitments, monetary policy reactions are generally not statistically significant. Commitments to stabilize the dollar lead to an initial strengthening of the dollar for all three countries, followed by a fairly flat response. Realignment commitments generally lead to a weakening of the dollar, although the effect is not statistically significant. Overall, the influence of the exchange rate commitments on the G-3 macroeconomic variables is quite weak, especially relative to the effects of inflation and growth commitments documented in figures 6 and 7.

The classification of the communique statements into "inflation" or "growth" oriented monetary policy commitments is necessarily subjective. Two sets of sensitivity analyses provide tests of the robustness of the results presented in table 5 and figures 6-9. One sensitivity analysis considers whether any individual coordination commitment had undue influence on the time series results. Each of the VAR systems was re-calculated a number of times, each time dropping a different coordination dummy variable from the sample in order to check whether the results depend heavily on a particular coordination episode. The results from these tests did not reveal any significant outliers. A second sensitivity analysis separates those coordination agreements made at regularly scheduled meetings (the yearly Summit and the two G-7

ministerial level meetings in the fall and spring) from those made at meetings called unexpectedly in order to confront specific crises (e.g. the Plaza and Louvre Agreements). Again, the VARs were repeated excluding commitments made at the non-regularly scheduled meetings. (The bulk of these meetings occurred during 1985-1987.) These tests also indicate that the results presented in the table 5 (and figures 6-9) are not unduly influenced by agreements made at non-regularly scheduled meetings.

The results from the five- and six-variable VAR systems suggest that G-3 monetary policies are interdependent, and that international monetary policy commitments to fight inflation and reduce interest rates influence the three countries. The use of non-structural VARs is always open to the criticism that identification is achieved mechanically, rather than being based on economic theory. In order to verify that the results in this paper do not depend on the VAR methodology, results from an alternative, structural approach are presented in Table 6.

I estimate a standard central bank reaction function (equation 5) for each country, and define the residuals from these three regressions as the monetary policy innovations. This procedure examines relationships between variables of interest and the unexplained portion of each country's monetary policy reaction function. For example, it is possible to examine whether the international coordination agreements help explain the reaction function residuals.

The first panel of Table 6 presents cross-correlations of the G-3 monetary policy indices. Ljung-Box Q-tests confirm that the policy indices are significantly correlated over a 12-month lag structure. The second three panels of the Table present the cross-correlations of monetary policy innovations (residuals from the monetary policy reaction function equations) with other countries' innovations, the policy indices, and the international coordination agreements. The G-3 monetary policy innovations are, unsurprisingly, much less correlated than are the policy indices. US policy innovations are significantly positively correlated with German innovations, and German innovations are significantly negatively correlated with

Japanese innovations. This suggests that there are unobserved common shocks that influence US and German monetary policies, and that Germany and Japan also share common shocks. The fact that the United States and Japan do not share common shocks suggests that G-3 coordination commitments are not the only missing variables in the central bank monetary policy reaction functions.

The third panel of Table 6 measures the cross-correlations between the G-3 monetary innovations and the monetary policy indices. These correlations indicate whether information regarding foreign monetary policies belongs in the domestic monetary policy reaction functions. These tests, therefore, are analogous to the impulse responses presented in figure 5. The cross-correlations suggest that both US and Japanese monetary policies belong in the German monetary policy reaction function, although the US correlation is much stronger than the Japanese correlation. Likewise, both US and German monetary policies belong in the Japanese monetary policy reaction function. And in this case, the German influence is stronger than the US influence, although both are statistically significant. There is no evidence that either German or Japanese monetary policies belong in the US reaction function. These results are quite similar to the results obtained using VARs. The one exception is that the cross correlations suggest two-way feedback between Japanese and German monetary policies.

The final panel in Table 6 presents the cross correlations between the G-3 monetary policy innovations and the international monetary policy commitments. Interestingly, the inflation commitments are negatively correlated with all three policy innovations, and the growth commitments are positively correlated with all three policy innovations. As in the VAR results, the G-3 react (honorably) by contracting monetary policy in response to inflation commitments, and by expanding monetary policy in response to growth commitments. However, the Ljung-Box Q-tests for significant correlation between the policy innovations and twelve lags of the coordination commitments suggest that these commitments did not significantly influence the German policy innovations. Whereas the VAR-based tests presented in figure 6

and 7 indicate that German monetary policy is influenced by inflation and growth commitments, the cross correlations do not support this hypothesis. One way to interpret these conflicting results is that the policy reaction function better describes German monetary policy than the VAR specification, and that the inflation and growth commitments generally coincide with policies based on domestic inflation and output targets. Under these circumstances, the commitments would provide no additional explanatory power in the German monetary policy reaction function. In the cases of the United States and Japan, the VAR results and the cross correlations provide identical implications: US monetary policy is influenced by both inflation and growth commitments, and Japanese monetary policy is influenced by growth commitments. Also, as was the case with the VAR results, neither the exchange rate stability or level commitments significantly influence the G-3 monetary policy innovations.

VII. Conclusions

This paper examines the interdependence and coordination of monetary and exchange rate policies among the G-3 countries over the period 1977 through 1993. Evidence from the first set of VARs suggests that the United States influences both Germany and Japan, and that Germany influences Japan. There is little evidence that Japanese policy influences either the United States or Germany. While the estimates suggest that the G-3 countries influence each others' monetary policies, they do not provide evidence on whether the countries actually coordinate policies. In order to test for policy coordination, dummy variables are used to represent public commitments to coordinate monetary or exchange rate policies. Tests of whether shocks to these commitment-dummy-variables influence G-3 monetary policies indicate that the three countries do react honorably to their joint commitments to fight inflation and reduce interest rates. However, additional evidence from structural reaction function estimates suggest that German monetary policy, while consistent with the international agreements, does not differ from what it would have been in

the absence of the agreements. In other words, there is no evidence that the international agreements have additional explanatory power, over and above domestic variables, in the German monetary policy reaction function.

Although the exchange rate stability and realignment commitments have received more attention in the financial press than the direct monetary policy commitments, these are not found to significantly influence G-3 monetary policies. One way to interpret this result is that the exchange rate commitments generally involve only sterilized interventions. It is noteworthy that the exchange rate reactions to the stability commitments are generally consistent with the commitment objectives; the DM/$ and Yen/$ rates remain quite stable in reaction to these commitments. The realignment commitments, on the other hand, had no significant influence on the dollar cross rates.

The results in the paper suggest that the international monetary transmission mechanism is important, and that, among the G-3, US policies are the most influential. Further, it suggests that the G-3 generally honor international monetary policy commitments, although in the case of Germany the commitments seem to have coincided with domestic policy objectives. One of the surprising results in the paper is the strong performance of U.S. monetary policy in the context of the coordination agreements. The likely explanation is that the United States is the dominant force in the coordination process over this period. If the coordination agreements mainly reflect monetary policies that are in the best interests of the United States, and coincide with policies that Germany would pursue on its own, then it makes sense that the United States and Germany consistently honor the commitments.

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TABLE 1
Selections from G-3, G-5, and G-7 Communiques

MEETING	Communique Statements
November 15-17, 1975 Rambouillet (Summit)	In consolidating the recovery, it is essential to avoid unleashing additional inflationary forces which would threaten its success...[and] our monetary authorities will act to counter disorderly market conditions, or erratic fluctuations, in exchange rates.
June 27-28, 1976 San Juan (Summit)	Sustained economic expansion cannot be achieved in the context of high rates of inflation. [T]he relationship between the dollar and most of the main currencies has been remarkably stable. However, some currencies have suffered substantial fluctuations. Our commitment to deliberate, orderly and sustained expansion, and to indispensable companion goal of defeating inflation, provides the basis for increased stability.
May 7-8, 1977 London (Summit)	Our most urgent task is to create more jobs which continuing to reduce inflation. Inflation does not reduce unemployment. On the contrary, it is one of its major causes.
July 17, 1978 Bonn (Summit)	We must create more jobs, fight inflation, and achieve greater stability in exchange markets... Although exchange rates need to respond to changes in underlying economic and financial conditions among nations, our monetary authorities will continue to intervene to the extent necessary to counter disorderly conditions in the exchange markets.
June 28-29, 1979 Tokyo (Summit)	Stability in the foreign exchange market is essential for the sound development of world trade and the global economy. We will continue close cooperation in exchange market policies ...
June 22-23, 1980 Venice (Summit)	...monetary restraint is required to break inflationary expectations. We reaffirm our commitment to stability in the foreign exchange markets. We will continue close cooperation in exchange market policies so as to avoid disorderly exchange rate fluctuations.
July 20-21, 1981 Ottawa (Summit)	We see low and stable monetary growth as essential to reducing inflation. Interest rates have to play their part in achieving this and are likely to remain high where fears of inflation remain strong. It is also highly desirable to minimize volatility of exchange rates; greater stability in foreign exchange and financial markets is important to sound development of the world economy.
June 4-6, 1982 Versailles (Summit)	continuing fight against inflation will help bring down interest rates, which are now unacceptably high, and to bring about more stable exchange rates. We are ready, if necessary, to use intervention in exchange markets to counter disorderly conditions...
May 28-30, 1983 Williamsburg (Summit)	Our governments will pursue appropriate monetary policies that will be conducive to low inflation. While retaining our freedom to operate independently, we are willing to undertake coordinated intervention in exchange markets in instances where it is agreed that such intervention would be helpful.

June 7-9, 1984 London (Summit)	We have agreed: To continue with and where necessary strengthen policies to reduce inflation and interest rates, to control monetary growth...
January 17, 1985 G5 Ministers Meeting	In light of recent developments in foreign exchange markets, reaffirmed their commitment made at the Williamsburg Summit to undertake coordinated intervention in the markets as necessary.
May 2-4, 1985 Bonn (Summit)	We will consolidate and enhance the progress made in bringing down inflation.
September 22, 1985 Plaza G5 Ministers Meeting	...in view of the present and prospective changes in fundamentals, some further orderly appreciation of the main non-dollar currencies against the dollar is desirable. They stand ready to cooperate more closely to encourage this when to do so would be helpful.
January 19, 1986 G5 Meeting	No communique: Participants agreed that lower inflation worldwide and lower oil prices had created conditions for lower interest rates... [Funabashi (1988), p.44].
February 10, 1986 Volcker-Pohl Meeting	No communique: U.S. and Germany agree to coordinated discount rate reductions [Funabashi (1988), p.250].
March 6, 1986 G3 Meeting	No communique: U.S., Germany and Japan agree to coordinated discount rate reductions [Funabashi (1988), p.47].
April 18, 1986 US-Japan Meeting	No communique: U.S. and Japan agree to coordinated discount rate reductions [Funabashi (1988), p. 50].
May 6, 1986 Tokyo (Summit)	...reaffirm the 1983 Williamsburg commitment to intervene in exchange markets when to do so would be helpful.
September 27, 1986 G7 Ministers Meeting	Inflation is likely to remain low. [We have agreed] to continue to follow sound monetary policies supporting non-inflationary growth...

October 31, 1986 Baker-Miyazawa Accord	...they shared the view that exchange rate instability can jeopardize stable economic growth. They expressed their mutual understanding that the exchange rate realignment achieved between the yen and the dollar since the Plaza Agreement is now broadly consistent with the present underlying fundamentals and reaffirmed their willingness to cooperate on exchange market issues. Japan agrees to lower interest rates in return for U.S. promises to reduce the budget deficit, enact tax reform and resist protectionist pressures [Funabashi (1988), p.160].
February 22, 1987 Louvre Accord G6 Ministers Meeting	Monetary policy [in Germany] will be directed at improving the conditions for sustained economic growth while maintaining price stability. The Bank of Japan announced that it will reduce its discount rate by one half percent on February 23. Monetary policy [in the U.S.] will be consistent with economic expansion at a sustainable non-inflationary pace. ...substantial exchange rate shifts among their currencies could damage growth and adjustment prospects in their countries. In current circumstances, therefore, they agreed to cooperate closely to foster stability of exchange rates around current levels.
April 8, 1987 G7 Ministers Meeting	They concluded that present and prospective progress in implementing the policy undertakings at the Louvre and in this statement provided a basis for continuing close cooperation to foster the stability of exchange rates.
June 8-10, 1987 Venice, (Summit)	In view of the outlook for low inflation in many countries, a further market-led decline of interest rates would be helpful. Given the policy agreements reached at the Louvre and in Washington, further substantial shifts in exchange rates could prove counterproductive to efforts to increase growth and facilitate adjustment.
September 26, 1987 G7 Ministers Meeting	The Ministers and Governors commit themselves to take further appropriate actions as necessary to achieve the agreed goals set forth in the Louvre agreement. They will particularly intensify their efforts to ... foster a high rate of sustained non-inflationary growth...reaffirmed that currencies are within ranges broadly consistent with underlying economic fundamentals. They recommitted themselves to continue to cooperate closely to foster the stability of exchange rates around current levels.
December 23, 1987 Telephone Accord G7	The marked exchange rate changes over the past few weeks, however, stress the need to strengthen underlying economic fundamentals and to continue policy cooperation.
April 13, 1988 G7 Ministers Meeting	They reiterated that either excessive fluctuation of exchange rates, a further decline of the dollar, or a rise in the dollar to an extent that becomes destabilizing to the adjustment process could be counterproductive by damaging growth prospects in the world economy. The Ministers and Governors also re-emphasized their common interest in stable exchange rates among their currencies and agreed to continue to cooperate closely in monitoring and implementing policies to strengthen underlying economic fundamentals to foster continued stability of exchange rates.

June 19-21, 1988 Toronto (Summit)	We need to maintain vigilance against any resurgence of inflation. We endorse the Group of Seven's conclusion that either excessive fluctuation of exchange rates, a further decline of the dollar, or a rise in the dollar to an extent that becomes destabilizing to the adjustment process, could be counterproductive by damaging growth prospects in the world economy.
September 24, 1988 G7 Ministers Meeting	Ministers and Governors emphasized their continued interest in stable exchange rates among their currencies. Therefore, they reaffirmed their commitments to pursue policies that will maintain exchange rate stability and to continue to cooperate closely on exchange markets.
April 2, 1989 G7 Ministers Meeting	The success of these efforts [coordinated non-inflationary growth] depends on continued progress in controlling inflation. The Ministers and Governors agreed that a rise of the dollar which undermined adjustment efforts, or an excessive decline, would be counterproductive, and reiterated their commitment to cooperate closely on exchange markets.
July 16, 1989 Paris (Summit)	Until now, the threat of inflation in many countries has been contained, thanks to the concerted efforts of governments and monetary authorities. But continued vigilance is required... There has been continued cooperation in exchange markets.
September 23, 1989 G7 Ministers Meeting	The Ministers and Governors considered the rise in recent months of the dollar inconsistent with longer-run economic fundamentals. They agreed that a rise of the dollar above current levels or an excessive decline could adversely affect prospects for the world economy. In this context, they agreed to cooperate closely in exchange markets.
April 7, 1990 G7 Ministers Meeting	The Ministers and Governors discussed developments in global financial markets, especially the decline of the yen against other currencies and its undesirable consequences for the global adjustment process, and agreed to keep these developments under review. They reaffirmed their commitment to economic policy coordination, including cooperation in exchange markets.
May 6, 1990 G7 Ministers Meeting	They agreed that price pressures warrant continued vigilance. They also noted that the yen had stabilized since their meeting in Paris, [4/7/90] but remained of the view that the present level may have undesirable consequences for the global adjustment process...and reaffirmed their [Ministers and Governors] commitment to economic policy coordination, including cooperation on exchange markets.
July 11, 1990 Houston (Summit)	Inflation, although considerably lower than in the early 1980s, is a matter of serious concern in some countries and requires continued vigilance.
September 22, 1990 G7 Ministers Meeting	They recalled that at their last meeting, they were of the view that the level of the yen then prevailing may have had undesirable consequences for the global adjustment process. They noted that since then, the yen had appreciated and concluded that exchange rates were now broadly in line with continued adjustment of external imbalances. They agreed to continue to cooperate closely on exchange markets in the context of the economic policy coordination process.

January 21, 1991 G7 Ministers Meeting	Implementation of sound fiscal policies, combined with stability-oriented monetary policies, should create conditions favorable to lower global interest rates... They agreed to strengthen cooperation and to monitor developments in exchange markets. The Ministers and Governors are prepared to respond as appropriate to maintain stability in international financial markets.
April 28, 1991 G7 Ministers Meeting	The Ministers and Governors emphasized the importance of monetary and fiscal policies which provide the basis for lower real interest rates and a sustained global economic recovery with price stability. They also reviewed developments in international financial markets and reaffirmed their commitment to cooperate closely on exchange markets.
June 23, 1991 G7 Ministers Meeting	The Ministers and Governors welcomed the reductions in interest rates that have taken place in a number of their countries and elsewhere. They also reviewed recent developments in international financial markets and reaffirmed their commitment to cooperate closely, taking account of the need for orderly markets, if necessary through appropriately concerted action in exchange markets.
July 17, 1991 London (Summit)	We therefore commit ourselves to implement fiscal and monetary policies,... provide the basis for lower real interest rates. We also welcome the close cooperation on exchange markets and the work to improve the functioning of the international monetary system.
October 12, 1991 G7 Ministers Meeting	The Ministers and Governors emphasized the importance of fiscal and monetary policies, which, ... provide the basis for lower real interest rates and sustained growth with price stability in a medium-term perspective. They reviewed developments in international financial markets and concluded that the recent exchange market developments were broadly in line with continued adjustment of external imbalances. They also reaffirmed their commitment to cooperated closely on exchange markets.
January 25, 1992 G7 Ministers Meeting	Monetary policies should be directed to preserving the gains that have been achieved in reducing inflation while providing adequate scope to finance sustainable growth. Those countries which in the future experience better than expected inflation performance may have a basis for an easing of monetary conditions and interest rates without jeopardizing the commitment to price stability and exchange rate objectives. They agreed to continue to monitor market developments and reaffirmed their commitment to cooperate closely in exchange markets, thus contributing to favorable conditions for stable exchange markets and economic recovery.
April 26, 1992 G7 Ministers Meeting	On monetary policies, the Ministers and Governors welcomed the reductions in cost and price pressures in most of their countries, which have permitted significantly lower interest rates in several cases. Exchange markets have been generally stable in recent months, though they noted that the decline of the yen since their last meeting was not contributing to the adjustment process. They agreed to continue to monitor market developments and reaffirmed their commitment to close cooperation in exchange markets, which can contribute to facilitating recovery.
July 8, 1992 Munich (Summit)	...we [Heads of State and Government of G7] all would gain greatly from stronger, sustainable non-inflationary growth.

September 19, 1992 G7 Ministers Meeting	The Ministers and Governors will continue to cooperate and to monitor closely economic and financial conditions in their countries and will take appropriate additional actions as needed to achieve sustained growth and greater currency stability.
April 29, 1993 G7 Ministers Meeting	We agreed that exchange rates should reflect economic fundamentals and that excessive volatility is undesirable. We reviewed recent developments in foreign exchange markets and affirmed our continued commitment to close cooperation in exchange markets.
July 9, 1993 Tokyo (Summit)	Japan will implement fiscal and monetary measures as necessary, to ensure sustained non-inflationary growth led by strong domestic demand...
November 25, 1993 G7 Ministers Meeting	no monetary or exchange rate policy commitments
April 25, 1994 US Treasury Sec Lloyd Bentsen on behalf of G7	Inflation remains low in all the major economies. In my view the fundamentals that drive interest rates still provide room for further reductions, particularly in countries with weak growth.

TABLE 2

G3, G5, and G7 Monetary and Exchange Rate Policy Commitments

Meeting	Inflation	Lower Interest Rates (Growth)	Exchange Rate Stability	Exchange Rate Level
November 15-17, 1975 Rambouillet (Summit)	X		X	
June 27-28, 1976 San Juan (Summit)	X		X	
May 7-8, 1977 London (Summit)	X			
July 17, 1978 Bonn (Summit)	X			X
June 28-29, 1979 Tokyo (Summit)			X	
June 22-23, 1980 Venice (Summit)	X		X	
July 20-21, 1981 Ottawa (Summit)	X		X	
June 4-6, 1982 Versailles (Summit)	X		X	
May 28-30, 1983 Williamsburg (Summit)	X			X
June 7-9, 1984 London (Summit)	X			
January 17, 1985 G5 Ministers Meeting				X
May 2-4, 1985 Bonn (Summit)	X			
September 22, 1985 Plaza G5 Ministers Meeting				X

Meeting	Inflation	Lower Interest Rates (Growth)	Exchange Rate Stability	Exchange Rate Level
January 19, 1986 G5 Meeting		X		
February 10, 1986 Volcker-Pohl Meeting		X US and Germany		
March 6, 1986 G3 Meeting		X		
April 18, 1986 US-Japan Meeting		X US and Japan		
May, 6, 1986 Tokyo (Summit)			X	
September 27, 1986 G7 Ministers Meeting		X		
October 31, 1986 Baker-Miyazawa Accord		X Japan		X
February 22, 1987 Louvre Accord G6 Ministers Meeting		X	X	
April 8, 1987 G7 Ministers Meeting			X	
June 8-10, 1987 Venice, (Summit)		X	X	
September 26, 1987 G7 Ministers Meeting		X	X	
December 23, 1987 Telephone Accord G7				X
April 13, 1988 G7 Ministers Meeting			X	
June 19-21, 1988 Toronto (Summit)	X		X	

Meeting	Inflation	Lower Interest Rates (Growth)	Exchange Rate Stability	Exchange Rate Level
September 24, 1988 G7 Ministers Meeting			X	
April 2, 1989 G7 Ministers Meeting	X		X	
July 16, 1989 Paris (Summit)	X			
September 23, 1989 G7 Ministers Meeting				X
April 7, 1990 G7 Ministers Meeting				X
May 6, 1990 G7 Ministers Meeting	X			X
July 11, 1990 Houston (Summit)	X			
September 22, 1990 G7 Ministers Meeting			X	
January 21, 1991 G7 Ministers Meeting		X	X	
April 28, 1991 G7 Ministers Meeting		X	X	
June 23, 1991 G7 Ministers Meeting		X	X	
July 17, 1991 London (Summit)		X	X	
October 12, 1991 G7 Ministers Meeting		X	X	
January 25, 1992 G7 Ministers Meeting		X	X	
April 26, 1992 G7 Ministers Meeting		X		X

Meeting	Inflation	Lower Interest Rates (Growth)	Exchange Rate Stability	Exchange Rate Level
July 8, 1992 Munich (Summit)		X		
September 19, 1992 G7 Ministers Meeting		X	X	
April 29, 1993 G7 Ministers Meeting			X	
July 9, 1993 Tokyo (Summit)		X Japan		
November 25, 1993 G7 Ministers Meeting				

TABLE 3

BundesBank Monetary Growth Targets

Year	Target	Explanation	Revision
1977	6-7	No revision	None
1978	5-7	Will not suspend target, although " it is no longer expected that the monetary growth target for 1978...will be met.."Overshooting mainly due to interventions and speculation on forex market. But BBank will not abandon, "its super ordinate objective of preventing an inflation..." [June]	None
1979	6-9	Focus has been on lower limit of the target range in the last few months [September]	None
1980	5-8	Declared the bottom end of the range as its objective. [July]	5-6.5
1981	4-7	"...the monetary growth target... should under the prevailing overall economic conditions be retained unchanged ...monetary growth has to be kept in the lower half of the target range for the rest of this year..." [July]	4-5.5

Year	Target	Explanation	Revision
1982	4-7	" If progress in the domestic and external adjustment and stabilisation process continues...it will be possible...to speed up monetary expansion and to keep the growth...on the middle or the upper part of the target range." [December 81]	None
1983	4-7	The target is still correct and although it has been overshot, it can still be achieved by years end. [July]	None
1984	4-6	"...monetary expansion continued to be consistent with the target set for 1984." [September]	None
1985	3-5	"During its regular review at mid-year the Central Bank Council... decided that the 1985 monetary growth target...would be retained." [July]	none
1986	3.5-5.5	CBC retains the target [July]	none
1987	3-6	Overshooting tolerated because, ..."the dampening effects on price and cost of the DM appreciation and the low world market prices of energy sources... helped to insure that domestic price share remained stable in the last two years." [Feb. ’88]	none

Year	Target	Explanation	Revision
1988	3-6	No revision	none
1989	4-6	"...the CBC confirmed the monetary target for 1989 at the end of June..." [September]	none
1990	4-6	No revision	none
1991	4-6	"By lowering the 1991 target... the CBC is taking due account of the structural changes in east German households' demand for money patterns which changes are now more clearly evident." [July]	3-5%
1992	3.5-6	"The assumptions the monetary target was originally based on still generally apply in mid-1992..." [August]	none
1993	4.5-6.5	"...The CBC... reviewed and reaffirmed the monetary target for 1993." [July]	none

TABLE 4

Variance Decompositions

(Percentage of Total Error Variance)

Innovation in: US Monetary Policy Index (3-variable system)

	One Year	Two Years	Three Years
US Monetary Policy Index	81 (9.24)**	84 (9.58)**	76 (6.10)**
German Monetary Policy Index	19 (1.78)†	21 (1.62)†	23 (1.62)
Japanese Monetary Policy Index	25 (2.12)*	43 (3.24)**	44 (3.03)**

Innovation in: US Monetary Policy Index (9-variable system)

	One Year	Two Years	Three Years
US Industrial Production	20 (2.58)*	38 (3.63)**	37 (3.38)**
German Industrial Production	3 (0.16)	1.5 (0.61)	6 (1.08)
Japanese Industrial Production	1.5 (0.87)	5 (1.13)	11 (1.34)
US Consumer Price Index	5 (1.29)	3 (0.72)	2 (0.45)
German Consumer Price Index	1 (0.44)	3 (0.57)	3.5 (0.64)
Japanese Consumer Price Index	17 (3.07)**	15 (2.27)*	11 (1.77)†
US Monetary Policy Index	40 (5.10)**	28 (3.57)**	25 (3.19)**
German Monetary Policy Index	19 (2.47)*	18 (2.15)*	14 (1.95)*
Japanese Monetary Policy Index	32 (3.52)**	24 (3.35)**	22 (2.64)*

TABLE 4 cont.

Variance Decompositions

(Percentage of Total Error Variance)

Innovation in: German Monetary Policy Index (3-variable system)

	One Year	Two Years	Three Years
US Monetary Policy Index	2 (0.57)	3 (0.56)	12 (1.15)
German Monetary Policy Index	78 (7.10)**	71 (5.17)**	67 (4.42)**
Japanese Monetary Policy Index	14 (1.69)†	17 (1.69)†	19 (2.03)*

Innovation in: German Monetary Policy Index

	One Year	Two Years	Three Years
US Industrial Production	2 (0.93)	3 (0.92)	2 (0.67)
German Industrial Production	2 (1.00)	6 (1.86)†	15 (2.53)*
Japanese Industrial Production	2 (0.89)	11 (2.03)*	16 (2.28)*
US Consumer Price Index	5 (1.29)	5 (1.11)	4 (0.89)
German Consumer Price Index	6 (1.54)	13 (2.11)*	15 (2.13)*
Japanese Consumer Price Index	2.5 (1.11)	7 (1.41)	6 (1.26)
US Monetary Policy Index	3 (1.03)	2 (.075)	2 (0.61)
German Monetary Policy Index	46 (4.66)**	31 (3.31)**	23 (3.11)**
Japanese Monetary Policy Index	10 (1.87)†	16 (2.01)*	19 (2.32)*

TABLE 4 cont.

Variance Decompositions

(Percentage of Total Error Variance)

Innovation in: Japanese Monetary Policy Index (3-variable system)

	One Year	Two Years	Three Years
US Monetary Policy Index	17 (2.03)*	12 (1.62)	11 (1.42)
German Monetary Policy Index	2 (0.54)	7 (0.90)	8 (0.84)
Japanese Monetary Policy Index	60 (4.94)**	39 (3.33)**	35 (3.17)**

Innovation in: Japanese Monetary Policy Index

	One Year	Two Years	Three Years
US Industrial Production	2 (0.59)	2 (0.59)	4 (0.88)
German Industrial Production	2 (0.67)	2 (0.51)	2 (0.54)
Japanese Industrial Production	8 (1.41)	8 (1.23)	11 (1.32)
US Consumer Price Index	.8 (0.29)	2 (0.37)	2 (0.35)
German Consumer Price Index	.2 (0.11)	.4 (0.12)	1 (0.28)
Japanese Consumer Price Index	9 (2.11)*	12 (1.82)†	12 (1.60)
US Monetary Policy Index	6 (1.61)	9 (1.49)	9 (1.31)
German Monetary Policy Index	.5 (0.23)	4 (0.81)	4 (0.73)
Japanese Monetary Policy Index	39 (4.35)**	27 (3.22)**	19 (2.26)*

NOTE (for table 4): Matrix entries are the point estimates of the percentage of total error variance for the variables in the first column explained by an innovation in the US, German and Japanese monetary policy index respectively, at the end of years 1, 2 and 3. Numbers in parentheses are t-statistics generated by Monte Carlo simulations involving five-hundred draws from the estimated asymptotic distribution of the underlying (3 and 9-variable) VAR coefficients and the covariance matrix of the innovations. ** denotes significance at the .01 level; * denotes significance ant the .05 level; and † denotes significance at the .10 level. The data are monthly and the sample period is 1977 through 1993.

TABLE 5
Bivariate Granger-Causality Tests

DEPENDENT VARIABLES	INDEPENDENT VARIABLES		
	US Monetary Policy Index	German Monetary Policy Index	Japanese Monetary Policy Index
US Industrial Production	.024*	.153	.363
German Industrial Production	.267	.048*	.121
Japanese Industrial Production	.384	.426	.027*
US Consumer Price Index	.114	.055†	.067†
German Consumer Price Index	.541	.045*	.451
Japanese Consumer Price Index	.123	.006**	.011*
US Monetary Policy Index		.584	.751
German Monetary Policy Index	.086†		.127
Japanese Monetary Policy Index	.091†	.053†	

NOTE: Matrix entries are the significance levels of F-statistics from tests of the null hypothesis that the independent variable (the monetary policy index) is zero in a bivariate regression of the dependent variable on own lags and lags of the independent variable. The number of lags in each bivariate regression is selected using the Akaike criterion. ** denotes significance at the .01 level; * denotes significance ant the .05 level; and † denotes significance at the .10 level. The data are monthly and the sample period is 1977 through 1993.

TABLE 6
Bivariate Granger-Causality Tests

DEPENDENT VARIABLES	INDEPENDENT VARIABLES				
	Inflation	Growth	Exchange Rate Stability	Exchange Rate Level	Change in Oil Prices
US Monetary Policy Index	.031*	.017*	.429	.265	.264
German Monetary Policy Index	.740	.263	.654	.317	.431
Japanese Monetary Policy Index	.053†	.072†	.142	.307	.034*

NOTE: Matrix entries are the significance levels of F-statistics from tests of the null hypothesis that the independent variable (the monetary policy index) is zero in a bivariate regression of the dependent variable on own lags and lags of the independent variable. The number of lags in each bivariate regression is selected using the Akaike criterion. ** denotes significance at the .01 level; * denotes significance ant the .05 level; and † denotes significance at the .10 level. The data are monthly and the sample period is 1977 through 1993.

TABLE 6 cont.

Variance Decompositions

(Percentage of Total Error Variance)

Innovation in: Inflation Dummy Variable (6-variable system)

	One Year	Two Years	Three Years
US Monetary Policy Index	.38 (1.11)	6.1 (1.11)	6.6 (1.11)
German Monetary Policy Index	.51 (0.15)	2.1 (0.34)	2.8 (0.39)
Japanese Monetary Policy Index	.53 (1.18)	3.3 (1.58)	5.1 (1.42)

Innovation in: Growth Dummy Variable (6-variable system)

	One Year	Two Years	Three Years
US Monetary Policy Index	18 (1.87)†	18 (1.81)†	18 (1.78)†
German Monetary Policy Index	.57 (0.14)	1.4 (0.26)	1.8 (0.31)
Japanese Monetary Policy Index	16 (1.65)†	23 (1.92)†	25 (2.03)*

NOTE: Matrix entries are the point estimates of the percentage of total error variance for the variables in the first column explained by an innovation in the inflation dummy variable at the end of years 1, 2 and 3. Numbers in parentheses are t-statistics generated by Monte Carlo simulations involving five-hundred draws from the estimated asymptotic distribution of the underlying (6-variable) VAR coefficients and the covariance matrix of the innovations. ** denotes significance at the .01 level; * denotes significance ant the .05 level; and † denotes significance at the .10 level. The data are monthly and the sample period is 1977 through 1993.

TABLE 6 cont.

Variance Decompositions

(Percentage of Total Error Variance)

Innovation in: Exchange Rate Stability Dummy Variable (6-variable system)

US Monetary Policy Index	.77 (0.22)	1.2 (0.25)	1.2 (0.24)
German Monetary Policy Index	.78 (0.21)	1.2 (0.21)	1.2 (0.21)
Japanese Monetary Policy Index	5.7 (0.88)	8.4 (0.95)	8.6 (0.93)

Innovation in: Exchange Rate Level Dummy Variable (6-variable system)

US Monetary Policy Index	2.7 (0.50)	4.2 (0.48)	4.4 (0.44)
German Monetary Policy Index	2.2 (0.47)	3.3 (0.45)	3.3 (0.41)
Japanese Monetary Policy Index	2.1 (0.45)	1.9 (0.31)	1.9 (0.27)

Innovation in: Oil Price Change Variable (6-variable system)

US Monetary Policy Index	.68 (0.26)	.73 (0.26)	.74 (0.26)
German Monetary Policy Index	.57 (0.17)	.67 (0.19)	.68 (0.20)
Japanese Monetary Policy Index	2.8 (1.73)†	3.1 (1.73)†	2.9 (1.71)†

NOTE: Matrix entries are the point estimates of the percentage of total error variance for the variables in the first column explained by an innovation in the labeled variable at the end of years 1, 2 and 3. Numbers in parentheses are t-statistics generated by Monte Carlo simulations involving five-hundred draws from the estimated asymptotic distribution of the underlying (6-variable) VAR coefficients and the covariance matrix of the innovations. ** denotes significance at the .01 level; * denotes significance ant the .05 level; and † denotes significance at the .10 level. The data are monthly and the sample period is 1977 through 1993.

FIGURE 1
Boschen and Mills Index of US Monetary Policy, 77-93

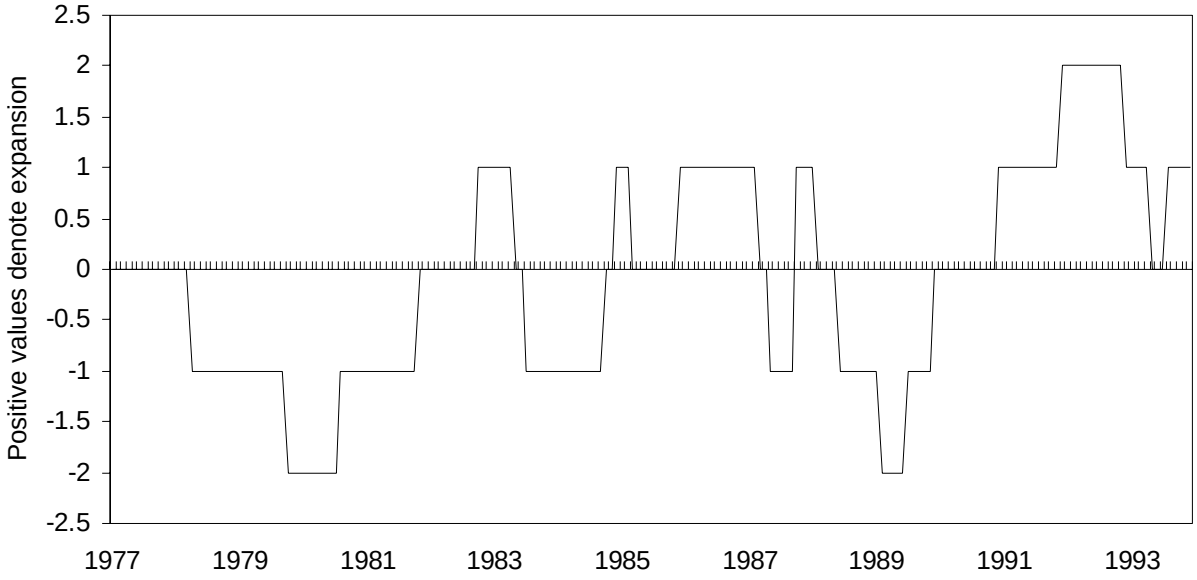


FIGURE 2
Index of German Monetary Policy, 77-93

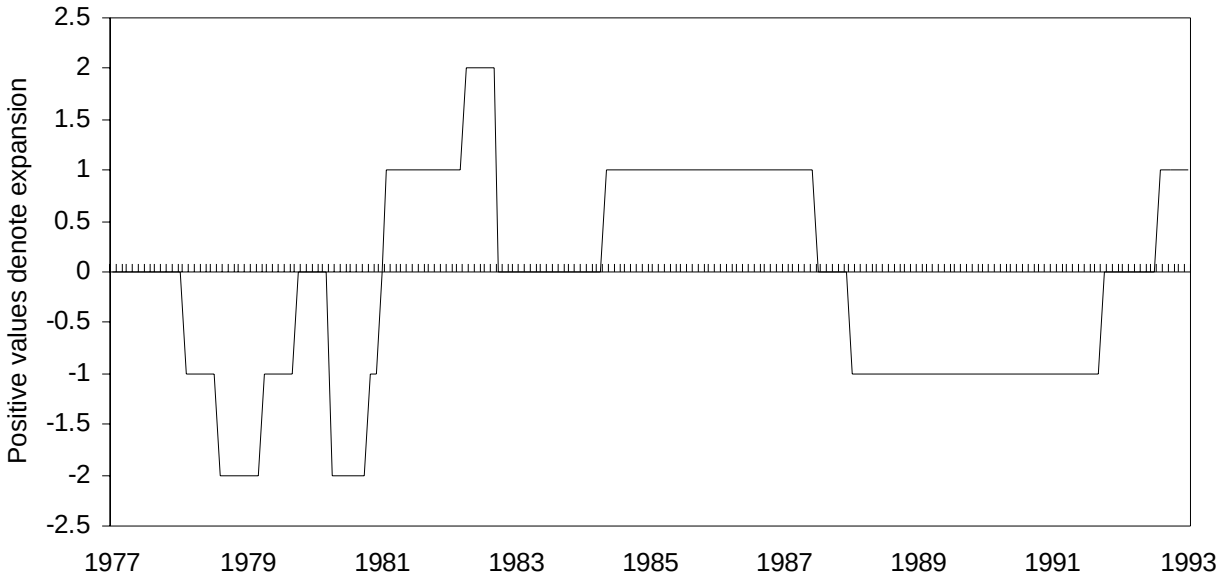


FIGURE 3
Index of Japanese Monetary Policy, 77-93

FIGURE 4
G-3 Monetary Indices, 1977-1993

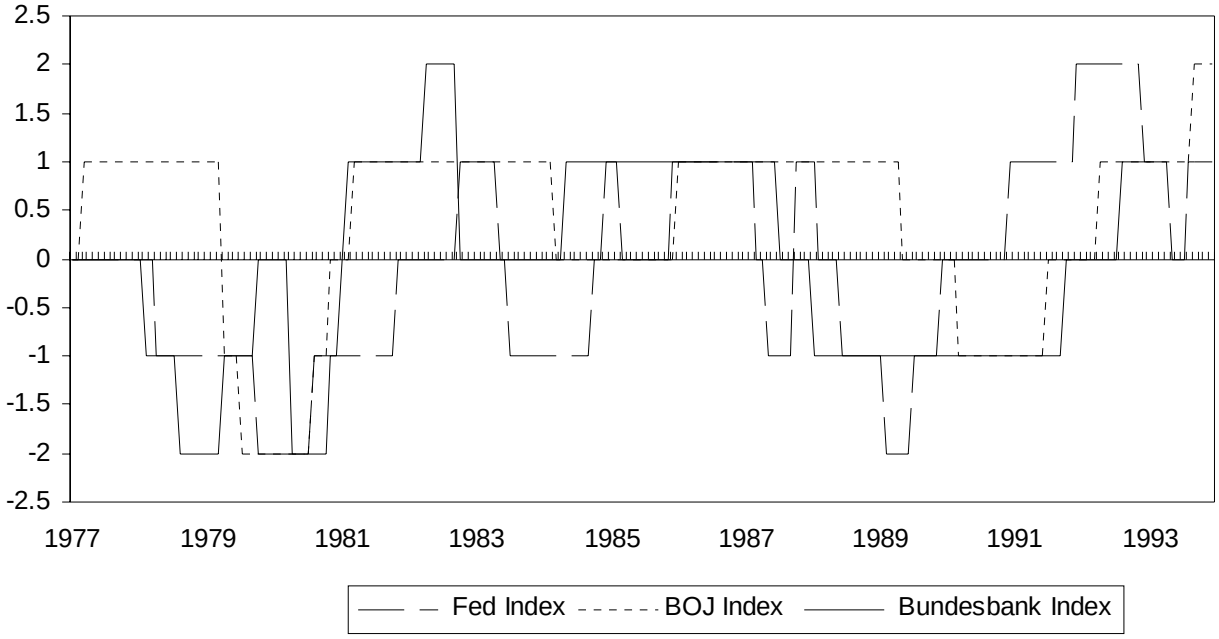


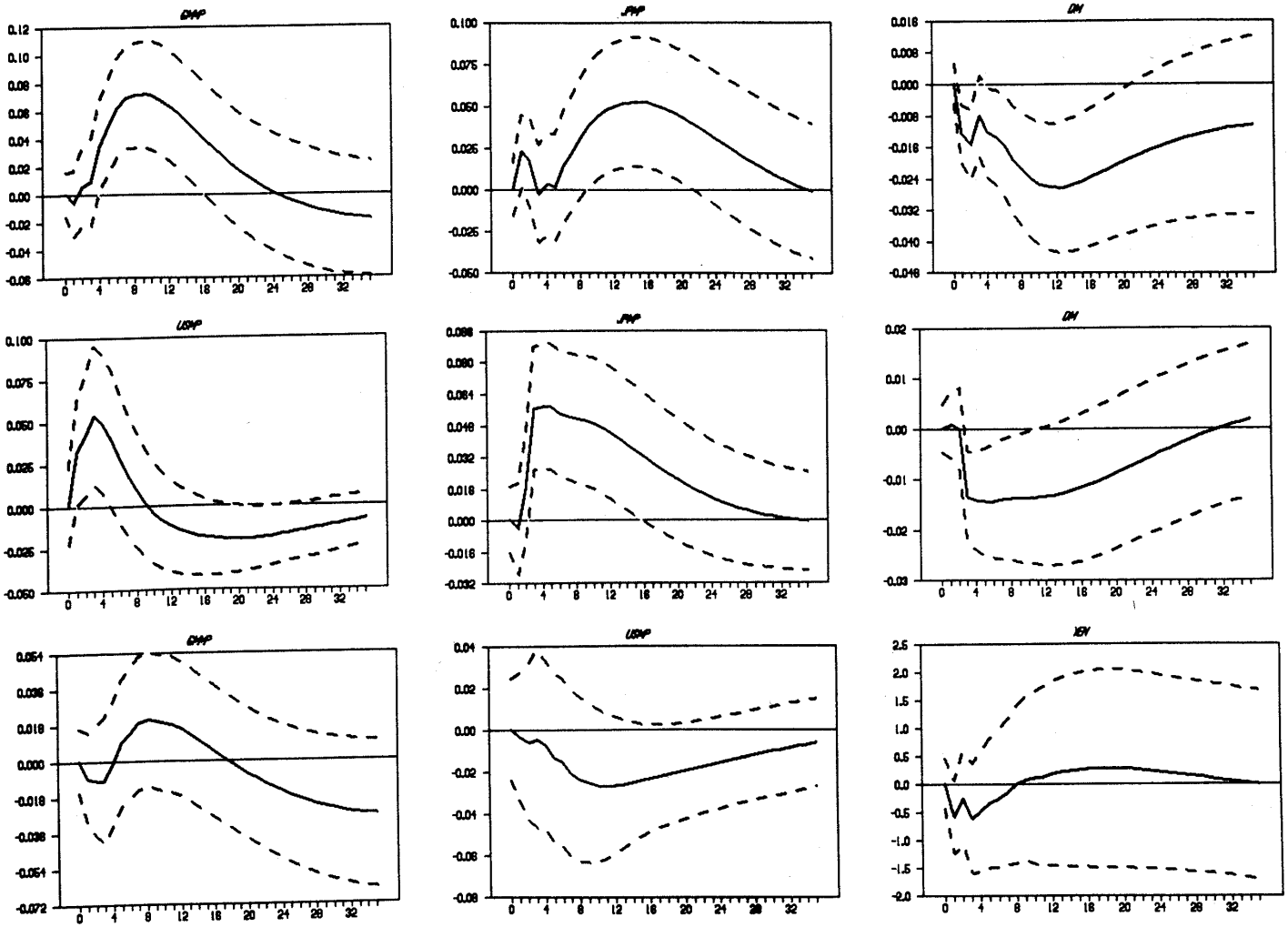
FIGURE 5

G-3 DYNAMIC RESPONSES TO SHOCKS IN EACH OTHER'S MONETARY POLICY

SHOCK TO US MONETARY POLICY

SHOCK TO GERMAN MONETARY POLICY

SHOCK TO JAPANESE MONETARY POLICY



NOTE: 6-Variable VAR Specification [Y^H,P^H,MP^H,MP^{F1},MP^{F2},S]; variables include: industrial production (Y), CPI (P), monetary policy (MP) measured using the indices, and DM/$ or Yen/$ (S), the nominal exchange rate. Superscript H denotes home country, F1 and F2 denote the two foreign countries. The dynamic responses of Y^H, P^H, and MP^H are excluded to save space. A 1-std-dev (orthogonalized) innovation in the MP^H dies out in all 3 countries in approximately 9-months. Each row represents the responses of MP^{F1} and MP^{F2} to a shock in MP^H. Solid lines represent the point estimates and the dashed lines denote the two-standard-deviation bands calculated using a Monte Carlo procedure.

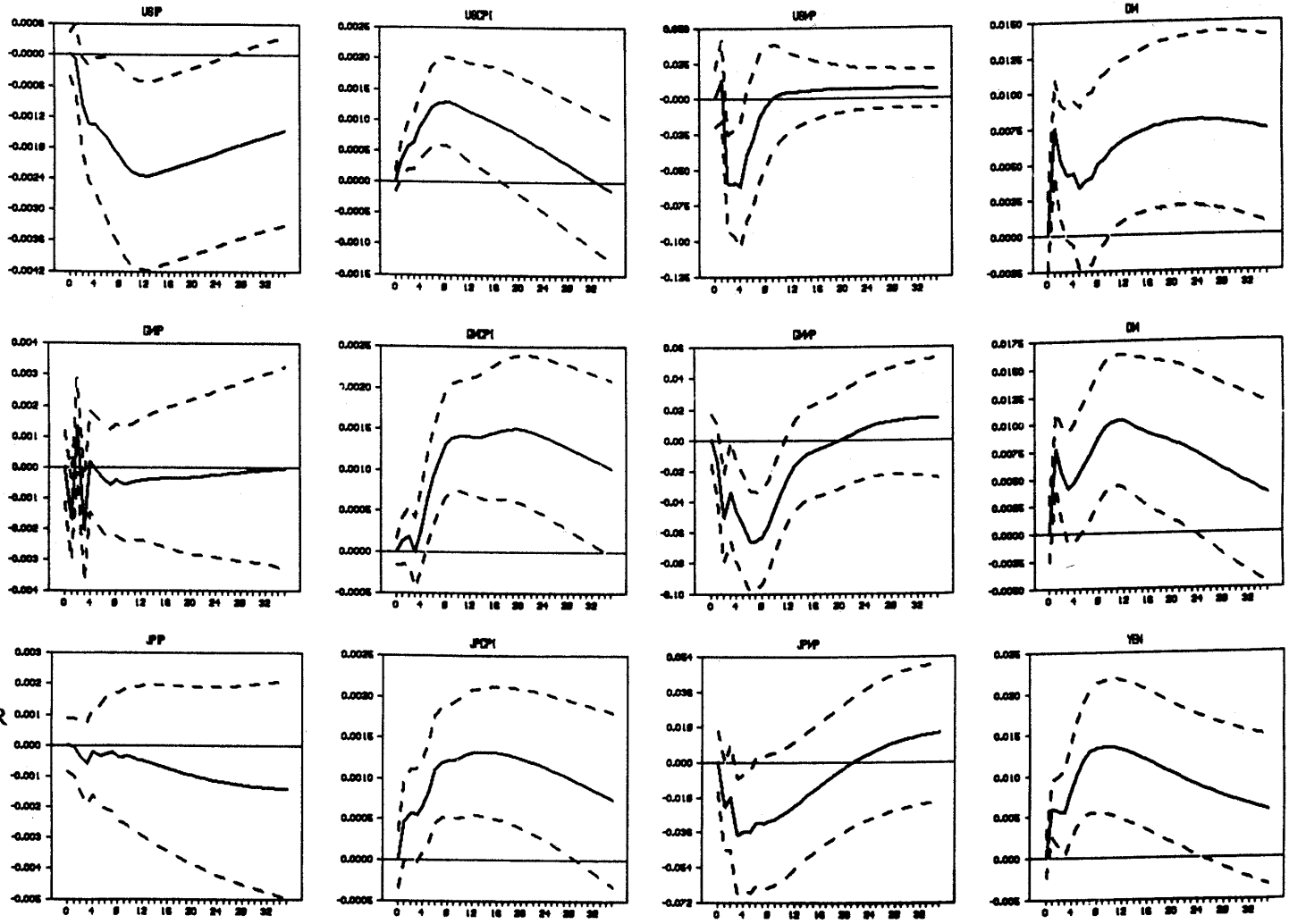
FIGURE 6

DYNAMIC RESPONSES OF G-3 MACROECONOMIC VARIABLES TO A JOINT COMMITMENT TO FIGHT INFLATION

U.S. VAR RESPONSES

GERMAN VAR RESPONSES

JAPANESE VAR RESPONSES



NOTE: Five-Variable VAR Specification [INFLATION-DUMMY,Y,P,MP,S]; variables include: industrial production (Y), CPI (P), monetary policy (MP) measured using the indices, and DM/$ or Yen/$ (S), the nominal exchange rate. The dynamic responses of the inflation-dummy are excluded to save space. A one-standard-deviation (orthogonalized) innovation in the inflation-dummy variable dies out in all three countries in approximately 6-months. Each row represents an individual country's response to the joint commitment. Solid lines represent the point estimates and the dashed lines denote the two-standard-deviation bands calculated using a Monte Carlo procedure.

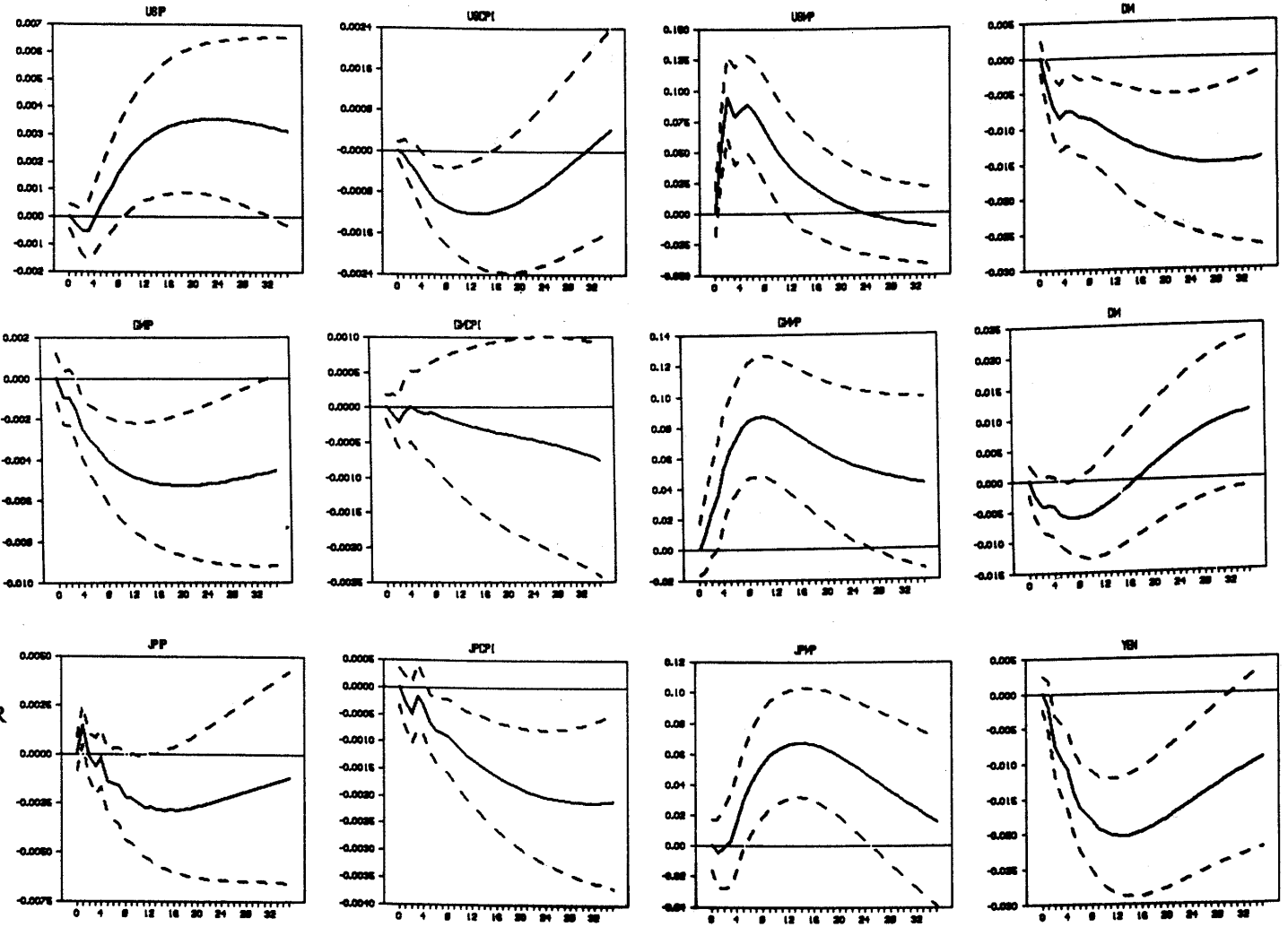
FIGURE 7

DYNAMIC RESPONSES OF G-3 MACROECONOMIC VARIABLES TO A JOINT COMMITMENT TO REDUCE INTEREST RATES

U.S. VAR RESPONSES

GERMAN VAR RESPONSES

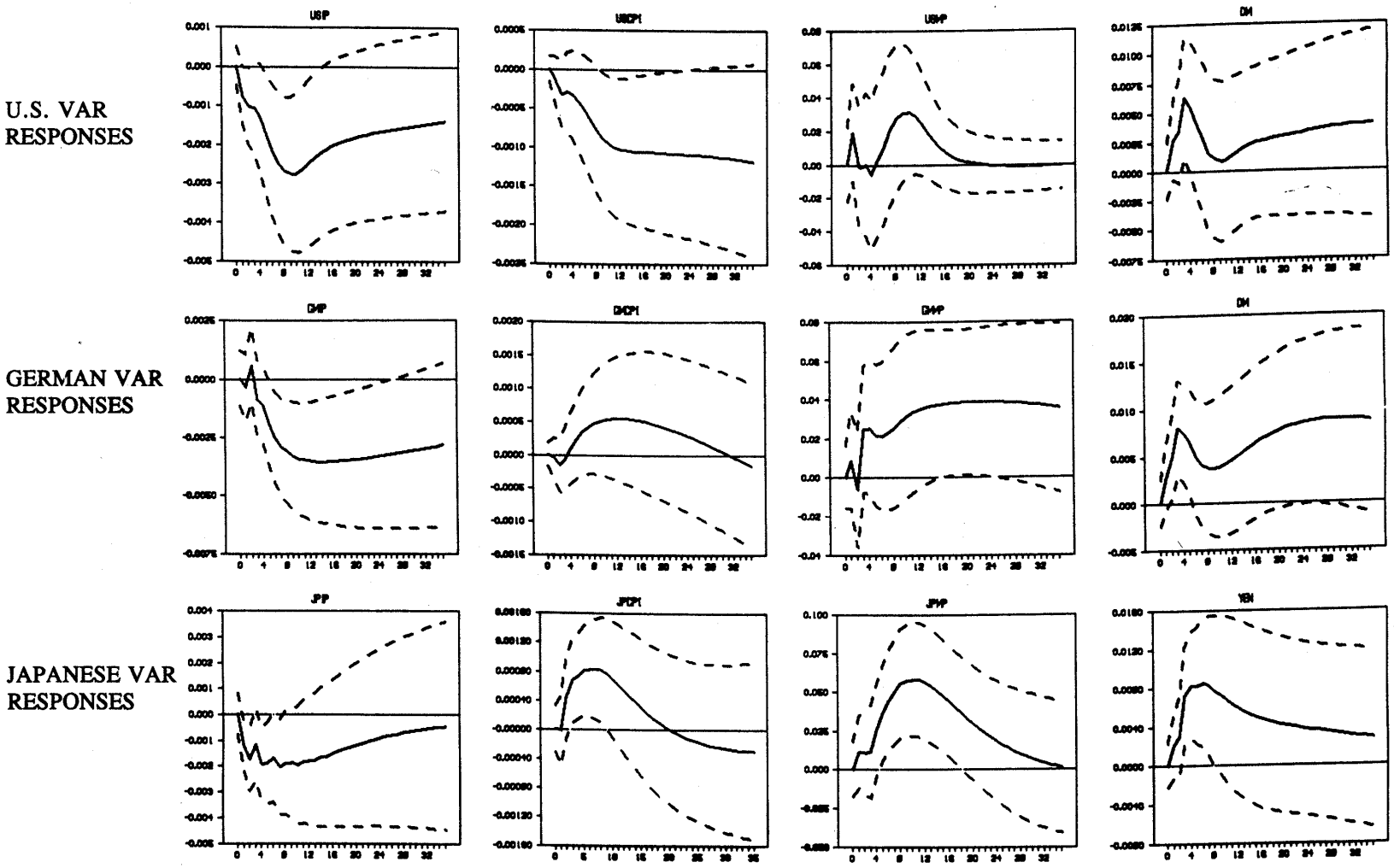
JAPANESE VAR RESPONSES



NOTE: Five-Variable VAR Specification [GROWTH-DUMMY,Y,P,MP,S]; variables include: industrial production (Y), CPI (P), monetary policy (MP) measured using the indices, and DM/$ or Yen/$ (S), the nominal exchange rate. The dynamic responses of the growth-dummy are excluded to save space. A one-standard-deviation (orthogonalized) innovation in the growth-dummy variable dies out in all three countries in approximately 20-months. Each row represents an individual country's response to the joint commitment. Solid lines represent the point estimates and the dashed lines denote the two-standard-deviation bands calculated using a Monte Carlo procedure.

FIGURE 8

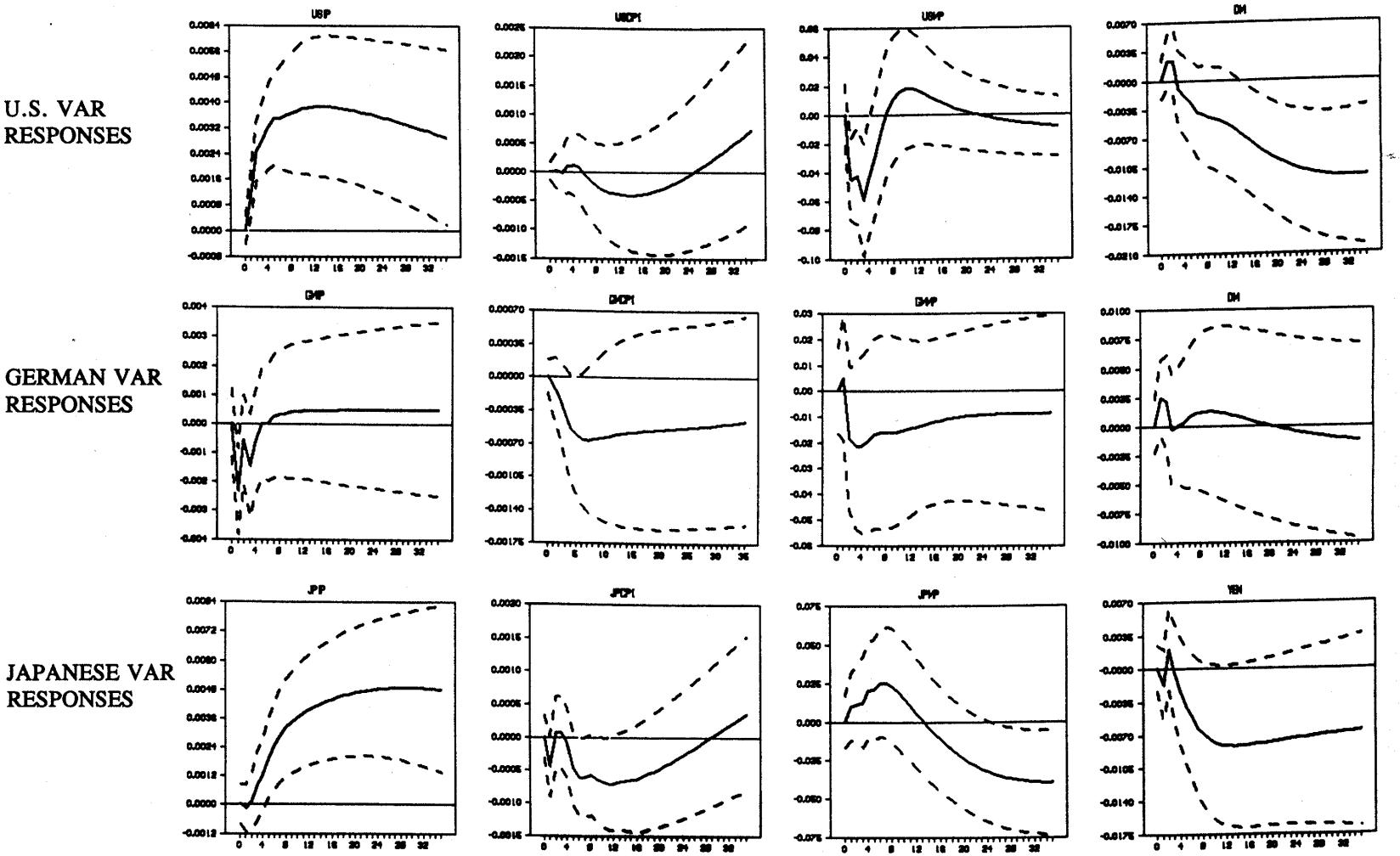
DYNAMIC RESPONSES OF G-3 MACROECONOMIC VARIABLES TO A JOINT COMMITMENT TO STABILIZE THE DOLLAR



NOTE: Five-Variable VAR Specification [STABILITY-DUMMY,Y,P,MP,S]; variables include: industrial production (Y), CPI (P), monetary policy (MP) measured using the indices, and DM/$ or Yen/$ (S), the nominal exchange rate. The dynamic responses of the stability-dummy are excluded to save space. A one-standard-deviation (orthogonalized) innovation in the stability-dummy variable dies out in all three countries in approximately 12-months. Each row represents an individual country's response to the joint commitment. Solid lines represent the point estimates and the dashed lines denote the two-standard-deviation bands calculated using a Monte Carlo procedure.

FIGURE 9

DYNAMIC RESPONSES OF G-3 MACROECONOMIC VARIABLES TO A JOINT COMMITMENT TO REALIGN THE DOLLAR



NOTE: Five-Variable VAR Specification [REALIGN-DUMMY,Y,P,MP,S]; variables include: industrial production (Y), CPI (P), monetary policy (MP) measured using the indices, and DM/$ or Yen/$ (S), the nominal exchange rate. The dynamic responses of the inflation-dummy are excluded to save space. A one-standard-deviation (orthogonalized) innovation in the realign-dummy variable dies out in all three countries in approximately 9-months. Each row represents an individual country's response to the joint commitment. Solid lines represent the point estimates and the dashed lines denote the two-standard-deviation bands calculated using a Monte Carlo procedure.