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A Monetary Impulse Measure for Medium-Term Policy Analysis

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Abstract

The paper presents a measure of monetary impulse that is intended to reflect the medium-term inflationary implications of a nation's current monetary policy. The measure consists of the growth rate of the monetary base, adjusted for reserve requirement changes and augmented by an implicit forecast of future growth rates of base velocity. Time series plots of the impulse measure for the G-7 countries are presented, and are compared with plots of inflation and of two alternative monetary indicators--the yield curve slope and the growth rate of a broad monetary aggregate. The impulse measure serves well as a medium-term indicator of future inflation, and on balance matches or outperforms the alternative indicators.

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<u>Contents</u>	<u>Page</u>
Summary	iii
I. Introduction	1
II. Design and Rationale	1
III. Annual Measures	5
IV. Evaluation of Annual Measures	7
V. Quarterly Measures and Alternative Monetary Indicators	11
VI. Conclusion	14
<u>Text Figures</u>	
Figure 1. United States: Monetary Impulse Measure, Monetary Base, Growth, and Low Inflation Band	8a
Figure 2. Japan: Monetary Impulse Measure, Monetary Base Growth, and Low Inflation Band	8a
Figure 3. Germany: Monetary Impulse Measure, Monetary Base Growth, and Inflation Band	8b
Figure 4. France: Monetary Impulse Measure, Monetary Base Growth, and Low Inflation Band	8b
Figure 5. Italy: Monetary Impulse Measure, Monetary Base Growth, and Low Inflation Band	8c
Figure 6. United Kingdom: Monetary Impulse Measure, Monetary Base Growth, and Low Inflation Band	8c
Figure 7. Canada: Monetary Impulse Measure, Monetary Base Growth and Low Inflation Band	8d
Figure 8. United States: Monetary Impulse Measure, 1954-93	8d
Figure 9. United States	12a
Figure 10. Japan	12b
Figure 11. Germany	12c
Figure 12. France	12d
Figure 13. Italy	12e
Figure 14. United Kingdom	12f
Figure 15. Canada	12g
Appendix: Description of Data	15
References	18

### Summary

This paper proposes a measure of monetary impulse that is intended to reflect the medium-term inflationary implications of a country's current monetary policy. The measure has been designed to be relatively uniform across the major industrial countries, and it could serve as a complement to the country-specific indicators that are relied upon for policy analysis and discussion.

The proposed measure consists of the growth rate of the monetary base, adjusted for reserve requirement changes and augmented by an implicit forecast of future growth rates of base velocity. Because this forecast is based on past velocity growth--its average value over the previous four years--the impulse statistic reflects an easy-to-calculate measure of a variable that could be accurately controlled by any central bank that chose to do so. Other controllable reserve aggregates could be considered instead, but the monetary base has the desirable property of reflecting the effect of open market purchases on both reserves and currency. Thus, if adjusted for changes in reserve requirements, the base provides a reasonably comprehensive summary measure of the actions of the central bank. The velocity adjustment term is designed to incorporate effects of technological and regulatory change in the payments and financial industries, and thus the impulse measure should also be useful for analyzing policy stances in the future.

Given the velocity-growth feature of the proposed measure, its magnitude at any time will reflect the implied medium-term growth rate of nominal GDP. The inflationary implications are then readily obtained from a comparison of this figure with the trend growth rate of real GDP for the economy in question. Figures for each of the seven major industrial countries present time series of the impulse measure together with bands reflecting an appropriate sample average annual rate of real GDP growth plus 1 to 3 percentage points. These bands then represent a low-inflation range centered on a rate of 2 percent. The figures serve as the basis for a discussion of the inflationary experiences of 1965 through 1993 for each of the economies and suggest that the impulse measure usefully characterizes monetary policy behavior and its consequences over those years.

To assess the impulse measure relative to other widely used monetary indicators, an additional set of figures for each country presents the impulse measure together with time series on consumer price inflation, the yield curve slope, and growth in a broad monetary aggregate. The impulse measure tracks inflation much more consistently over time than does the yield curve slope indicator, although changes in the yield curve slope have served in some periods as a signal of a change in monetary stance. The proposed impulse measure performs at least as well as the broad money growth measure in almost all countries, and in several cases the impulse measure signals future inflation more closely and more consistently over time.



## I. Introduction

For a number of years, the biannual issues of the *World Economic Outlook* have regularly featured a measure of "fiscal impulse" for each of the G-7 economies in the discussion of conditions and prospects of the industrial countries. Although it has recently been given less emphasis, as attention has shifted to the concepts of structural and cyclical fiscal balances, the fiscal impulse measure continues to be reported. In contrast, there has been no presentation of a comparable common or standardized measure of monetary impulse for all G-7 countries. Since monetary policy is unquestionably a crucial influence on the success or failure of macroeconomic policies, it would seem that some additional attempt at systematization could be useful, and could provide a complement to the ranges of monetary indicators relied upon by individual monetary authorities and in the *World Economic Outlook* analysis itself. Consequently, the present paper is devoted to the development and investigation of one potential measure of monetary policy stance.

Organizationally, the paper proceeds as follows. First, the design and rationale of the proposed monetary impulse measure are discussed in Section II. Values of the proposed measure for the past 25 years are presented in Section III. These annual values illustrate the construction of the measure and provide the basis for an evaluation, presented in Section IV, of its historical reliability. Next, values of the measure based on quarterly observations are reported in Section V, and some brief comparisons with other potential impulse measures are provided. Concluding remarks are presented in Section VI. Information concerning monetary base data is included as an Appendix.

## II. Design and Rationale

In designing our proposed measure of monetary impulse, we have been guided significantly by two main criteria. The first of these is that the measure should clearly reflect the medium-term inflationary implications of the current stance of monetary policy, while the second is that the measure should pertain to actions taken by the central bank itself--indeed, should pertain primarily to a variable over which the central bank could exert accurate control, if it chose to do so. The first of these criteria suggests some aggregate spending variable such as the growth rate of nominal GDP, with other possibilities provided by the growth rate of nominal domestic demand, final sales, or personal income, for example. <sup>1/</sup> The second criterion, by contrast, points toward a measure such as the growth rate of the (adjusted) monetary base. Other controllable reserve aggregates could be considered instead, but the monetary base has the desirable property of reflecting the effect of open market purchases on both reserves

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<sup>1/</sup> Whether the aggregate spending measure should pertain to asset exchanges as well as production (or consumption) flows is an issue, raised by Hargraves and Schinasi (1993), that will be reserved for a future study.

and currency. Thus, if adjusted for changes in reserve requirements, the base provides a reasonably comprehensive summary measure of the actions of the central bank. 1/ Short-term nominal interest rates are also controllable, of course, and are emphasized by central banks but are less satisfactory indicators of monetary policy actions for reasons that will be discussed below.

Together, our two main criteria can be reasonably well satisfied by our proposed measure of monetary impulse, which is defined as the growth rate of the (adjusted) monetary base plus the expected medium-term growth rate of base velocity. This expected rate will provisionally be represented in this study by the actual change in base velocity over the most recent four years. 2/ To be specific, let DLX and DLB denote growth rates (i.e., changes in the logs) of nominal GDP and the monetary base, respectively. Then the growth rate of velocity over a single period--either a quarter or a year--will be  $DLV = DLX - DLB$ . Its average over the past four years will then be  $DLVBAR = (1/N)(DLV + DLV(-1)) + \dots + DLV(-N+1))$ , where N equals 16 or 4 depending on the time interval adopted.

With quarterly data, then, the impulse measure to be studied below is

$$IM1 = DLB + DLVBAR(-1), \quad (1)$$

where DLVBAR is lagged one quarter so as to reflect data available to the central bank when setting DLB. When using annual data, however, we have chosen to represent the impulse measure as

$$IM = DLB + DLVBAR, \quad (2)$$

with no time lag for the average velocity term. This choice represents a compromise in terms of our controllability criterion, but to impose a full-year lag would seem to be excessively conservative.

In the sections that follow, values of the impulse measures in (1) and (2) will be reported for each of the G-7 economies. Since the measures are GDP-velocity-adjusted rates of base growth, they represent nominal growth rates of GDP that are implied--on average, from a medium-term perspective--by current monetary policy actions. Consequently, they are appropriately compared with "target" paths of nominal GDP growth that would be consistent with low inflation rates (i.e., approximate price stability) in terms of GDP deflators. For presentational purposes, we have adopted 2 percent per year as the common inflation target and will treat 1 percent

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1/ That actual central banks, at least in the G-7 countries, do not use the base as a control instrument is well known and will be discussed below.

2/ Other approaches could be explored, such as extracting the "permanent" component of the velocity series by means of time-series decomposition methods.

to 3 percent as the range of low inflation. 1/ Average growth rates of real output must be accounted for, of course. Accordingly, the figures that present the impulse measures include low inflation bands that represent the relevant economy's estimated long-run growth rate of real GDP plus 1 percent to 3 percent. For several economies the estimate of long-run real growth is 3 percent, so in those cases the low inflation bands extend from 4 percent to 6 percent. 2/

It is important to recognize that our impulse measure builds upon growth rates of the monetary base for the reasons mentioned above, not because of a belief that the base (or any other monetary aggregate) has any mystical properties. It should also be noted that the case for this measure does not rely upon any presumption that technological and regulatory change in the payments and financial industries will be insignificant. Indeed, the purpose of the DLVBAR term is in large part to account for precisely such changes, which have been important over recent decades in several nations and which may, we suspect, be important in the future.

We are, as was mentioned above, well aware that the monetary base is not currently used as an instrument or intermediate target variable in any of the nations under study--although a variant (termed central bank money) served as a target in Germany prior to 1987. That fact does not negate our reasons for focusing upon the base, however: that it could be accurately controlled 3/ and that it represents a reasonably comprehensive measure of the impact of central bank actions (however governed) on aggregate demand. The precision that is lost by not using a measure that reflects more specifically individual nations' policy mechanisms is outweighed, we believe, by the advantages of using one that can be calculated in the same way for different countries and that can be used to study long periods of monetary history.

We are also well aware that the base is in many countries largely composed of currency, and that currency is demand determined in the sense that demand deposits can be redeemed for currency at the wish of the deposit holder. But that does not imply that the base could not be controlled by

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1/ Actual inflation targets and monetary policy objectives vary among the major industrial countries, but 2 percent inflation per year may be considered roughly consistent with price stability. See International Monetary Fund (1993).

2/ Our estimates of long-run real growth rate are not intended to be refined measures. They are simply averages of realized rates over 1961-92, rounded to the nearest 1/2 percent (annual basis). The values obtained in this manner are 3 percent except for Japan (4 percent for 1972-92), Canada (4 percent), and the United Kingdom (2 percent). It would be straightforward to adopt more sophisticated estimates of potential output growth.

3/ As a sum of liability items on the central bank's own balance sheet, the base could be monitored daily--or even more frequently--and adjusted by open-market operations whenever observations depart from desired values.

the central bank or that manipulation of the base (rather than reserves alone) would not be more effective for influencing total spending. Somewhat more troublesome is the likelihood that a large fraction of recent currency issues in the United States and Germany has gone abroad. In that regard, it should be kept in mind that such movements will eventually be reflected in our velocity growth term DLVBAR. For the first year or two after a major change, however, the impulse measures (1) and (2) will reflect its effects only partially and will accordingly yield signals that are somewhat distorted.

A few words should be added concerning more traditional monetary indicators such as growth rates of M1 or M2 and interest rates. With regard to the usual growth rate measures, our contention is that they fare poorly in terms of both of our adopted criteria. Aggregates of the M1 and M2 variety cannot be controlled with a high degree of accuracy, in comparison with the monetary base, and the growth rate of M1 or M2 that is necessary to yield a target inflation rate (on average over a decade or two) is much more uncertain than the necessary growth rate for nominal GDP. 1/ One could of course add predicted velocity growth to an M1 or M2 measure, as (1) and (2) do for the base. But this would still fail to produce a variable that is accurately controllable by the central bank.

With regard to interest rates, the most basic point is that the level of any short-term nominal interest rate is an ambiguous indicator of monetary policy stance. Specifically, high interest rates are associated with tight monetary policy from a short-term perspective but with easy monetary policy from a longer-term point of view. This implies that the interest rate effects of a monetary tightening--e.g., an open market sale of securities--are in opposite directions from the short-term and long-term perspectives. Moreover, whether a particular level of interest rates corresponds to a "tight" or "easy" monetary stance depends on economic conditions at the time. These would seem to be extremely undesirable features for a monetary indicator.

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1/ Much has been made recently of the "stability" of M2 velocity in the United States over the past 30 years. But this phenomenon--more accurately described as the absence of any upward or downward drift--most emphatically did not prevail prior to 1960; see Friedman and Schwartz (1963, p. 640). Reasons for the change in behavior are not known so we are dubious regarding explicit or implicit predictions of future drift-free behavior.

It is conceivable that other variables involving interest rates--changes or spreads, for example--could be found that would perform more satisfactorily. 1/ A preliminary examination of the performance of one interest spread measure is reported below in Section VI. A more extensive consideration of other measures is a possible topic for future research.

### III. Annual Measures

The purpose of this section is to calculate and present annual values of the impulse measure IM, defined in equation (2), for the G-7 economies. 2/ In a fundamental sense only two basic variables are utilized--nominal GDP and the adjusted monetary base. Indeed, that is one attractive feature of our proposed measure. Regarding the nominal GDP series little needs to be said for most countries except that our basic source of data is quarterly (seasonally adjusted) observations; for annual series the quarterly observations are averaged. Natural logarithms of these averages are calculated and first differenced to yield growth rates (denoted DLX).

One economy for which more needs to be said is Germany, with the difficulty arising from the east-west reunification of 1990. Our procedure for handling that event is determined in large measure by data availability. Specifically, the monetary statistics are those of the Bundesbank, and pertain to west Germany before July 1, 1990, and to unified Germany thereafter. Official quarterly GDP figures since 1990 are available, unfortunately, only for west Germany. (Annual GDP figures are available, however, for west and east Germany separately.) An IMF staff estimate of quarterly GDP for unified Germany has been used for 1990-93.

For the monetary base series a bit more discussion is needed. As mentioned above, it is important to have a measure of the base--currency held by banks and the private nonbank sector plus banks' reserves at the

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1/ Recent papers on the information content of the term structure spread, or the spread between short-term rates on private and government securities, have explored their predictive value for aggregate variables. One of the explanations offered for the information content of these spreads is that they reflect the current stance of monetary policy. Some of these studies stress, however, that it is the real effects of monetary policy, not the effects on prices, that is relevant. See, for example, Estrella and Hardouvelis (1991). To the extent that the information content does derive from monetary policy however, the choice between such interest rate spreads and the monetary impulse measure is in part an empirical one, and some assessments are made in Section VI.

2/ Data underlying the measures are available from the authors.

central bank--that is adjusted for reserve requirement changes. 1/ For four of our seven nations, such series were obtained from national statistics. 2/ For Japan, Germany, and France, however, we could locate no such series and were therefore forced to make our own adjustments. The basic idea of our procedure is as follows. Suppose that there were only one type of bank deposit subject to reserve requirements and these were governed by a single flat-rate requirement ratio--e.g., 10 percent of deposits. Then the magnitude of deposits would be approximately equal to the ratio of the volume of reserves (R) to the reserve requirement ratio (rr). Consequently, an appropriate measure of adjusted reserves would be R multiplied by the factor  $rr^0/rr$ , where  $rr^0$  is the value of rr at some reference date. In practice, more than one type of deposit is subject to requirements in these countries, and in Japan and Germany the rr values depend on bank size. 3/ But we have proceeded as if these complications did not exist by using the rr values pertaining to demand deposits at the largest banks. 4/ In the case of France, the calculation was nevertheless more complicated than just described because of zero or very low rr values over parts of the sample. For details, the reader is referred to the Appendix.

Once adjusted reserve series had been obtained, they were added to currency magnitudes to yield an adjusted base series. Then these (quarterly) series were seasonally adjusted. 5/ Finally, averages of the quarterly values--which are used below in Section V--were calculated to yield the annual data used in the present section. Logarithmic differences, denoted DLB, are used as growth rates.

It is a straightforward step to calculate series for  $DLV - DLX - DLB$ , the rate of change of base velocity, and  $DLVBAR = (1/4) (DLV + DLV(-1) + DLV(-2) + DLV(-3))$ . The annual impulse measure  $IM = DLB + DLVBAR$  is then

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1/ The importance of adjusting for reserve requirements can be illustrated by the case of France in 1975. The *International Financial Statistics* "Reserve Money" series fell from FF 152.3 billion at the end of 1974 to FF 119.4 billion at the end of 1975, which might appear to be a contraction of epic proportions. Over the same time, however, the ratio of required reserves on sight deposits fell from 17 to 2 percent. With initial required reserves in excess of FF 50 billion, roughly FF 44 billion were freed by the reduction in the required ratio. So the overall effect was not strongly contractionary.

2/ In the case of the United Kingdom the series is not adjusted, but reserve requirements are low enough to be nonbinding.

3/ In Germany, reserve requirements on demand deposits varied according to bank size until March 1977, after which they varied on a "progressive scale" based on the first DM 10 million of a bank's deposits, the next DM 10-100 million, etc.

4/ For Japan the reference value of  $rr^0$  chosen was the 2.5 percent rate that prevailed without change from April 1981 until October 1991. For Germany, the reference value was the 12.1 percent rate that prevailed from February 1987 to February 1992.

5/ Seasonal adjustment was also required for the Italian series.

readily obtained. With observations on GDP and the monetary base beginning in 1960 in our data set, the earliest year for which DLVBAR and IM values are available is 1964. For some nations, one or both of the basic series begins after 1960, so the starting date for the IM values is correspondingly delayed. The figures that follow in Section IV present values of the IM measure for each economy together with a pair of dashed horizontal lines marking the upper and lower limits of the low inflation band described earlier. For reference, the figures also present data on the growth of the adjusted monetary base alone (DLB), corresponding to the impulse measure without the velocity adjustment component.

The interpretation of the IM values and low inflation bands in the figures is as follows. When the IM magnitude is above (below) the band, current monetary policy as reflected in base growth rates is too rapid (slow) to be consistent on a sustained basis with low inflation. In that sense, the impulse measure suggests that monetary policy is overly expansionary (restrictive) in the case at hand. The emphasized qualification is important, however, because real-time decision making must recognize the existence of substantial time lags in the inflationary process. In addition, there may be other policy goals besides the attainment of low inflation. Consequently, a value of IM above the low inflation band does not necessarily imply that policy should be tighter from the perspective of that moment in time.

#### IV. Evaluation of Annual Measures

In this section the agenda is to discuss the interpretations of monetary policy over the years 1965-93 that are suggested by the annual impulse measure plots appearing in Figures 1-7. A leading purpose of the discussion is to consider whether the measure has accurately signalled episodes that are now generally regarded to have featured monetary policy stances that were inappropriate--either excessively lenient or stringent--from a medium-term perspective.

Before focusing on IM plots for individual economies, accordingly, it will be useful to emphasize that the impulse measures indicate that monetary policy was extremely lenient for a period of several years in the early 1970s in all seven nations. In each of Figures 1-7, that is, the IM measure remained substantially above the low inflation band for three or more years during the interval 1970-75. In most of the plots, furthermore, this period of leniency extended until 1979 or beyond. But the plots for two nations, Japan and Germany, stand out by indicating a distinctly earlier movement toward the low-inflation range around 1974 or 1975. Thus, taken as a group, the figures very clearly suggest the existence of a widespread inflationary stance in the early 1970s that was eliminated during the 1980s by most countries but which ended much earlier in Japan and Germany. That general feature of the charts corresponds quite accurately, we would argue, with views concerning the 1970s and 1980s that are very widely accepted today. We consider this feature to be quite important. To some readers it might not seem to represent a major achievement, but it is our conjecture that

most alternative measures of monetary policy stance would fail to satisfy this basic criterion. Plots of long- and short-term interest rate spreads, for instance, do not show a contrast between the 1970s and 1980s and do not indicate markedly different policy patterns for Japan and Germany in comparison with the other G-7 economies. This is demonstrated below in Section VI.

We turn now to the individual country charts, beginning with the United States in Figure 1. Here the IM plot shows a gradually increasing movement in the inflationary direction before 1980, a tendency that shows up even more strongly in Figure 8 (which begins with 1954 rather than 1964). A sharp drop in the IM measure occurs between 1979 and 1982 and another one between 1987 and 1989. The first of these drops represents the major deflationary episode that began with the Federal Reserve's famous actions of October 6, 1979, and ended in the third quarter of 1982. The second drop pertains to a period of tightening that has not been so widely publicized, but which we believe was quite significant: an attempt by the Fed to reduce the "trend" rate of inflation from around 4.5 percent to something closer to 2 percent. Whether that attempt was partially responsible for the recession of 1990-91 is debatable, but Figure 1 would certainly provide support to anyone inclined to make such an argument. 1/ The sharp upward movement of IM over 1990 and 1991 is probably overstated to some extent, because of an increase in the fraction of currency outstanding that is held abroad. 2/ Changes such as these will eventually be reflected in the IM measure, as we have pointed out above, but not promptly.

To clarify the contribution of the DLVBAR term in the impulse measure, Figures 1-7 include plots of the growth of the adjusted base alone, that is, just the first component of the impulse measure. In Figure 1, the importance of the velocity adjustment is apparent in the sustained difference between the two series from 1971 through 1981 and in the trend movement of DLB from below to above the impulse measure. Base growth during this ten-year period is not much different from its average in the following six years, and yet, as later discussion will make clear, U.S. inflation performance did differ during these two periods, and the impulse measure captures the change in inflationary pressures much more closely.

Figure 2 plots the monetary impulse measure for Japan, with the first value pertaining to 1967 because of the absence of monetary base data for 1960-62. The low inflation band limits are not shown before 1972 because average real growth was considerably higher than 4 percent during the 1960s. The Japanese record is dominated by a major tightening of monetary policy over the years 1973-81, with a relatively brief interruption during 1977-79.

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1/ Inflation did indeed fall beginning in 1990, but not all the way to 2 percent.

2/ In addition, during much of 1992 and 1993 mortgage refinancing activity contributed greatly to faster M1 and reserve growth in the United States because some mortgage funds were mandated to hold demand deposits for a period following the prepayment of mortgages.

Figure 1. United States: Monetary Impulse Measure, Monetary Base Growth, and Low Inflation Band

(In percent)

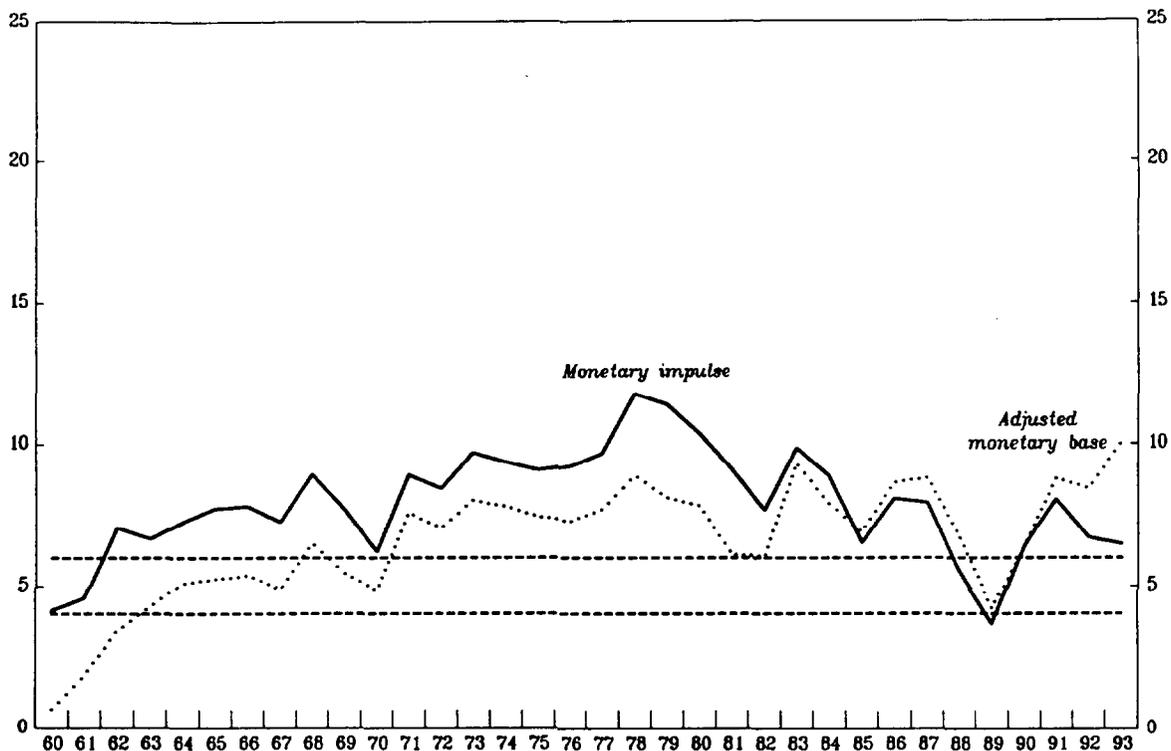
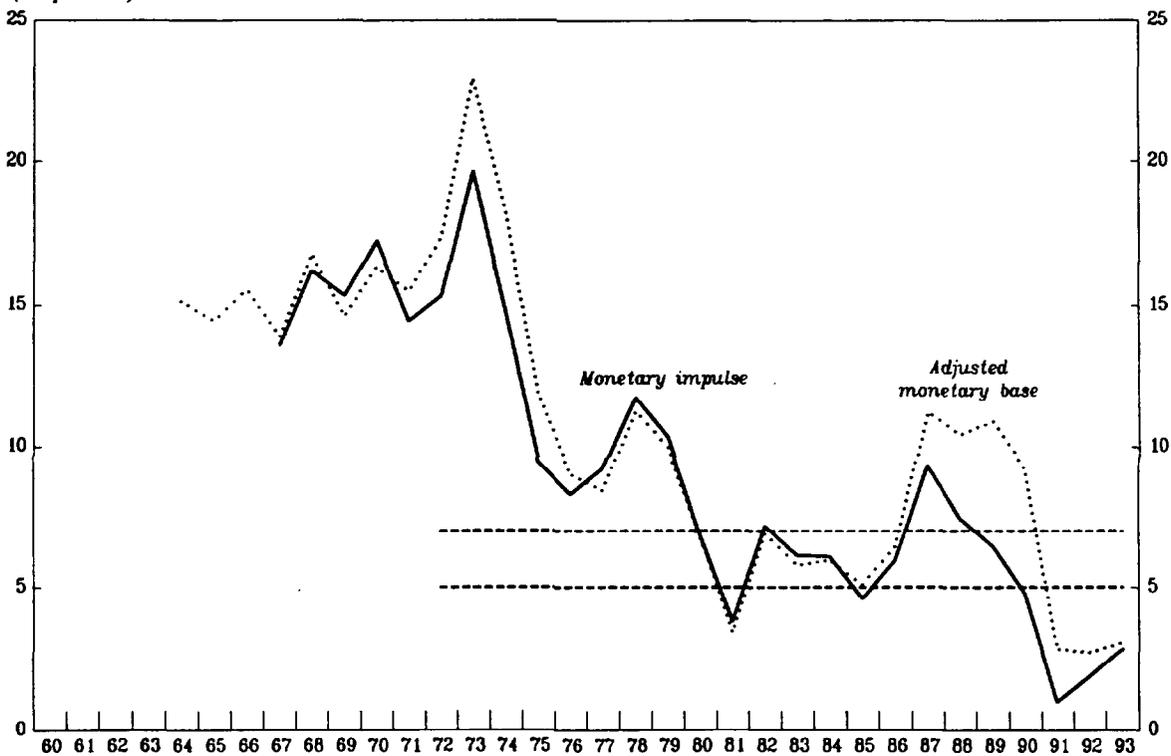


Figure 2. Japan: Monetary Impulse Measure, Monetary Base Growth, and Low Inflation Band

(In percent)



Note: The low inflation band for Japan is presented only from 1972 onward, because average real growth in Japan was significantly higher during the 1960s than in the following decades.

Figure 3. Germany: Monetary Impulse Measure, Monetary Base Growth, and Low Inflation Band

(In percent)

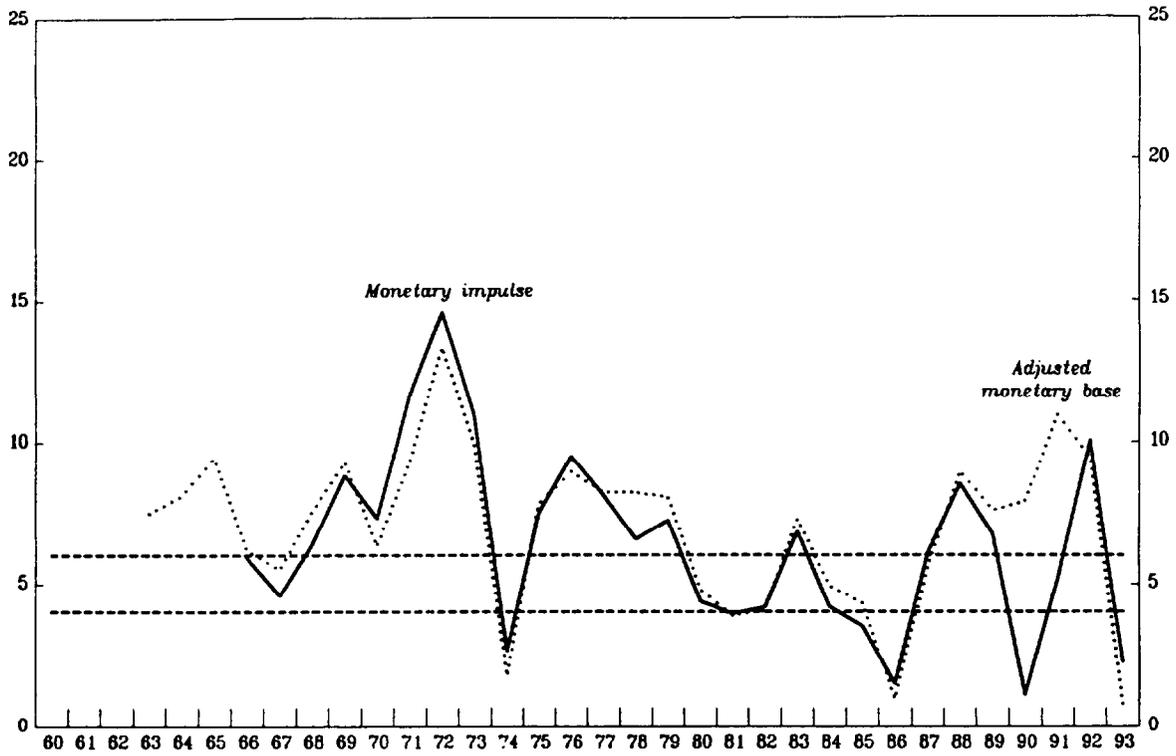


Figure 4. France: Monetary Impulse Measure, Monetary Base Growth, and Low Inflation Band

(In percent)

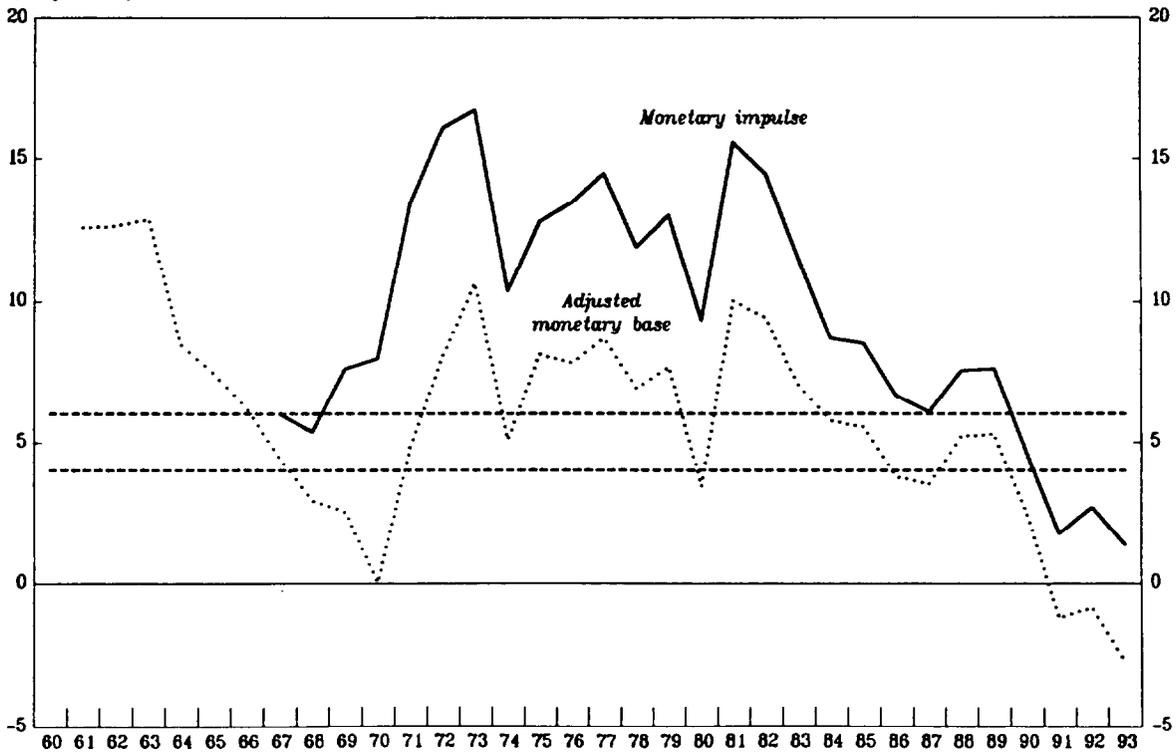


Figure 5. Italy: Monetary Impulse Measure, Monetary Base Growth, and Low Inflation Band

(In percent)

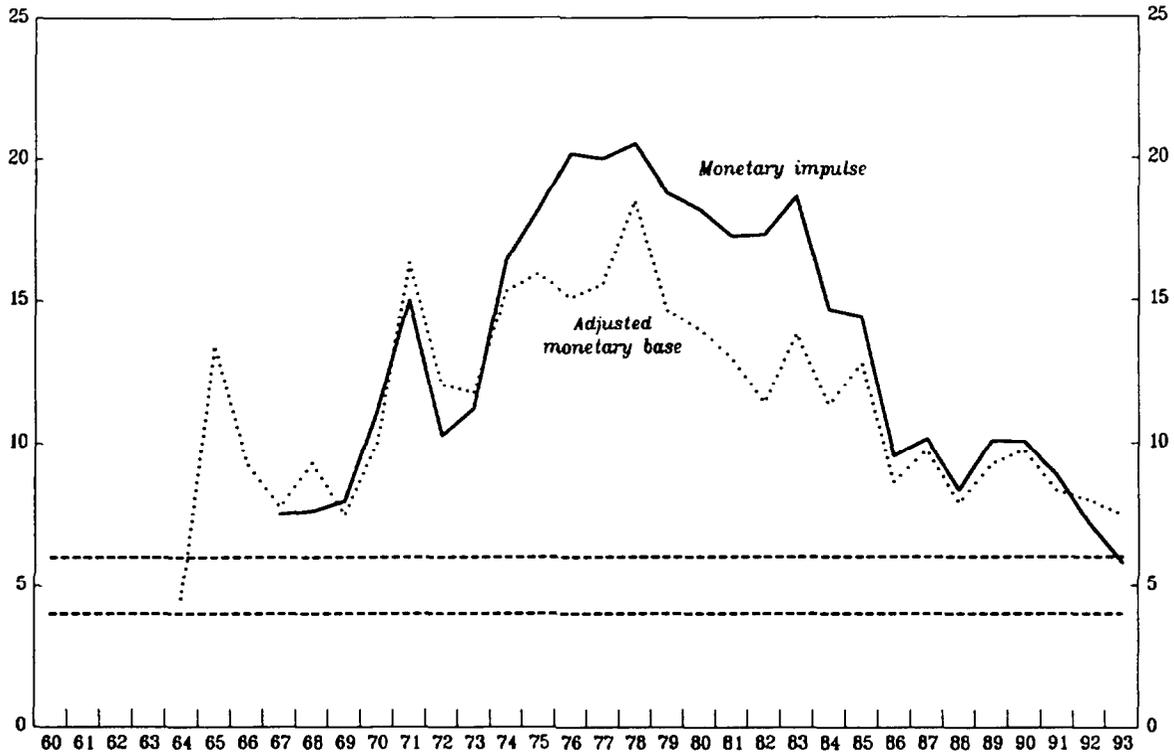


Figure 6. United Kingdom: Monetary Impulse Measure, Monetary Base Growth, and Low Inflation Band

(In percent)

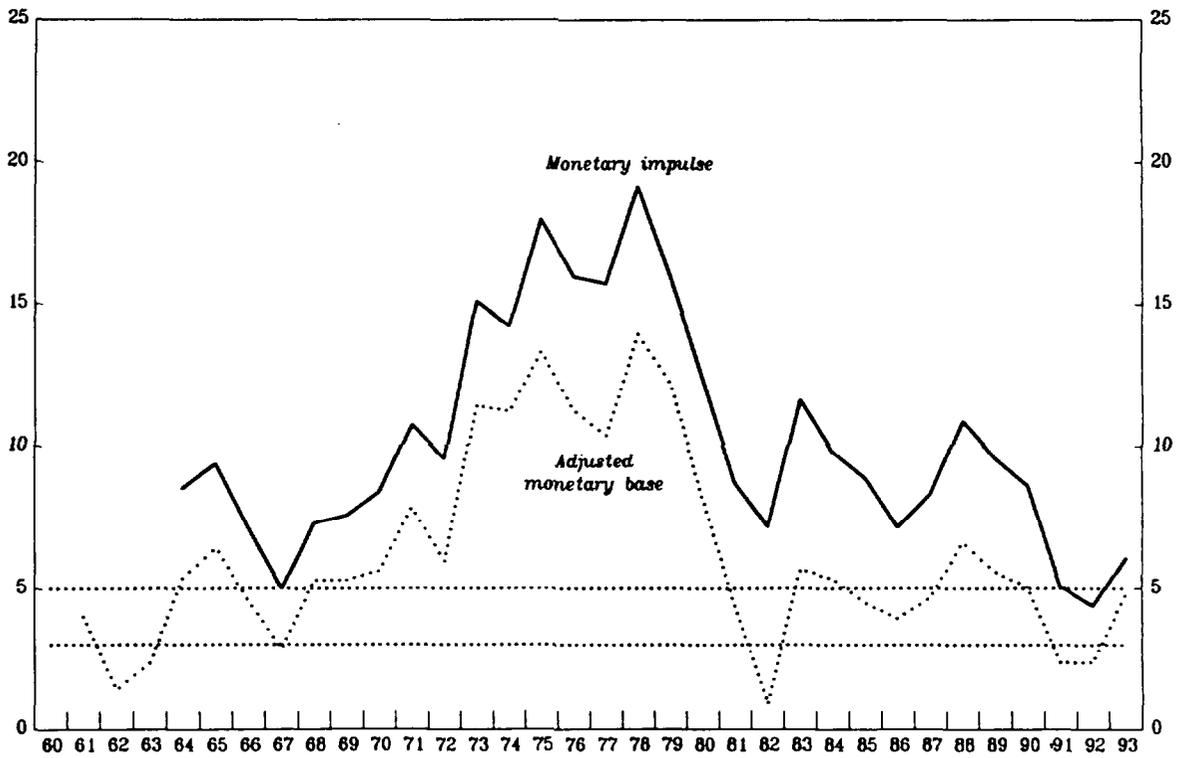


Figure 7. Canada: Monetary Impulse Measure, Monetary Base Growth, and Low Inflation Band

(In percent)

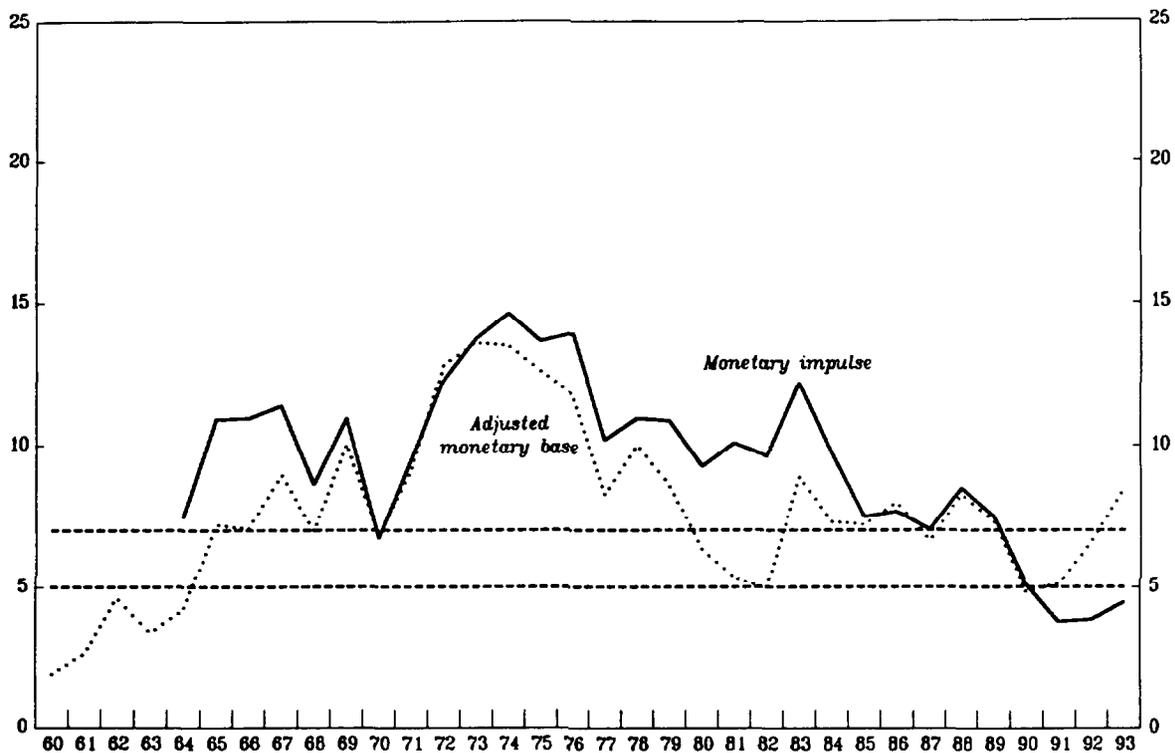
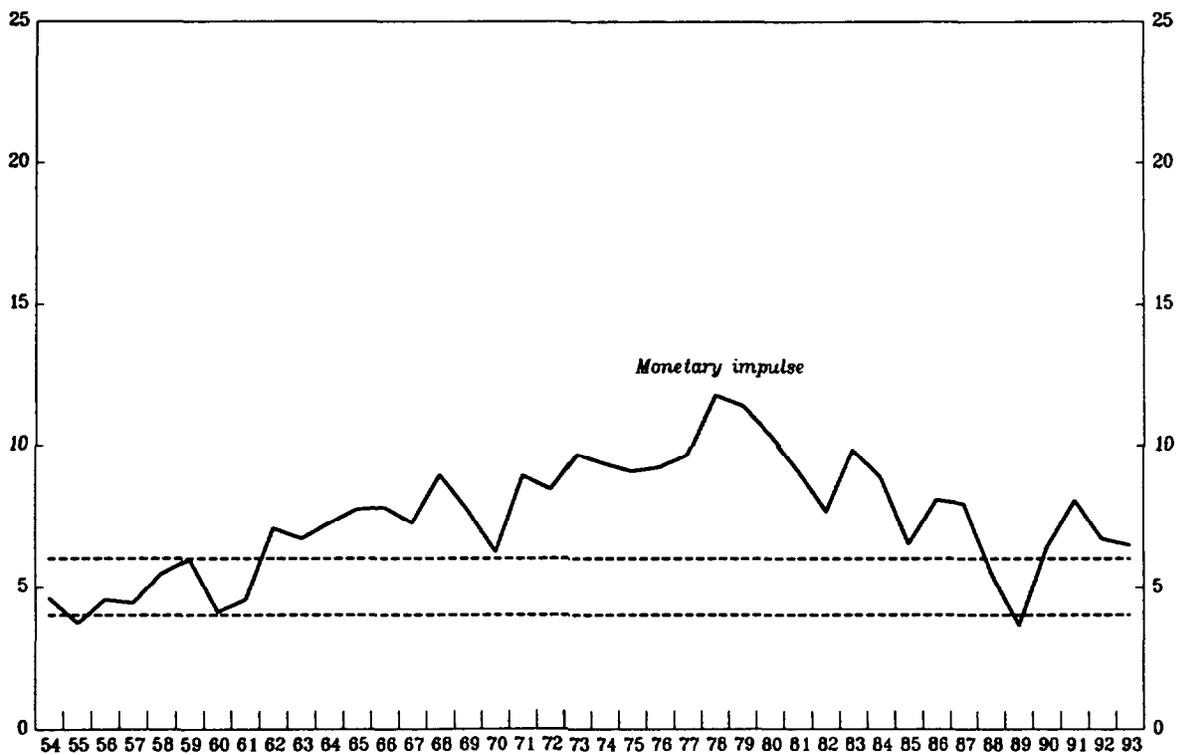


Figure 8. United States: Monetary Impulse Measure, 1954-93

(In percent)



Since 1975 the IM measure has stayed fairly close to the low inflation band, a pattern that is entirely consistent with the excellent record actually compiled in terms of realized inflation. The IM measure moves from below the band in 1985 to above it in 1987, however, thereby representing a tendency toward more lenient monetary conditions. This shift probably reflects actions, prompted by the Louvre Accord and the U.S.-Japan bilateral agreement of October 1986, designed to prevent major changes in the yen-dollar exchange rate. 1/ The ensuing period of easier monetary conditions may have contributed to the asset price "bubble" of the late 1980s. 2/ Quite notable in the chart is the degree of monetary stringency indicated for 1991 and 1992. The slight easing of monetary conditions evident in 1993--to a point still well below the low-inflation range--captures the Bank of Japan's response to the prolonged recession.

Figure 3 pertains to Germany. The proximity of IM to the low-inflation band over 1974-89 has already been mentioned. The Bundesbank's sharp tightening during 1973 and 1974 occurred after a five-year buildup of inflationary tendencies had threatened, during the final years of the Bretton Woods regime, to get out of hand. The other prominent feature of this plot is its suggestion of unusually tight monetary policy in 1990 and distinctly loose policy in 1992-93. 3/ With regard to these values it is important to consider an adjustment to the impulse measure that was necessitated by the major event of recent German experience, the unification of mid-1990. To understand our adjustment, consider the two components of the impulse measure in turn. In principle, unification might be expected to have had some impact on measured velocity, both because of possible differences in money demand relationships in the former east and west Germany, and possibly in reaction to unification itself or to the associated uncertainty. As such, DLVBAR would have been affected and adjustments would be needed. Estimates of such effects are, however, very difficult to make. We have adjusted instead just for the effects of unification on the other component of the impulse measure, the base growth term. The monetary base

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1/ The 1986 episode is mentioned by Fischer (1988, p. 33).

2/ Between 1986 and their peak in 1989, stock prices in Japan more than quadrupled, while goods price inflation as reflected in the CPI or GDP deflator remained below 2 percent per year. It is noteworthy in Figure 2 that the velocity adjustment term in 1987-90 is relatively large and negative, possibly reflecting in part the shift in the pattern of transactions during this period away from the flow of goods and services and toward assets whose sales are not included in GDP. For a discussion of the role of monetary policy in the asset price inflation in Japan--and, to a lesser extent, in the United States and United Kingdom--see Hargraves and Schinasi (1993).

3/ The sharp decline in the IM measure in 1986 is an artifact of our reserve adjustment procedure. In May 1986, reserve requirements on time and saving deposits were reduced substantially, leading to a considerable reduction in reserve demand. However reserve requirements on demand deposits were not changed at the time, so the reserve adjustment procedure described earlier does not capture this change.

expanded very rapidly during 1990 and 1991 to accommodate the jump in the size of the German economy represented by the unification. The appropriate adjustment would be to subtract from the unadjusted impulse measure a magnitude equal to the fractional increase in the size of the economy brought about by unification. But the appropriate distribution over time of this adjustment is not obvious and the exact magnitude is itself open to question. The adjustment that we have implemented, which is reflected in Figure 3, involves a subtraction of terms summing to 0.12 from the raw IM measure. 1/ Our distribution of this magnitude over years was to assign half to 1990 and half to 1991. 2/

From the foregoing discussion it should be apparent that we can not be confident about the accuracy of our adjustments and are therefore somewhat uncomfortable with Figure 3's suggestion that monetary policy was quite tight in 1990, about right in 1991, and rather loose in 1992. Those indications could be altered significantly by a different adjustment magnitude pertaining to unification or a different distribution over time. An additional problem, as mentioned previously, is the increased use of deutsche mark currency outside Germany.

The French IM values in Figure 4 show a beginning of the usual movement over 1974-80 away from the inflationary stance of the early 1970s, and then a sharp jump upward in 1981 and 1982, clearly representing the so-called "Mitterrand Experiment". Since that time, however, the impulse measure has moved toward and finally through the low-inflation zone, with values for 1991-93 that represent a policy stance that is quite tight. The contribution of the velocity adjustment term is very apparent for much of the period of study, and particularly in the early 1970s and again in the early 1990s. Here again, the impulse measure corresponds more closely to subsequent inflation than does base growth by itself.

The Italian impulse measure in Figure 5 indicates a continuation of substantial monetary leniency until the mid-1980s. Since its peak value is quite high, the plot shows a substantially greater cumulative magnitude of excessive monetary impulse than for any of the other six countries. A sustained movement toward a low-inflation stance has dominated the record since the mid-1980s, however, despite a slight interruption in 1989-90.

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1/ The 0.12 magnitude exceeds the fraction of west German GDP represented by east Germany, but is smaller than the analogous fraction in terms of domestic demand.

2/ The 1990 values of the GDP and base variables are averages of quarterly values, and two quarters passed before unification, so even if the full impact occurred in 1990, the appropriate adjustment to the annual average growth rates is to assign half to 1990 and half to 1991.

The U.K. measure in Figure 6, by contrast, shows a sharp tightening as early as 1979-1982, but one that reached the low-inflation zone only in 1991. 1/ The upward surge in 1987-88 presumably reflects a monetary loosening that was the consequence of Chancellor Lawson's controversial device of "shadowing the deutsche mark" at a time that turned out, in retrospect, to have been inappropriate.

Finally, Figure 7 for Canada shows a predominantly downward path since 1974, with temporary upward blips in 1983 and 1988. The velocity adjustment term contributes to make this downward path less steep through 1982, indicating less disinflationary impulse than would have been indicated by base growth alone. The drive toward a "zero inflation" target, that began about a year after John Crow became Governor in 1987, appears visibly in the diagram. For 1992, the Canadian monetary policy stance appears to have been quite tight, but policy shifted toward a more neutral stance in 1993.

It should perhaps be mentioned explicitly that, with one exception, the range on the vertical axis is the same throughout Figures 1-8, rather than depending on the range of IM values experienced by the nation in question. This convention was chosen, despite a slight loss of detail for the countries with lower inflation peaks, in order to reveal more clearly the comparative performance of the various nations in terms of keeping their monetary policy close to a low-inflation range. The one exception is the case of France, for which the scale is the same but the range of values is different, in order to accommodate the very low values in the 1990s.

#### V. Quarterly Measures and Alternative Monetary Indicators

In this section we turn to impulse measures based on quarterly data. Quarterly values of the impulse measure IM1 defined in equation (1) are very choppy in appearance, so we have chosen instead to present plots of a smoothed series. 2/ This series, denoted IMLAVG, is a four-quarter moving average of IM1 defined as  $(1/4) (IM1 + IM1(-1) + IM1(-2) + IM1(-3))$ . 3/

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1/ During 1979-82 the monetary aggregate then being targeted, Sterling M3, grew very rapidly--well above its target range--thereby inappropriately signalling that monetary policy was loose. The instability of M3 velocity at that time was recognized and attributed to financial innovation and the removal in 1980 of the "corset" that had suppressed M3 growth.

2/ Regarding the unsmoothed quarterly IM1 measures that have not reported, it may be worth mentioning that their severe choppiness comes primarily from the DLB series, rather than from DLVBAR (which is already smoothed), and presumably reflects the fact that the various central banks have not regarded stability of base growth rates as a desideratum. An exception to this statement applies to Germany, where Central Bank Money was a target variable for a number of years.

3/ It should be noted that the IMLAVG measure is equivalent to one based on growth rates calculated for each quarter relative to the same quarter one year earlier.

Plots are presented in the top panels of Figures 9-15 in Section VI, with magnitudes scaled to represent annual growth rates comparable to those in Figures 1-8. 1/ The story told by the new figures is basically consistent with that of the plots utilizing annual data (Figures 1-8), but with details that are not identical because the two measures involve different timing.

A question that arises naturally in response to the foregoing presentation is whether there are other controllable variables that might be superior to our measure of monetary impulse--superior in terms of reflecting more accurately the medium-term inflationary implications of current monetary policy. Here we shall consider two such measures, namely, the spread or difference between long-term and short-term nominal interest rates, and growth in a broad monetary aggregate. Before looking at that series, however, it will be useful to consider time plots of the actual inflationary experiences of the countries in our sample. Our discussion in Section IV proceeded as if the general profile of these plots was firmly implanted in each reader's memory. That is possibly a false assumption, however.

Consequently, the second panels of Figures 9-15 show inflation rates in terms of consumer price indices for each of the countries in our sample. The figures are expressed in percent on an annualized basis, and reflect four-quarter changes (rather than year-to-year values based on annual averages of price level indexes).

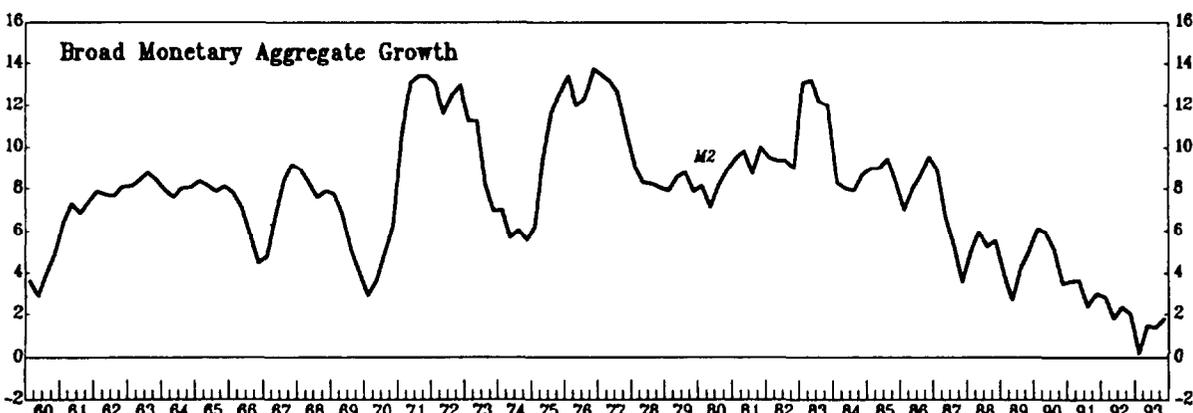
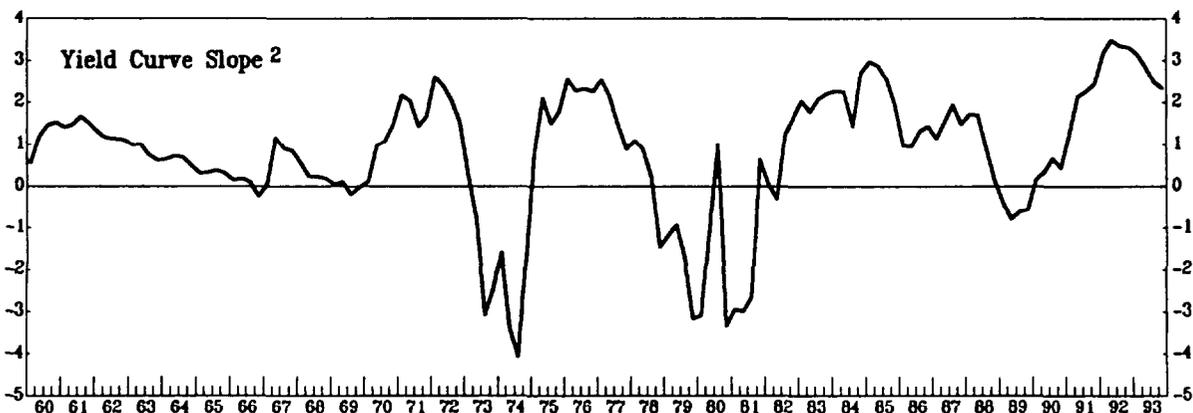
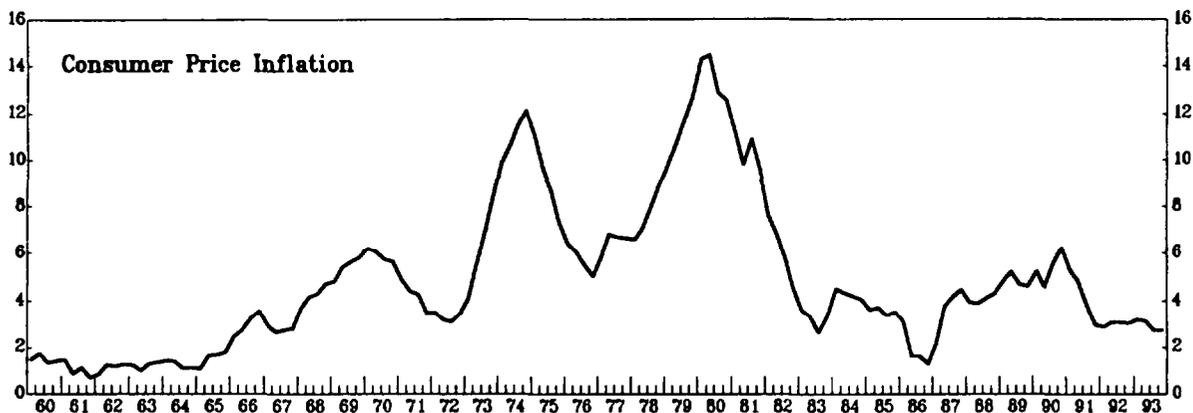
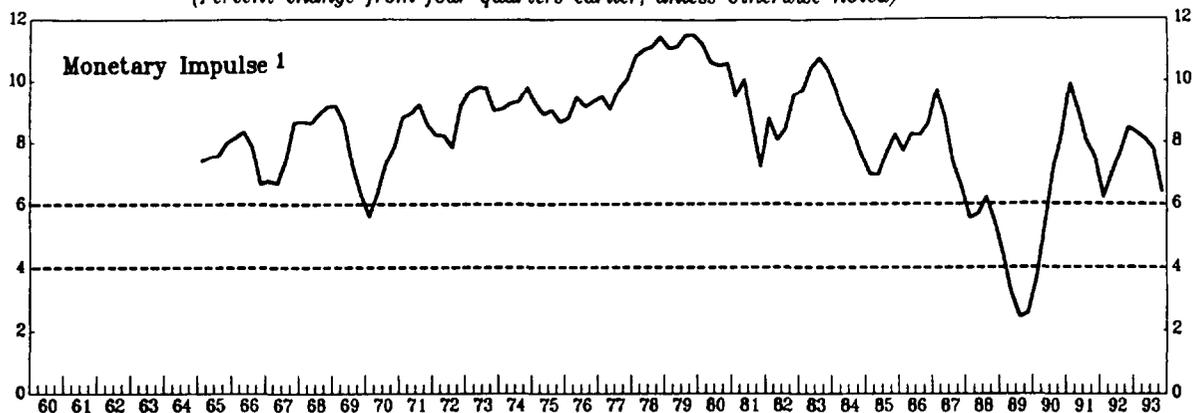
In these inflation plots there are several important aspects of the trajectories that match parallel movements in the monetary impulse plots in the top panels or in Figures 1-7. For the United States, to begin with, Figure 9 reveals a fairly regular upward trend persisting from 1960 until 1980, with dips around 1971-72 and 1975-76 that show up two years earlier for the IM measure. The sharp decline in inflation in 1981-83 also has a corresponding decline in the IM measure roughly two years earlier. Next, for Japan we see a period of very high inflation rates in the mid-1970s, followed by an abrupt decline and a low-inflation record subsequently (Figure 10). For Germany, the inflation rate has stayed reasonably low throughout most of the period but surged around 1972, corresponding to the 1969-73 buildup evident in the top panel of Figure 11 and in Figure 3. 2/ In France, by contrast, the inflation was more severe and despite a temporary slowdown in the late 1970s, inflation did not begin to fall steadily until after 1982 (Figure 12). The case of Italy is somewhat similar, but with even more severe inflation in the 1970s (Figure 13). In

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1/ The adjustment made for German unification in the quarterly data was to subtract 7 percent from the growth rate of the monetary base in 1990:3; 3 percent in 1990:4; and 2 percent in 1991:1. The caveats noted earlier in the discussion of the adjustment to the annual series apply here as well.

2/ The sharp increase in inflation in 1980-81 does not have a correspondingly large rise in the impulse measure in prior years. However, as the other panels in Figure 11 show, alternative measures of monetary conditions also do not seem to capture this episode.

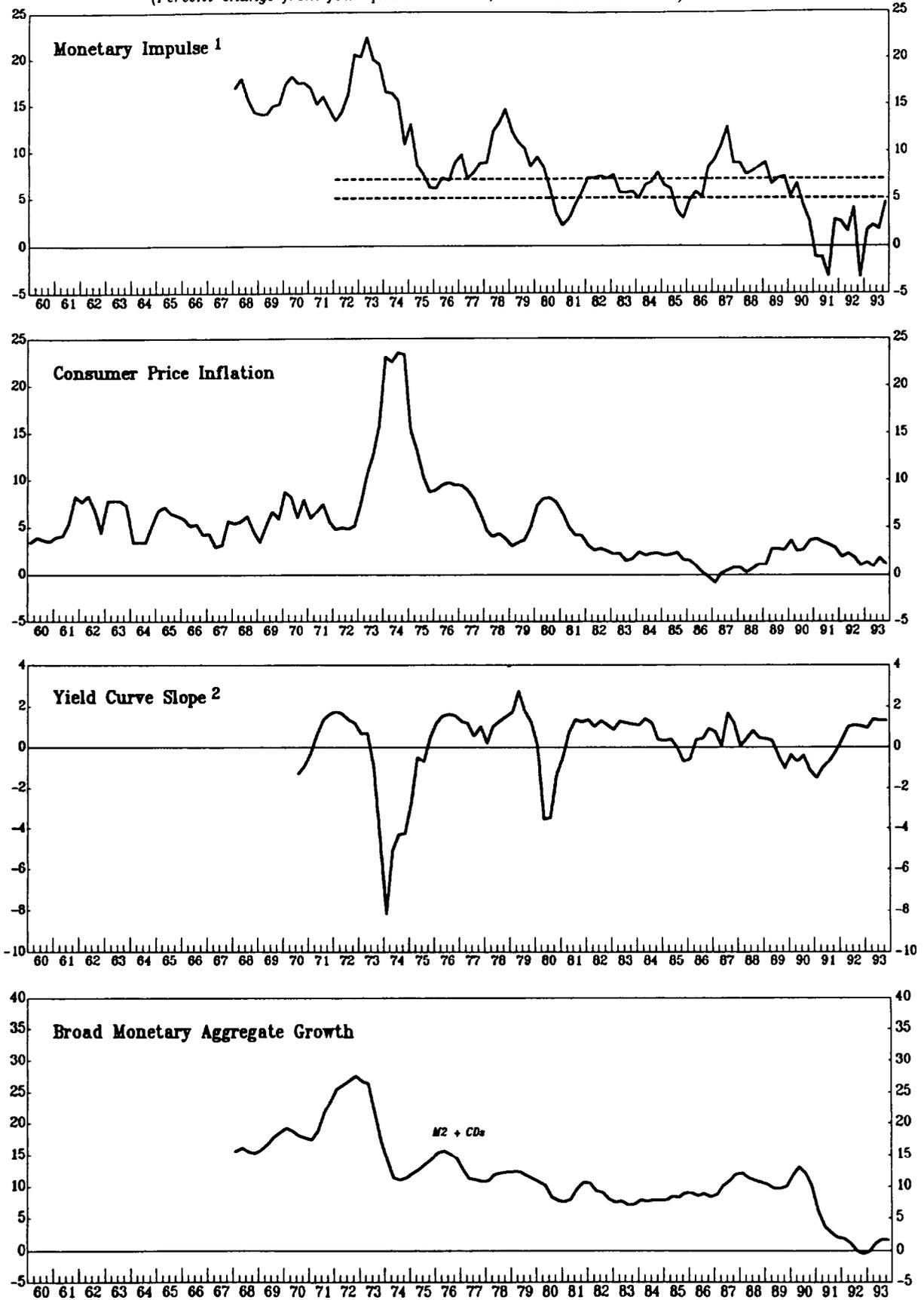
Figure 9: United States  
(Percent change from four quarters earlier, unless otherwise noted)



1 Four-quarter moving average of quarterly impulse measure.

2 Difference between ten-year government bond yield and three-month Treasury bill rate.

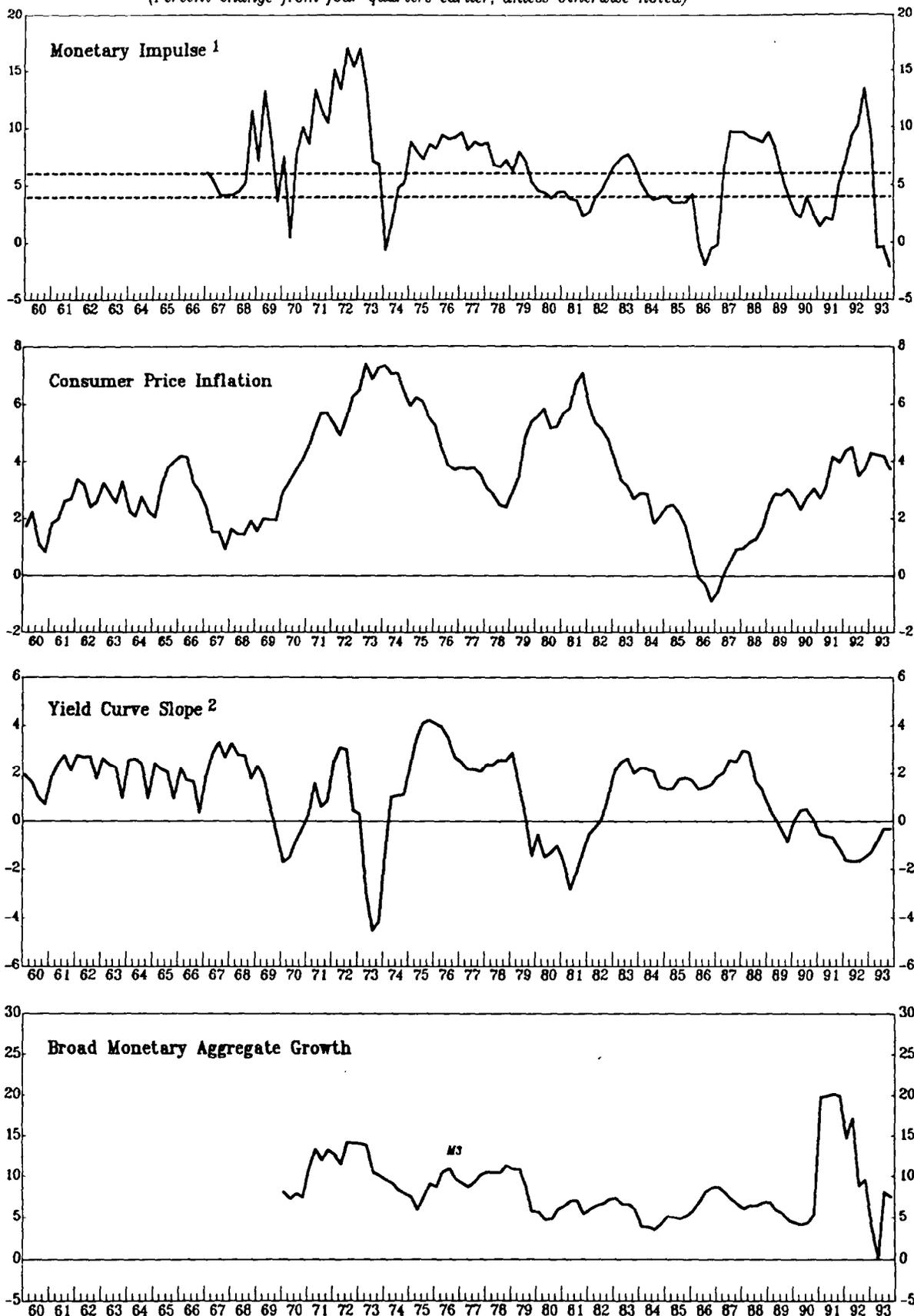
**Figure 10: Japan**  
(Percent change from four quarters earlier, unless otherwise noted)



1 Four-quarter moving average of quarterly impulse measure.

2 Difference between ten-year government bond yield and average three-month repurchase (Gensaki) rate.

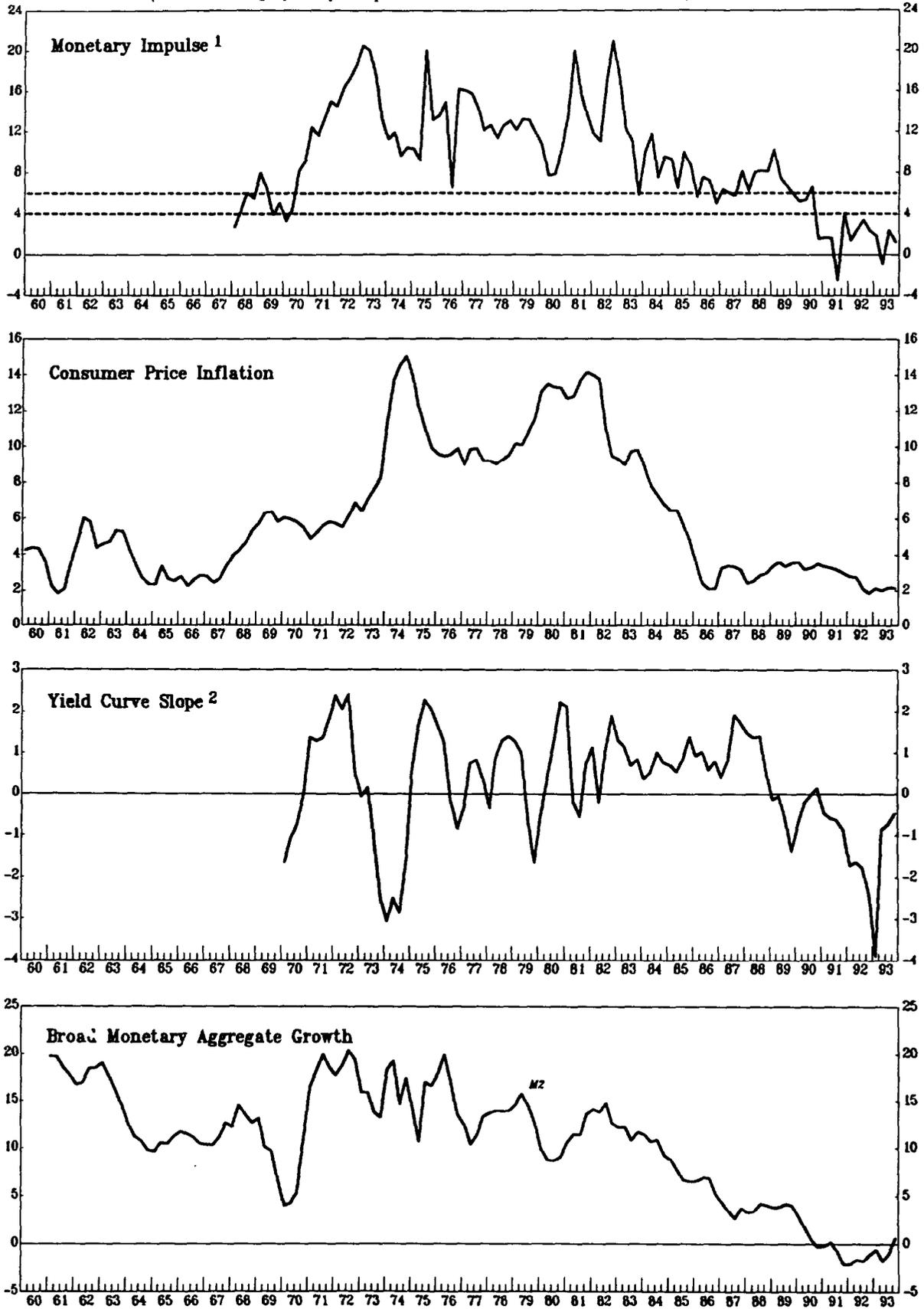
Figure 11: Germany  
(Percent change from four quarters earlier, unless otherwise noted)



1 Four-quarter moving average of quarterly impulse measure.  
2 Difference between ten-year government bond yield and three-month interbank rate.

Figure 12: France

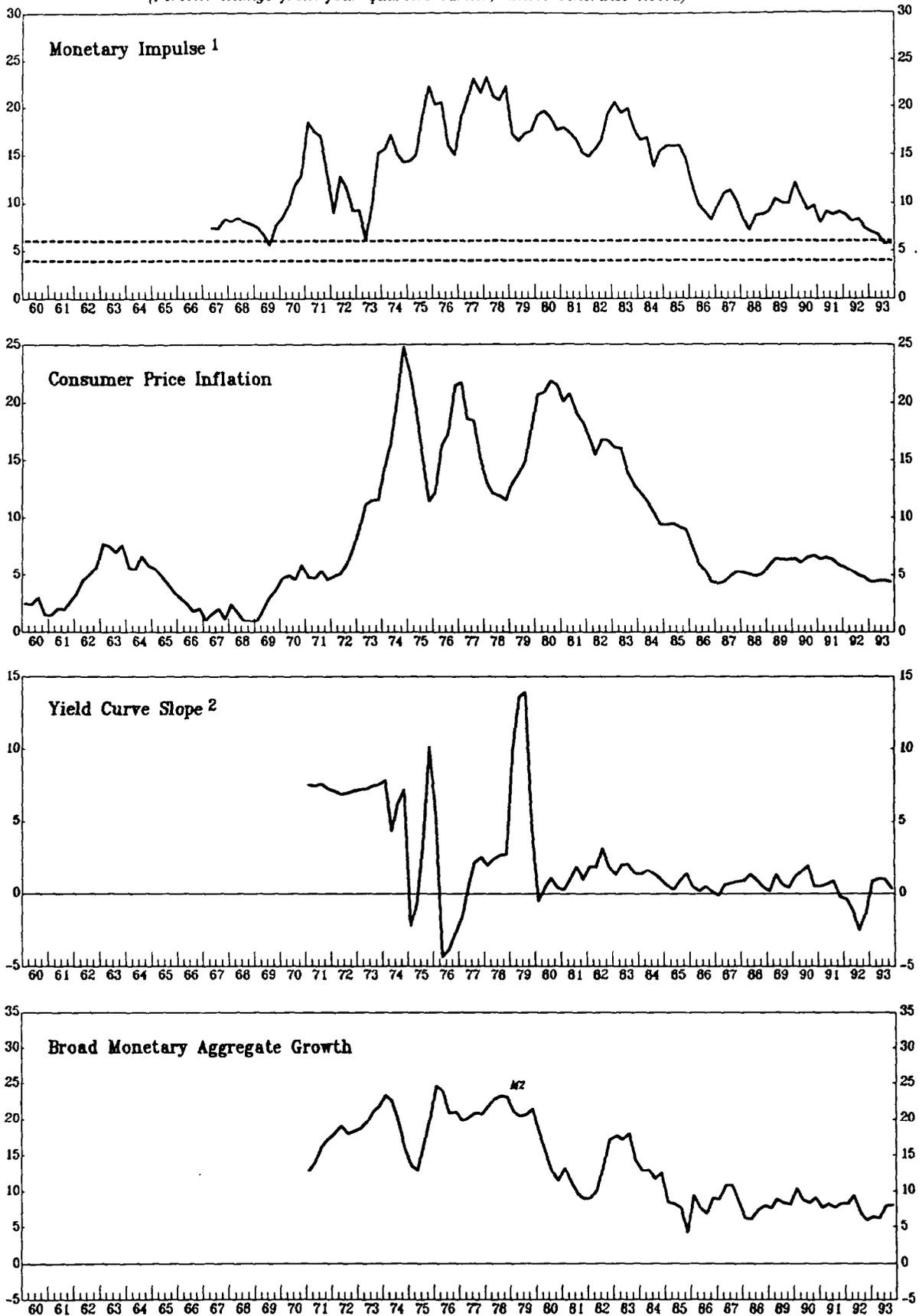
(Percent change from four quarters earlier, unless otherwise noted)



1 Four-quarter moving average of quarterly impulse measure.

2 Difference between seven to ten-year government bond yield and three-month interbank rate.

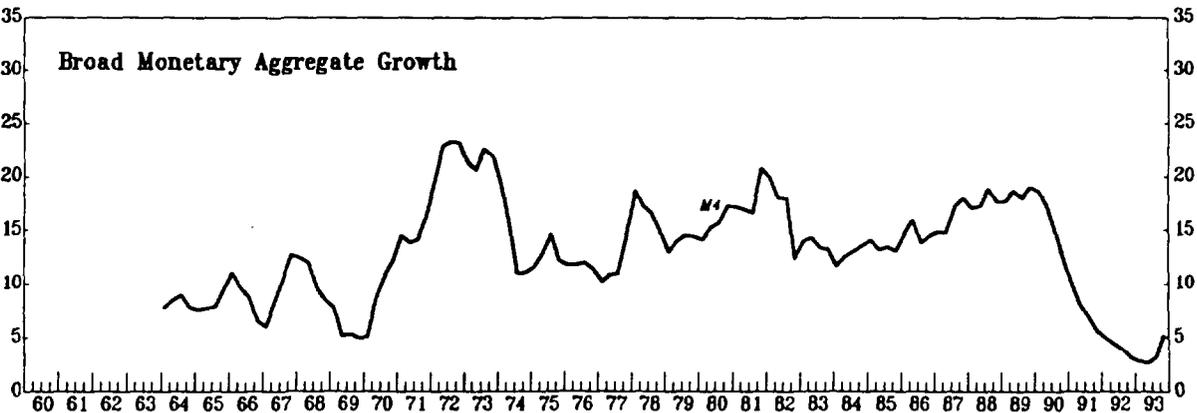
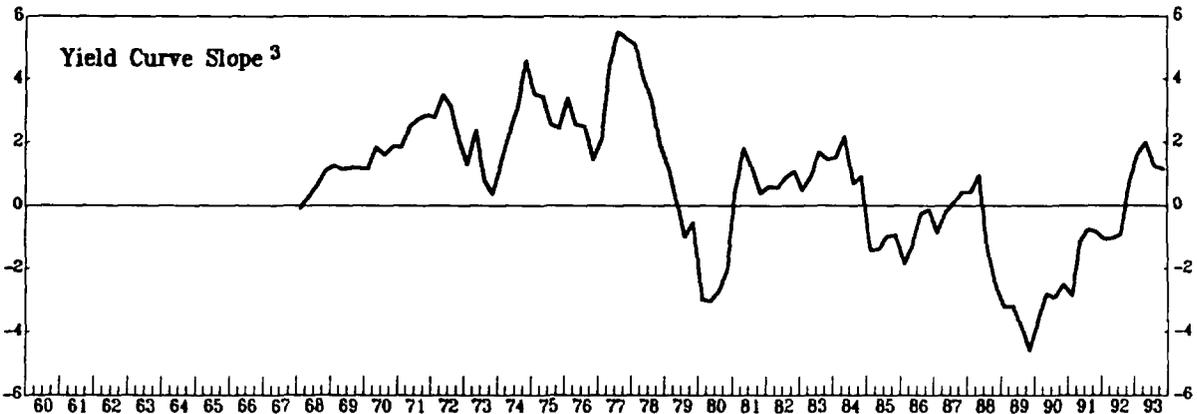
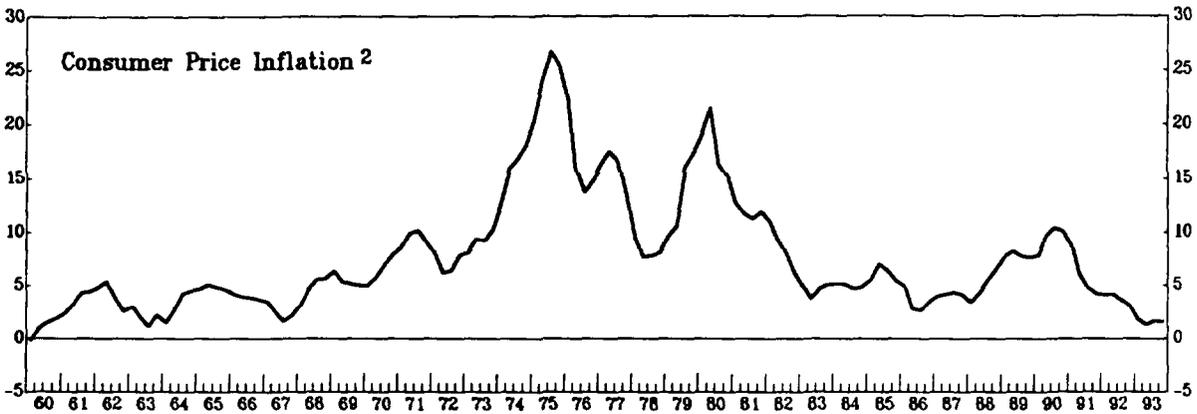
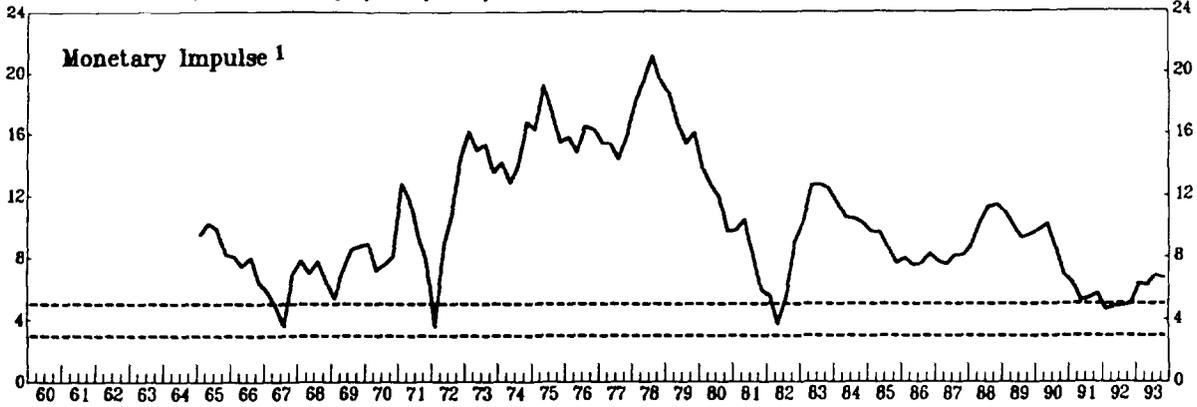
Figure 13: Italy  
(Percent change from four quarters earlier, unless otherwise noted)



1 Four-quarter moving average of quarterly impulse measure.

2 Before June 1991, difference between average yield on government bonds with two- to four-year residual maturity and three-month Treasury bill rate, thereafter yield on ten-year government bonds.

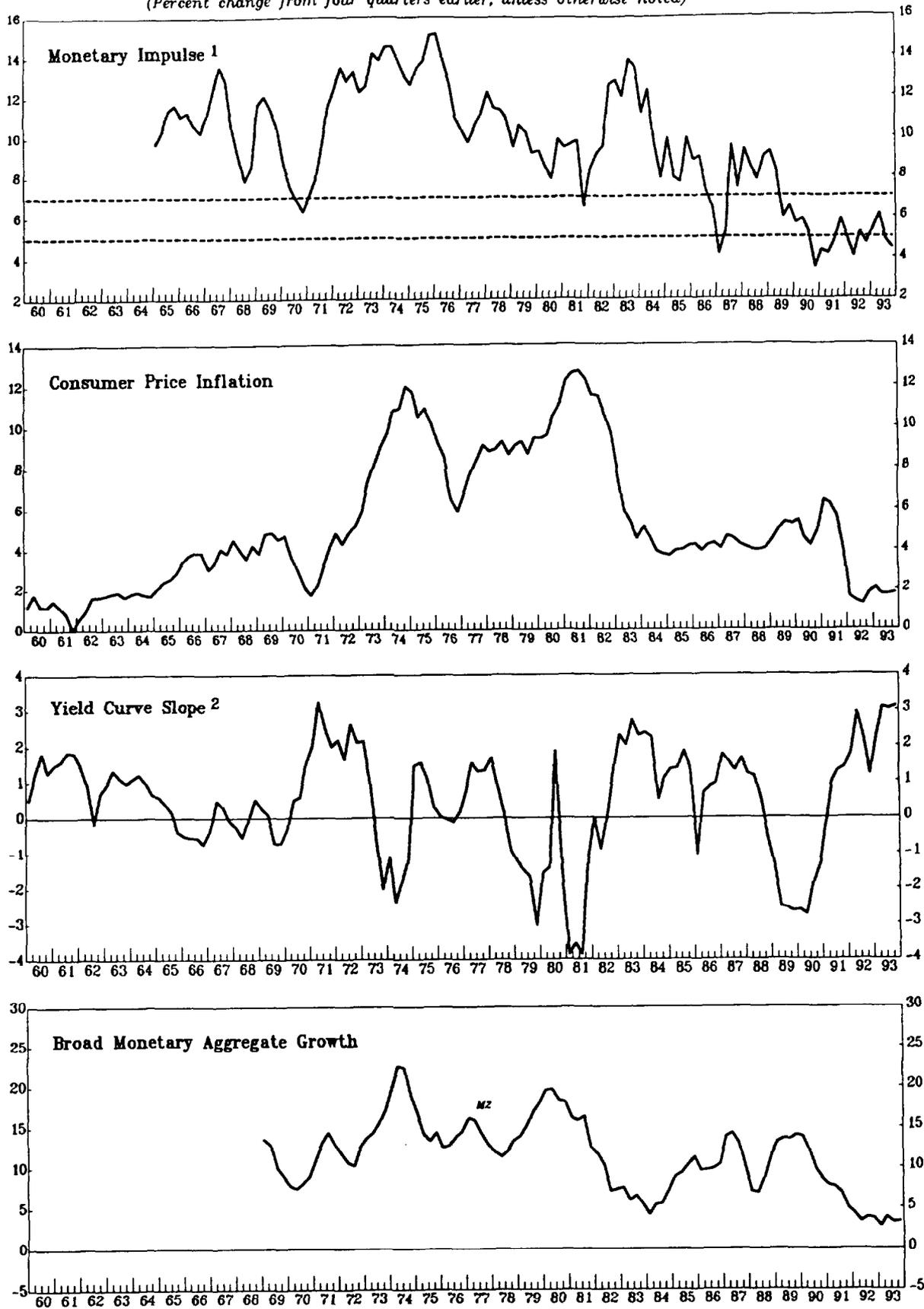
Figure 14: United Kingdom  
(Percent change from four quarters earlier, unless otherwise noted)



1 Four-quarter moving average of quarterly impulse measure.  
2 Retail price inflation excluding mortgage interest.  
3 Difference between ten-year government bond yield and three-month interbank rate.

Figure 15: Canada

(Percent change from four quarters earlier, unless otherwise noted)



1 Four-quarter moving average of quarterly impulse measure.

2 Difference between average yield on government bonds with ten or more years residual maturity and three-month corporate commercial paper rate.



the United Kingdom, the 1970s inflation was again rather severe but its elimination began somewhat earlier and was interrupted by an increase over 1987-89 (that follows the upward IM jump in Figure 6 or the top panel of Figure 14). And in Canada, the main movement away from the moderate 1970s inflation came only after 1982 (Figure 15).

More generally, these plots of CPI inflation rates are encouragingly similar to those of the monetary impulse measures. There are disagreements, of course, pertaining to timing and to brief movements. But in terms of broad tendencies, the profiles have many features in common.

Turning now to the interest rate spread, the third panels of Figures 9-15 show values of the long-minus-short-rate spread. The precise series utilized are those listed in Table A18 of the October 1994 *World Economic Outlook*; ten-year government bonds and three-month treasury bills are fairly representative. Thus the plotted spread is supposed to serve as an indicator of monetary ease, as with our impulse measure, rather than tightness. But in general these profiles do not agree to any significant extent with the inflation-rate profiles. Most of the figures do show substantial dips around 1980-81, presumably reflecting policy movements toward an anti-inflationary posture. But the story told by the pictures does not accord with the inflationary experience nearly as well as is the case with our impulse measure.

Other measures could be examined, of course, especially if the criterion of controllability is sacrificed. Here we shall limit our consideration to growth rates of a broad monetary aggregate, plots of which appear as the final panels of Figures 9-15. 1/ For the United States, the plot shows a steady but irregular inflationary buildup from 1960 into the 1980s, but the date of the tightening of policy is not as clearly located as in Figure 1 (or the top panel of Figure 9). In particular, there is little evidence of sustained anti-inflationary efforts before 1986.

For Japan the behavior of the M2 + CD growth rate does provide a satisfactory picture of policy stance, one that is quite similar to that based on our impulse measure. For Germany, however, the inflationary stance of the early 1970s is not adequately signalled by the broad aggregate's growth rate. Broad money growth in France does not accord well with inflation performance in the 1960s; and in the 1980s seems to lag behind the downturn in inflation. In the case of Italy, the short time span covered by the data make evaluation difficult; there appears to be some correspondence in the movements of M2 growth and inflation, although in many instances the lags appear to be extremely short.

For the United Kingdom, the growth of the broad aggregate indicates a generally increasing inflationary tendency from 1975 through the 1980s,

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1/ The choice of broad aggregate differs across countries so as to conform somewhat with national preferences. The aggregates used are as noted in the figures.

followed by a sharp dip beginning in 1990. Our impulse measure, by contrast, turns down in 1979 and remains comparatively low through the 1980s--a pattern that is significantly closer to that of the CPI inflation rate. In the case of Canada, however, the impulse measure does not outperform the broad monetary aggregate as an indicator of inflationary pressures.

Overall, the impulse measure performs somewhat better than the broad monetary aggregates even though the aggregates have been selected so as to reflect the most reliable of various available candidates on a country-by-country basis. Besides being the same for all nations, the impulse measure also has the additional advantage of being based on a variable that--unlike broad aggregates--is potentially controllable by central banks.

## VI. Conclusion

We have proposed a measure of monetary impulse that is intended to reflect the medium-term inflationary implications of a nation's current monetary policy. The measure consists of the growth rate of the monetary base, adjusted for reserve requirement changes and augmented by an implicit forecast of future growth rates of base velocity. Since this forecast is based on past velocity growth--its average value over the previous four years--the impulse statistic reflects an easy-to-calculate measure of a variable that could be accurately controlled by any central bank that chose to do so.

Given the velocity-growth feature of the proposed measure, its magnitude at any time will reflect the implied medium-term growth rate of nominal GDP. The inflationary implications are then readily obtained by a comparison of this figure with the trend growth rate of real GDP for the economy in question. We have plotted time series of the impulse measure together with bands reflecting an appropriate sample-average rate of real GDP growth plus 1 to 3 percentage points (per annum). These bands then represent a low-inflation range centered around a rate of 2 percent. On the basis of these plots we have briefly discussed the inflationary experiences of 1965 through 1993 for each of the G-7 economies and have argued that the impulse measure provides a useful characterization of monetary policy behavior over those years. Since the velocity adjustment term is designed so as to incorporate effects of technological and regulatory change in the payments and financial industries, we expect that the impulse measure will also be useful for analyzing policy stances in the future.

Description of Data

All data on nominal and real GDP are seasonally adjusted quarterly series. These series, and the data on consumer prices, the yield curve, and broad monetary aggregates are all obtained from national sources compiled by IMF staff. For the monetary base, various sources were utilized. These are described for each of the seven countries in the following paragraphs, and the resulting annual adjusted monetary base series are presented in Table A1.

*United States*

The series comes from the "adjusted monetary base" series developed by the Federal Reserve Bank of St. Louis and available from the WEFA database. Monthly (seasonally adjusted) values were averaged to obtain the quarterly series.

*Japan*

These figures were taken from McCallum (1993). The basic underlying data were provided by Bank of Japan end-of-month series on "Cash Currency Issued" and "Deposits from Deposit-Money Banks." The latter was adjusted for changes in reserve requirements as explained in McCallum (1993). Then quarterly averages were calculated, added to the cash series, and the sum was seasonally adjusted to provide a series on the adjusted monetary base (1963:1-1992:4). The extension through 1994:1 was based on data from the Bank of Japan available from Nikkei Services.

*Germany*

For 1960 to October 1968, the reserve series is the sum of "Total Reserve Required" and "Excess Reserves" published in the Bundesbank's *Monthly Report*, Table II.A.5. For November 1968 to February 1978, the reserve series is "Actual Reserves," from Table IV.3(a) and then IV.2(a). Beginning in March 1978, vault cash in banks began to count as reserves, so our reserve series becomes "Actual Reserves" plus "Deductible Cash Balances," from Table IV.2(a) and then Table V.2. Beginning in August 1990, the reserve and vault cash data cover the entire Deutsche Mark currency area. In order to make the reserve data correspond to the data on currency in circulation (which cover unified Germany beginning in July 1990) the reserve and vault cash figures for July were scaled up by the respective series' average ratios of unified to west-only figures for the next three months.

The resulting (monthly) reserve series is adjusted for reserve requirements changes, converted to a quarterly average series, seasonally adjusted, and added to quarterly averages of the monthly seasonally adjusted

"Currency in Circulation" series. 1/ The latter was provided by the Bundesbank and is reported in the Bundesbank's *Statistical Supplement* to the *Monthly Report*, Table I.2.

#### France

For 1960-77, data on notes and currency in circulation and bank reserves (quarterly averages), constructed by Sylvie LeCarpentier for a doctoral thesis, were provided by the Bank of France. For 1978-93, data on reserves and on coins and currency in circulation were obtained from the *International Financial Statistics*. 2/ Data on vault cash (end-of-quarter) were obtained for 1990-93 from various issues of the following Bank of France publications: *Statistiques Monétaires et Financières Trimestrielles* (Tables 06 and 1.8); and *Bulletin de la Banque de France, Supplément Statistiques* (Table 1.1.1.8).

Basically, the monetary base series amounts to a sum of these components, but the reserve series had to be adjusted for frequent major changes in reserve requirements. This adjustment procedure was necessarily more complex than in the case of Japan and Germany because reserve requirements were nonexistent before 1967 and became extremely low in 1992--possibly low enough to be non-binding. Instead of simply multiplying the unadjusted reserve figure by  $rr^0/rr$  (as mentioned in the text and employed for Japan and Germany), for France our multiplicative adjustment factor is  $rr^*/\max(rr, rr^*)$  where  $rr$  is the current required ratio for sight deposits and  $rr^*$  is the ratio that would be held voluntarily, in the absence of requirements. This  $rr^*$  value was estimated by us to be 3.0 percent prior to 1967 and then to decline geometrically toward a value of 1.76 percent in 1994:1 (the value each quarter is 0.9951 times its previous value).

Our quarterly series for the adjusted monetary base is then equal to adjusted reserves plus the sum of notes and coins in circulation and those held by banks. After 1990:3, however, "reserves" includes currency in banks and so the base is simply notes and coins outside banks plus adjusted reserves. The quarterly values of the base were seasonally adjusted; annual values are averages of quarterly figures.

1/ Because of data limitations, one difference between our calculated base series for Germany and those for other countries is that currency held by banks is not counted in "currency in circulation."

2/ The quarterly series for coins in an end-of-period series. For 1978 to 1990:3, a quarterly series on reserves and currency was obtained by averaging monthly data. For 1990:4 to 1993, end-of-quarter values for currency and reserves were used because vault cash--which began to count toward reserve requirements in 1990:4--is published as an end-of-quarter series.

*Italy*

The basic sources were two monthly series, not seasonally adjusted but adjusted for changes in reserve requirements, provided by the Bank of Italy. The first series, from February 1962 to September 1990, presents end-of-month reserve holdings. Beginning in October 1990, reserve requirements were specified instead in terms of average monthly reserve holdings, and the second series is accordingly on a monthly average basis, October 1990-May 1994. 1/ The monthly values were averaged to yield quarterly figures, which were seasonally adjusted.

*United Kingdom*

For the United Kingdom, a quarterly series labelled "M0, break-adjusted, sa" beginning in 1969:3 was obtained from the Central Statistical Office database. For quarters before 1969:3, the monetary base series developed by Capie and Webber (1985) was utilized. It was seasonally adjusted by means of the (multiplicative) ratio-to-moving average routine of Micro TSP and spliced on to the later series with 1969:3 the splice date.

*Canada*

A monthly series on the adjusted monetary base, seasonally adjusted, was obtained from the CANSIMS database, based on Bank of Canada data. Because reserve requirements are being phased out, the adjustment for reserve requirement changes is intended to determine what the monetary base would have been had reserve requirements been zero over the entire period, and it amounts to the non-inclusion of required reserves. This method may be somewhat problematic, since quantities desired for transaction purposes will exceed quantities required when requirements are small.

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1/ The Bank of Italy's *Statistical Bulletin* reports growth rates of its adjusted monetary base series; underlying level data were obtained from the Bank of Italy.

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