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THE GOLD STANDARD,
BRETTON WOODS AND
OTHER MONETARY REGIMES:
AN HISTORICAL APPRAISAL

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ABSTRACT

This paper provides answers to two questions. The first question is which international monetary regime is best for economic performance? One based on fixed exchange rates: including the gold standard and its variants? Adjustable peg regimes such as the Bretton Woods system and the European Monetary System? Or one based on floating exchange rates?

The second question is why have some monetary regimes been more successful than others? Specifically, why did the classical gold standard last close to a century (at least for Great Britain) and why did Bretton Woods only endure for twenty-five years (or less)? Why was the European Monetary System successful for only a few years?

To answer the first question I examine empirical evidence on the performance of three monetary regimes: the classical gold standard; Bretton Woods; and the current float; and as a backdrop the mixed regime interwar period. I answer the second question by linking regime success to the presence of credible commitment mechanisms, that is to the incentive compatibility features of the regime. Successful fixed rate regimes, in addition to being based on simple transparent rules, contained features which encouraged a center country to enforce the rules and other countries to comply.

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1. Introduction *

1.1 Two Questions

Which international monetary regime is best for economic performance? One based on fixed exchange rates; including the gold standard and its variants? Adjustable peg regimes such as the Bretton Woods system and the European Monetary System? Or one based on floating exchange rates? This question has been debated since Nurkse's (1944) classic indictment of flexible rates and Friedman's (1953) classic defense.

Why have some monetary regimes been more successful than others? Specifically, why did the classical gold standard last close to a century (at least for Great Britain) and why did Bretton Woods only endure for twenty-five years (or less)? Why was the European Monetary System successful for only a few years?

This paper attempts to answer these questions. To answer the first question I examine empirical evidence on the performance of three monetary regimes: the classical gold standard; Bretton Woods; and the current float; and as a backdrop the mixed regime interwar period. I answer the second question by linking regime success to the presence of credible commitment mechanisms, that is to the incentive compatibility features of the regime. Successful fixed rate regimes, in addition to being based on simple transparent rules, contained features which encouraged a center country to enforce the rules and other countries to comply.

1.2 The Issues

These questions touch upon a number of important issues raised in the literature. The first is the effect of the exchange rate regime on welfare. The key advantage of fixed exchange rates is that they reduce the transactions costs of exchange. The key disadvantage is that in a world of wage and price stickiness the benefits of reduced transaction costs may be outweighed by the costs of more volatile output and employment.

The welfare issue has been raised by Helpman and Razin (1979), Helpman (1981) and others. This theoretical literature concludes that it is difficult to provide an unambiguous ranking of

exchange rate arrangements (DeKock and Grilli, 1989, 1992).

Meltzer (1990) argues the need for empirical measures of the excess burdens associated with flexible and fixed exchange rates--the costs of increased volatility on the one hand compared to the output costs of sticky prices on the other hand. His comparison between EMS and non-EMS countries in the postwar period, however, does not yield clear-cut results.

Earlier literature comparing the macro performance of the classical gold standard, Bretton Woods, and the current float also yielded mixed results. Bordo (1981), Cooper (1982) showed that the classical gold standard was associated with greater price level and real output volatility than post-World War II arrangements for the U.S. and U.K. On the other hand, Klein (1975) and Schwartz (1986) presented evidence that the gold standard provided greater long-term price stability than did the post World War II arrangements¹.

Bordo (1992) compared the means and standard deviations of nine variables for the G-7 countries under the three regimes as well as the interwar period. According to these measures, the Bretton Woods convertible period from 1959 to 1970 was the most stable regime for the majority of countries and variables examined. Eichengreen (1992a) measured volatility applying two filters (the first difference of logarithms and a linear trend), following the methodology of Baxter and Stockman (1989). Comparing Bretton Woods and the float for a sample of ten countries, he found no clear cut connection between the volatility of real growth and the exchange rate regime. He also found no significant difference in the correlation of output volatility across countries between the two regimes.

A second issue is whether the exchange rate regime provides insulation from shocks and monetary policy independence. Under fixed rates, coordinated monetary policy may provide effective insulation from common supply shocks but not from country specific shocks. Under flexible rates, country specific shocks can be offset by independent monetary policy.²

The evidence on this issue is limited. Bayoumi and Eichengreen (1992a) applied the Blanchard-Quah approach to show that both supply (permanent) and demand (temporary) shocks, for a sample of five countries, were considerably greater under the gold standard than under post World

War II regimes. However, they found little difference in the incidence of shocks between Bretton Woods and the float. Their results also showed that the dispersion of shocks across countries was higher under the gold standard than the two more recent regimes and slightly higher under Bretton Woods than under the float. They attributed the ability of the gold standard to withstand greater shocks to evidence measured by impulse response functions, of a faster speed of adjustment of both prices and output.³

A third issue is the case for rules versus discretion. A fixed exchange rate may be viewed as a commitment mechanism or rule. It binds the hands of policy makers to prevent them from following inflationary discretionary policies (Kydland and Prescott, 1977, Barro and Gordon, 1983; Persson and Tabellini, 1990). The monetary authority, in a closed economy or else under flexible rates, might be tempted to engineer an inflation surprise to raise revenue.⁴ The outcome is higher inflation since the public, assuming rational expectations, will anticipate the policy. Were some credible mechanism such as a monetary rule in place the expansionary policy would not be implemented. Alternatively, a commitment to a fixed exchange rate by, a pledge to maintain gold convertibility for example, could achieve the same results, but because it is more transparent, possibly at a lower cost (Giavazzi and Pagano, 1988).

However, such binding commitments may be undesirable in the presence of extreme emergencies such as major wars, supply shocks, or financial crises (Rogoff, 1985a, Fischer, 1990). Under such circumstances a contingent rule, or one with escape clauses, which allows member countries to temporarily suspend parity (convertibility), may be optimal (Bordo and Kydland, 1992, Flood and Isard 1989a, 1989b, DeKock and Grilli, 1989, 1992).

The rule constrains the government to adhere to the fixed exchange rate except in the case of a well understood emergency, when it can suspend parity (convertibility under the gold standard) and issue fiat money. Once the emergency has passed, with allowance for a suitable delay, the authority is expected to return to the rule--to the fixed rate at the original parity. If the public believes in the government's commitment to return to the rule, the government will be able to raise more revenue

than would be the case in the absence of credibility. The inflation rate during the emergency would be higher than under the rule (when presumably it would be zero) but less than in the case of pure discretion. The pattern of alternating fixed and floating exchange rate regimes over the past 200 years may be well explained by adherence to a rule with an escape clause (DeKock and Grilli, 1989, Giovannini, 1992).

On the other hand, in a regime of floating exchange rates the inflationary bias of discretionary policy may be overcome by instituting credible monetary rules or other commitment mechanisms such as an independent conservative central bank (Rogoff, 1985a). Such mechanisms may avoid the perceived disadvantage of sacrificing national sovereignty to the supernational dictates of a fixed exchange rate.

A fourth issue is that of international cooperation and policy coordination. Recent game theoretic literature has demonstrated that coordination of policies (by fixing exchange rates) can offset spillover effects from uncoordinated policy actions (Hamada, 1979, Canzoneri and Henderson, 1988, 1991). However, cooperative fixed exchange rate arrangements, unless enforced by a supernational authority whose power exceeds national sovereignty, tend to break down as individual members devalue. Cooperation is more likely, without a supernational authority, in a world of repeated games because the benefits of reputation can offset the advantages to each country of cheating (Dominguez, 1992). But even in this case, cooperation between nations may produce an inflationary bias when no credible commitment mechanism is present to prevent governments from following discretionary policies (Rogoff, 1985b). Thus for an international monetary arrangement to be effective both between countries and within them, a consistent credible commitment mechanism is required. Such a mechanism likely prevailed under the gold standard but was less evident under Bretton Woods.

A fifth and final issue is the case for international monetary reform. Several, prominent proposals have been made to reform the present managed floating exchange rate regime and move it back towards one of greater fixity. These proposals in part derive from a perception, based on the

historical record, that fixed exchange rates are preferable to the current float. These proposals include: McKinnon's (1988) case for a gold standard without gold; Mundell's (1992) proposal to target the real price of gold; and the case for target exchange rate zones (Williamson, 1985a, Bergsten, 1992). Even more immediate is the move to convert the adjustable peg of the European Monetary System to a unified currency area with irrevocably fixed exchange rates.

1.3 Overview

The paper accomplishes a number of tasks. Part 2 answers the first question by presenting a compilation of statistical evidence on different aspects of the performance of alternative monetary regimes. The measures cover the stability of several macro variables; the dispersion of macro variables across countries; the persistence of inflation; forecast errors in inflation and growth; the incidence of supply (permanent) and demand (temporary) shocks; the dispersion of shocks between countries and the mean response of prices and output to supply and demand shocks. Part 3 stresses the importance of adherence to credible rules in a historical examination of three international monetary regimes: the classical gold standard; Bretton Woods and the European Monetary System, Part 4 answers the question why some regimes endured longer than others. It concludes by discussing why even a regional exchange rate arrangement--the EMS--has faced considerable difficulty in surviving.

The statistical evidence on performance of alternative monetary regimes in Part 2 makes it clear that the performance of regimes in the post-World War II era is superior to that of the regimes in the preceding half century. The key exception is the classical gold standard which exhibits the lowest inflation persistence and a relatively high degree of financial market integration. The Bretton Woods convertible regime from 1959 to 1970 performed by far the best on virtually all criteria.

The greater durability of the gold standard compared to Bretton Woods can not be explained by a lower incidence of shocks. The key explanation for its success lies with the credibility of the commitment to the gold standard rule of convertibility by England and the other core countries, and its near universal acceptance. As a contingent rule, it was flexible enough to withstand the major

shocks which buffeted it. The Bretton Woods adjustable peg was in some respects similar to the gold standard contingent rule, but it invited speculative attack hence weakening the escape clause. Unlike England, the leading country before World War I, the U.S., the dominant country under Bretton Woods, only maintained a credible commitment to a noninflationary policy for a few years. The world, faced with imported inflation in the late 1960's, lost the incentive to follow its leadership and the system collapsed in 1971.

The longevity of general floating since 1973 suggests that the lessons of Bretton Woods have been well learned. Countries are not willing to subject their domestic policy autonomy to that of another country whose commitment they cannot be sure of in a stochastic world nor to a supernational monetary authority they cannot control. Even the recent experience of the EMS--a regional exchange rate arrangement between countries supposedly pursuing common goals--revealed differing national priorities in the face of asymmetric shocks that placed intolerable strains on the system.

2. The Performance of Alternative Monetary Regimes

To make the case for one monetary regime over another empirical and historical evidence on their performance is crucial. In this section I present some evidence on different aspects of the macro performance of alternative international monetary regimes over the past one hundred and ten years. The comparison for the seven largest (non-Communist) industrialized countries (the United States, United Kingdom, Germany, France, Japan, Canada, Italy) is based on annual data for the classical gold standard (1881-1913), the interwar period (1919-1939), Bretton Woods (1946-70), and the present regime of floating rates (1971-1989). The Bretton Woods period (1946-1970) is divided into two subperiods: the preconvertible phase (1946-1958) and the convertible phase (1959-1970).⁵

The comparison relates to the theoretical issues raised by the debate over fixed versus flexible exchange rates. According to the traditional view, adherence to a (commodity based) fixed-exchange rate regime, such as the gold standard, ensured long-run price stability for the world as a whole because the fixed price of gold provided a nominal anchor to the world money supply. Individual nations by pegging their currencies to gold fixed their price levels to that of the world.⁶ A fixed-

rate system based on fiat money however, may not provide a stable nominal anchor unless a credible commitment mechanism constrains the growth of the world's money supply (Giovannani, 1992). The disadvantage of fixed rates is that individual nations are exposed to both monetary and real shocks transmitted from the rest of the world via the balance of payments and other channels of transmission (Bordo and Schwartz 1989a). The advantage of floating exchange rates is to provide insulation from foreign shocks. The disadvantage is the absence of the discipline of the fixed-exchange-rate-rule, since monetary authorities might adopt inflationary policies.

Theoretical developments in recent years have complicated the simple distinction between fixed and floating rates. In the presence of capital mobility, currency substitution, policy reactions, and policy interdependence, floating rates no longer necessarily provide insulation from either real or monetary shocks (Bordo and Schwartz, 1989a). Moreover, according to recent real business cycle approaches, there may be no relationship between the international monetary regime and the transmission of real shocks (Baxter and Stockman, 1989). Nevertheless, the comparison between regimes may shed light on these issues.

One important caveat is that the historical regimes presented here do not represent clear examples of fixed and floating rate regimes. The interwar period is composed of three regimes: general floating from 1919 to 1925; the gold exchange standard from 1926 to 1931; and a managed float to 1939.⁷ The Bretton Woods regime cannot be characterized as a fixed exchange rate regime throughout its history: the preconvertibility period was close to the adjustable peg envisioned by its architects; the convertible period was close to a de facto fixed dollar standard.⁸ Finally, although the period since 1973 has been characterized as a floating exchange rate regime, at various times it has experienced varying degrees of management.

2.1 Stability and Convergence

Table 1 presents descriptive statistics on nine macro variables for each country, the data for each variable converted to a continuous annual series from 1880 to 1989. The nine variables are: the rate of inflation, real per capita growth; money growth; short-term and long-term nominal interest

rates; short-term and long-term real interest rates; the absolute rates of change of nominal and real exchange rates. The definition of the variable used, e.g., M_1 versus M_2 , was dictated by the availability of data over the entire period. For each variable and each country I present two summary statistics: the mean and standard deviation. For all the countries taken as a group, I show two summary statistics: the grand mean and a simple measure of convergence defined as the mean of the absolute differences between each country's summary statistic and the grand means of the group of countries.⁹ I comment on the statistical results for each variable.

Inflation (Panel a). The classical gold standard had the lowest rate of inflation and the interwar period displayed mild deflation. The rate of inflation during the Bretton Woods period was on average and for every country except Japan lower than during the subsequent floating exchange rate period. The average rate of inflation in the two Bretton Woods subperiods was virtually the same. However, this comparison conceals the importance of two periods of rapid inflation in the 1940's and 1950's and in the late 1960's. See figure 1.¹⁰ Thus the evidence based on country and period averages of very low inflation in the gold standard period and of a lower inflation rate during Bretton Woods than the subsequent floating period is consistent with the traditional view on price behavior under fixed (commodity based) and flexible exchange rates.

In addition, the inflation rates show the highest degree of convergence between countries during the classical gold standard and to a lesser extent during the Bretton Woods convertible subperiod compared to the floating rate period and the mixed interwar regime. This evidence also is consistent with the traditional view of the operation of the classical price specie-flow mechanism and commodity arbitrage under fixed rates and insulation and greater monetary independence under floating rates.¹¹

The Bretton Woods convertible subperiod had the most stable inflation rate of any regime judged by the standard deviation. By contrast the preconvertible Bretton Woods period exhibited greater inflation variability than either the gold standard or the recent float. The evidence of a high degree of price stability in the convertible phase of Bretton Woods is also consistent with the

traditional view that fixed rate (commodity based) regimes provide a stable nominal anchor; however, the remarkable price stability during this period may also reflect the absence of major shocks.

Real per capita GNP (Panel b). Generally, the Bretton Woods period, especially the convertible period, exhibited the most rapid output growth of any monetary regime, and not surprisingly the interwar period the lowest (see figure 2). Output variability was also lowest in the convertible subperiod of Bretton Woods, but because of higher variability in the preconvertible period, the Bretton Woods system as a whole was more variable than the floating period. Both pre-World War II regimes exhibit higher variability than their post-World War II counterparts.¹² The Bretton Woods regime also exhibited the lowest divergence of output variability between countries of any regime, with the interwar regime the highest.¹³ The greater convergence of output variability under Bretton Woods may reflect conformity between countries' business fluctuations, created by the operation of the fixed-exchange rate regime (Bordo and Schwartz, 1989a, and Darby and Lothian, 1989).

Money growth (M_2) (Panel c). It was considerably more rapid across all countries post-World War II than before the war (see figure 3). There is not much difference between Bretton Woods and the subsequent floating regime. Within the Bretton Woods regime, money growth was more rapid in the preconvertibility period than in the convertibility period. Money growth rates showed the least divergence between countries during the fixed-exchange-rate gold standard and the convertible Bretton Woods regime with the greatest divergence in the preconvertible Bretton Woods period and the interwar period.

Like inflation and real output variability, money growth variability was lowest in the convertible Bretton Woods period. This, however, was not the case for the preconvertible period which was the most variable of any regime. It also exhibited the greatest divergence in variability between countries. To the extent that one of the properties of adherence to a fixed-exchange-rate regime is conformity of monetary growth rates between countries, these results are sympathetic to the view that the Bretton Woods system really began in 1959.

Short-term and long-term interest rates (Panels d and e). The underlying data can be seen in figures 4 and 5. As in other nominal series, the degree of convergence of mean short-term interest rates is highest in the convertible Bretton Woods period. Long-term rates are most closely related in the classical gold standard with the convertible Bretton Woods period not far behind. These findings are similar to these of McKinnon (1988), who views them as evidence of capital market integration under fixed exchange rates. The lack of convergence in the preconvertibility Bretton Woods period reflects the presence of pervasive capital controls. Convergence of nominal interest rates would not be expected under floating exchange rates. Convergence of standard deviations is also highest in the gold standard period followed by Bretton Woods. Long-term rates were most stable and least divergent under the classical gold standard, followed by the two Bretton Woods subperiods, with floating exchange rates the least stable. The evidence that nominal interest rates are more stable and convergent between countries under fixed exchange rate (commodity based) regimes is consistent with the traditional view.

Real short-term and real long-term interest rates (Panels f and g). For the underlying data see figures 6 and 7. The real interest rates are ex post rates calculated using the rate of change of a consumer price index.¹⁴ Unlike the nominal series, the degree of convergence in means between real short-term interest rates is lowest in the floating exchange rate period, next lowest in the Bretton Woods convertible period, and highest in the preconvertible period. For long-term real rates, as in the case of nominal rates, convergence is highest under the gold standard followed by the Bretton Woods convertible regime. It is lowest under preconvertible Bretton Woods. The real short-term interest rate is most stable across countries during the Bretton Woods convertible period. It also shows the least amount of divergence in standard deviations. The same holds for real long-term interest rates.

The behavior of real interest rates across regimes is consistent with McKinnon's (1988) explanation. He argued that fixed exchange rates encourage capital market integration by eliminating devaluation risk. This reduces variability in short-term real interest rates. Similarly, real long-term

interest rates are stabilized by pooling across markets, which reduces capital market risk.

Nominal and real exchange rates (Panels h and i). The lowest mean rate of change of the nominal exchange rate and the least divergence between rates of change occurred during the Bretton Woods convertible and gold standard periods, with the former exhibiting the lowest degree of divergence. Exchange rates during the preconvertibility Bretton Woods regime changed almost as much as during the floating period. This mainly reflected the major devaluations of 1949 (see figure 8 and Bordo (1992) table 2). Nominal exchange rates were least variable in the gold standard and convertible Bretton Woods periods and the most variable and most divergent in the Bretton Woods preconvertible period.

As with the nominal exchange rate the lowest mean rate of change in the real exchange rate across countries and the least divergence between countries was in the Bretton Woods convertible period with the gold standard period next in size of these measures (see figure 9). The highest rate of change was in the floating period. Similarly the lowest standard deviation across countries and the least divergence between standard deviations was the Bretton Woods convertible period with the gold standard again next in these rankings. The other regimes were characterized by much greater variability and divergence. These results shed light on the relationship between the nominal exchange rate regime and the behavior of real exchange rates. Mussa (1986) presented evidence for the G-10 countries in the post-World War II period showing the similarity between nominal and real exchange rate variability under floating rates. His explanation for greater real exchange rate variability under floating rates than under fixed rates is nominal price rigidity.¹⁶ The explanation may be questioned, for example, fixed nominal exchange rate may produce greater trade stability that will be reflected in the real exchange rate, as is evident for both the Bretton Woods and gold standard periods. Yet as Eichengreen (1991b) points out and as can be seen in Table 4 below. These results could be explained by the fact that both periods were characterized by few shocks.¹⁶

Finally, based on monthly data 1880-1986 for the U.K. and the U.S., Grilli and Kaminsky (1991), show that, with the exception of the post-World War II period, no clear connection exists

between the nominal exchange rate regime and the variability of real exchange rates. My results for the G-7 show a clear correlation between nominal exchange rate rigidity and lower real exchange rate variability for the gold standard and Bretton Woods convertible regime. For the preconvertible Bretton Woods period - de jure a type of fixed exchange rate regime - the correlation is not evident. I do not distinguish between fixed and flexible periods in the interwar segment as do Grilli and Kaminsky, hence that period cannot be used in the comparison.¹⁷

In summary, the Bretton Woods regime exhibited the best overall macro performance of any regime. This is especially so for the convertible period 1959-1970.¹⁸ As the summary statistics in Table 1 show, both nominal and real variables were most stable in this period. The floating rate regime, on most criteria, was not far behind the Bretton Woods convertible regime, while the classical gold standard exhibited the most stability and the closest convergence of financial variables.

The preconvertible Bretton Woods period 1946-1958 was considerably less stable for the average of all countries for both nominal and real variables than other regimes. Also both nominal and real variables did not vary nearly as closely together. These differences likely reflect the presence of pervasive exchange and capital controls before 1958, and related to these, more variable and more rapid monetary growth. These data are limited. Although they show excellent performance for the convertible Bretton Woods regime, they do not tell us why it did so well--whether it reflected a set of favorable circumstances or the absence of aggravating shocks or whether it reflected stable monetary policy by the key country of the system, the U.S., or whether it masked underlying strains to the system.

2.2 Inflation Persistence

A second piece of evidence is the persistence of inflation. Evidence of persistence in the inflation rate suggests that market agents expect the monetary authorities to continually follow an inflationary policy; its absence would be consistent with the belief that the authorities are following a stable monetary rule such as the gold standard's convertibility rule. Barsky (1987) presented evidence for the UK and US based on both autocorrelations and time series models that inflation

under the gold standard was very nearly a white-noise process, whereas in the post-World War II period, the inflation rate exhibited considerable persistence. Alogoskoufis and Smith (1991) also show, based on AR(1) regressions of the inflation rate, that inflation persistence in the two countries increased between the classical gold standard period and the interwar period and between the interwar period and the post World War II period.¹⁹

Table 2 presents the inflation-rate coefficient (from the type of AR(1) regressions on CPI inflation estimated by Alogoskoufis and Smith (1991)), for the G-7 countries over successive regimes since 1880,²⁰ as well as the standard errors and the Dickey-Fuller tests for a unit root.²¹

The results, as in Alogoskoufis and Smith, show an increase in inflation persistence for most countries between the classical gold standard and the interwar period, and also between the interwar period and the post-World War II period as a whole. Within the post-World War II period, inflation persistence is generally lower, with the exceptions of France and Japan, in the preconvertible Bretton Woods than the convertible period. This suggests that though the immediate post-World War II period was characterized by rapid inflation, market agents may have expected a return to a stable price regime. The higher degree of persistence in the convertible regime suggests this expectation lost credence. Finally, the evidence that persistence was generally highest during the float may imply the public's realization that there was no longer a stable nominal anchor.

2.3 Forecast Errors in Inflation and Growth

A third piece of evidence relates to the forecast errors of inflation and real output growth. According to Meltzer and Robinson (1989) "a welfare maximizing monetary rule would reduce variability to the minimum inherent in nature and institutional arrangements." (p. 179). They measure variability by the mean absolute error (MAE) of a one period forecast based on the univariate multi-state Kalman Filter (MSKF). Following their approach, Table 3 presents the MAE's for inflation and real growth for the G-7 countries over successive regimes. The MSKF forecasts incorporate both transitory and permanent shocks to the rate of change series.²²

The lowest forecast errors for inflation on average were for the Bretton Woods convertible

period, followed by the gold standard and the floating rate period. The highest were for the interwar period, followed by the preconvertible Bretton Woods period. The most notable exception to the pattern was for the U.K., where the floating rate period exhibited the largest variability.

For real growth, as for the inflation rate, the lowest MAE, on average occurred in the convertible Bretton Woods period. Another exception to this pattern was Japan. The highest MAE was again in the interwar and the preconvertible Bretton Woods period. The floating period, though more variable than the convertible Bretton Woods period was slightly less variable than the gold standard.

These results are quite consistent with those of Table 1. The Bretton Woods convertible period was the most stable both in an ex post and ex ante sense. However the performance of the gold standard and the float are not much worse, at least for real growth for the float, and inflation for the gold standard.

2.4 Demand and Supply Disturbances

An important issue is the extent to which the performance of alternative monetary regimes as revealed by the data in the preceding tables, reflects the operation of the monetary regime in constraining policy actions or the presence or absence of shocks to the underlying environment. One way to shed light on this issue, following earlier work by Bayoumi and Eichengreen (1992a) (1992b) (1992c) (1992d), is to identify underlying shocks to aggregate supply and demand. According to them, aggregate supply shocks reflect shocks to the environment and are independent of the regime, but aggregate demand shocks likely reflect policy actions and are specific to the regime.

The approach used to calculate aggregate supply and demand shocks is an extension of the bivariate structural vector autoregression (VAR) methodology developed by Blanchard and Quah (1989). Following Bayoumi and Eichengreen (1992a), I estimated a two-variable VAR in the rate of change of the price level and output.²³ Restrictions on the VAR identify an aggregate demand disturbance, which is assumed to have only a temporary impact on output and a permanent impact on the price level, and an aggregate supply disturbance, which is assumed to have a permanent

impact on both prices and output.²⁴ Overidentifying restrictions, namely, that demand shocks are positively correlated and supply shocks are negatively correlated with prices, can be tested by examining the impulse response functions to the shocks.

The methodology has important limitations which suggest that the results should be viewed with caution. The key limitation is that one can easily imagine frameworks in which demand shocks have permanent effects on output while supply shocks have only temporary effects.²⁵

I estimated supply (permanent) and demand (temporary) shocks, using annual data for each of the G-7 countries, over alternative regimes in the period 1880-1989. The VAR's are based on three separate sets of data: 1880-1913, 1919-1939, and 1946-1989, omitting the war years because complete data on them was only available for four of the countries.²⁶ The VARS have two lags. I also did the estimation for aggregated price and output data for the G-7.²⁷

The overidentifying restrictions that demand shocks be positively correlated and supply shocks negatively correlated with the price level are satisfied for all countries for the two post-World War II regimes. But for the period before World War II, for a number of countries including the U.S., U.K., and France, they are not. Supply shocks were positively correlated with prices. This can be seen in the impulse response functions displayed in figures 10 and 11. Figure 10 shows the impulse responses, to one standard deviation shocks in aggregate supply and aggregate demand, on output and prices for the G-7 aggregate by regime. Figure 11 shows the impulse response functions for the individual countries.²⁸

Keating and Nye (1991) attempted to explain this result by possible hysteresis effects. Bayoumi and Eichengreen (1992a) argued that the perverse impulse response patterns for the classical gold standard and interwar periods reflected the interaction of a positive aggregate demand curve with a very steep aggregate supply curve. They explain the positively sloped aggregate demand curve as reflecting the effects of gold discoveries induced by the supply shock of agricultural settlements in the U.S. and Australia. These results may also reflect a limitation of the Blanchard-Quah methodology.

Table 4 presents the standard deviations of supply and demand shocks for the G-7 countries and the G-7 aggregate by regimes. I also show, following Bayoumi and Eichengreen (1992a), the weighted average of the individual country shocks. Figures 12 and 13 show the shocks for the G-7 aggregate and for each of the seven countries.

Table 4 shows for the G-7 aggregate that the convertible Bretton Woods regime was the most tranquil of all the regimes--neither supply nor demand shocks dominated. However, it was not that much less turbulent than the succeeding float. The interwar period, unsurprisingly, shows the largest supply and demand shocks.²⁹ Sizeable supply and demand shocks which are two or three times greater than the post World War II period also characterize the classical gold standard.³⁰

For individual countries, the Bretton Woods convertible period was the most stable in four countries and flexible rates in three. However, the difference between the convertible Bretton Woods period and the float was not great in any country. The interwar period as expected was the most volatile. Both types of shocks were the largest in every country except the U. K. Finally, in the majority of countries, with the principal exceptions of the U. K. and Germany, both supply and demand shocks were considerably greater in the gold standard period than in the post-World War II period.

The dispersion of demand shocks across countries, as measured by the GNP weighted standard deviation of the individual country shocks around the G-7 aggregate, reveals very little difference between the gold standard and the post World War II regimes, with the convertible Bretton Woods regime displaying the highest degree of convergence. Dispersion is much greater in the interwar period. The dispersion of supply shocks is considerably greater during the gold standard and the interwar periods than in any of the post World War II regimes.

In sum, the evidence on supply and demand shocks is quite similar to the measures of volatility drawn from the forecast errors using the MSKF. The gold standard emerges as a relatively unstable period stressed by widely dispersed supply shocks, as does the interwar period. By contrast, the Bretton Woods convertible period is the most stable, with the float not far behind.

These results raise the interesting question as to why the classical gold standard was so durable in the face of substantial shocks, whereas Bretton Woods was so fragile in the face of the mildest shocks in the past century.

2.5 Responsiveness to Shocks

The final piece of evidence to be calculated in the comparison of regime performance is the response of the price level and output to the aggregate supply (permanent) and aggregate demand (temporary) shocks. Evidence of a more rapid adjustment of prices and output to shocks may help explain why one regime may have been more durable than another.

A measure of speed of response can be gleaned from the impulse response functions derived from the bivariate VARs. In addition, as a crude measure of response speed which allow easy comparison of all seven countries during the four regimes, I calculated the mean absolute lag of the response functions.³¹ Table 5. presents these measures.

The response of output to both demand and supply shocks for the G-7 aggregate and for most of the individual countries was markedly more rapid under the gold standard than under the postwar regimes--an exception is the U.S. response to demand shocks--and within the postwar regimes was slightly more rapid under the Bretton Woods than the float. The response of prices to both demand and supply shocks was considerably more rapid during the gold standard (and the interwar) than the postwar regimes for the G-7 and most countries.³² Within the postwar period, it was considerably more rapid under Bretton Woods than the floating period.

Perhaps the gold standard was able to endure the greater shocks that it faced owing to both greater price flexibility and greater factor mobility before World War I. Alternatively, the gold standard was more durable than Bretton Woods because before World War I the suffrage was limited, central banks were often privately owned and, before Keynes, there was less understanding of the link between monetary policy and the level of economic activity. Hence there was less of an incentive for the monetary authorities to pursue full employment policies which would threaten adherence to convertibility.

In addition, the Bretton Woods regime was both more stable and seemingly more flexible than the float and yet more fragile. This suggests that its collapse is attributable less to outside shocks to the environment or the structure of the G-7 economy and more to flaws in the design of the regime.

2.6 Summary

The performance of alternative international monetary regimes suggests that the Bretton Woods convertible regime (1959 to 1970) was the most stable, followed by the float and the classical gold standard. The stability of forecast errors to both inflation and growth paralleled that of the ex post data. Limited inflation persistence--evidence for credibility of the nominal anchor--was lowest during the classical gold standard. Though considerably higher than under the gold standard, persistence was less under Bretton Woods than under the float. Under Bretton Woods apparently the nominal anchor of the U. S. commitment to peg the price of its currency to gold still was effective. Finally supply shocks were greater and less symmetric and demand shocks were greater under the classical gold standard than was true of the post-World War II regimes. A more rapid response of both prices and output to these shocks also occurred under the gold standard.

The question still remains why some fixed exchange rate regimes endured longer than others or why the world periodically shifted between fixed and flexible rates. The durability of the gold standard may be due to greater price flexibility and factor mobility before World War I that allowed the world economy to respond more rapidly to shocks. It also may be due to the absence of discretionary monetary policies dedicated to maintaining full employment. But the fragility of the most stable regime, Bretton Woods, in the face of mild shocks, suggests that an understanding of its demise requires a closer look at the history, institutions, and rules of behavior of alternative monetary regimes.

3. The Gold Standard, Bretton Woods, and the EMS as Commitment Mechanisms

Perhaps the answer to the foregoing questions concerning regime performance and durability may be linked to the commitment technology of the regime. In this section I argue that the gold

standard rule of convertibility was a credible commitment mechanism, which was crucial to its success and the absence of such a mechanism underlies the failure of the Bretton Woods variant. The EMS, though not anchored to gold convertibility, may have been successful for a number of years because it embodied a commitment technology reminiscent of the gold standard. However, like Bretton Woods, it was subject in September 1992 to intolerable strains because the commitment mechanism proved not to be credible for many of the members.

Under the classical gold standard, the monetary authorities committed themselves to fix the prices of their currencies in terms of a fixed weight of gold and to freely buy and sell gold in unlimited amounts. The pledge to fix the price of a country's currency in terms of gold represents the basic rule of the gold standard. The fixed price of domestic currency in terms of gold provided a nominal anchor to the international monetary system. Under the Bretton Woods system only the United States fixed the price of the dollar in terms of gold. All other convertible currencies were pegged to the dollar. Also, under Bretton Woods, free convertibility of gold into dollars was limited. Thus, Bretton Woods was a weak variant of the gold standard. Although the Bretton Woods system in its convertible phase 1959 to 1971 was the most stable monetary regime of the past century, it was short-lived. It collapsed both because of fatal flaws in its design (the adjustable peg in the face of improved capital mobility and the confidence problem associated with the gold dollar standard) and the lack of commitment by the United States to the gold standard convertibility rule.

The EMS, although not based on gold, incorporated many of the features of the Bretton Woods adjustable peg system. Its success in promoting the convergence of inflation rates among its members in the 1980's has been linked to the presence of an effective commitment mechanism--the adherence by the German central bank to price stability and the willingness of other members to tie their currencies to the German mark. However, like Bretton Woods, it suffered serious stress in September 1992 in the face of massive shocks because of the basic incompatibility of pegged exchange rates, capital mobility, and policy autonomy. Both the center country and the members were unwilling to commit to a common policy.

An overview of the three regimes as embodying the operation of credible monetary rules follows.

3.1. The Gold Standard as a Commitment Mechanism

In the recent literature on the time inconsistency of optimal government policy, the absence of a credible commitment mechanism leads governments, in pursuing stabilization policies, to produce an inflationary outcome (Kydland and Prescott, (1977); Barro and Gordon (1983). In a closed economy environment, once the monetary authority has announced a given rate of monetary growth, which the public expects it to validate, the authority then has an incentive to create a monetary surprise to either reduce unemployment or capture seigniorage revenue. The public, with rational expectations, will come to anticipate the authorities perfidy, leading to an inflationary equilibrium. A credible precommitment mechanism, by preventing the government from cheating, can preserve long-run price stability. The gold standard rule of maintaining a fixed price of gold can be viewed as such a mechanism.

The gold standard rule can be viewed as a form of contingent rule or rule with escape clauses (Grossman and Van Huyck 1988; DeKock and Grilli 1989; Bordo and Kydland 1992). The monetary authority maintains the standard--keeps the price of the currency in terms of gold fixed--except in the event of a well understood emergency such as a major war (or financial crisis). In wartime it may suspend gold convertibility and issue paper money to finance its expenditures, and it can sell debt issues in terms of the nominal value of its currency, on the understanding that debt will eventually be paid off in gold. The rule is contingent in the sense that the public understands that the suspension will only last for the duration of the wartime emergency plus some period of adjustment. It assumes that afterwards the government will follow the deflationary policies necessary to resume payments at the original parity. Following such a rule will also allow the government to smooth its revenue from different sources of finance: taxation, borrowing, and seigniorage, (Lucas and Stokey, 1983, Mankiw, 1987).

According to Bordo and Kydland (1992), the gold standard contingent rule worked

successfully for three core countries of the classical gold standard: Britain, the U.S., and France. In all these countries the monetary authorities adhered faithfully to the fixed price of gold except during major wars. During the Napoleonic War and World War I for England, the Civil War for the U.S., and the Franco Prussian War for France, specie payments were suspended, paper money and debt were issued. But in each case, after the wartime emergency had passed, policies leading to resumption were adopted.³³ Indeed, successful adherence to the rule may have enabled the belligerents to obtain access to debt finance more easily in subsequent wars. Other countries, such as Italy, which did not continuously maintain gold convertibility, nevertheless adopted policies consistent with long-run convertibility.³⁴

The gold standard rule may also have been enforced by reputational considerations. Long-run adherence to the rule was based on the historical evolution itself of the gold standard. Gold was accepted as money because of its intrinsic value and desirable properties. Paper claims, developed to economize on the scarce resources tied up in a commodity money, became acceptable only because they were convertible into gold. An alternative commitment mechanism was to guarantee gold convertibility in the constitution. This was the case for example in Sweden before 1914, when laws pertaining to the gold standard could be changed only by two identical parliamentary decisions with an election in between (Jonung, 1984, p.368). Convertibility was also enshrined in the laws of a number of gold standard central banks (Giovannini, 1992).

The gold standard originally evolved as a domestic commitment mechanism but its enduring fame is as an international rule. The classical gold standard emerged as a true international standard by 1880 following the switch by the majority of countries from bimetallism, silver monometallism, and paper to gold as the basis of their currencies, (Eichengreen, 1985). As an international standard, the key rule was maintenance of gold convertibility at the established par. Maintenance of a fixed price of gold by its adherents in turn ensured fixed exchange rates. Recent evidence suggests that, indeed, exchange rates throughout the 1880 to 1914 period were characterized by a high degree of fixity in the principal countries. Although exchange rates frequently deviated from par, violations

of the gold points were rare (Officer 1986), as were devaluations (Eichengreen 1985).

According to the game theoretic literature, for an international monetary arrangement to be effective both between countries and within them, a time consistent credible commitment mechanism is required. Adherence to the gold convertibility rule provided such a mechanism. In addition to the reputation of the domestic gold standard and constitutional provisions which ensured domestic commitment, adherence to the international gold-standard rule may have been enforced by other mechanisms. These include improved access to international capital markets, the operation of the rules of the game, and the hegemonic power of England.

Support for the international gold standard likely grew because it provided improved access to the international capital markets of the core countries. Countries were eager to adhere to the standard because they believed that gold convertibility would be a signal to creditors of sound government finance and the future ability to service debt.³⁵

This was the case both for developing countries seeking access to long-term capital, such as Austria-Hungary (Yeager 1984) and Latin America (Fishlow 1989), and for countries seeking short-term loans, such as Japan, which financed the Russo-Japanese war of 1905-1906 with foreign loans seven years after joining the gold standard (Hayashi 1989). Once on the gold standard, these countries feared the consequences of suspension (Eichengreen, 1989a, p.19, Fishlow 1987, 1989). The fact that England, the most successful country of the nineteenth century, as well as other "progressive" countries were on the gold standard was probably a powerful argument for joining (Friedman 1990, Gallarotti 1991).

The operation of the "rules of the game," whereby the monetary authorities were supposed to alter the discount rate to speed up the adjustment to a change in external balance, may also have been an important part of the commitment mechanism to the international gold-standard rule. To the extent the "rules" were followed and adjustment facilitated, the commitment to convertibility was strengthened and conditions conducive to abandonment were lessened.

Evidence on the operation of the "rules of the game" questions their validity. Bloomfield

(1959), in a classic study, showed that, with the principal exception of England, the rules were frequently violated in the sense that discount rates were not always changed in the required direction (or by sufficient amounts) and in the sense that changes in domestic credit were often negatively correlated with changes in gold reserves. In addition, a number of countries used gold devices--practices to prevent gold outflows.

For the major countries, however, at least before 1914, such policies were not used extensively enough to threaten the convertibility into gold--evidence for commitment to the rule (Schwartz 1984). Moreover, as McKinnon (1992) argues, to the extent monetary authorities followed Bagehot's rule and prevented a financial crisis while seemingly violating the "rules of the game," the commitment to the gold standard in the long run may have been strengthened.

An additional enforcement mechanism for the international gold-standard rule may have been the hegemonic power of England, the most important gold-standard country (Eichengreen 1989b). A persistent theme in the literature on the international gold standard is that the classical gold standard of 1880 to 1914 was a British-managed standard (Bordo 1984). Because London was the center for the world's principal gold, commodities, and capital markets, because of the extensive outstanding sterling-denominated assets, and because many countries used sterling as an international reserve currency (as a substitute for gold), it is argued that the Bank of England, by manipulating its bank rate, could attract whatever gold it needed and, furthermore, that other central banks would adjust their discount rates accordingly. Thus, the Bank of England could exert a powerful influence on the money supplies and price levels of other gold-standard countries.

The evidence suggests that the Bank did have some influence on other European central banks (Lindert 1969). Eichengreen (1987) treats the Bank of England as engaged in a leadership role in a Stackelberg strategic game with other central banks as followers. The other central banks accepted a passive role because of the benefits to them of using sterling as a reserve asset. According to this interpretation, the gold-standard rule may have been enforced by the Bank of England.³⁶ Thus, the monetary authorities of many countries may have been constrained from following independent

discretionary policies that would have threatened adherence to the gold-standard rule.

Indeed, according to Giovannini (1989), the gold standard was an asymmetric system. England was the center country. It used its monetary policy (bank rate) to maintain gold convertibility. Other countries accepted the dictates of fixed parities and allowed their money supplies to passively respond. His regressions support this view--the French and German central banks adapted their domestic policies to external conditions, whereas the British did not.

The benefits to England as leader of the gold standard--from seigniorage earned on foreign-held sterling balances, from returns to financial institutions generated by its central position in the gold standard and from access to international capital markets in wartime--were substantial enough to make the costs of not following the rule extremely high.

The classical gold standard ended in the face of the massive shocks of World War I.³⁷ The gold exchange standard, which prevailed for only a few years from the mid-1920's to the Great Depression, was an attempt to restore the beneficial features of the classical gold standard while allowing a greater role for domestic stabilization policy. This in turn created a growing conflict between adherence to the rule and discretion. It also attempted to economize on gold reserves by restricting its use to central banks and by encouraging the use of foreign exchange as a substitute. As is well known, the gold exchange standard suffered from a number of fatal flaws (Kindleberger 1973, Temin 1989, Eichengreen 1992c). These include the use of two reserve currencies (the pound and the dollar), the absence of leadership by a hegemonic power, the failure of cooperation between the key members (England, France and the United States), and the unwillingness of its two strongest members, the United States and France, to follow the "rules of the game," instead exerting deflationary pressure on the rest of the world by persistent sterilization of balance-of-payment surpluses. The gold exchange standard collapsed, but according to Friedman and Schwartz (1963), Temin (1989), and Eichengreen (1992c), not before transmitting deflation and depression across the world.

3.2 The Bretton Woods International Monetary System

The planning that led to Bretton Woods aimed to avoid the chaos of the interwar period.³⁸ The perceived ills to be avoided included; (1) floating exchange rates that were condemned as subject to destabilizing speculation; (2) the gold exchange standard that was vulnerable to problems of adjustment, liquidity and confidence, which enforced the international transmission of deflation in the early 1930's and (3) the resort to beggar-thy-neighbor devaluations, trade restrictions, exchange controls, and bilateralism after 1933. To avoid these ills, the case for an adjustable peg system was made by Keynes, White, Nurkse and others. The new system would combine the favorable features of the fixed-exchange rate gold standard--stability of exchange rates--and of flexible rates--monetary and fiscal independence.

Both Keynes, leading the British negotiating team, and White, leading the American team at Bretton Woods, planned an adjustable peg system to be coordinated by an international monetary agency. The Keynes plan gave the International Currency Union substantially more reserves and power than the United Nations Stabilization Fund proposed by White, but both institutions would have had considerable control over the domestic financial policy of the members.

The British plan contained more domestic policy autonomy than did the U.S. plan, while the American plan put more emphasis on exchange rate stability. Neither architect was in favor of a rule-based system.³⁹ The British were most concerned to avoid the deflation of the 1930's which they attributed to the constraint of the gold standard rule and to deflationary U.S. monetary policies. Thus they wanted an expansionary system.

The American plan was closer to the gold standard rule in that it stressed the fixity of exchange rates. It did not explicitly mention the importance of rules as a credible commitment mechanism but there were to be strict regulations on the linkage between UNITAS (the proposed international reserve account) and gold. Members, in the event of a fundamental disequilibrium, could only change their parities on approval by a three-quarters majority of all members of the Fund (Giovannini, 1992).

The Articles of Agreement incorporated elements of both the Keynes and White plans

although in the end, U.S. concerns predominated.⁴⁰ The main points of the Articles were: the creation of the par value system; multilateral payments; the use of the Fund's resources; the Fund's powers; and its organization.

- The Par Value System

Article IV defined the numeraire of the international monetary system as either gold or the U.S. dollar of the weight and fineness on July 1, 1944. All members were urged to declare a par value and maintain it within a one-percent margin on either side of parity. Parity could be changed in the event of a fundamental payments disequilibrium at the decision of the member, after consultation with the Fund. However, the Fund would not disapprove the change if it was not more than 10% and, if more than 10%, the Fund would decide within 72 hours. Unauthorized changes in the exchange rate could make members ineligible to use the Fund's resources and if they were to persist could lead to a member's expulsion. A uniform change in par value of all currencies (in terms of gold) required a majority of the total voting power and also had to be approved by every member with 10% or more of the total quota.

Multilateral Payments

Members were supposed to make their currencies convertible for current account transactions (Article VIII) but capital controls were permitted (Article VI.3). They were also to avoid discriminatory currency and multiple currency arrangements. However, countries could avoid declaring their currencies convertible by invoking Article XIV which allowed a three year transition period after establishment of the Fund. During the transition period, existing exchange controls could be maintained.⁴¹

The Fund's Resources

As under the White plan, members could obtain resources from the Fund to help finance short- or medium-term payments disequilibria. The total Fund, contributed by members quotas (25% in gold, 75% currencies) was set at \$8.8 billion. It could be raised every five years if the majority of members wanted to do so. The Fund set a number of conditions on the use of its resources by deficit

countries to prevent it from accumulating soft currencies and from depleting its holdings of harder currencies.⁴² It also established requirements and conditions for repurchase (repayment of a loan) including giving the Fund the right to decide the currency in which repurchase would be made. In the case of countries prone to running large surpluses, the scarce currency clause (Article VII) would come into play. If the Fund's holdings of a currency were insufficient to satisfy the demand for it by other members, it could declare it scarce and then urge members to ration its use by discriminatory exchange controls.

The Powers of the Fund

The Fund had considerably less discretionary power over the domestic policies of its members than either of the architects wanted but it still had power to strongly influence the international monetary system. These powers included its authority to approve or disapprove of: changes in parity; the use of multiple exchange rates and other discriminatory practices; the conditionality that was implicit in member's access to the credit tranches of their quotas and made explicit by 1952 (Diz, 1984); its authority to declare currencies scarce, its authority to declare members ineligible to use its resources--used against France in 1948 following an unapproved devaluation--and its ultimate authority to expel members. The Fund also had considerable power as the premier international monetary organization in consulting and co-operating with national and other international monetary authorities.

Organization

The Fund was to be governed by a Board of Governors appointed by the members. It would make the major policy decisions such as approving a change in parity. Operations of the Fund were to be directed by Executive Directors appointed by the members and a Managing Director selected by the Executive Directors. Major changes such as a uniform change in the par value of all currencies or the Second Amendment creating the SDR would require a majority vote by the members. The number of votes in turn was tied to the size of each member's quota, which was determined by its economic size.

Though the Articles could not be interpreted strictly as a return to the gold standard rule of the fixed price of gold with free convertibility, the fixed price of gold at \$35 per ounce which the U.S. was to maintain, represented the nominal anchor of the system. Members were required to maintain parity of their exchange rates in terms of dollars (or gold). Also, like the gold standard, it was a rule with an escape clause--members at their initiative could alter their parities in the event of a fundamental disequilibrium.

The architects never spelled out exactly how the system was supposed to work. However subsequent writers have suggested a number of salient features.⁴³ First, currencies were treated as equal in the Articles. This meant that in theory each country was required to maintain its par value by intervening in the currency of every other country--a practice which would have worked at cross purposes. In fact, because the U.S. was the only country which pegged its currency in terms of gold (bought and sold gold), all other countries would fix their parities in terms of dollars and would intervene to monitor their exchange rates within 1% of parity with the dollar.

Second, countries would use their international reserves or draw resources from the Fund to finance payments deficits. In the case of surpluses, countries would temporarily build up reserves or repurchase their currencies from the Fund. In the event of medium-term disequilibria, they would use monetary and fiscal policy to alter aggregate demand. In the event of a fundamental disequilibrium, which was never defined but presumably reflected either some permanent structural shock or sustained inflation, a member was supposed to alter parity by an amount sufficient to restore external equilibrium. Third, capital controls were permitted to prevent destabilizing speculation from forcing members to alter their parities prematurely or unintentionally.

3.2.1 The History of Bretton Woods: Pre Convertibility 1946-1958

The international monetary system that began after World War II was far different from the system that the architects of Bretton Woods envisioned. The transition period from war to peace was much longer and more painful than was anticipated. Full convertibility of the major industrial countries was not achieved until the end of 1958 although the system had started functioning normally

by 1955. Two interrelated problems dominated the first postwar decade: bilateralism and the dollar shortage.

Bilateralism

The legacy of World War II for virtually every country, except the U.S., was one of pervasive exchange controls and controls on trade. No major currency except the dollar was convertible.⁴⁴ Under Article XIV of the Bretton Woods agreement, countries could continue to use exchange controls for an indefinite transition period after the establishment of the IMF on March 1, 1947. In conjunction with exchange controls, every country negotiated a series of bilateral payments agreements with each of its trading partners. The rationale for the continued use of controls and bilateralism was a shortage of international reserves. After the war, the economies of Europe and Asia were devastated. To produce the exports needed to generate foreign exchange, industries required new and improved capital. There was an acute shortage of key imports, both foodstuffs to maintain living standards and raw materials and capital equipment. Controls allocated the scarce reserves.

The Dollar Shortage

By the end of World War II, the U.S. held two thirds of the world's monetary gold stock (see figure 14). The gold avalanche in the U.S. in the 1930's was the consequence of both the dollar devaluation in 1934, when the Roosevelt administration raised the price of gold from \$20.67 per ounce to \$35.00, and capital flight from Europe. During the war, gold inflows continued to finance wartime expenditures by the allies. At the end of World War II, Europe's (and Japan's) gold and dollar reserves were depleted. Europe ran a massive current account deficit reflecting the demand for essential imports and the reduced capacity of the export industries. The OEEC deficit, aggravated by the bad winter of 1946-47, reached a 1947 high of \$9 billion (Triffin, 1957, p. 32), the amount of the U.S. current account surplus, since the U.S. as the only major industrial country operating at full capacity supplied the needed imports. The dollar shortage was likely aggravated by overvalued official parities set by the major European industrial countries at the end of 1946 (Triffin, 1957,

Chapter 2).

By the mid 1950's both problems had been solved. The currencies of Western Europe were virtually convertible by 1955 and their current accounts were generally in surplus. The key developments in this progress were the Marshall Plan and the European Payments Union.

The Marshall Plan

The Marshall Plan funnelled approximately \$13 billion in aid (grants and loans) to Western Europe between 1948 and 1952 (See Milward, 1984 and Hoffman and Maier, 1984). The Plan required the members to cooperate in the liberalization of trade and payments. Consequently, the Organization for European Economic Cooperation (OEEC) was established in April, 1948. It presided over the allocation of aid to members based on the size of their current account deficits. U.S. aid was to pay for essential imports and to provide international reserves. Each recipient government provided matching funds in local currency to be used for investment in the productive capacity of industry, agriculture, and infrastructure. Each country also had a delegation of U.S. administrators which advised the host government on the spending of its counterpart funds. The plan encouraged the liberalization of intra-European trade and payments by granting aid to countries which extended bilateral credits to other members. Finally, the European Payments Union was established in 1950, under the auspices of the OEEC, to simplify bilateral clearing and pave the way to multilateralism.

By 1952, in part thanks to the Marshall Plan, the OEEC countries had achieved a 39% increase in industrial production, a doubling of exports, an increase in imports by one-third, and a current account surplus (Solomon, 1976, p. 18).

The European Payments Union and the Return to Convertibility

It took twelve years from the declaration of official par values by thirty-two nations in December 1946, to the achievement of convertibility for current transactions by the major industrial countries, as specified by the Bretton Woods Articles. The Western European nations tried several schemes to facilitate the payments process before establishing the European Payments Union (EPU) in 1950 (See Kaplan and Schleiminger, 1989).

The EPU, established September 19, 1950 by the OEEC countries, initially was to run for two years, renewable thereafter on a yearly basis. It followed the basic principle of a commercial bank clearinghouse. At the end of each month, each member would clear its net debit or credit position (against all other members) with the Union (the BIS acting as its agent). The unit of account for these clearings was the U.S. dollar. The EPU also provided extensive credit lines. The EPU was highly successful in reducing the volume of payments transactions and provided the background for the gradual liberalization of payments, so that by 1953 commercial banks were able to engage in multicurrency arbitrage (Tew 1988, Yeager 1976). On December 27, 1958, eight countries declared their currencies convertible for current account transactions.

The movement to convertibility was aided by the devaluations of 1949. Following a speculative run on the pound in the summer of 1949, the British, twenty-four hours after informing the IMF, devalued the pound by 30.5%. Shortly thereafter, twenty-three countries reduced their parities by, in most cases, similar magnitudes.

The devaluations of 1949 were important for the Bretton Woods system for two reasons. First, they, along with the Marshall Plan aid, helped move the European countries from a current account deficit to a surplus, a movement important to the eventual restoration of convertibility. Second, they revealed a basic weakness of the adjustable peg arrangement--the one-way option of speculation against parity. By only allowing changes in parity in the event of fundamental disequilibrium, the Bretton Woods system encouraged the monetary authorities to delay adjustment until they were sure it was necessary. By that time, speculators also would be sure and they would take a position from which they could not lose. If the currency is devalued, they win and if it is not, they just lose the interest (if any) on the speculative funds (Friedman 1953). The crisis associated with the 1949 sterling devaluation in turn created further resistance by monetary authorities to changes in parity, which ultimately changed the nature of the international monetary system from the adjustable peg intended by the Articles to a fixed rate regime.

Other developments in the preconvertibility period included the decline of sterling as a reserve

asset and the reduced prestige of the IMF. The IMF by intention was not equipped to deal with the postwar reconstruction problem. Although some limited drawings occurred before 1952, most of the structural balance of payments assistance in this period was provided by the Marshall Plan and other U.S. assistance, including the Anglo-American Loan of 1946. The consequence of this development is that other institutions such as the BIS, the agent for the EPU, emerged as competing sources of international monetary authority (Mundell 1969).

The Fund's prestige was dealt a severe blow by three events in the preconvertibility period. The first event was the French devaluation of January 1948, which created a multiple exchange rate system. The Fund censured France for creating broken cross rates between the dollar and the pound. France was denied access to the Fund's resources until 1952. France ended the broken cross rates in October 1948 and adopted a unified rate in the devaluation of 1949. Since France had access to the Marshall Plan, the Fund's actions had little effect. The second event was the sterling devaluation of September 1949 when the Fund, instead of being actively involved in consultation, was given twenty-four hours perfunctory notice. The third event was the decision by Canada to float its currency in September 1950. Though the Fund was highly critical of the action, it was unable to prevent it. The Canadian dollar floated successfully until 1961.

Finally, the Fund's resources were inadequate to solve the emerging liquidity problem of the 1960's. The difference between the required growth of international reserves (to finance the growth of real output and trade and to avoid deflation) and the growth in the world's monetary gold stock was met largely by an increase in official holdings of U.S. dollars resulting from growing U.S. balance of payments deficits. By the time full convertibility was achieved, the U.S. dollar was serving the buffer function intended by the Articles for the Fund's resources (Mundell, 1969, p.481).

3.2.2 The History of Bretton Woods: The Heyday of Bretton Woods 1959-1967

With the establishment of current account convertibility by the Western European industrial nations at the end of December, 1958, the full blown Bretton Woods system was in operation. Each member intervened in the foreign exchange market, either buying or selling dollars, to maintain its

parity within the prescribed 1% margins. The U.S. Treasury in turn pegged the price of the dollar at \$35.00 per ounce by freely buying and selling gold. Thus each currency was anchored to the dollar and indirectly to gold. Triangular arbitrage kept all cross rates within a band of 2% on either side of parity. Through much of this period capital controls prevailed in most countries except the U.S. in one form or another, although by the mid-1960's their use declined while increasing in the U.S..

The system that operated in the next decade turned out to be quite different from what the architects had in mind. First, instead of a system of equal currencies, it evolved into a variant of the gold exchange standard--the gold-dollar system. Initially, it was a gold exchange standard with two key currencies, the dollar and the pound. But the role of the pound as key currency declined steadily throughout the 1960's. Parallel to the decline of sterling was the rise in the dollar as a key currency. Use of the dollar as both a private and official international money increased dramatically in the 1950's and continued into the 1960's. With full convertibility, the dollar's fundamental role as intervention currency led to its use as international reserves. This was aided by stable and low monetary growth and relatively low inflation (before 1965). See figure 1 and table 1.

The gold exchange standard evolved in the post World War II period for the same reasons it did in the 1920's--to economize on noninterest-bearing gold reserves. Postwar, the growth of the world's monetary gold stock was by the late 1950's insufficient to finance the growth of world real output and trade (Triffin, 1960 and Gilbert, 1968). The other intended source of international liquidity--the resources of the Fund--was also insufficient.

The second important difference between the convertible Bretton Woods system, and the intentions of the Articles was the evolution of the adjustable peg system into a virtual fixed exchange rate system. Between 1949 and 1967, there were very few changes in parities of the G-10 countries. The only exceptions were the Canadian float in 1950, devaluations by France in 1957 and 1958 and minor revaluations by Germany and the Netherlands in 1961. The adjustable peg system became less adjustable because the monetary authorities, based on the 1949 experience, were unwilling to accept the risks associated with discrete changes in parities--loss of prestige, the likelihood that others would

follow, and the pressure of speculative capital flows if even a hint of a change in parity were present.

As the system evolved into a fixed exchange rate gold dollar standard, the three key problems of the interwar system re-emerged: adjustment, liquidity and confidence. These problems dominated academic and policy discussions during the period.

The Adjustment Problem

The adjustment issue focused on how to achieve it in a world with capital controls, fixed exchange rates, and domestic policy autonomy. Various policy measures were proposed to aid adjustment including incomes policies, rescue packages, capital and trade controls, a mix of monetary and fiscal policy, and the injection of new liquidity. Of particular interest during the period was asymmetry in adjustment between deficit countries like the U.K. and surplus countries like Germany and between the U.S. as the reserve currency country and rest of the world.

Both the U.K. and Germany ran the gauntlet between concern over external convertibility and domestic stability. The U.K. alternated between expansionary policy that led to balance of payments deficits and austerity. Germany alternated between a balance of payments surplus that led to inflation and austerity.

The United States had an official settlements balance of payments deficit in 1958 which persisted, with the notable exception of 1968-1969, until the end of Bretton Woods. See figure 15. However, with the exception of 1959, the U.S. had a current account surplus until 1970. The balance of payments deficit under Bretton Woods arose because capital outflows exceeded the current account surplus. In the early postwar years, the outflow consisted largely of foreign aid. By the end of the 1950's private long-term investment abroad (mainly direct investment) exceeded military expenditures abroad and other official transfers (Eichengreen 1991c).

The balance of payments deficit was perceived as a problem by the U.S. monetary authorities because of its effect on confidence. As official dollar liabilities held abroad mounted with successive deficits, the likelihood increased that these dollars would be converted into gold and eventually the U.S. monetary gold stock would reach a point low enough to trigger a run. Indeed the U.S. monetary

gold stock by 1959 equalled total external dollar liabilities and the rest of the world's monetary gold stock exceeded that of the U.S. See figure 14. By 1964 official dollar liabilities held by foreign monetary authorities exceeded the U.S. monetary gold stock.

A second reason the balance of payments deficit was perceived as a problem was the dollar's role in providing liquidity to the rest of the world. Elimination of the U.S. deficit would create a worldwide liquidity shortage.

For the Europeans the U.S. balance of payments deficit was a problem for different reasons. First, as the reserve currency country the U.S. did not have to adjust her domestic economy to the balance of payments. As a matter of routine, the Federal Reserve automatically sterilized dollar outflows. The asymmetry in adjustment was resented. The Germans viewed the U.S. as exporting inflation to surplus countries through its deficits. Their remedy was for the U.S. (and the U.K.) to pursue contractionary monetary and fiscal policy (Emminger, 1967). In fact, U.S. inflation was less (on a GNP weighted average basis) than that of the rest of the G-7 before 1968. See figures 1 and 19. The French resented U.S. financial dominance and the seigniorage which they believed the U.S. earned on its outstanding liabilities. Acting upon this perception, the French in 1965 began to systematically convert outstanding dollar liabilities into gold. The French solution to the dollar problem was to double the price of gold--the amount by which the real price of gold had declined since 1934. The capital gains earned on the revaluation of the world's monetary gold reserves would be sufficient to retire the outstanding dollar (and sterling) balances. Once the U.S. returned to balance of payments equilibrium, the world could return to a fully functioning classical gold standard. (Rueff, 1967).

Some economists argued that the U.S. balance of payments deficit was not really a problem. The rest of the world voluntarily held dollars because of their valuable service flow--the deficit was demand determined (Despres, Kindleberger and Salant, 1966).

The policy response of the U.S. monetary authorities was fourfold: to impose controls on capital exports; to institute measures to improve the balance of trade; to alter the monetary fiscal

policy mix; and to employ measures to stem the conversion of outstanding dollars into gold.

During this period, various solutions to the U.S. adjustment problem were proposed: provision of an alternative international reserve media to increase world liquidity; an increase in the price of gold, either unilaterally which would devalue the dollar against other currencies, or by a uniform change in all parities as under Article IV, and increased exchange rate flexibility.⁴⁶

The U.S. balance of payments policies were in the main ineffective (Meltzer, 1991). As long as the U.S. maintained relatively stable prices, as it did before 1965, the system could be preserved for a number of years. The real problem was that of the gold exchange standard--ultimately a convertibility crisis was inevitable. The twin solutions advocated at the time of an increase in the price of gold and an increase in world liquidity by creation of an artificial reserve asset would not have permanently eradicated the problem.⁴⁶

The Liquidity Problem

The liquidity problem, posed by Robert Triffin and others, evolved from a shortfall of monetary gold beginning in the late 1950's. The real price of gold had been falling since World War II and would eventually reduce world gold production. This happened in the early 1950's but was offset by new sources of production. Gold production declined again in 1966. Moreover, the falling real price would stimulate private demand for gold and it seemed unlikely that Russian gold sales would make up much of the shortfall. The prospect for growth in the world monetary gold stock to be adequate to finance the growth of world real output and the value of trade (without deflation) seemed dim. As can clearly be seen in figure 16 for the G-7, this was the case. A large gap opened in 1958 between the growth of output and the volume of trade and the growth of G-7 gold reserves. As can be seen in figure 17, the shortfall for the G-7 excluding the U.S., was made up by a drain on the U.S. monetary gold reserves until 1966.

As Triffin (1960) pointed out, dollars, supplied by the U.S. deficit could not be a permanent solution to the impending gold shortage because with continuous deficits, U.S. monetary gold reserves would decline both absolutely and relatively to outstanding dollar liabilities until an eventual

convertibility crisis. However, should the U.S. monetary authorities close the deficit before such a crisis, it would create a massive shortage of international liquidity and the prospect of world deflation. New sources of liquidity were required, answered by the creation of the SDR's in 1967. However, by the time SDR's were injected into the system in 1970, they exacerbated worldwide inflation.

The Confidence Problem

The key perceived problem of the convertible Bretton Woods period was the confidence crisis for the dollar.⁴⁷ As argued by Triffin (1960), Kenen (1960) and Gilbert (1968), the gold dollar system that evolved after 1959 was bound to be dynamically unstable if the growth of the world monetary gold stock was insufficient to finance the growth of world output and trade and to prevent the U.S. monetary gold stock from declining relative to outstanding U.S. dollar liabilities. The pressure on the U.S. monetary gold stock would continue, as growth of the world monetary gold stock declined relative to the growth of world output and trade and the world substituted dollars for gold, until at some point a confidence crisis would be triggered leading to the collapse of the system as occurred in 1931. However, at the same time as fears over U.S. gold convertibility threatened the dynamic stability of the Bretton Woods system gold still served two positive roles.

Gold was the numeraire of the system; all currencies were anchored to its fixed price via the U.S. commitment to peg its price. Until 1968 gold still served as backing to the U.S. dollar via a 25% gold reserve requirement against Federal Reserve notes; the requirement may have served as a brake on U.S. monetary expansion.

The first glimpse of a confidence crisis was the gold rush of October 1960 when speculators pushed the free market price of gold on the London market up from \$35.20 (the U.S. Treasury's buying price) to \$40.00. See figure 18. This first significant runup in gold prices, since the London gold market was reopened in 1954, was supposedly triggered by concerns over a Democratic victory in the 1960 U.S. Presidential election.

The U.S. monetary authorities feared that private speculation in the gold market might spill over into official demands for conversion. Consequently remedial action was quickly taken. The

Treasury supplied the Bank of England sufficient gold to restore stability and the monetary authorities of the G-10 agreed to refrain from buying gold above \$35.20. In succeeding months, the London Gold Pool was formed between the U.S. and seven other central banks, which agreed to buy or sell gold in order to peg the price at \$35.00 per ounce. The pool became official in November, 1961. For the next six years, it succeeded in stabilizing the price of gold, but did not prevent a steady decline in the U.S. monetary gold stock. See figure 14. In fact, though the seven other central banks supplied 40% of the gold required to stabilize the price of gold, they replenished their monetary gold stocks outside the Pool by converting outstanding dollar balances into gold at the U.S. Treasury (Meltzer, 1991, p.63).

During the period 1961 to 1967, the U.S. made a series of arrangements to protect its monetary gold reserves. These included a network of swap arrangements with other central banks, Roosa bonds, and moral suasion. However, France did not go along with these efforts and began its campaign against the dollar in February, 1965.

The period was marked by two sets of underlying forces which would undermine the dollar's relationship to gold--growing gold scarcity and a rise in U.S. inflation. World gold production levelled off in the mid 1960's and even declined in 1966, while at the same time private demand soared, precipitating a drop in the world monetary gold stock after 1966. Indeed, beginning in 1966, the Gold Pool became a net seller of gold. Also, U.S. money growth accelerated in 1965, in part to finance the Vietnam War, and inflation began to rise (figures 1 and 19). The current account surplus began to deteriorate in 1964 (figure 15), and U.S. competitiveness to deteriorate, mirrored in a rise of the ratio of U.S. unit labor costs relative to trade weighed unit labor costs (Meltzer, 1991, p. 71). The balance of payments deficit worsened between 1964 and 1966, but was reversed in 1966 by capital inflows triggered by tight monetary policy.

After the devaluation of sterling, which the U.S. tried unsuccessfully to prevent, pressure mounted against the dollar via the London gold market. From December 1967 to March 1968 the Gold Pool lost \$3 billion in gold, with the U.S. share at \$2.2 billion (Solomon, 1976, p. 119). The

immediate concerns of the speculators may have been fears of a dollar devaluation but, according to Gilbert (1968) and Johnson (1968), it reflected the underlying gold scarcity. In the face of the pressure, the Gold Pool was disbanded on March 17, 1968, and a two-tier arrangement put in its place. Henceforth, the monetary authorities of the Gold Pool agreed neither to sell nor buy gold from the market. They would only transact among themselves at the official \$35.00 price. In addition, on March 12, 1968, the U.S. removed the 25% gold reserve requirement against Federal Reserve notes. The key consequence of these new arrangements was that gold was demonetized at the margin. The link between gold production and other market sources of gold and official reserves was cut. Moreover, in the following years, the U.S. put considerable pressure on other monetary authorities to refrain from converting their dollar holdings into gold.

By 1968 the international monetary system had evolved very far indeed from the model of the architects of the Articles of Agreement. In reaction to both developments in financial markets and the confidence problem, the system had evolved into a de facto dollar standard. However, gold convertibility still played a role. Though the major industrial countries tacitly agreed not to convert their outstanding dollar liabilities into U.S. monetary gold, the threat of their doing so was always present. At the same time, as the countries of continental Europe and Japan gained in economic strength relative to the U.S., they became more reluctant to absorb outstanding dollars. They also were reluctant to adjust their surpluses by revaluing their currencies, increasingly coming to believe that adjustment should be undertaken by the U.S.

The system also had developed into a de facto fixed-exchange rate system. However, unlike the classical gold standard, where the fixed exchange rate was the voluntary focal point for both internal and external equilibrium, in the Bretton Woods system exchange rates became fixed out of member's fears of the consequences allowing them to change. Nevertheless, because of increased capital mobility, the pressure for altering the parities of countries with persistent deficits and surpluses became harder to stop through the use of domestic policy tools and the aid of international rescue packages. Pressure increased from both academic and official sources for greater exchange

rate flexibility.

By 1968, the system had also evolved a form of international governance which was quite different from that envisioned at the beginning. Instead of a community of equal currencies managed by the IMF, the system was managed by the U.S. in cooperation with the other members of the G-10. In many respects, it was closer to the key currency system proposed by Williams (1936,1943). (See Johnson, 1972b).

According to Dominguez (1992), the IMF was designed to facilitate international cooperation by serving as a commitment mechanism. It was to use its influence and its financial assistance to enforce the par value system. However, it did not have sufficient power to prevent devaluations by major countries and its financial resources were too limited to provide adequate adjustment assistance, for them. The IMF still had an important role as a clearing house for different views on monetary reform, as a center of information, as the principal voice for the countries of the world other than the G-10, as their primary source of adjustment assistance and finally as an important partner in the major G-10 rescue packages.

In sum, the problems of the interwar system that Bretton Woods was designed to avoid re-emerged with a vengeance. The fundamental difference, however, was that the system was not likely to collapse into deflation as in 1931 but rather explode into inflation.

3.2.3 The Collapse of Bretton Woods

After the establishment of the two-tier arrangement, the world monetary system was on a de facto dollar standard. The system became increasingly unstable until it collapsed with the closing of the gold window in August 1971. The collapse of a system beset by the fatal flaws of the gold exchange standard and the adjustable peg was triggered by an acceleration in world inflation, in large part the consequence of an earlier acceleration of inflation in the United States. Before 1968, the U.S. inflation rate was below that of the GNP weighted inflation rate of the G-7 excluding the U.S. (see figure 19). It began accelerating in 1964, with a pause in 1966-67. The increase in inflation in the U.S. and the rest of the world was closely related to an increase in money growth, figure 20, and in

money growth relative to the growth of real output. See figure 21. Indeed, a prevalence of excess demand shocks in the mid and late 1960's is apparent for the U.S. and other G-7 countries in figures 12 and 13.

Darby et al (1983) provided considerable evidence on the transmission of inflation in the Bretton Woods system. Their regressions led to a number of important conclusions. First, U.S. inflation was caused by lagged U.S. money growth. Second U.S. money growth was independent of changes in international reserves--the balance of payments had no effect on the Federal Reserve's reaction function. Third, U. S. money growth had strong and significant effects on money growth in seven major countries with very long lags - up to four years. These lags reflected the fact that central banks in the seven countries partially sterilized reserve flows. Finally, money growth in the seven countries explained inflation in these countries with a significant lag. (Darby, et al, 1983, chapter 1).

The key transmission mechanism of inflation was the classical price specie flow mechanism augmented by capital flows. Little evidence for other mechanisms including commodity market arbitrage was detected (Darby et al, 1983, Ch. 12). According to these authors, the Bretton Woods system collapsed because of the lagged effects of U.S. expansionary monetary policy. As the dollar reserves of Germany, Japan and other countries accumulated in the late 1960's and early 1970's, it became increasingly more difficult to sterilize them. This fostered domestic monetary expansion and inflation. In addition, world inflation was aggravated by expansionary monetary and fiscal policies in the rest of the G-7, as their governments adopted full employment stabilization policies. The only alternative to importing U.S. inflation was to float--the route taken by all countries in 1973.⁴⁸

The crisis mounted from 1968 to 1971. The U.S. current account balance continued to deteriorate in 1968 but the overall balance of payments exhibited a surplus in 1968 and 1969, thanks to a large short-term capital inflow. The capital inflow was activated by events in the Eurodollar market. In the face of tight monetary policy in 1968-69 and Regulation Q ceilings on time deposits, deposits shifted from U.S. banks to the Eurodollar market. U.S. banks in turn borrowed in the

Eurodollar market repatriating these funds. In 1970, as U.S. interest rates fell in response to rapid monetary expansion and Regulation Q was suspended for large CD's, the borrowed funds returned abroad and the deficit grew to \$9 billion, exploding to \$30 billion by August 1971. See figure 15. The dollar flood increased the reserves of the surplus countries auguring inflation. German money growth doubled from 6.4% to 12% in 1971 and the German inflation rate increased from 1.8% in 1969 to 5.3% in 1971 (Meltzer, 1991, p. 73). Pressure mounted for a revaluation of the mark. In April 1971 the dollar inflow to Germany reached \$3 billion. On May 5, 1971, the German central bank suspended official operations in the foreign exchange market and allowed the Deutschmark to float. Similar action by Austria, Belgium, the Netherlands and Switzerland followed (Solomon, 1976, p. 179).

In the following months advocates of cutting the link with gold surfaced. In April 1971 the U.S. balance of trade turned to deficit for the first time and influential voices began urging dollar devaluation. The decision to suspend gold convertibility was triggered by French and British intentions in early August to convert dollars into gold. On August 15, at Camp David, President Nixon announced that he had directed Secretary Connolly "to suspend temporarily the convertibility of the dollar into gold or other reserve assets ..." The accompanying policy package included a 90-day wage-price freeze, a ten percent import surcharge, and a ten percent investment tax credit (Solomon, 1976, p. 186).

The U.S. decision to suspend gold convertibility ended a key aspect of the Bretton Woods system. The remaining part of the system--the adjustable peg--disappeared 19 months later.

The Bretton Woods system collapsed for three basic reasons. First, two major flaws undermined the system. One flaw was the gold exchange standard which placed the U.S. under threat of a convertibility crisis. In reaction it pursued policies which in the end made adjustment more difficult. The second flaw was the adjustable peg. Because the costs of discrete changes in parities were deemed high, in the face of growing capital mobility, the system evolved into a reluctant fixed exchange rate system without an effective adjustment mechanism.

Finally, U.S. monetary policy was inappropriate for a key currency. The U.S., after 1965, by

inflating followed an inappropriate policy for a key currency country. Though the acceleration of inflation was low by the standards of the following decade, when superimposed upon the cumulation of low inflation since World War II, it was sufficient to trigger a speculative attack on the world's monetary gold stock in 1968, leading to the collapse of the Gold Pool (Garber, 1992). Once the regime had evolved into a de facto dollar standard, the obligation of the U.S. was to maintain price stability. Instead, it conducted an inflationary policy, which ultimately destroyed the system.

3.2.4 Did the Bretton Woods System Operate As a System Based On Credible Rules?

One can view the Bretton Woods system as a set of rules or commitment mechanisms.⁴⁹ For nonreserve currency countries the rules were to maintain fixed parities, except in the contingency of a fundamental disequilibrium in the balance of payments, and to use financial policy to smooth out short-run disturbances. The enforcement mechanism was presumably the dominant power of the U.S.--access to its open capital markets--since the IMF had little power.

For the U.S., the center country, the rule was to fix the gold price of the dollar at \$35 per ounce and to maintain price stability. However, if a majority of members (and every member with 10% or more of the total quotas) agreed, the U.S. could change the dollar price of gold. There was no explicit enforcement mechanism other than reputation and the commitment to gold convertibility. According to Giovannini (1992), the Bretton Woods system was an asymmetric solution to Mundell's (1968) n-1 currency problem. The U.S. as the nth country, had to maintain the nominal anchor by following a stable monetary policy. In addition, it had to supply the dollars demanded by the rest of the world as reserves.

The rest of the world had to accept, via its commitment to fixed parities, the price level set by the U.S. But because of the adjustable peg it had the option to change parities. The rule was defective for the nonreserve currencies because the fundamental disequilibrium contingency was never spelled out and no constraint was placed on the extent to which domestic financial policy could stray from maintaining external balance. In addition, with growing capital mobility the option to change parities became less viable.

For the U.S. this rule suffered from a number of fatal flaws. First, because of the fear of a confidence crisis, the gold convertibility requirement may have prevented the U.S. in the early 1960's from acting as a center country and willingly supplying the reserves demanded by the rest of the world. Second, as became evident in the later 1960's, this requirement was useless in preventing the U.S. monetary authorities from pursuing an inflationary policy. Finally, although a mechanism was available for the U.S. to devalue the dollar, the monetary authorities were loath to use it for fear of undermining confidence. No effective enforcement mechanism existed. Ultimately, the U.S. attached greater importance to domestic economic concerns than to its role as the center of the international monetary system.

Thus, although the Bretton Woods system can be interpreted as one based on rules, the system did not provide a credible commitment mechanism⁵⁰. The U.S. was unwilling to subsume domestic considerations to the responsibility of maintaining a nominal anchor. At the same time other G-7 countries became increasingly unwilling to follow the dictates of the U.S. imposed world inflation rate.

The failure of the Bretton Woods rule suggests a number of requirements for a well designed fixed exchange rate system. These include: that the countries follow similar domestic economic goals (underlying inflation rates); that the rules be transparent; and that some central monetary authority enforce them. The recent EMS system was quite successful for a number of years because it seemed to encompass these three elements. However, its recent crisis reflected the emergence of some of the same problems that led to the breakdown of Bretton Woods. I discuss these issues below in the following subsection.

3.3 Post Bretton Woods: Managed Floating and the EMS

As a reaction to the flaws of the Bretton Woods system the world turned to generalized floating in March 1973. Though the early years of the float were often characterized as a dirty float, whereby monetary authorities extensively intervened to affect both the levels of volatility and exchange rates, by the end of the 1970's it evolved into a system where exchange market intervention

was done primarily to smooth out fluctuations. Again in the 1980's exchange market intervention was used by the G-7 as part of a strategy of policy coordination (Bordo and Schwartz, 1991). In recent years, floating exchange rates have been assailed from many quarters for excessive volatility in both nominal and real exchange rates, that in turn increase macro instability and raise the costs of international transactions.

The attack cites the favorable experience of the EMS from 1987 to 1991 in producing exchange rate and price stability as a recommendation for a return to a global system of fixed exchange rates. It is argued that recent attempts at policy coordination can be formalized and extended into a more general managed system based either on close policy coordination (to keep exchange rates within specified target zones) or a renewed gold standard. In this paper I do not consider the merits/ demerits of policy coordination in general⁵¹, but I briefly examine the EMS as a monetary regime similar to Bretton Woods. Of interest is whether lessons for the international monetary system can be derived from its experience.

The European Monetary System, like the Bretton Woods System, represents an agreement among countries to set exchange rate parities, to manage intra-European Community exchange rates, and to finance exchange market intervention. Like Bretton Woods, it is an adjustable peg system.

The origins of the EMS date back to the Bretton Woods period. The case for stable exchange rates within Europe was made in the context of the European Common Market (EEC). In addition to a strong dislike by Europeans for flexible exchange rates--based on their perception of interwar experience, and their belief that exchange rate volatility reduces trade in highly open economies--the key motivation for extensive policy coordination to stabilize exchange rates was the common agricultural policy established in 1959 (Giavazzi and Giovannini, 1989, Chapter 1).

Food prices in the community are set in terms of a central unit of account (the ECU) but quoted in local currency. Consequently, any changes in exchange rates lead to changes in local prices. During the Bretton Woods era a system of subsidies and taxes was worked out to insulate the local economy from policy realignments. This led to an asymmetric adjustment between hard currency

countries reluctant to lower their agricultural prices and soft currency countries which allowed their prices to rise. The result was overproduction of agricultural products and an ever increasing fraction of the EEC budget directed to subsidizing agriculture.

Early attempts to stabilize intra-European exchange rates during the Bretton Woods era were unsuccessful, as was the Snake in the Tunnel agreement of the 1970's. The European Monetary System, established in 1979 was a formal attempt to overcome earlier obstacles to exchange rate stabilization. It was designed to avoid the defects of the Bretton Woods system: the asymmetric adjustment mechanism, with the U.S. as center setting the tune for the rest of the world; the problems associated with growing capital mobility; and the dramas of parity realignments. Instead, the EMS designed a set of intervention rules which would produce a symmetric system of adjustment; create a mechanism to finance exchange market interventions, and establish a code of conduct for realigning parities (Giavazzi and Giovannini, 1989, Chapter 2).

Like Bretton Woods, the EMS was based on a set of fixed parities called the Exchange Rate Mechanism (ERM). Each country was to establish a central parity of its currency in terms of ECU, the official unit of account. The ECU consisted of a basket containing a set number of units of each currency. As the currency value of currencies varied, the weights of each country in the basket would change. A parity grid of all bilateral rates could then be derived from the ratio of members' central rates. Again, like Bretton Woods, each currency was bounded by a set of margins of 2.25% on either side of parity, creating a total band of 4.5% (for Italy and later the U.K., when it joined the ERM in 1990, the margins were set at 6% on either side of parity). The monetary authorities of both the depreciating and appreciating countries were required to intervene when a currency hit one of the margins. It also was allowed, but not required, to undertake intramarginal intervention. The Indicator of Divergences, which measured each currency's average deviation from the central parity, was devised as a signal for the monetary authorities to take policy actions to strengthen or weaken their currencies. It was supposed to work symmetrically.

Intervention and adjustment was to be financed under a complicated set of arrangements.

These arrangements were designed to overcome the weaknesses of the IMF during Bretton Woods. The Very Short-Term Financing Facility (VSTF) was to provide credibility to the bilateral parties by ensuring unlimited financing for marginal intervention. It provided automatic unlimited lines of credit from the creditor to the debtor members. The Short-Term Monetary Support (STMS) was designed to provide short-term finance for temporary balance of payments disequilibria. The Medium Term Financial Assistance (MTFA) would provide longer term support.

Unlike Bretton Woods, where members (other than the U.S.) could effectively decide to unilaterally alter their parities, changes in central parities were to be decided collectively. Finally, like Bretton Woods, members could (and did) impose capital controls. These have recently been phased out.

The evidence on the performance of the EMS is that it was successful in the latter half of the 1980's at stabilizing both nominal and real exchange rates within Europe,⁵² at producing credible bilateral bands, and at reducing divergence between members' inflation rates (Giavazzi and Giovannini 1989; Fratianni and von Hagen 1990, 1992 and Meltzer 1990).

Giavazzi and Pagano (1988), Giavazzi and Giovannini (1989) and Giovannini (1989) make a strong case that the success of the EMS was largely because, like the gold standard and Bretton Woods, it was an asymmetric system with Germany acting as the center country. The other EMS members adapted their monetary policies to maintain fixed parities with Germany. Also, according to the aforementioned writers, the Bundesbank exhibited a strong credible commitment to low inflation and the other members of the ERM, by tying their currencies to the Deutschmark, used an exchange rate target as a commitment mechanism to successfully reduce their own rates of inflation. Evidence for the asymmetry hypothesis is based on the fact that the Bundesbank only intervened when bilateral exchange rates were breached, while the other countries engaged in intra- marginal intervention, and on evidence of asymmetrical behavior of interest rates in Germany and the other EMS countries. In the period preceding several EMS realignments, non German EMS interest rates changed drastically whereas no change was observed in their German counterparts. Evidence that the Bundesbank's

reputation was responsible for the disinflation of the 1980's is based on an out-of-sample simulation of a VAR to predict the inflation rate. Downward shifts in the predicted values of inflation for a number of countries after the advent of the EMS makes the case. The fact that inflation expectations were only significantly reduced in France and Italy several years after the advent of the EMS, the argument goes, may reflect slow learning or alternatively that these countries used the EMS to justify following unpopular austerity policies.

Fratianni and von Hagen (1990, 1992) dispute both the asymmetry and the imported disinflation hypotheses.⁵³ Evidence based on Granger causality tests from a structural VAR suggests that the German monetary base was not insulated from other EMS base movements nor were non- German EMS monetary bases insulated, by the German monetary base, from external shocks. In this interpretation, the EMS is a coordinated monetary policy system with all members playing a role.

Finally, Fratianni and von Hagen (1990) provide evidence that the EMS has reduced intra-European exchange rate volatility but at the expense of increased volatility with respect to non-EMS currencies. Thus they argue that the EMS is on net balance beneficial to welfare because intra-EMS trade exceeds external trade. They also show that although the advent of the EMS has not reduced inflation uncertainty relative to non-EMS countries, it has reduced the effects of foreign inflation shocks on the members.

Despite its favorable performance since the mid 1980's, the EMS was recently subjected to the same kinds of stress that plagued Bretton Woods. September and November 1992 marked a series of exchange rate crises in Europe that paralleled the events of 1967 to 1971. Precipitated by concerns that French voters would reject the Maastricht treaty on European Monetary Union in a referendum on September 20, speculators staged attacks early in the month on the Nordic currencies and then later on the Italian lira, the British pound, the French franc, and other weaker currencies. The crisis led to the disabling of the ERM: both Italy and the U.K. left it while Spain, Portugal and Ireland reimposed or strengthened existing capital controls; in November Sweden floated and Portugal and

Spain devalued.

The fundamental causes of the crisis, like the crises that plagued Bretton Woods, lay in large part with the exchange rate system. The EMS, like Bretton Woods, is a pegged exchange rate system which requires that member countries follow similar domestic monetary and fiscal policies and hence have similar inflation rates. This is difficult to do in the face of both differing shocks across countries, and differing national priorities. Under Bretton Woods, capital controls and less integrated international capital markets allowed members to follow divergent policies for considerable periods of time. Under the EMS, the absence of controls (after 1990) and the presence of extremely mobile capital meant that any movement of domestic policies away from those consistent with maintaining parity would quickly precipitate a speculative attack. Also, just as under Bretton Woods, the adjustable peg in the face of such capital mobility became unworkable. Thus, the difference between the two regimes when faced with asymmetric shocks or differing national priorities was the speed of reaction by world capital markets.

Through the fundamental cause of the crisis was similar in the two regimes, the source of the problem differed. Under Bretton Woods, the shock that led to its collapse was an acceleration of inflation in the U.S., ostensibly to finance the Vietnam War, as well as social policies, and to maintain full employment. Under the EMS, the shock was bond financed German reunification and the Bundesbank's subsequent deflationary policy. In each case, the system broke down because other countries were unwilling to go along with the policies of the center country. The commitments to price stability by both the center country of the other members were revealed to be not credible. Under Bretton Woods, Germany and other Western European countries were reluctant to inflate or to revalue, the U.S. reluctant to devalue. Under the EMS, the U.K., Italy, Spain, Portugal, Ireland and Sweden were unwilling to deflate and Germany was unwilling to revalue. As under Bretton Woods, although the EMS had the option for a general realignment, both improved capital mobility and the Maastricht commitment to a unified currency made it an unrealizable outcome.

Thus the lesson from both the EMS and Bretton Woods is that pegged exchange rate systems

do not work for long no matter how well they are designed. Pegged exchange rates, capital mobility, and policy autonomy just do not mix. The case made years ago, during the heyday of Bretton Woods, for floating exchange rates for major countries still holds. This is not to say that European countries could not eventually form a currency union with perfectly fixed exchange rates, if member countries were completely willing to give up domestic policy autonomy. In an uncertain world subject to diverse shocks the costs for individual countries of doing so apparently are extremely high.

4. Conclusion

This paper has examined statistical evidence on the performance of alternative monetary regimes over the past century. It also examines some aspects of the history of these regimes. Both statistical and historical evidence may help provide answers to the question why some regimes have been more successful than others. They also have implications for current issues in international monetary reform and the ongoing debate over rules and discretion.

The statistical evidence on performance of alternative monetary regimes in Section 2 leads to the conclusion that the Bretton Woods convertible regime from 1959 to 1970 was by far the best on virtually all criteria, but the recent floating regime is not much worse. Indeed, it is clear that the performance of the regimes in the post World War II era is superior to the performance of regimes in the preceding half century. Finally, though the classical gold standard does relatively poorly in terms of the stability of real variables, it performed best on inflation persistence and financial market integration--evidence for the successful operation of gold as a nominal anchor.

This evidence leads to the question why was Bretton Woods so stable yet so fragile and the classical gold standard so unstable and yet so durable? The answer may be due in part to the shocks the two regimes faced. However, this seems unlikely since the gold standard was subject to both supply and demand shocks that were a multiple of those facing Bretton Woods. It could also be due to greater flexibility of wages and prices and greater factor mobility before World War I, so that adjusting to the greater shocks did not have as serious consequences on real activity and employment

as later in the twentieth century. Alternatively, political economy factors such as: a more limited suffrage, less concern over the maintenance of full employment, limited understanding of the link between monetary policy and the level of economic activity, and hence loss of an incentive for monetary authorities to pursue policies which would threaten adherence to convertibility; could be responsible. These hypotheses clearly need more investigation.

It also could be due to regime design and especially the incentive compatibility features of the regime. The classical gold standard may have been so successful because of the credibility of the commitment to the gold standard rule of convertibility and because of its near universal acceptance. In turn, the credibility of the gold standard may stem from the origins of gold as money and the importance of Great Britain, the most important commercial nation of the nineteenth century, in enforcing the rules. England's commitment to convertibility in turn was aided by stabilizing private capital flows.

The classical gold standard for the core countries worked as a contingent rule or rule with escape clauses. As a consequence, it was flexible enough to withstand major shocks. It also enabled governments to flexibly finance major wars, by allowing them to leave the gold standard and temporarily use seigniorage to finance unusual government expenditures. The rule may have endured because the requisite deflation required to restore convertibility after the emergency had passed may not have had severe effects on real variables. This may have been because wages and prices were highly flexible. Alternatively the deflation accompanying resumption may have had significant real effects but no political constituency existed strong enough to oppose it.

The classical gold standard collapsed under the unprecedented shocks of World War I. It was reinstated as the short-lived gold exchange standard. Its brief life reflected the fatal flaws made famous by the Triffin dilemma. But regardless of the weakness of the gold exchange standard, it suffered from the absence of an effective commitment mechanism. There was no center country to enforce the rule, just three rivals pulling in different directions. Also, it was the beginning of an era when countries were less willing to go along with the gold convertibility rule because they attached

greater weight to the objective of domestic economic stability.

The Bretton Woods system was set up to avoid the perceived flaws of the classical gold standard and the trauma of the interwar period. The Bretton Woods adjustable peg was in some respects similar to the gold standard contingent rule, but it invited speculative attack hence compromising its role as an escape clause. Bretton Woods evolved into a gold exchange standard fraught with the adjustment, liquidity, and confidence problems of the interwar. Though the problems of the gold exchange standard could possibly have been corrected by raising the price of gold, as it turned out, it evolved into an asymmetric dollar standard. The U.S. maintained the credible commitment to a non-inflationary policy for only a few years. By the mid-1960's it shifted to an inflationary policy to further its domestic interests. The rest of the world, faced with imported inflation, soon lost the incentive to follow U.S. leadership and the system collapsed in 1971.

The advent of general floating in 1973 and its longevity suggests that the lessons of Bretton Woods have been well learned. Countries are not willing to subject their domestic policy autonomy to that of another country whose commitment they cannot be sure of in a stochastic world nor to a supernational monetary authority they cannot control. The key advantage of floating stressed a generation ago by Milton Friedman and Harry Johnson--the freedom to pursue an independent monetary policy--still holds today. Major countries can design domestic monetary policy rules to achieve domestic price stability without the costs of giving up their policy autonomy.

The experience of the EMS reveals that countries with similar goals and facing not too dissimilar shocks can establish a regional exchange rate regime. This regime requires both a credible commitment mechanism and the willingness of member countries to give up sovereignty for a higher purpose. However, as attested to by the events of September and November 1992, the durability of such an arrangement seems doubtful, as was the case for Bretton Woods, in an uncertain world subject to diverse shocks where national priorities can change and commitments can be broken. Some have argued that the EMS can only be preserved by precommitment to price stability and fixed exchange rates by independent central banks (Neumann, 1991), others, that the only solution is rapid movement

to a unified currency enforced by a European central bank (Delors 1989). However, as Feldstein (1992) points out, full fledged monetary union completely precludes the use of domestic monetary policy. To the extent that country specific shocks dominate common shocks and labor is relatively immobile between European countries, the benefits of permanently fixed exchange rates may not outweigh the cost of increased economic dislocation (Eichengreen, 1992d).

Finally, proposals for monetary reform such as exchange rate target zones or targeting the real price of gold, though of possible scientific merit, would work only if nations are willing to give up domestic autonomy and follow credible commitments. The history of international monetary regimes casts doubt on the likelihood that the nations of the world will do so in the foreseeable future.

Endnotes

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1. This result is disputed by Meltzer and Robinson (1989).
2. Similarly a monetary union such as the proposed European Monetary Union could provide effective insulation from common supply shocks for its members. However, giving up monetary independence imposes additional burdens in the case of member specific (regional) shocks, Feldstein (1992).
3. Addressing the issue of the optimum currency area, Bayoumi and Eichengreen (1992b), (1992c), (1992d) also apply this methodology to examine the incidence of shocks within Western Europe and within regions of North America.
4. Alternatively the monetary authority may create an inflation surprise to offset a labor market distortion that raises the unemployment rate above some desired level.
5. I also examined the period (1946-1973) which includes the three years of transition from the Bretton Woods adjustable peg to the present floating regime. The results are similar to those of the 1946-1970 period.
6. However, the common world price level under the gold standard exhibited secular periods of deflation and inflation reflecting shocks to the demand for and supply of gold (Bordo, 1981. Rockoff, 1984). A well-designed monetary rule, it is argued, could have avoided the long-run swings that characterized the price level under the gold standard (Cagan, 1984).
7. To be more exact, the U.S. stayed on gold until 1933 and France until 1936. For a detailed

comparison of the performances of these three regimes in the interwar period, see Eichengreen (1991a).

8. Within the sample of seven countries, Canada floated from 1950 to 1961.

9. This is a very crude measure of convergence or divergence between the different countries' summary statistics. Because it is based on the average for the whole period, it suppresses unusual movements within particular subperiods. Bayoumi and Eichengreen (1992d) presented an alternative measure of convergence or dispersion--the GDP-weighted standard deviation of the individual country series around the G-7 aggregate. I calculated this alternative measure of convergence for the data in Table 1. The results are very close to those reported here for virtually every variable.

10. The data sources for figure 1 and all subsequent figures are listed in the [Data Appendix](#) to Bordo (1992).

11. For similar evidence see Bordo (1981). Darby, Lothian et.al. (1983) and Darby and Lothian (1989).

12. Baxter and Stockman (1989) and Eichengreen (1992a) use residuals from a linear trend to the logarithm of real output as a detrending filter rather than the logarithmic first difference used here. According to their results, real output variability is not greater in the floating than in the fixed period.

13. However, using their alternative measure of convergence--the GDP-weighted standard deviation of the individual country series around the G-7 aggregate--Bayoumi and Eichengreen (1992a) report that the lowest degree of dispersion of real GDP growth was in the floating rate period, followed by the Bretton Woods convertible period. Similar results hold for the real GNP per capita data in Table 1. For Bayoumi and Eichengreen (1992a) the decline in the dispersion of real growth and the rise in the dispersion of inflation rates between the Bretton Woods convertible period and the float have the following explanations: the move to flexible rates allowed countries to stabilize their relative growth rates in the face of asymmetric supply shocks at the expense of their relative inflation rates. They also report that, when they apply the linear trend filter of Baxter and Stockman (1989), evidence

of a rise in the cross country correlation between output movements after 1970 is considerably reduced.

14. Define the real interest rate as $r_t = i_t - \Delta \log P_t$; where i_t is the nominal interest rate and $\Delta \log P_t = \log P_t - \log P_{t-1}$, is the percentage change in the consumer price index.

15. Also see Dornbusch (1976).

16. Stockman (1983, 1988) argues that greater variability in real exchange rates under floating rates than under fixed rates reflects the response of real exchange rates to productivity shocks, with changes in the real exchange rate producing nominal exchange rate volatility. This volatility is offset under fixed rates by exchange market intervention.

17. Meltzer (1990) in a comparison of EMS and non-EMS countries in the floating rate period also finds a strong correlation between changes in nominal and real exchange rates.

18. McKinnon (1992) treats the period 1950 to 1970 as the defacto dollar standard. He views this period rather than 1959 to 1971 as the appropriate one for making the type of regime comparisons undertaken here. I made the same calculations as those shown in Table I for the period 1950 to 1971. Virtually every variable for each country exhibited greater instability than in the 1959 to 1970 period. This reinforces my choice of dates.

19. Also see Alogoskoufis (1992), who attributes the increase in persistence to the accommodation by the monetary authorities of shocks. This evidence is also consistent with the results of Klein (1975).

20. I ran the same regression for the GNP deflators, with similar results.

21. Eichengreen (1992b) also presents these statistics for four of the countries.

22. Meltzer and Robinson (1989) present their results for levels, growth rates, and permanent growth rates of the series. I present only growth rates to make the results comparable to those in Table I.

23. Both variables were rendered stationary by first differencing.

24. Specifically, four restrictions are placed on the matrix of the shocks: two are simple normalizations, which define the variances of the shocks to aggregate demand and aggregate supply;

the third assumes that demand and supply shocks are orthogonal; the fourth is that demand shocks have only temporary effects on output, i.e., that the cumulative effect of demand shocks on the rate of change in output must be zero.

25. See Keating and Nye (1991).

26. For results using the complete data set for these four countries, see [Appendix](#) Table 1 and [Appendix](#) figure 1.

27. The G-7 aggregate income growth and inflation rate are a weighted average of the rates in the different countries. The weights for each year are the share of each country's nominal national income in the total income in the G-7 countries, where the national income data are converted to U.S. dollars using the actual exchange rates.

28. The impulse response functions were calculated from VAR's run for the separate regime periods. Because the number of observations was limited, the Bretton Woods regime could not be split into the two subperiods shown in preceding tables.

29. The results for the G-7 in the interwar period (figures 12 and 13) as well as those for four countries ([Appendix](#), figure 1) are similar to those reported for the U.S. by Cecchetti and Karras (1992), who estimate a three-variable VAR with monthly data. The late 1920's and early 1930's reveal a major negative demand shock consistent with Friedman and Schwartz's (1963) attribution of the onset of the Great Depression to monetary forces. After 1931, negative supply shocks predominate, consistent with Bernanke's (1983) and Bernanke and James (1991) explanation for the severity of the Great Depression that stresses the collapse of the financial system.

30. Though the shocks are smaller, the rankings by regime for the weighted average of individual country shocks are similar to the G-7 aggregate.

31. The formula was $\sum_t |\Delta c_t| / \sum |\Delta c_t|$ for $t = 1$ to 40, where t is the year and Δc_t the impulse response, calculating absolute changes because of the presence of both positive and negative responses. This measure is only a rough approximation because it is not possible to calculate the standard errors.

32. However, as mentioned above, according to the overidentifying restrictions of the Bayoumi-Eichengreen-Blanchard-Quah approach, supply shocks should have produced a negative response in prices, not the positive one shown here for the pre-World War II periods.

33. A case study comparing British and French finances during the Napoleonic Wars shows that Britain was able to finance its wartime expenditures by a combination of taxes, debt, and paper money issue--to smooth revenue; whereas France had to rely primarily on taxation. France had to rely on a less efficient mix of finance than Britain because she had used up her credibility by defaulting on outstanding debt at the end of the American Revolutionary War and by hyperinflating during the Revolution. Napoleon ultimately returned France to the bimetallic standard in 1803 as part of a policy to restore fiscal probity, but because of the previous loss of reputation France was unable to take advantage of the contingent aspect of the bimetallic standard rule. See Bordo and White (1991).

34. The behavior of asset prices (exchange rates and interest rates) suggests that market agents viewed the commitment to gold as credible. See Roll (1972) and Calomiris (1988), who present evidence of expected appreciation of the greenback during the American Civil War based on a negative interest differential between bonds that were paid in greenbacks and those paid in gold.

Giovannini (1992) finds the variation of both exchange rates and short-term interest rates varied within the limits set by the gold points in the 1899-1909 period consistent with market agents' expectations of a credible commitment by the four "core" countries to the gold-standard rule in the sense of this paper.

35. A case study of Canada during the Great Depression provides evidence for the importance of the credible commitment mechanism of adherence to gold. Canada suspended the gold standard in 1929 but did not allow the Canadian dollar to depreciate nor the price level to rise for two years. Canada did not take advantage of the suspension to emerge from the depression because of concern for its credibility with foreign lenders. See Bordo and Redish (1990).

36. According to Eichengreen (1989a), the Bank of England's ability to ensure convertibility was aided by the cooperation of other central banks. In addition, as mentioned above, belief based on past performance that England attached highest priority to convertibility encouraged stabilizing private capital movements in times of threats to convertibility, such as in 1890 and 1907.
37. The standard deviations of both supply and demand shocks during World War I for the countries for which we have continuous data were two to three times as great as during the classical gold standard. See [Appendix Table 1](#) and figure 1.
38. This section draws heavily on Bordo (1992).
39. In the sense of a commitment mechanism to avoid the time consistency problem. According to Meltzer (1988) and Moggridge (1986) Keynes had a strong preference for rules over discretion, interpreting rules in the traditional sense.
40. At the same time as the Articles of Agreement for the International Monetary Fund were signed, the International Bank for Reconstruction and Development (the World Bank) was established. The Charter of the International Trade Organization (ITO) was drafted and signed in 1947 but never ratified. It was succeeded by the General Agreement for Tariffs and Trade (GATT) originally negotiated in Geneva in 1947 as an interim institution until the ITO came into force.
41. Under Article XIV, three years after March 1, 1947, the IMF would begin reporting on the countries with existing controls, two years later it would begin consulting with individual members and advising them on policies to restore payments equilibrium and convertibility. Countries which did not make satisfactory progress would be censured and ultimately be asked to leave the Fund. In fact, the Fund always accepted the member's reason for remaining under Article XIV.
42. Members could draw on their quotas without condition. Beyond that, referred to later as the credit tranches, although not spelled out in the articles, increasingly more exacting conditions were required.
43. See, e.g., Tew (1988), Scammell (1976) and Yeager (1976). For Williamson (1985b) it was a comprehensive set of rules for assigning macroeconomic policies: exchange rates to medium-run

external balance, monetary and fiscal policy to short-run internal balance, and international reserves to provide a buffer to allow short-run departures from external balance.

44. Under the classical gold standard convertibility meant the ability of a private individual to freely convert a unit of any national currency into gold at the official fixed price. A suspension of convertibility meant that the exchange rate between gold and national currency became flexible but the individual could still freely transact in either asset (Triffin, 1960, p.22). By the eve of World War II, convertibility referred to the ability of a private individual to freely make and receive payments in international transactions in terms of the currency of another country. Under Bretton Woods, convertibility meant the freedom for individuals to engage in current account transactions without being subject to exchange controls. Tew (1988, p.50) defines this as market convertibility and distinguishes it from official convertibility whereby the monetary authorities of each country freely buy and sell foreign exchange (primarily dollars) to keep the parity fixed (within the 1% margin) and the U.S. freely buys and sells gold to maintain the fixed price of \$35.00 per oz. (within the 1% margin). He refers to both market and official convertibility as "Bretton Woods convertibility." See also McKinnon (1979, chapter 2) and Black (1987).

45. The official view, which was strongly opposed to increased exchange rate flexibility, is in marked contrast to the academic view, which by the end of the decade was solidly in favor of increased flexibility, as evident at the famous Burgenstock Conference (Halm, 1970). Also see Johnson (1972a).

46. Even at some higher price of gold, world gold production would eventually be inadequate to produce long-run price stability. In the long-run, when account is taken of gold as a durable exhaustible resource, deflation is inevitable (Bordo and Ellson, 1985). Moreover, an increase in world liquidity by an artificial reserve asset, if convertible into gold would not remove the basic convertibility problem (McKinnon, 1988). Finally as Townsend (1977, Salant (1983), and Buiter (1989) point out, the gold exchange standard as a type of commodity stabilization scheme is bound to collapse in the face of unforeseen shocks. See Garber (1992). However according to Meltzer

(1991), a 50% gold revaluation would have succeeded in preserving the Bretton Woods System well into the 1970's had the U.S. not followed an inflationary policy in the late 1960's.

47. Although, according to Meltzer (1991) there is little evidence in asset markets through the 1960's of a growing loss of confidence in the dollar. Real interest rates did not rise significantly relative to trade-weighted real interest rates. Nor did the gold and foreign exchange markets suggest a flight from the dollar.

48. Except for the case of Japan (Marston, 1987), there is little evidence for the leading alternative explanation for the collapse--that it reflected growing misalignment in real exchange rates between the U.S. and her principal competitors in the face of differential productivity trends. See Eichengreen (1992 b).

49. See McKinnon (1992) for his version of the rules of the Bretton Woods Articles and the dollar standard. Also see Giovannini (1992) and Obstfeld (1992).

50. Giovannini's (1992) calculations show that during the Bretton Woods convertible period credibility bounds on interest rates for the major currencies, in contrast to the classical gold standard, were frequently violated.

51. See Feldstein (1988), Bordo and Schwartz (1989a).

52. At its outset, there was considerable doubt that the EMS would be successful at withstanding the strains of greatly divergent money growth and inflation rates among its members (Fратиanni, 1980).

53. Also, Collins (1988) and Eichengreen (1992d) present evidence that EMS membership may not have been responsible for reducing the inflation rates of EMS countries. Their cross country regressions show that EMS membership had little effect on inflation performance. Changing public attitudes towards inflation within each country represent a more important determinant (Giavazzi and Collins, 1992).

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Table 1: Descriptive Statistics of Selected Open Economy Macro Variables, the G-7 Countries 1881-1989

Annual Data: Mean, Standard Deviation

	Gold Standard (1881-1913)		Interwar (1919-1938)	
a: Inflation PGNP^a				
United States	0.3	3.1	-1.8	7.6
United Kingdom	0.3	3.1	-1.5	7.8
Germany	0.6	2.6	-2.1	4.7
France	-0.0	5.0	2.2	9.1
Japan	4.6	5.5	-1.7	7.3
Canada	0.4	1.4	-1.9	6.0
Italy	0.6	3.2	-1.1	11.7
mean	1.0	3.4	-1.1	7.7
convergence	1.0	1.0	1.0	1.5
b: Real per capita growth^a				
United States	1.8	5.0	0.2	8.1
United Kingdom	1.1	2.4	1.2	4.5
Germany	1.7	2.9	2.6	8.5
France	1.5	4.6	1.3	7.2
Japan	1.4	3.8	2.0	6.1
Canada	2.3	2.8	0.2	8.8
Italy	1.0	4.1	0.9	4.7
mean	1.5	3.7	1.2	6.8
convergence	0.3	0.8	0.7	1.5
c: Money Growth^a				
United States	6.1	5.9	0.6	8.6
United Kingdom	2.1	1.7	0.8	4.7
Germany	5.7	4.7	1.3	10.1
France	2.2	3.5	6.4	8.5
Japan	5.8	10.8	0.5	9.7
Canada	7.4	5.3	1.1	4.7
Italy	3.2	3.1	3.6	6.2
mean	4.6	5.0	2.0	7.5
convergence	1.8	2.0	1.7	2.0
d: Short-term interest rate				
United States	4.8	0.9	3.5	2.0
United Kingdom	2.8	0.8	3.0	1.8
Germany	3.2	0.9	4.8	1.6
France	2.5	0.6	3.1	1.4
Japan	2.4	0.5	2.0	0.5
Canada	n.a.		0.9	0.4
Italy	n.a.		n.a.	
mean	3.2	0.7	2.9	1.3
convergence	0.7	0.2	0.9	0.4
e: Long term interest rate				
United States	3.8	0.3	4.2	0.6
United Kingdom	2.9	0.2	4.1	0.7
Germany	3.7	0.2	6.9	1.8
France	3.2	0.3	4.6	0.8
Japan	n.a.		n.a.	
Canada	3.5	0.4	4.7	0.8
Italy	4.2	0.5	5.9	0.6
mean	3.6	0.3	5.1	0.9
convergence	0.3	0.1	0.9	0.3

Bretton Woods (Total (1946-1970))		Bretton Woods (Preconvertible) (1946-1958)		Bretton Woods (Convertible) (1959-1970)		Floating Exchange (1974-1989)	
2.4	2.6	2.8	3.5	2.6	1.5	5.6	2.4
3.7	2.2	4.6	2.5	3.4	1.5	9.4	6.1
2.7	4.0	2.1	6.2	3.2	1.8	3.3	1.3
5.6	4.1	5.6	5.1	5.5	3.6	8.8	3.2
4.5	4.6	4.2	5.7	5.5	1.0	2.6	2.4
2.7	3.0	2.1	3.1	3.5	1.1	7.9	3.0
3.8	11.5	5.9	16.0	3.8	2.1	12.9	4.6
3.6	4.6	3.9	6.0	3.9	1.8	7.2	3.3
0.9	2.0	1.3	2.9	0.9	0.6	2.9	1.2
2.0	2.8	1.8	3.4	2.9	1.9	2.1	2.7
2.1	1.8	2.1	2.2	2.3	1.4	1.5	4.2
5.0	3.3	7.3	3.9	3.6	2.6	2.2	1.9
3.9	2.2	4.6	2.7	3.9	1.3	1.7	1.5
8.1	2.7	7.3	2.8	8.9	2.4	3.5	1.1
2.5	2.6	1.9	3.2	3.8	1.1	1.6	2.6
5.6	3.3	5.2	4.4	5.8	1.9	2.5	2.2
4.2	2.7	4.3	3.2	4.5	1.8	2.2	2.3
1.8	0.4	2.1	0.6	1.7	0.5	0.5	0.7
6.3	5.8	6.4	8.3	7.0	1.5	8.6	2.4
3.2	3.2	1.7	2.9	5.5	2.9	13.5	5.6
12.8	6.0	17.6	5.6	10.9	4.7	5.7	4.5
11.5	7.5	14.7	7.2	8.6	6.6	8.8	3.4
17.3	15.9	18.2	18.5	14.6	2.5	5.7	6.2
6.0	4.0	5.0	3.9	9.4	4.3	11.0	5.5
13.3	7.8	15.9	10.5	12.4	2.0	13.4	4.9
10.1	7.2	11.4	8.1	9.8	3.5	9.5	4.6
4.2	2.8	6.0	3.7	2.5	1.4	2.7	1.1
3.4	1.9	2.0	0.9	4.8	1.6	8.9	2.6
4.0	2.5	2.3	1.8	5.8	1.6	11.2	2.1
4.0	1.5	4.1	1.1	4.0	1.7	5.9	2.4
4.2	1.9	3.2	1.5	5.1	1.9	10.3	2.6
6.5	0.8	6.8	0.8	5.9	0.4	5.2	2.0
2.9	2.0	2.2	1.3	4.8	1.3	9.2	3.4
n.a.		n.a.		n.a.		n.a.	
4.2	1.8	3.5	1.2	5.1	1.4	8.5	2.5
0.8	0.3	1.3	0.2	0.5	0.2	1.9	0.3
3.9	1.3	3.0	0.4	5.0	1.1	10.4	2.1
5.2	1.8	3.9	0.8	6.6	1.3	12.1	2.8
6.3	0.7	5.9	0.5	6.7	0.7	7.8	1.5
5.7	0.8	5.8	0.5	5.7	1.0	10.9	2.4
7.0	0.1	n.a.		7.0	0.1	7.1	1.8
4.5	1.5	3.8	0.8	5.9	1.0	10.3	2.3
6.0	0.7	6.3	0.4	5.7	0.7	13.7	3.3
5.5	1.0	4.8	0.6	6.1	0.9	10.3	2.3
0.9	0.5	1.2	0.1	0.6	0.3	1.7	0.5

Table 1 continued

	Gold Standard (1881-1913)		Interwar (1919-1938)	
f: Real short term interest rate ^b				
United States	4.8	2.0	3.8	6.7
United Kingdom	2.9	2.3	4.2	7.1
Germany	2.4	2.3	5.1	5.2
France	2.8	6.4	1.2	14.7
Japan	-1.5	5.5	1.4	8.8
Canada	n.a.		-0.8	1.3
Italy	n.a.		n.a.	
mean	2.3	3.7	2.5	7.3
convergence	1.5	1.8	1.9	2.7
g: Real long term interest rate ^b				
United States	3.7	2.2	4.6	6.8
United Kingdom	3.0	2.5	5.4	7.1
Germany	2.9	2.4	6.9	6.0
France	3.5	6.5	1.0	15.1
Japan	n.a.		n.a.	
Canada	3.5	0.4	4.7	0.8
Italy	4.2	0.5	5.9	0.6
mean	3.5	2.4	4.8	6.1
convergence	0.4	1.4	1.3	3.6
h: Nominal exchange rate ^d				
United States ^e				
United Kingdom	0.2	0.2	6.8	7.9
Germany	0.2	0.1	3.9	9.5
France	0.3	0.2	17.8	16.9
Japan	2.9	4.5	6.7	8.9
Canada	0.0	0.0	2.6	3.4
Italy	1.4	1.5	13.6	20.1
mean	3.5	1.1	4.8	11.1
convergence	0.4	1.3	1.3	4.9
i: Real exchange rate ^{cd}				
United States ^e				
United Kingdom	1.7	1.5	6.5	6.9
Germany	2.4	1.2	5.8	9.2
France	4.3	5.0	8.9	6.9
Japan	6.6	5.6	7.8	7.2
Canada	2.6	2.2	3.2	2.8
Italy	2.1	1.7	13.3	16.9
mean	3.3	2.9	7.6	8.3
convergence	0.9	1.6	2.4	3.2

Notes:

- ^a Mean growth rate calculated as the time coefficient from a regression of the natural logarithm of the variable on a constant and a time trend
- ^b Calculated as the nominal interest rate minus the annual rate of change of the CPI
- ^c Calculated as the nominal exchange rate divided by the ratio of foreign to the U.S. CPI
- ^d Absolute rates of change
- ^e Trade-weighted nominal and real exchange rate starting in 1960

Data Sources: See Data Appendix to Bordo (1992)

Bretton Woods (Total) (1946-1970)	Bretton Woods (Preconvertible) (1946-1958)	Bretton Woods (Convertible) (1959-1970)	Floating Exchange (1974-1989)
0.3 3.9	-1.2 4.7	2.4 0.4	2.5 2.8
-0.1 3.4	-2.4 3.3	2.3 1.1	1.3 5.1
2.2 2.6	3.0 3.6	1.6 1.5	2.5 1.9
-0.9 5.2	-3.3 6.9	1.2 1.4	2.1 2.8
1.9 2.5	2.7 2.8	0.5 1.1	1.4 3.5
-0.3 4.2	0.1 3.4	2.0 0.7	2.5 3.2
n.a.	n.a.	n.a.	n.a.
0.5 3.6	-0.2 4.1	1.7 1.0	2.0 3.2
1.0 0.6	2.1 0.9	0.6 0.3	0.5 0.7
0.8 3.6	-0.7 4.4	2.5 0.7	3.9 3.8
1.1 2.8	-0.8 2.6	3.2 1.0	2.2 3.7
4.3 2.8	4.3 4.4	4.3 1.0	4.4 0.9
0.4 4.4	-1.2 6.2	1.8 1.0	2.7 3.1
1.7 1.3	n.a.	1.7 1.3	2.0 4.2
1.3 3.8	3.8 0.8	3.0 0.6	3.6 2.8
-0.4 12.1	6.3 0.4	2.2 2.2	0.5 5.3
1.3 4.4	2.0 3.1	2.7 1.1	2.7 3.4
1.0 2.2	2.9 1.9	0.7 0.4	1.1 1.0
0.7 0.8		0.7 0.8	
2.4 6.3	3.6 8.3	1.4 3.9	10.1 4.7
1.8 3.8	2.4 5.3	1.3 2.1	9.3 8.2
2.5 7.7	4.4 11.3	1.1 3.3	10.7 7.8
15.9 37.2	22.0 42.6	0.2 0.2	8.8 9.5
1.6 1.9	2.2 2.0	0.8 1.9	3.7 2.4
7.4 20.6	14.1 27.4	0.2 0.2	10.9 9.0
4.6 11.2	8.1 16.1	0.8 1.8	2.7 6.6
4.0 10.1	6.6 12.6	0.4 1.2	1.1 6.5
1.7 1.0		1.7 1.0	
3.5 5.5	4.7 7.1	2.5 3.5	9.4 4.3
2.8 5.1	3.8 7.3	1.9 1.8	8.8 8.2
4.1 5.6	6.2 7.7	2.5 2.9	9.2 7.7
3.0 1.5	4.4 4.3	2.1 1.2	9.6 8.9
2.4 2.3	2.4 2.3	1.2 1.7	3.8 2.0
8.0 18.7	13.1 25.2	2.4 1.6	8.6 7.8
5.7 3.6	9.0 5.8	2.0 2.0	8.2 6.5
3.7 1.4	5.4 2.6	0.4 0.7	1.4 1.9

Table 2: Persistence of CPI Inflation: G7 Countries 1880-1989

Annual Data: Coefficient of ARI Regression; (Standard error); t-statistic for unit root test

	United States	United Kingdom	Germany	France
Gold Standard	0.27 (0.18) 4.05	0.30 (0.17) 4.03	0.51 (0.16) 3.06	-0.22 (0.18) 6.78
Interwar	0.45 (0.17) 3.18	0.35 (0.19) 3.37	0.51 (0.21) 2.33	0.42 (0.24) 2.42
Bretton Woods (Total)	0.49 (0.19) 2.68	0.33 (0.20) 3.38	0.03 (0.21) 4.90	0.56 (0.16) 2.75
Bretton Woods (Preconvertible)	0.41 (0.27) 2.15	0.15 (0.29) 2.96	-0.07 (0.31) 3.45	0.60 (0.27) 1.48
Bretton Woods (Convertible)	1.07 (0.20) -0.33	0.57 (0.34) 1.27	0.44 (0.31) 1.81	0.12 (0.14) 6.29
Floating Exchange	0.68 (0.18) 1.76	0.69 (0.19) 1.67	0.83 (0.14) 1.21	0.85 (0.16) 0.94
Post World War II	0.65 (0.12) 2.92	0.75 (0.10) 2.50	0.31 (0.15) 4.60	0.69 (0.11) 2.82
	Japan	Canada	Italy	
Gold Standard	0.22 (0.18) 4.33*	0.08 (0.18) 5.11	0.28 (0.14) 5.14	
Interwar	0.72 (0.21) 1.36	0.35 (0.17) 3.82	0.28 (0.17) 4.24	
Bretton Woods (Total)	0.55 (0.09) 1.61	0.39 (0.19) 3.21	0.21 (0.12) 6.58	
Bretton Woods (Preconvertible)	0.57 (0.14) 3.11	0.32 (0.27) 2.52	0.18 (0.18) 4.56	
Bretton Woods (Convertible)	0.18 (0.31) 2.64	0.81 (0.20) 0.95	0.38 (0.29) 2.14	
Floating Exchange	0.70 (0.19) 2.67	0.75 (0.18) 1.39	0.75 (0.17) 1.47	
Post World War II	0.55 (0.07) 6.67	0.65 (0.12) 2.92	0.28 (0.10) 7.20	

Data Sources: See Table 1

* 5% significance level for unit root test with 25 observations is 3.00

• GNP Deflator was used because of unavailability of CPI data.

Table 3: Forecast Errors in Inflation And Real Growth: G7 countries 1880-1989
Annual Data: Mean Absolute Errors using the Multi State Kalman Filter

	Gold Standard	Interwar	Bretton Woods (Total)	Bretton Woods (Preconvertible)	Bretton Woods (Convertible)	Floating Exchange
	1880-1913	1919-1939	1946-1970	1946-1958	1959-1970	1973-1989
	Growth Inflation	Growth Inflation	Growth Inflation	Growth Inflation	Growth Inflation	Growth Inflation
United States	2.00	4.90	3.22	5.01	1.28	1.67
United Kingdom	1.42	4.11	1.41	1.82	0.97	2.71
Germany	1.69	8.07	2.77	3.24	2.49	1.45
France	2.25	5.54	1.51	2.28	0.87	1.44
Japan	1.69	2.69	1.59	0.85	1.89	1.54
Canada	1.58	7.16	2.19	3.06	1.24	1.72
Italy	2.08	2.08	4.21	7.04	1.15	1.14
Average	1.82	4.94	2.41	3.33	1.41	1.67

Data Sources: See Table 1

Table 4: Supply (Permanent) and Demand (Temporary) Shocks: 1880-1989
 Annual Data: Standard Deviations of Shocks (%); Dispersion of shocks across countries(%)

	Gold Standard		Interwar		Bretton Woods (Total) 1948-1970		Bretton Woods (Preconvertible) 1948-1958		Bretton Woods (Convertible) 1959-1970		Floating Exch. 1973-1989		Post WW-II 1948-1989	
	D	S	D	S	D	S	D	S	D	S	D	S	D	S
United States	2.03	3.81	4.46	6.74	2.33	1.54	3.11	1.99	1.37	1.07	1.72	1.94	2.08	1.69
United Kingdom	2.66	2.16	1.93	3.52	2.62	1.95	3.06	2.61	2.26	1.14	3.57	4.31	3.03	3.10
Germany	2.36	2.32	4.47	3.13	2.88	2.65	1.85	2.87	3.34	2.66	1.66	1.39	2.36	2.20
France	4.58	3.75	7.17	5.19	3.50	1.75	3.23	1.61	3.77	1.84	1.93	1.52	2.84	1.70
Japan	4.85	3.39	6.28	5.36	3.18	2.56	4.05	1.97	2.83	2.78	2.39	2.50	2.75	2.69
Canada	0.93	2.75	4.01	8.61	2.42	2.60	3.08	3.70	1.74	0.98	2.66	2.10	2.48	2.47
Italy	3.16	3.12	7.40	4.14	2.76	1.75	2.93	1.85	2.56	1.73	3.58	1.91	3.30	2.47
G7	1.56	2.21	3.09	4.12	1.24	0.86	1.99	1.00	0.75	0.80	1.51	0.96	1.40	0.91
G7*	1.49	2.09	2.99	4.61	1.11	0.81	1.64	1.01	0.75	0.71	1.40	1.60	1.28	1.32
Dispersion	3.34	4.54	7.60	7.82	3.52	2.29	3.05	1.79	3.67	2.45	3.02	2.30	3.24	2.35

G7 : G7-aggregate data

G7* : Weighted average of individual country shocks; The weights are calculated as the share of each country's National Income in the the Total Income in the G7 countries, where the G.N.P./G.D.P. data are converted to dollars using the actual exchange rate.

Dispersion = $\sum (\text{weight}_i (\text{shock}_i - \bar{\text{shock}})^2)^{0.5}$
 for $i = \text{United States, United Kingdom, Germany, France, Japan, Canada, Italy}$

Table 5: The Mean Lag of Adjustment to Demand and Supply Shocks, G7 Countries 1880-1989¹

		Gold Standard	Interwar	Post WWII	Bretton Woods	Floating Exchange
United States	a)	2.77	3.79	2.16	2.29	3.65
	b)	1.65	2.89	2.68	1.85	6.48
	c)	1.61	1.65	2.21	2.12	4.64
	d)	2.24	2.31	2.55	3.06	5.52
United Kingdom	a)	2.52	2.01	3.38	4.24	3.43
	b)	2.13	1.97	4.93	3.06	4.46
	c)	1.88	1.48	1.96	2.39	2.62
	d)	3.14	3.06	3.04	2.23	2.44
Germany	a)	2.74	3.08	2.70	3.48	4.02
	b)	2.23	2.86	2.67	3.13	7.19
	c)	1.87	3.09	1.86	1.80	3.83
	d)	2.03	3.50	1.92	2.85	5.46
Canada	a)	1.76	2.53	2.55	3.12	2.40
	b)	1.75	1.87	2.75	1.79	2.67
	c)	1.20	1.36	2.32	1.52	2.26
	d)	2.51	2.62	2.87	2.98	2.98
France	a)	1.79	3.84	2.19	3.50	4.97
	b)	1.70	2.60	1.83	3.06	5.53
	c)	1.85	2.05	2.54	2.19	3.79
	d)	2.85	4.80	1.92	3.50	6.02
Japan	a)	2.67	4.16	2.94	3.14	4.55
	b)	1.85	3.87	2.70	1.99	9.42
	c)	1.96	3.41	2.97	1.96	3.66
	d)	1.52	3.13	4.69	2.81	8.34
Italy	a)	2.13	2.50	3.51	1.86	2.99
	b)	1.71	1.60	4.20	1.43	5.57
	c)	2.43	1.57	6.20	1.63	1.94
	d)	1.66	2.19	6.68	1.66	3.02
Average:	a)	2.34	3.13	2.78	3.08	3.72
	b)	1.86	2.52	3.11	2.33	5.90
	c)	1.93	2.09	2.87	1.94	3.25
	d)	2.28	3.09	3.38	2.73	4.83
G7-aggregate	a)	2.19	3.61	3.27	4.61	5.16
	b)	1.38	2.68	6.00	5.16	11.84
	c)	1.78	2.63	4.18	6.05	6.15
	d)	2.10	3.35	4.74	5.13	11.27

- a) : Effect of Temporary Shock on Output
 b) : Effect of Temporary Shock on Prices
 c) : Effect of Permanent Shock on Output
 d) : Effect of Permanent Shock on Prices

¹ the mean lag of adjustment is calculated as:

$$\sum i|\Delta c_i| / \sum |\Delta c_i|$$

for $i = 1$ to 40

where c_i is the value of the impulse response function in period i .

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- Figure 12. Impulse Response Functions of Demand and Supply Shocks on Prices and Output, G-7 Aggregate by Regimes, Annual Data, 1881–1989
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Figure 21. Money (M1) growth less real output growth in the U.S., G-7 and G-7 excluding the U.S., 1951-1973

Appendix

Figure 1. Supply and Demand Shocks, 1880-1989, Including the War Years, Annual Data

Figure 1: Inflation Rates, 1880-1989, G7 countries

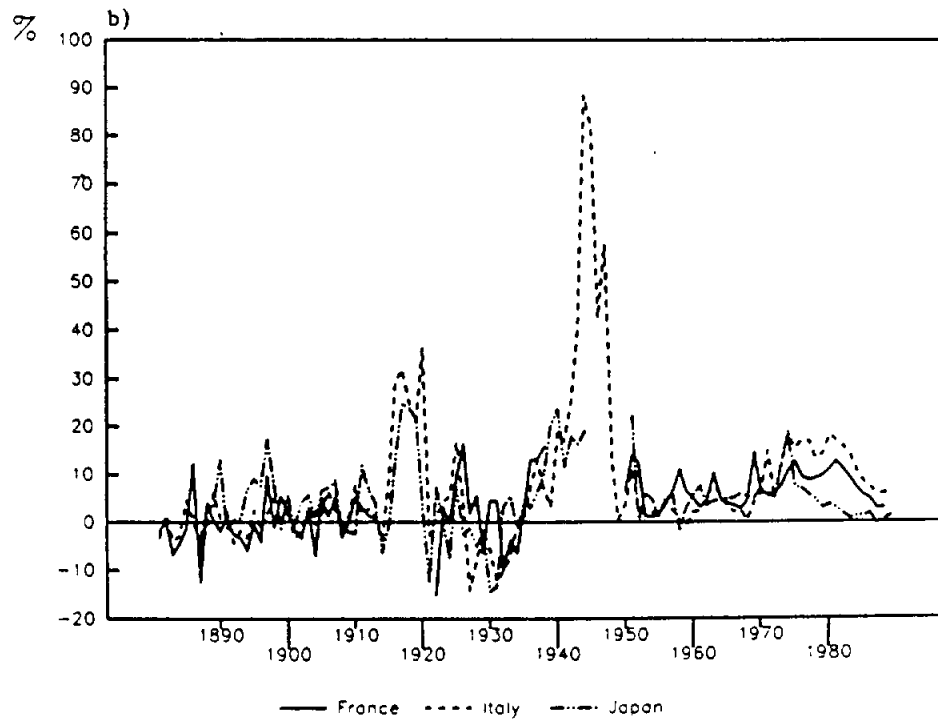
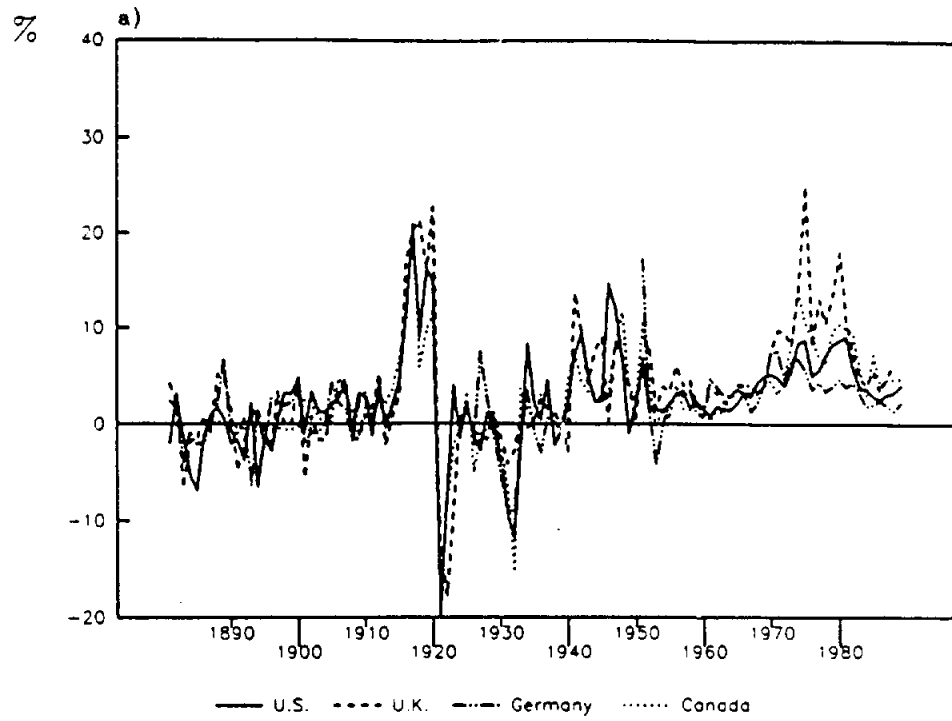


Figure 2: Per Capita Income Growth Rates, 1880-1989.

G7 countries

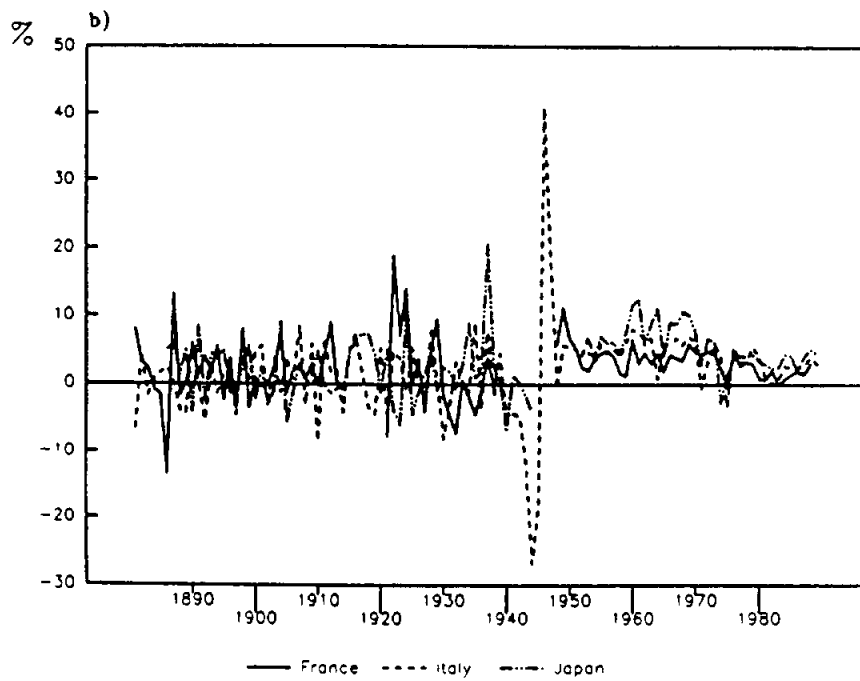
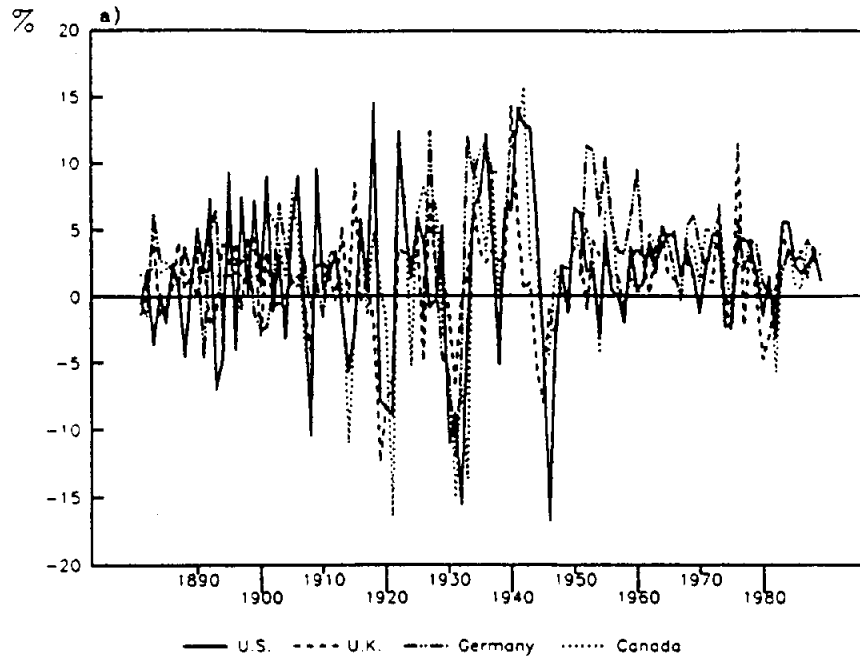


Figure 3: Money Growth Rates, 1880-1989, G7 countries

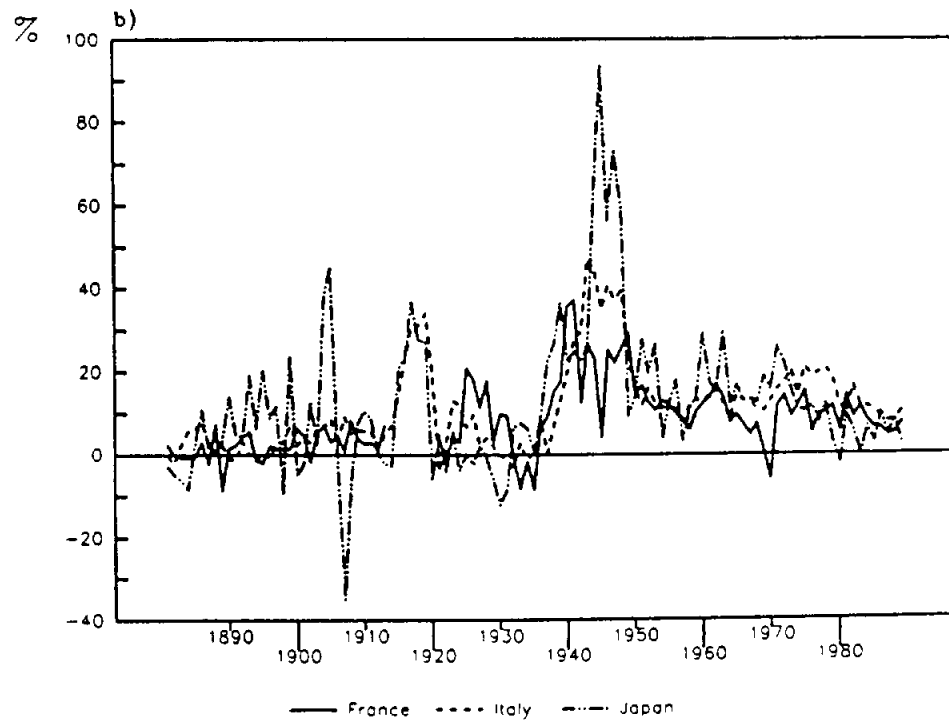
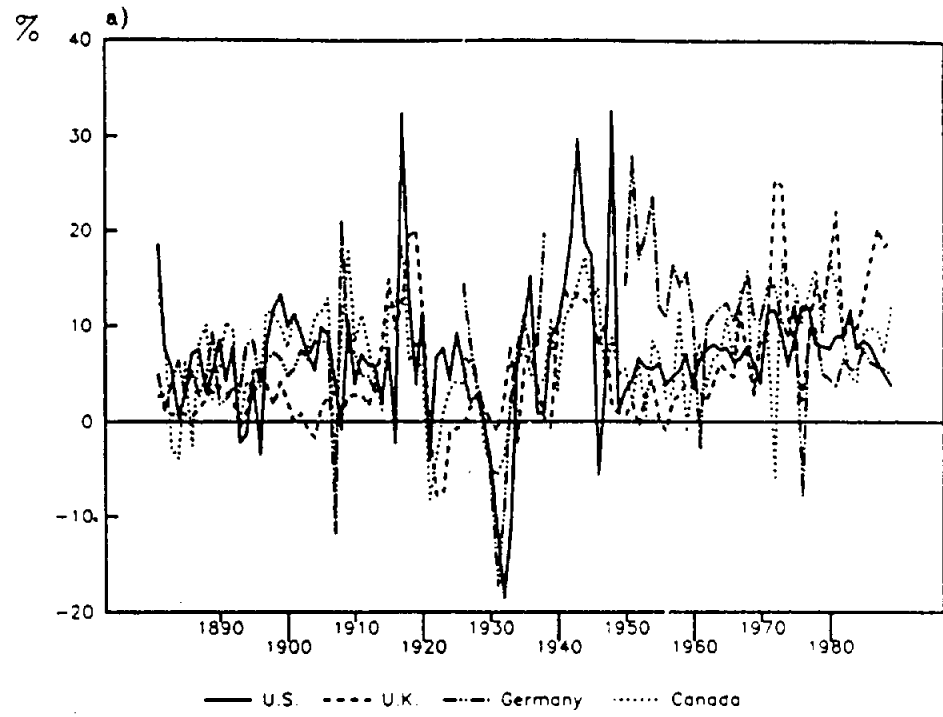


Figure 4: Short-term Interest Rates, 1880-1989, G7 countries

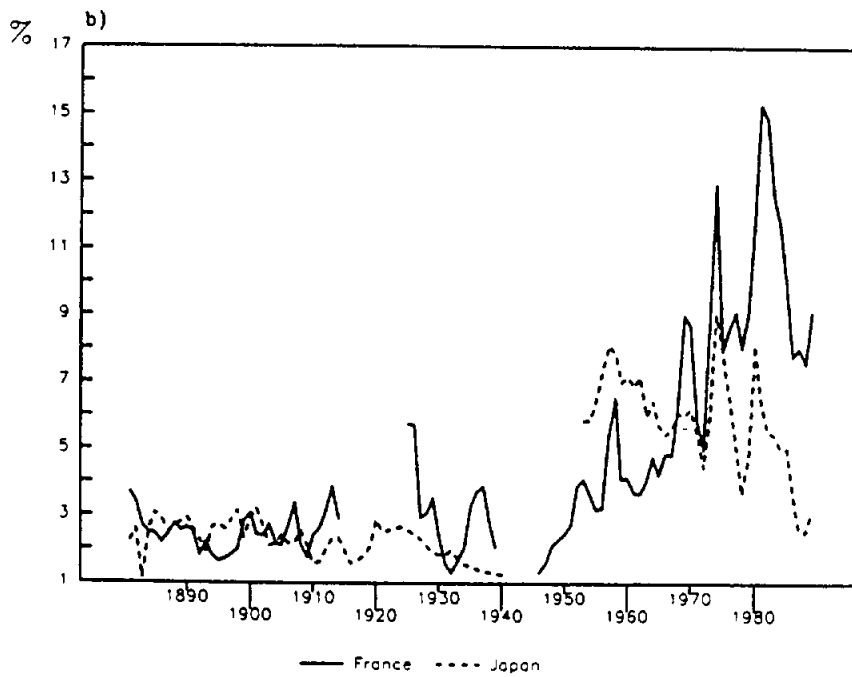
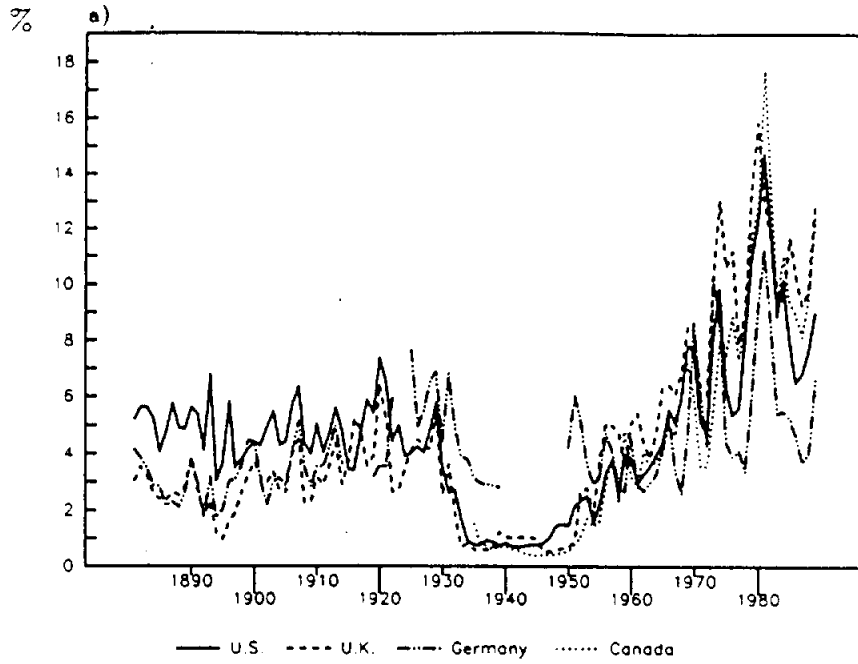


Figure 5: Long-term Interest Rates, 1880-1989, G7 countries

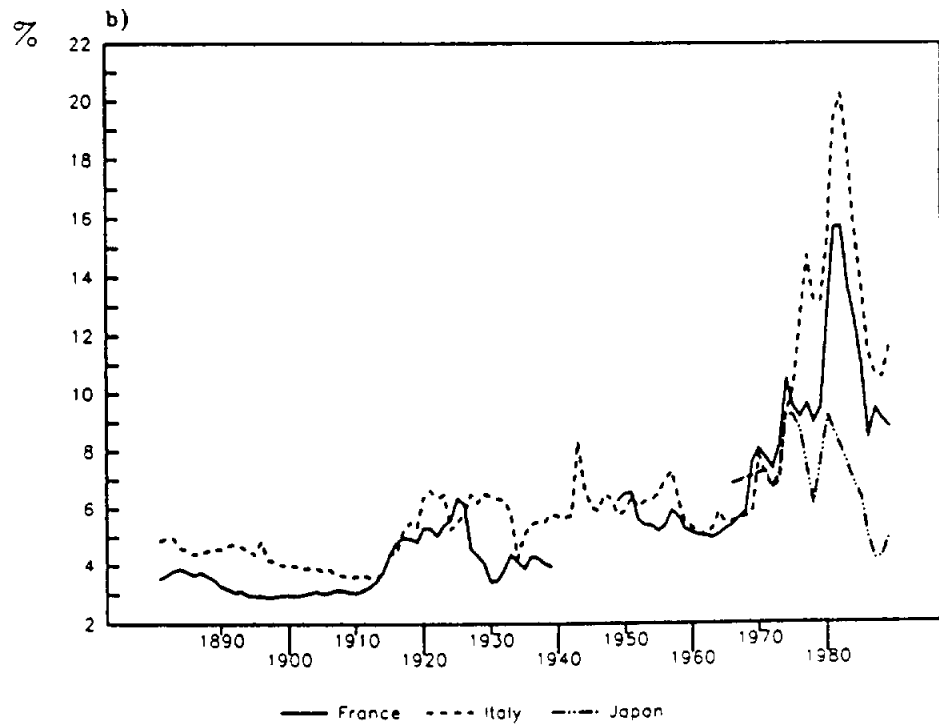
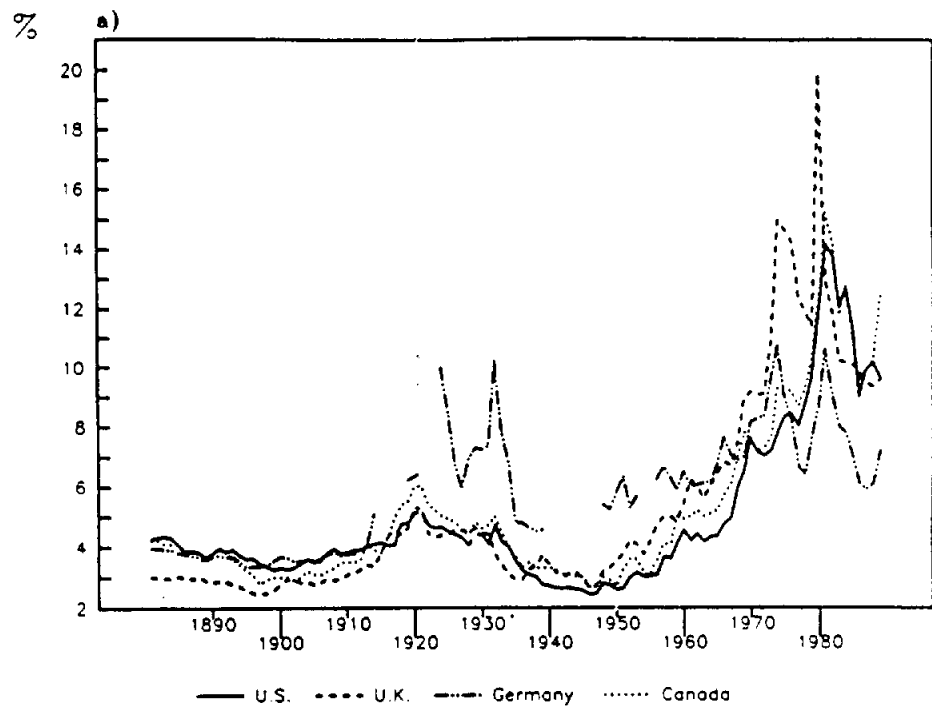


Figure 6: Real Short-term Interest Rates, 1880-1989.
G7 countries

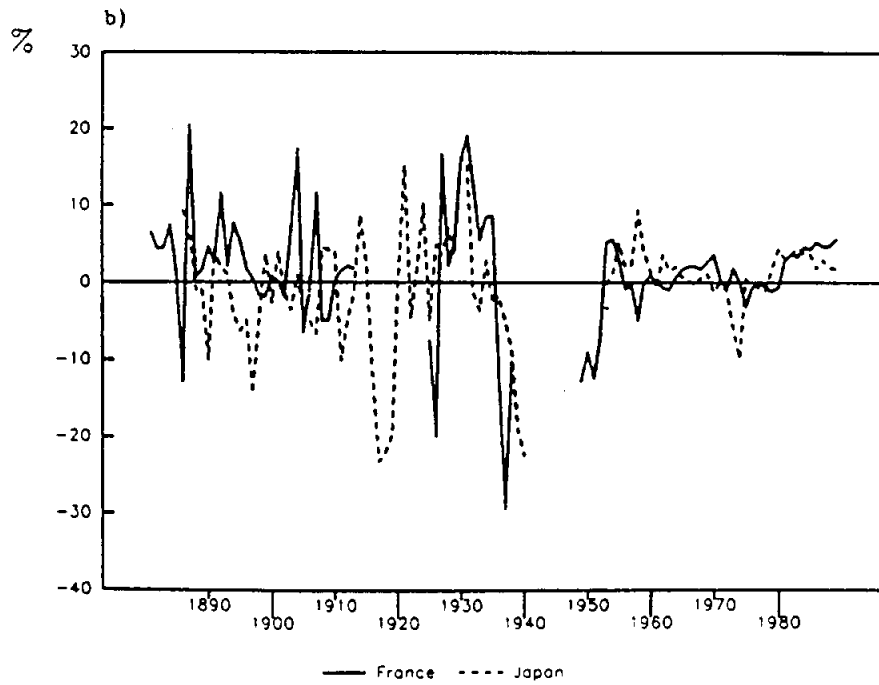
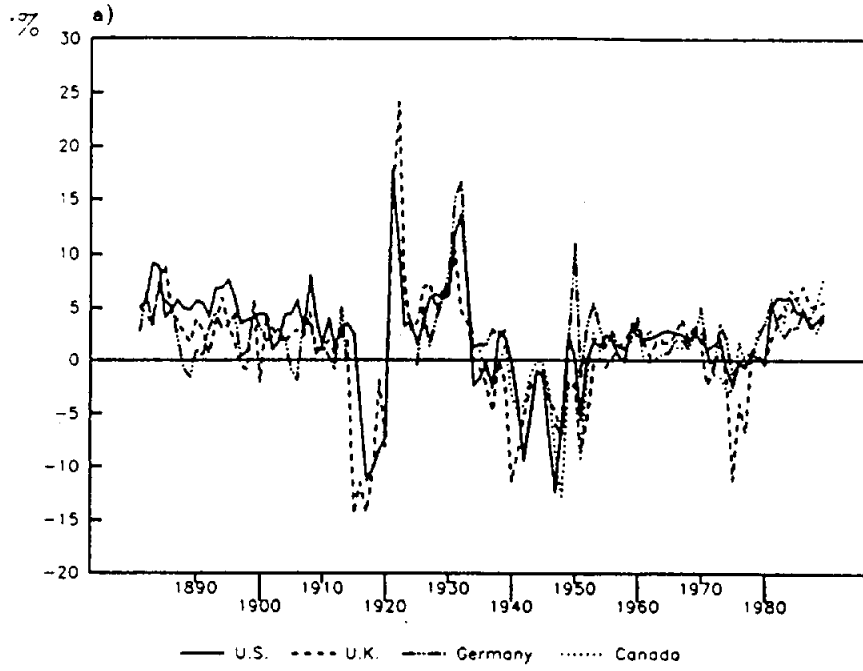


Figure 7: Real Long-term Interest Rates, 1880-1989,
G7 countries

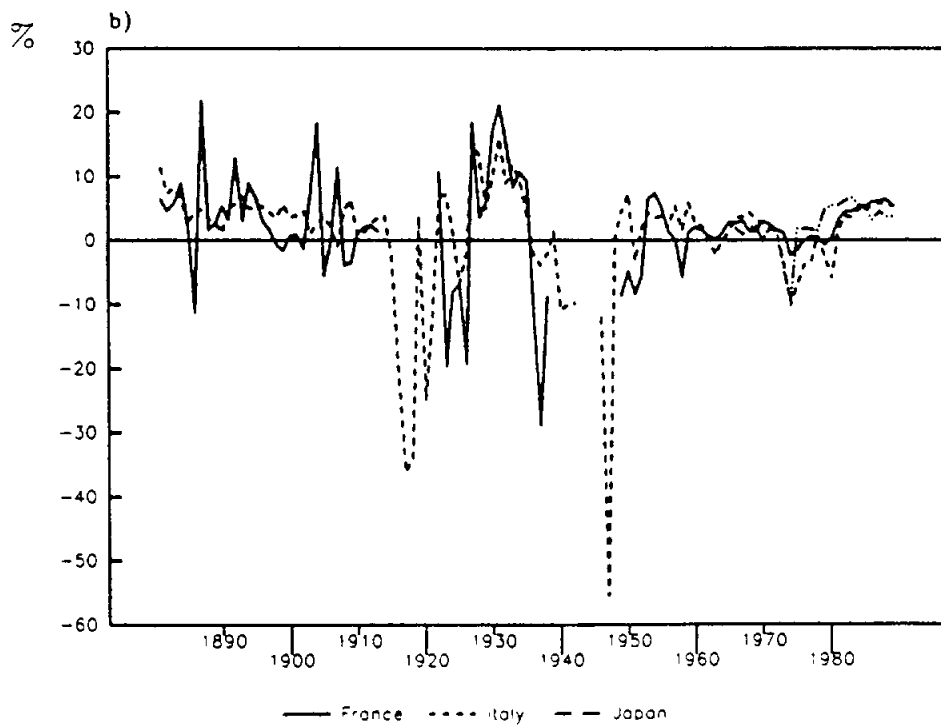
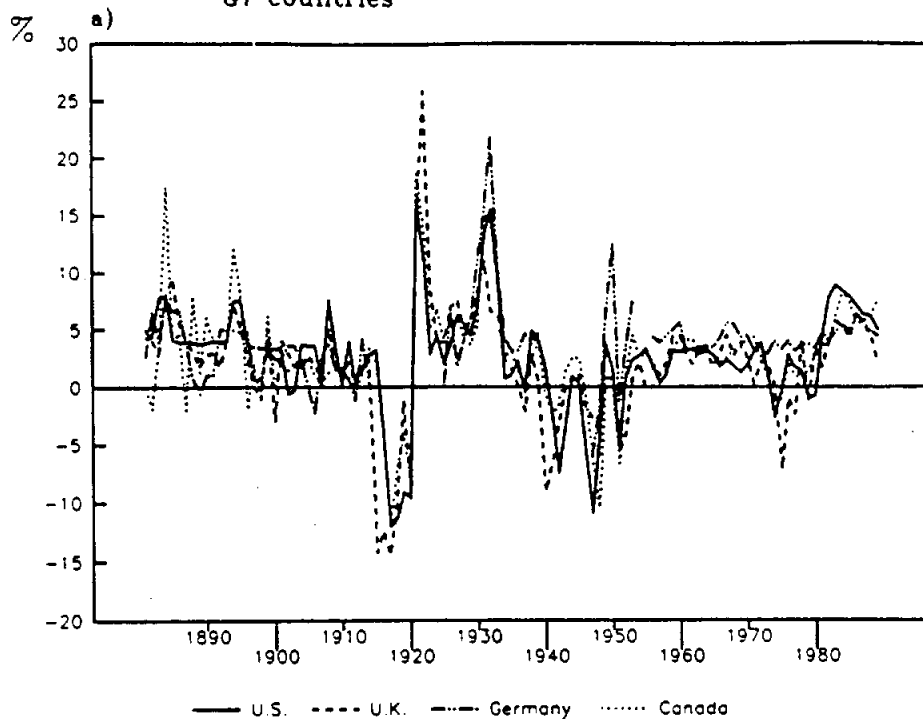


Figure 8: Absolute Change in Nominal Exchange Rates,
1880-1989, G7 countries

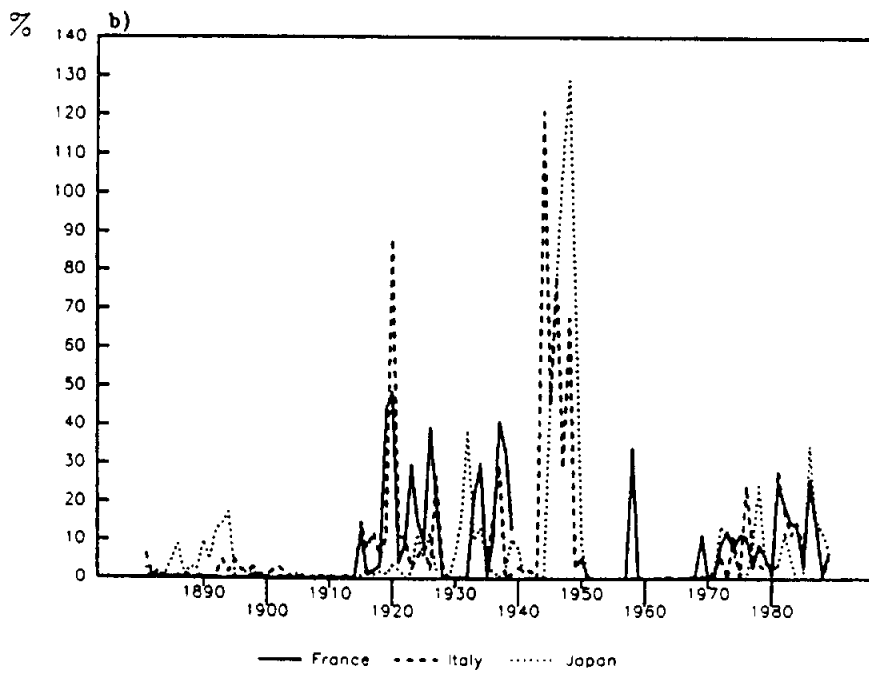
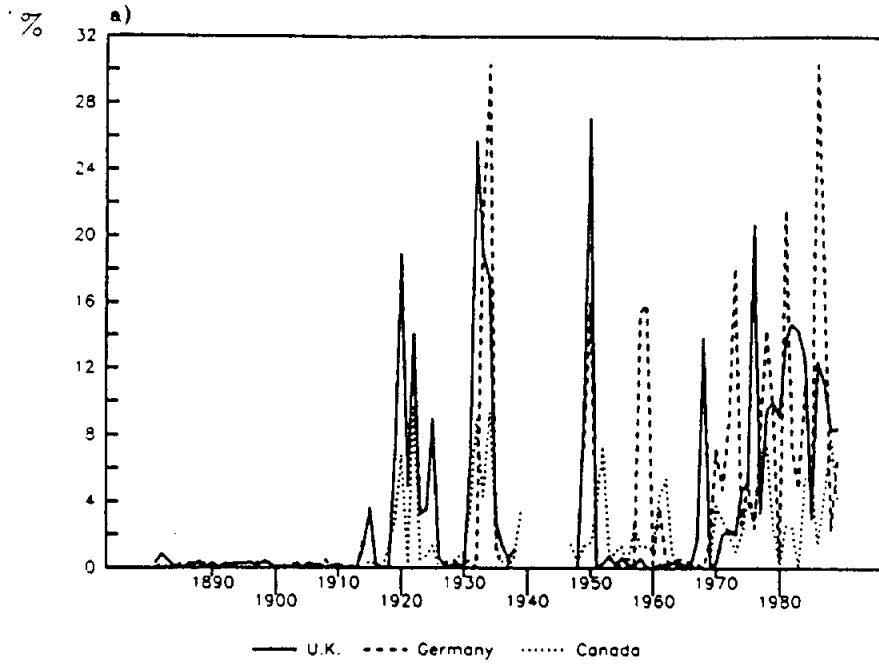


Figure 9: Absolute Change in Real Exchange Rates,
1880-1989, G7 countries

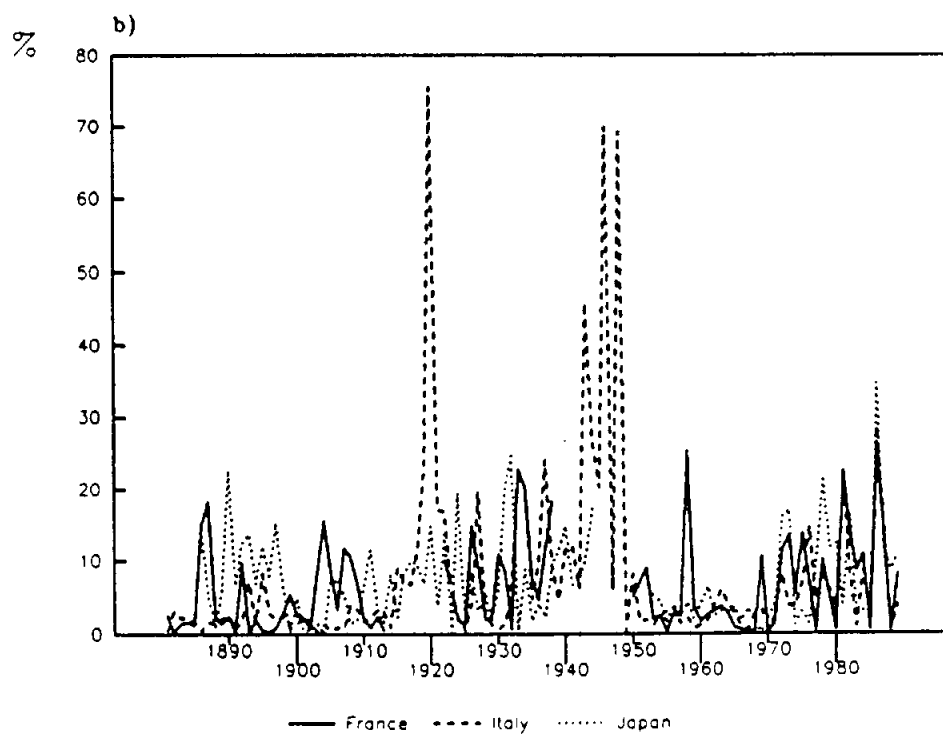
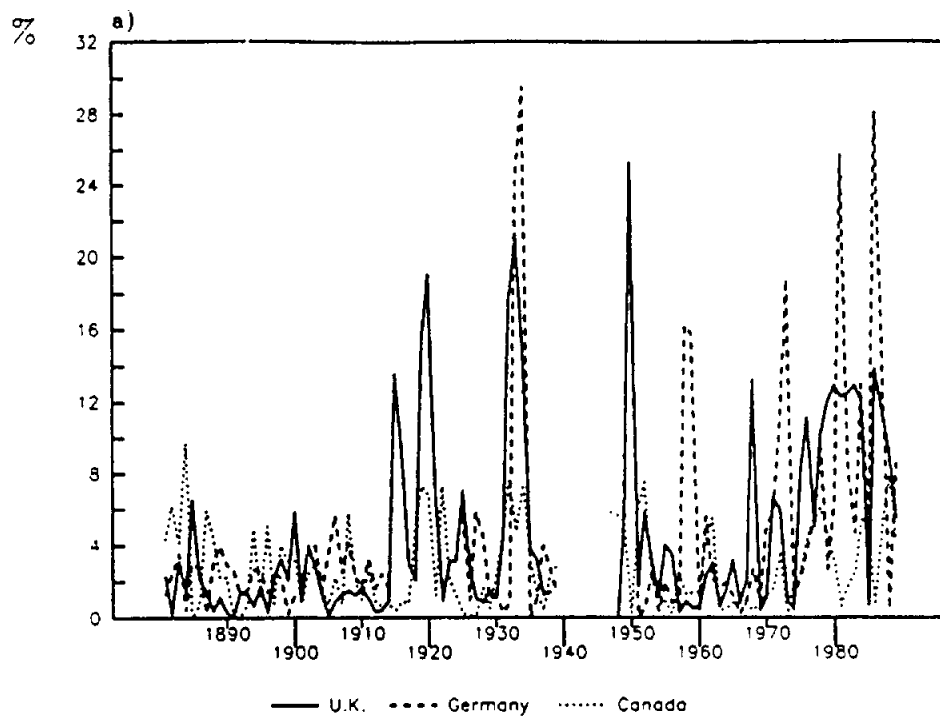


Figure 10: Impulse Response Functions of Demand and Supply Shocks on Prices (dotted lines) and Output (solid lines), G7 Aggregate by Regimes, Annual Data, 1881-1989

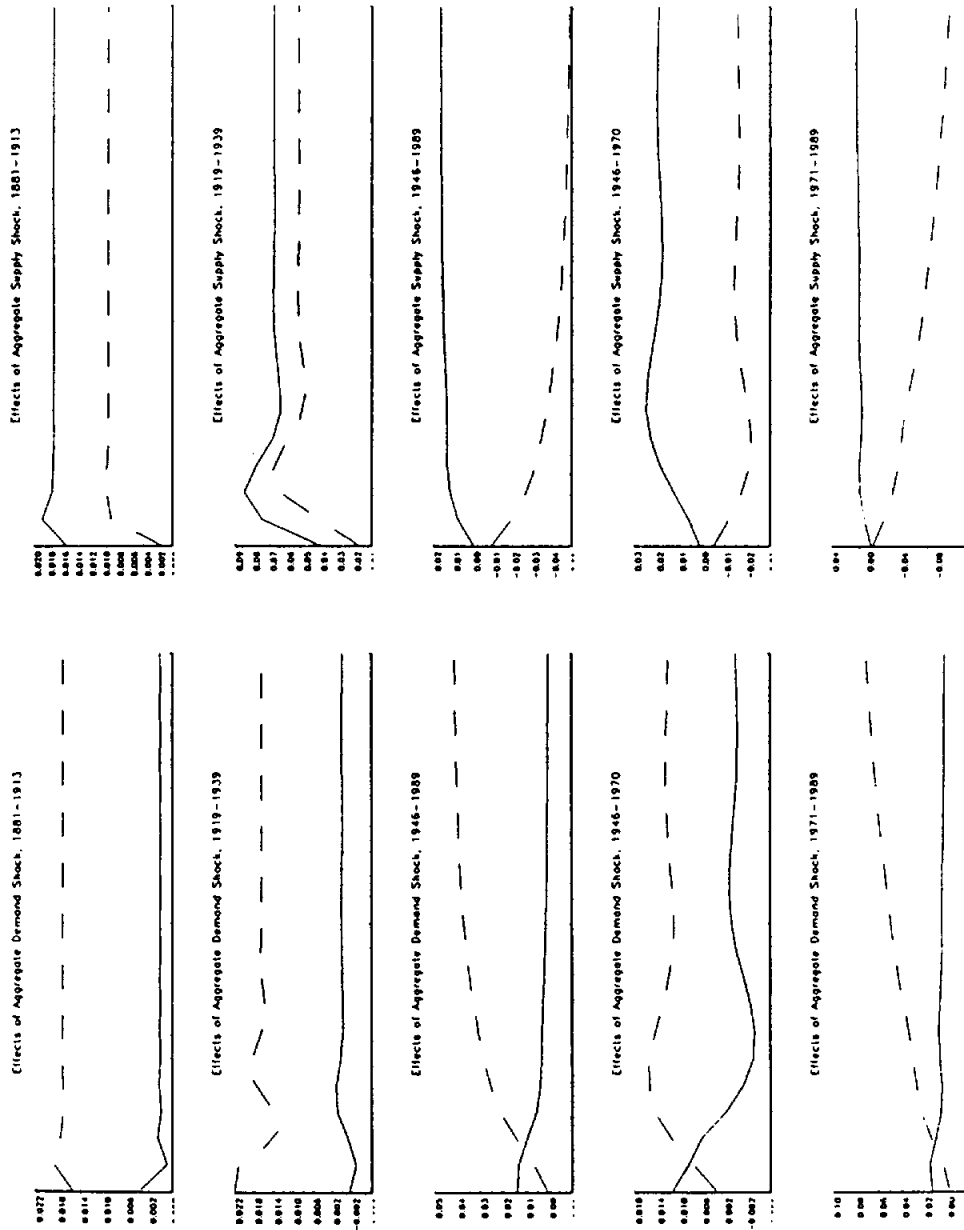
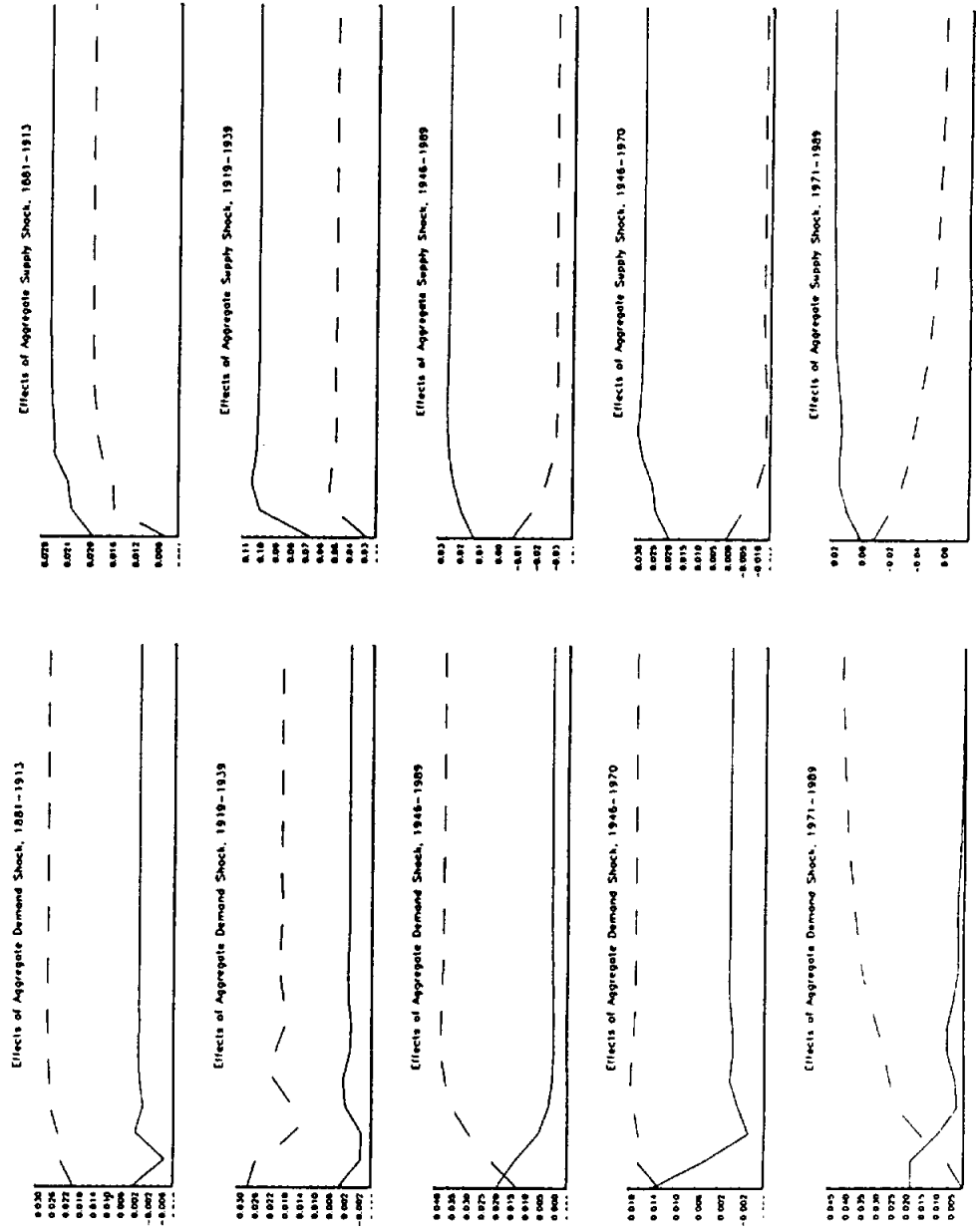


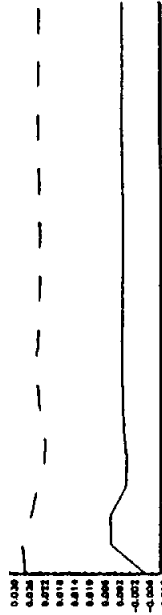
Figure 11: Impulse Response Functions of Demand and Supply Shocks on Prices (dotted lines) and Output (solid lines) and Output (solid lines) and Prices (dotted lines) and Supply Shocks on Prices (dotted lines) and Output (solid lines), G7 Countries by Regimes, Annual Data, 1881-1989

a) United States

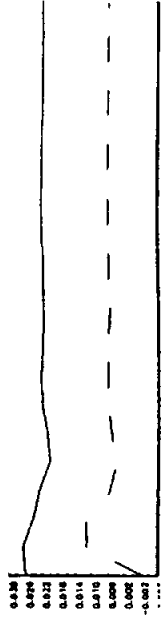


b) United Kingdom

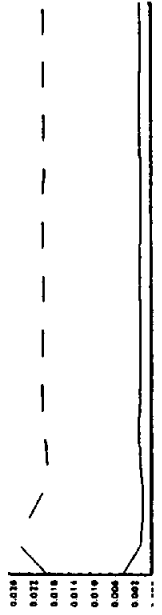
Effects of Aggregate Demand Shock, 1881-1913



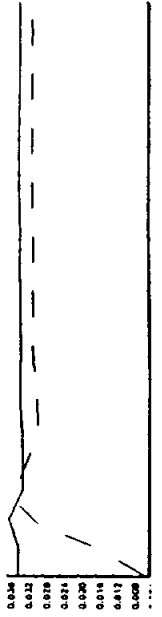
Effects of Aggregate Supply Shock, 1881-1913



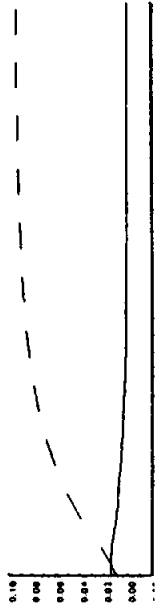
Effects of Aggregate Demand Shock, 1919-1939



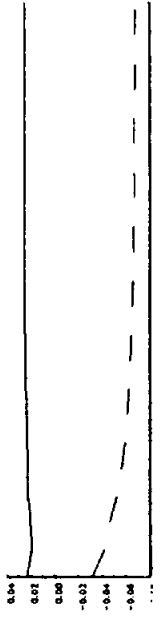
Effects of Aggregate Supply Shock, 1919-1939



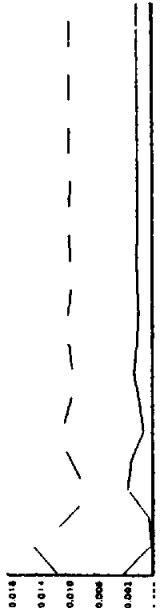
Effects of Aggregate Demand Shock, 1948-1968



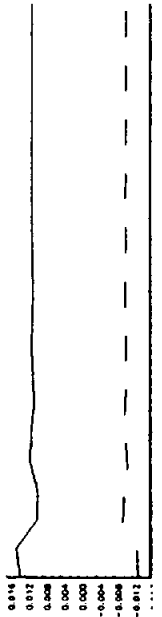
Effects of Aggregate Supply Shock, 1948-1968



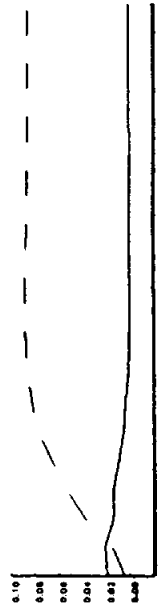
Effects of Aggregate Demand Shock, 1948-1970



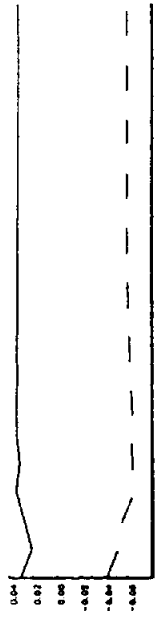
Effects of Aggregate Supply Shock, 1948-1970



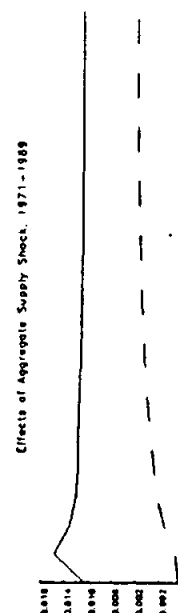
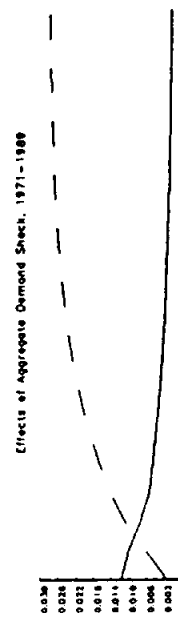
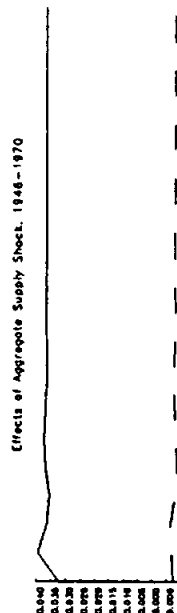
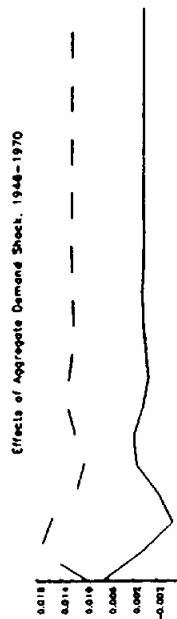
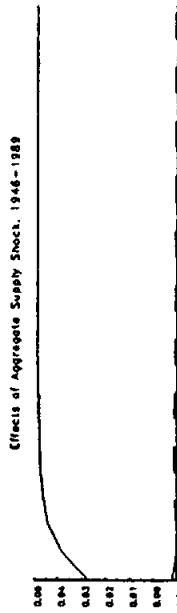
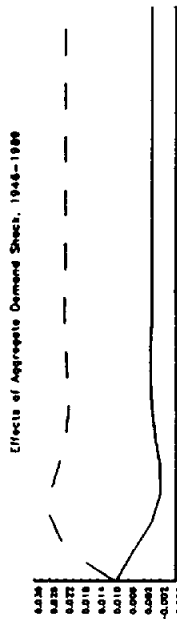
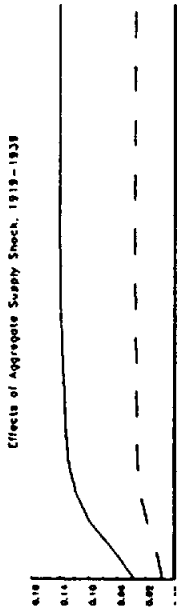
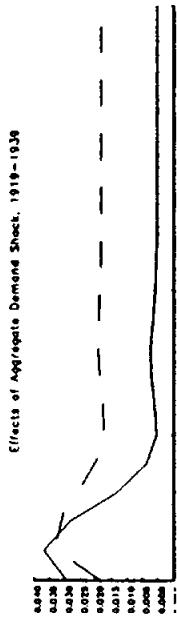
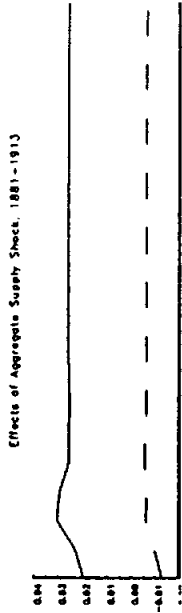
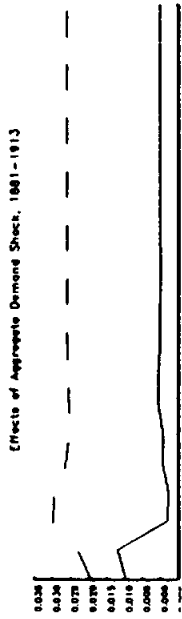
Effects of Aggregate Demand Shock, 1971-1989



Effects of Aggregate Supply Shock, 1971-1989

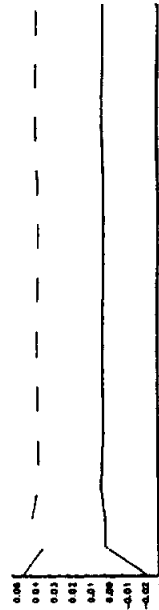


c) Germany

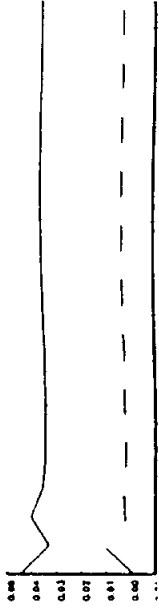


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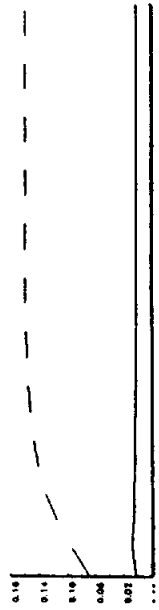
Effects of Aggregate Demand Shocks, 1981-1913



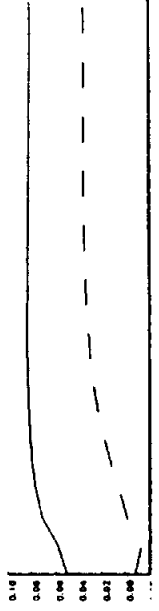
Effects of Aggregate Supply Shocks, 1981-1913



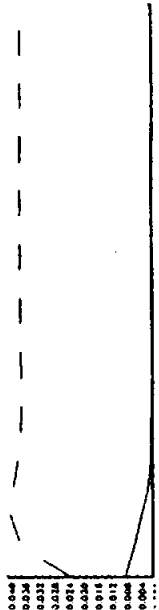
Effects of Aggregate Demand Shocks, 1919-1939



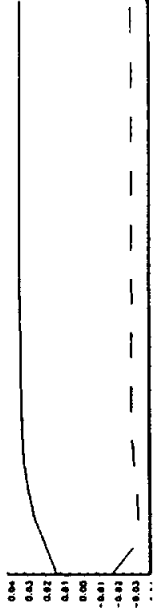
Effects of Aggregate Supply Shocks, 1919-1939



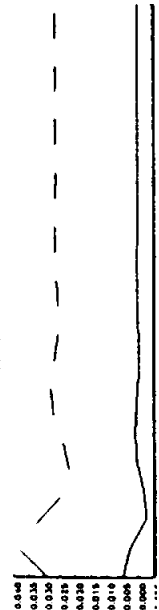
Effects of Aggregate Demand Shocks, 1948-1969



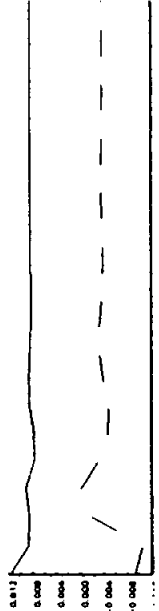
Effects of Aggregate Supply Shocks, 1948-1969



Effects of Aggregate Demand Shocks, 1948-1970



Effects of Aggregate Supply Shocks, 1948-1970



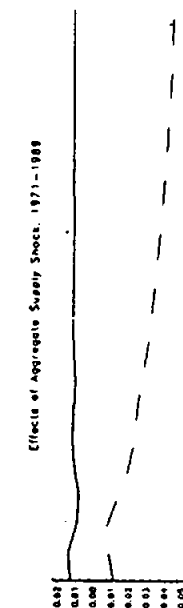
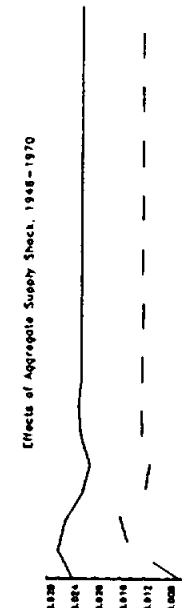
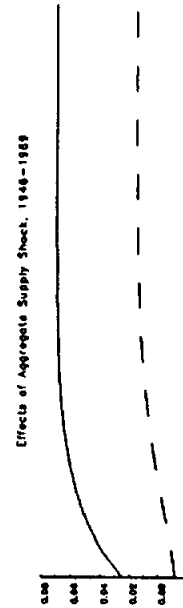
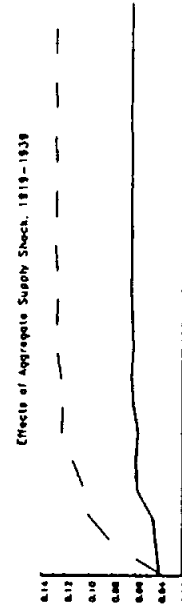
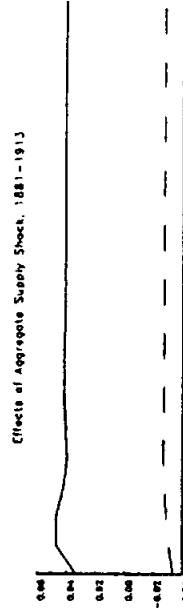
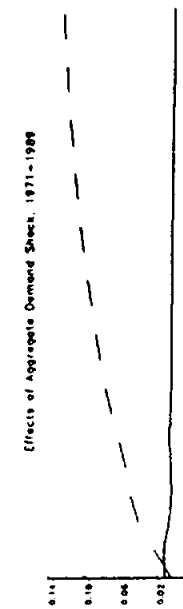
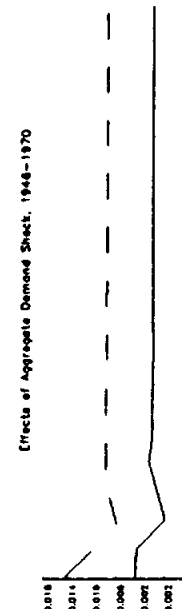
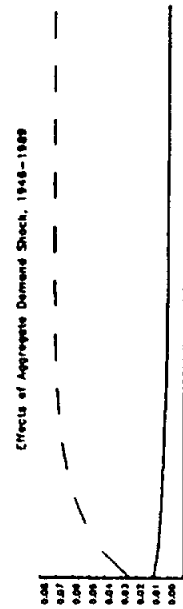
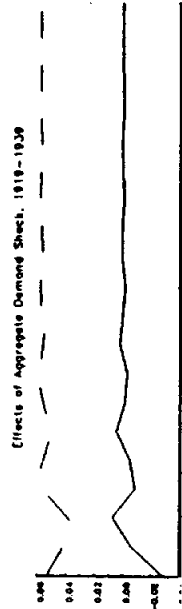
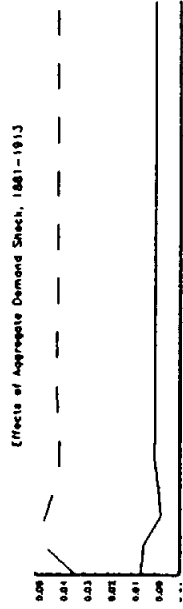
Effects of Aggregate Demand Shocks, 1971-1989



Effects of Aggregate Supply Shocks, 1971-1989

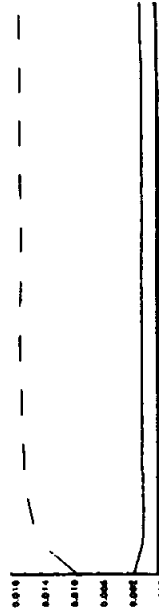


c) Japan

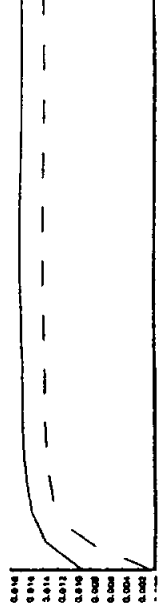


Canada

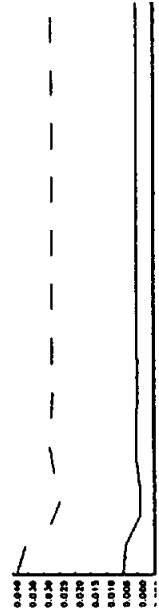
Effects of Aggregate Demand Shocks, 1881-1913



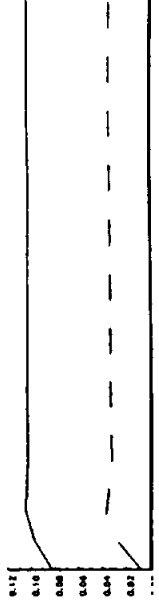
Effects of Aggregate Supply Shocks, 1881-1913



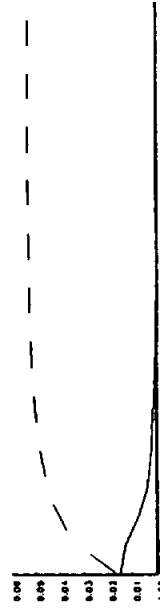
Effects of Aggregate Demand Shocks, 1919-1939



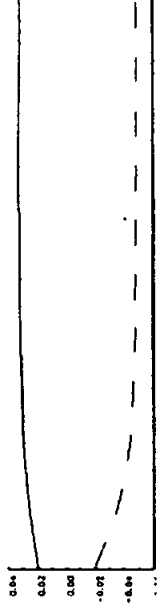
Effects of Aggregate Supply Shocks, 1919-1939



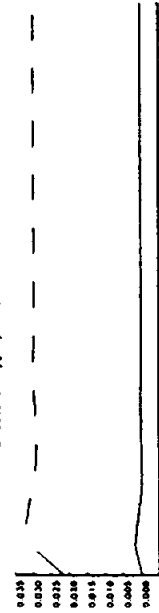
Effects of Aggregate Demand Shocks, 1946-1969



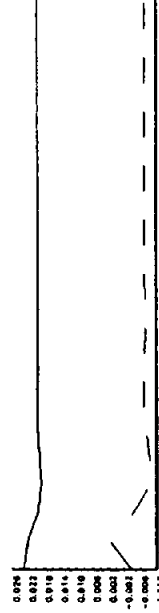
Effects of Aggregate Supply Shocks, 1946-1969



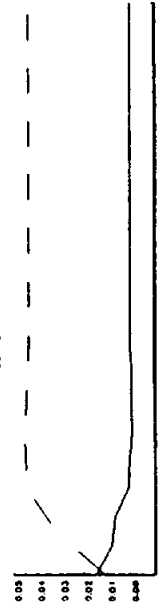
Effects of Aggregate Demand Shocks, 1946-1970



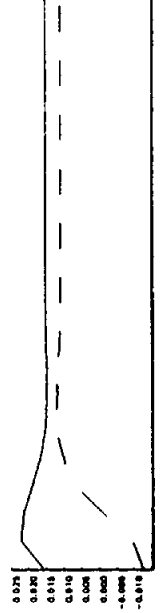
Effects of Aggregate Supply Shocks, 1946-1970



Effects of Aggregate Demand Shocks, 1971-1989

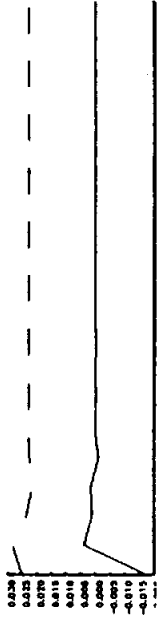


Effects of Aggregate Supply Shocks, 1971-1989

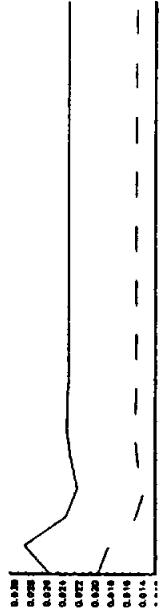


g) Italy

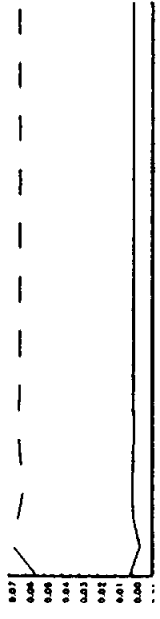
Effects of Aggregate Demand Shock, 1881-1913



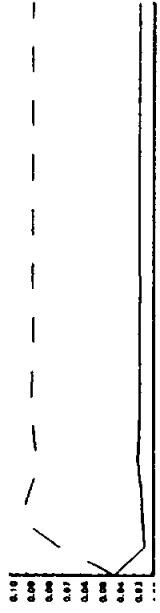
Effects of Aggregate Supply Shock, 1881-1913



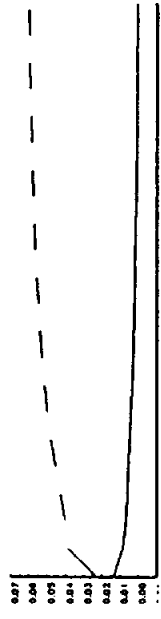
Effects of Aggregate Demand Shock, 1919-1939



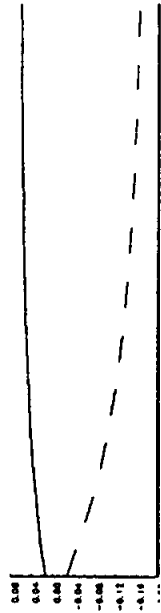
Effects of Aggregate Supply Shock, 1919-1939



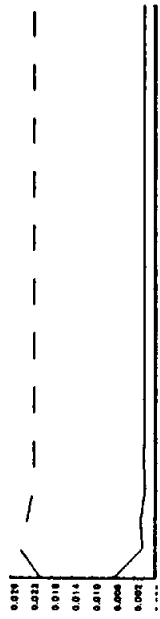
Effects of Aggregate Demand Shock, 1948-1989



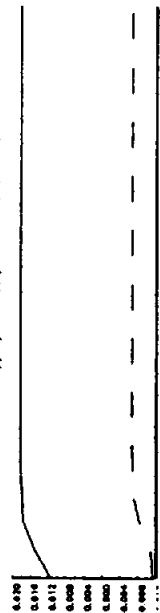
Effects of Aggregate Supply Shock, 1948-1989



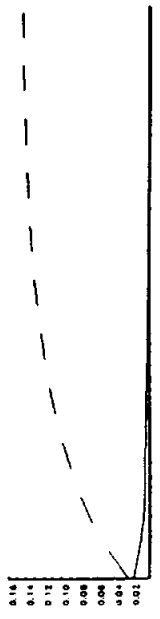
Effects of Aggregate Demand Shock, 1948-1970



Effects of Aggregate Supply Shock, 1948-1970



Effects of Aggregate Demand Shock, 1971-1989



Effects of Aggregate Supply Shock, 1971-1989

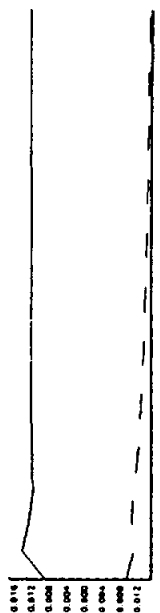


Figure 12: Supply and Demand Shocks: G7 Aggregate, 1880-1989
Annual Data

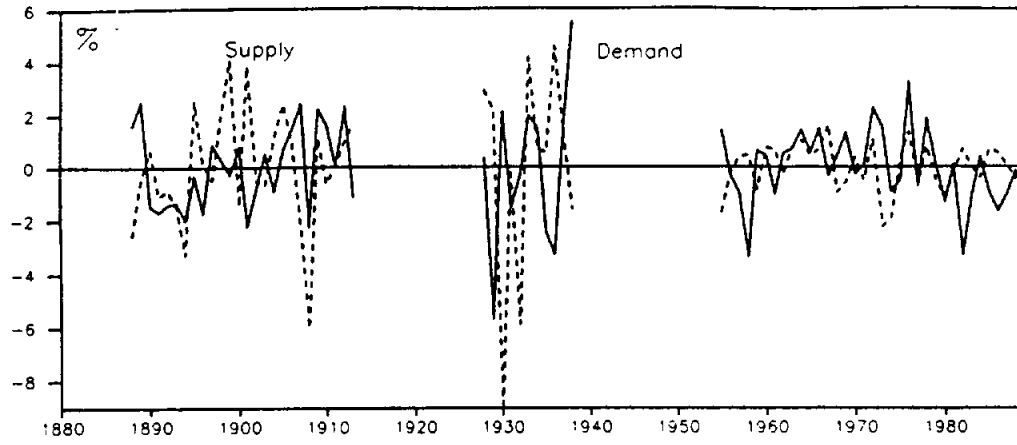
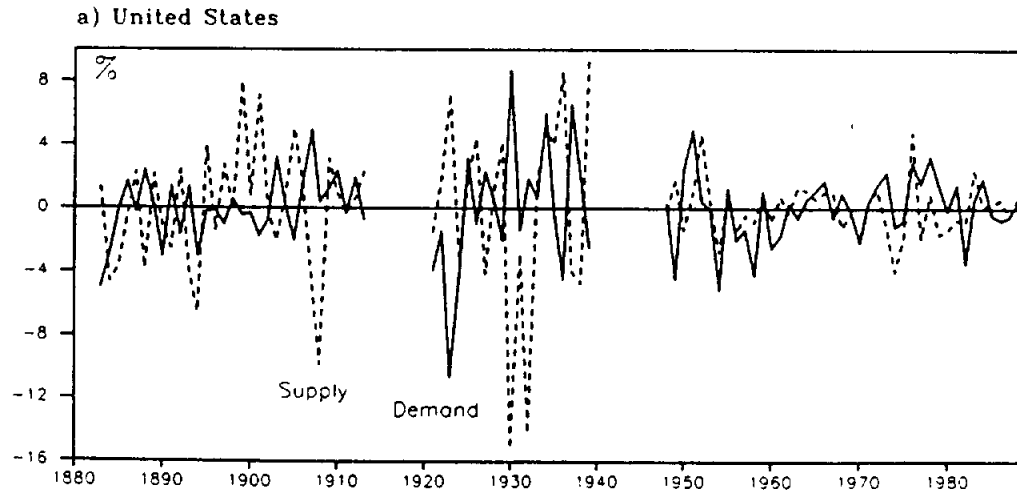
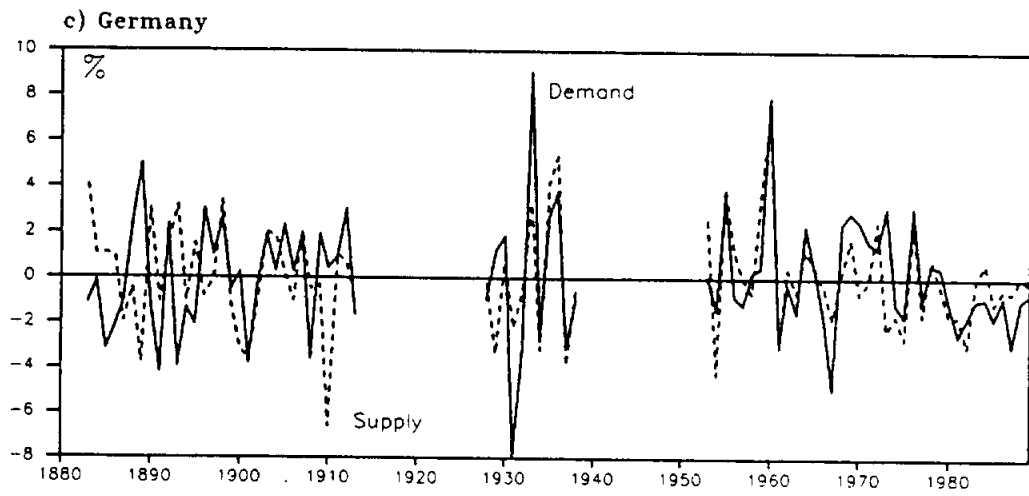
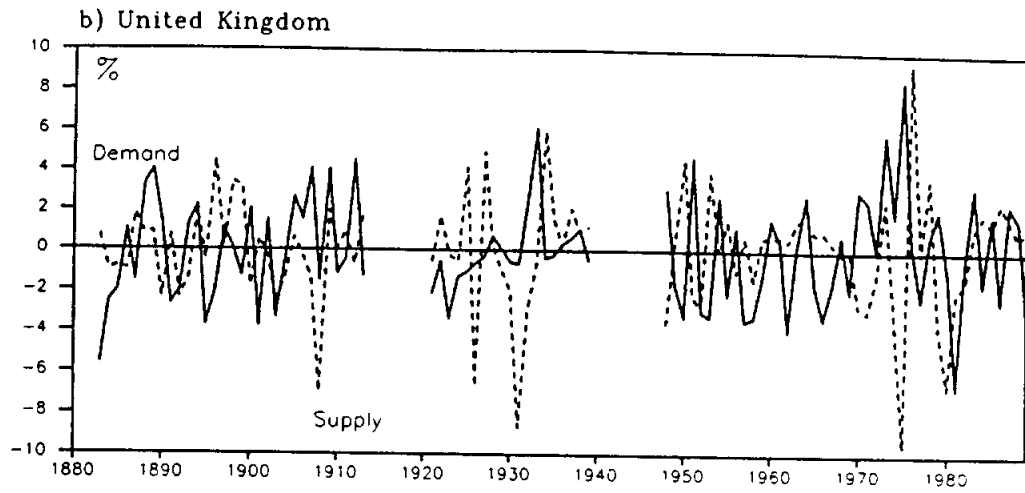
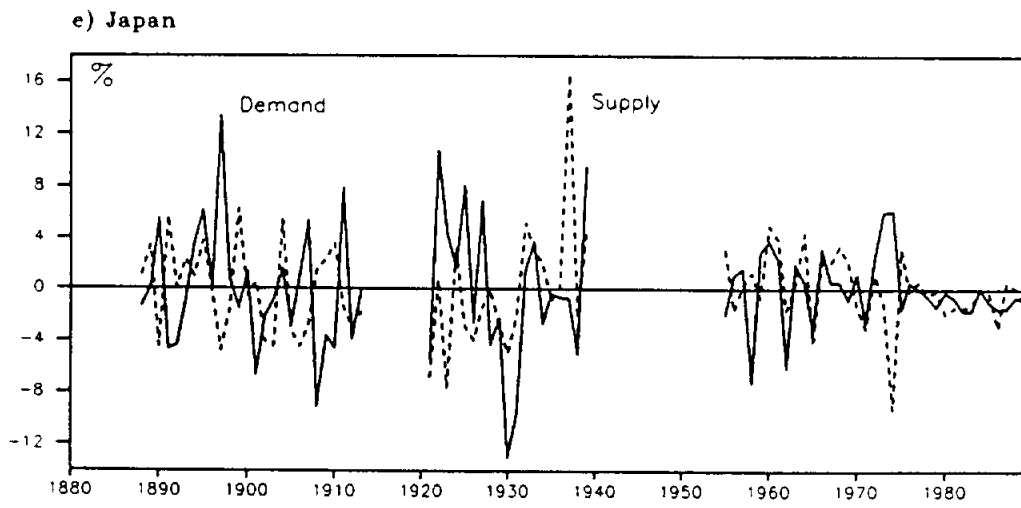
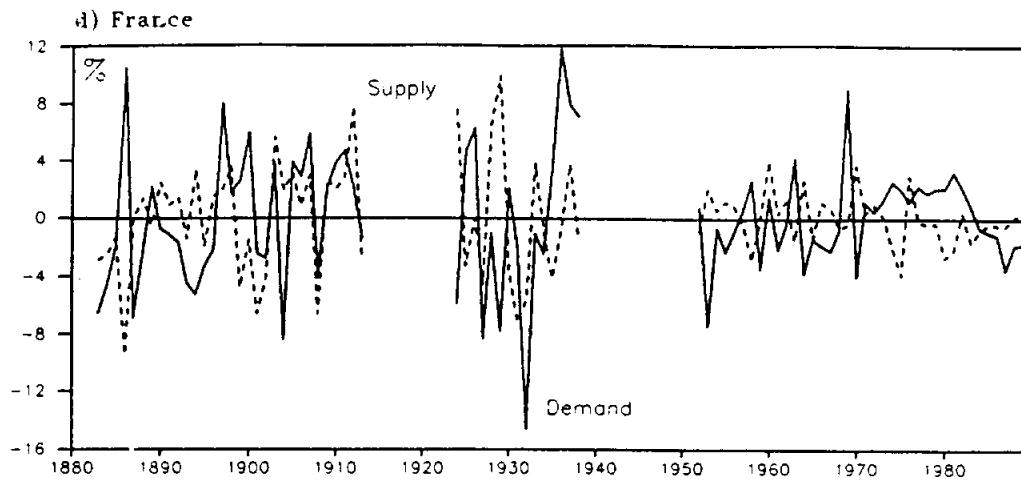


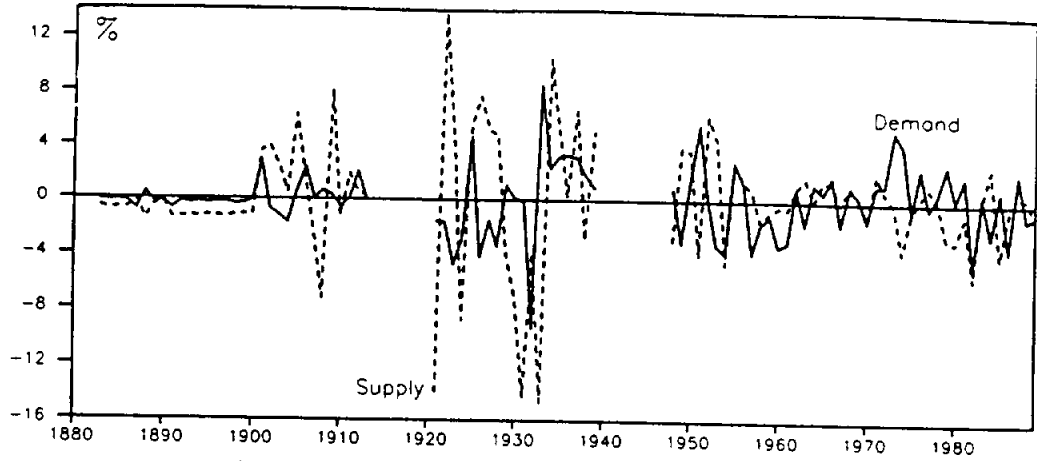
Figure 13: Supply and Demand Shocks: G7-Countries, 1880-1989
Annual Data







f) Canada



g) Italy

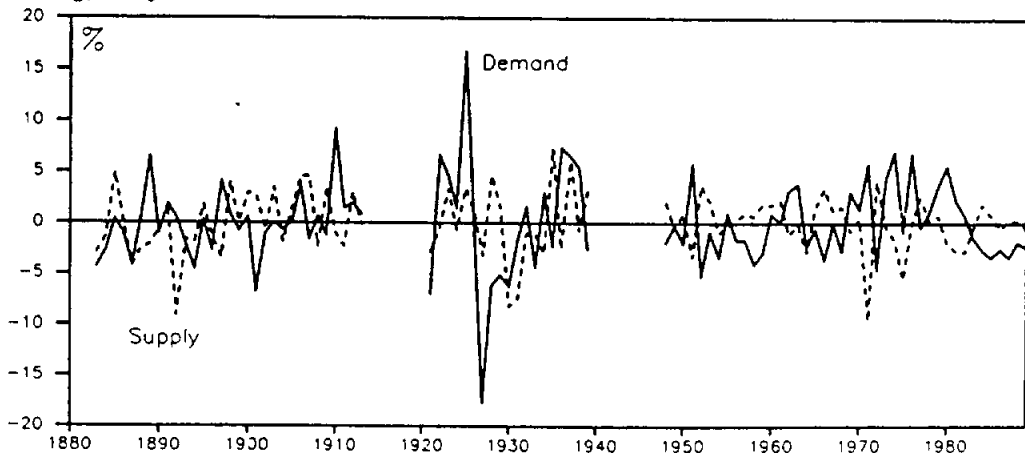


Figure 14: Monetary Gold and Dollar Holdings: the U.S. and the rest of the World, 1945-1971

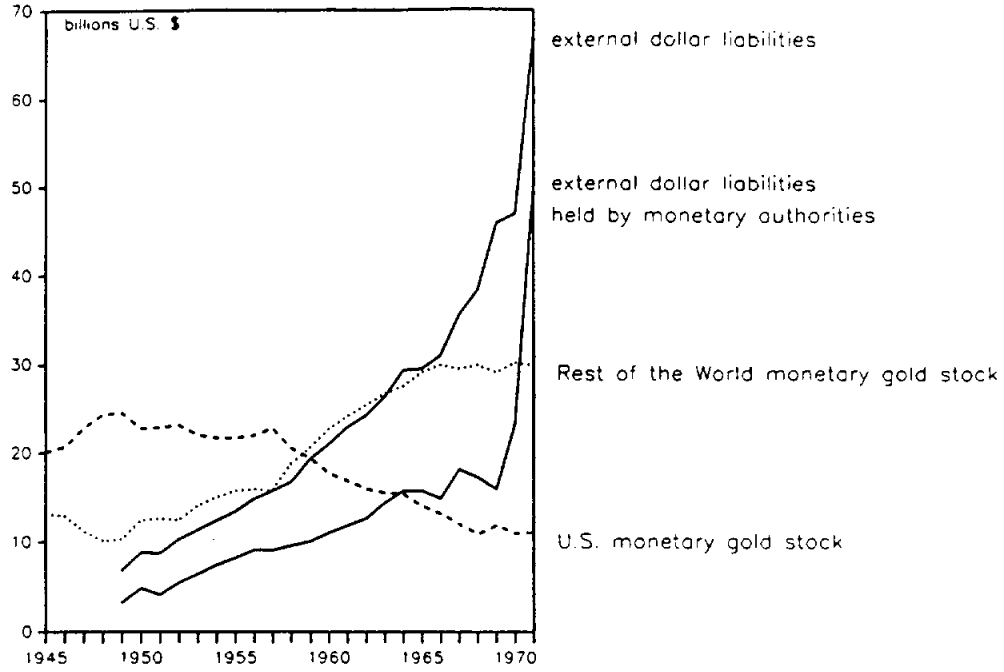


Figure 15: Balance of Payments: United States, 1950-1971

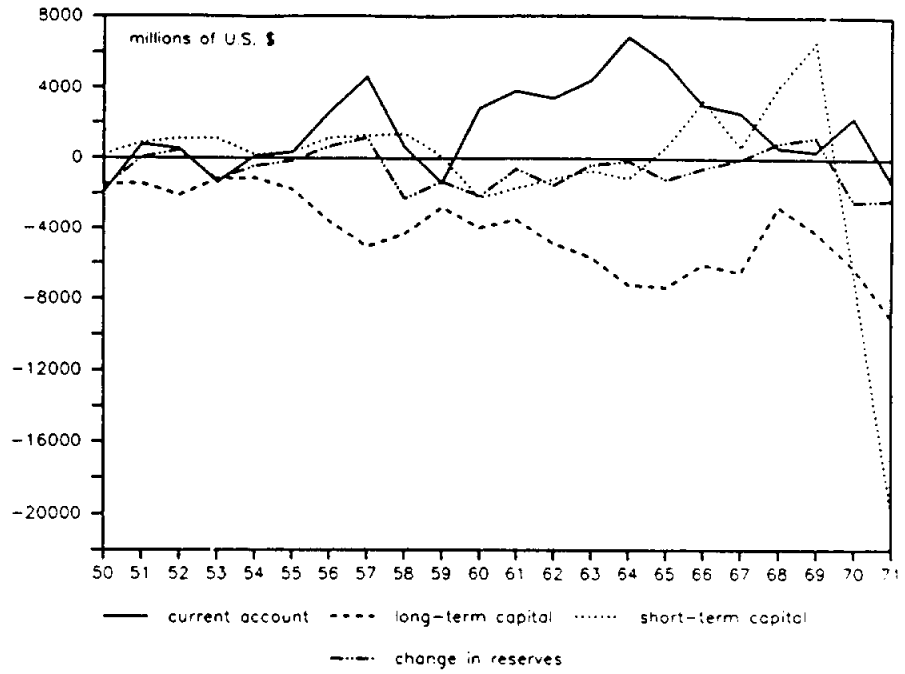


Figure 16: The Growth of the Monetary Gold Stock, the Growth in International Reserves and the Growth of the Volume of Real Trade and Real Income, G7, 1950-1973

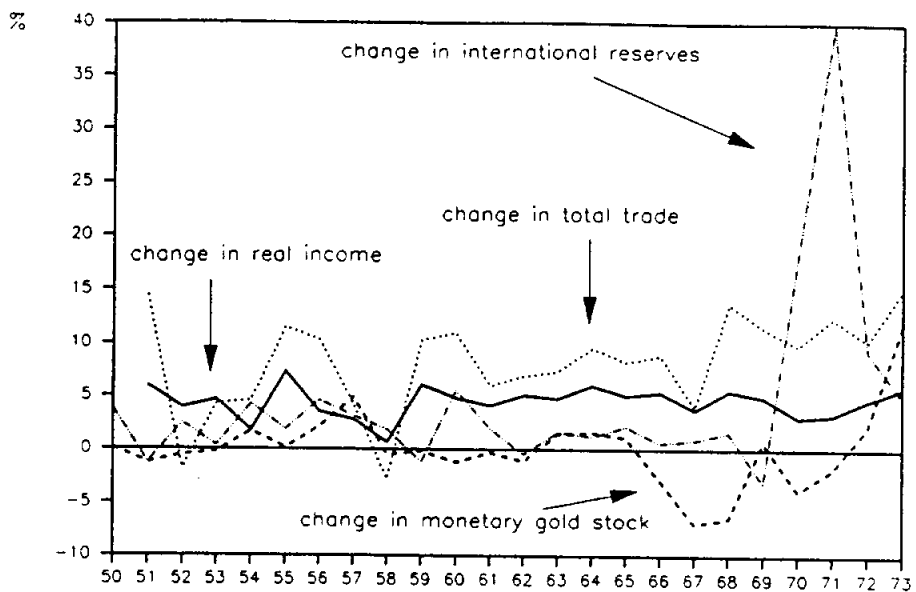


Figure 17: The Growth of the Monetary Gold Stock, the Growth in International Reserves and the Growth of the Volume of Real Trade and Real Income, G7 minus the U.S., 1950-1973

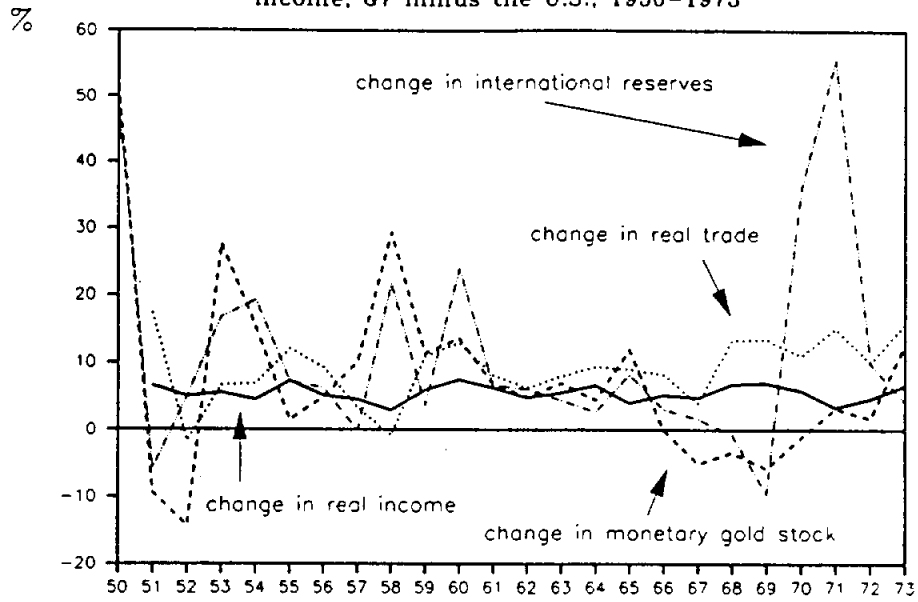


Figure 18: London Gold Price

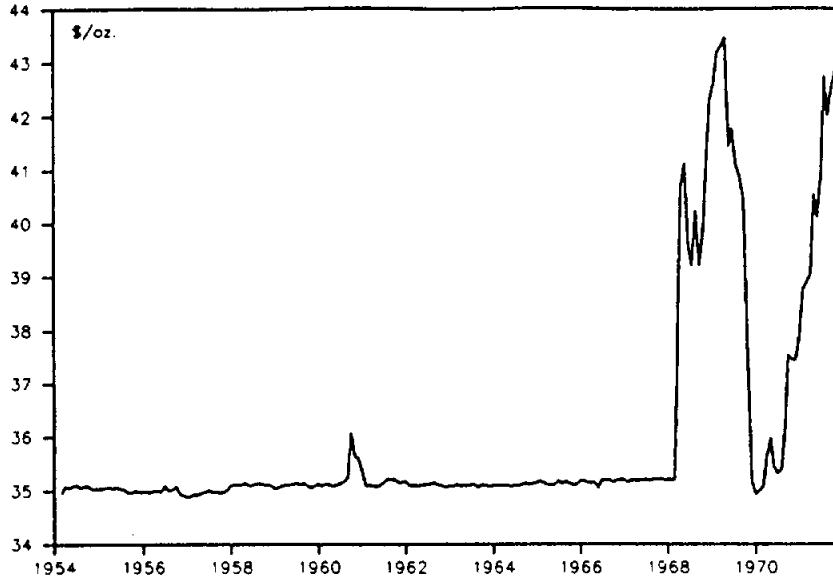


Figure 19: Inflation Rates in the U.S., G7 and G7 excluding the U.S., 1951-1973

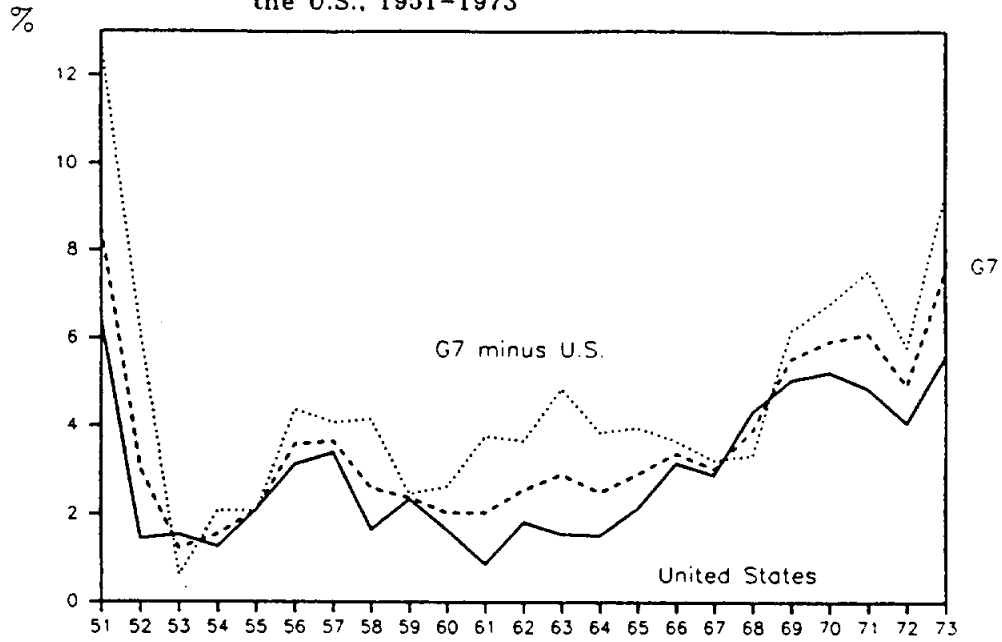


Figure 20: Money (M1) growth rates in the U.S., G7 and G7 excluding the U.S., 1951-1973

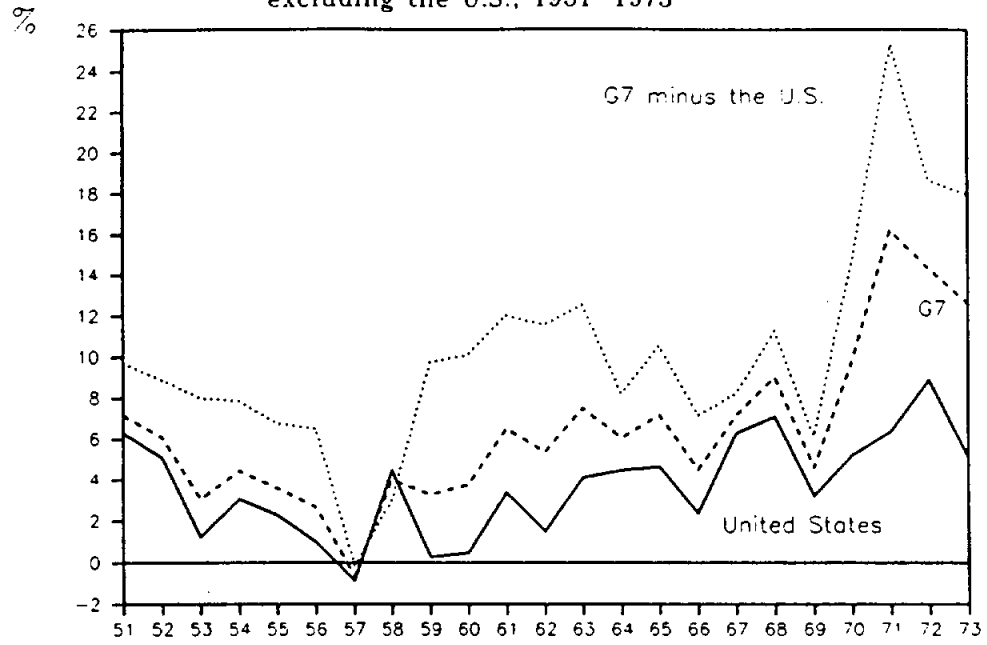
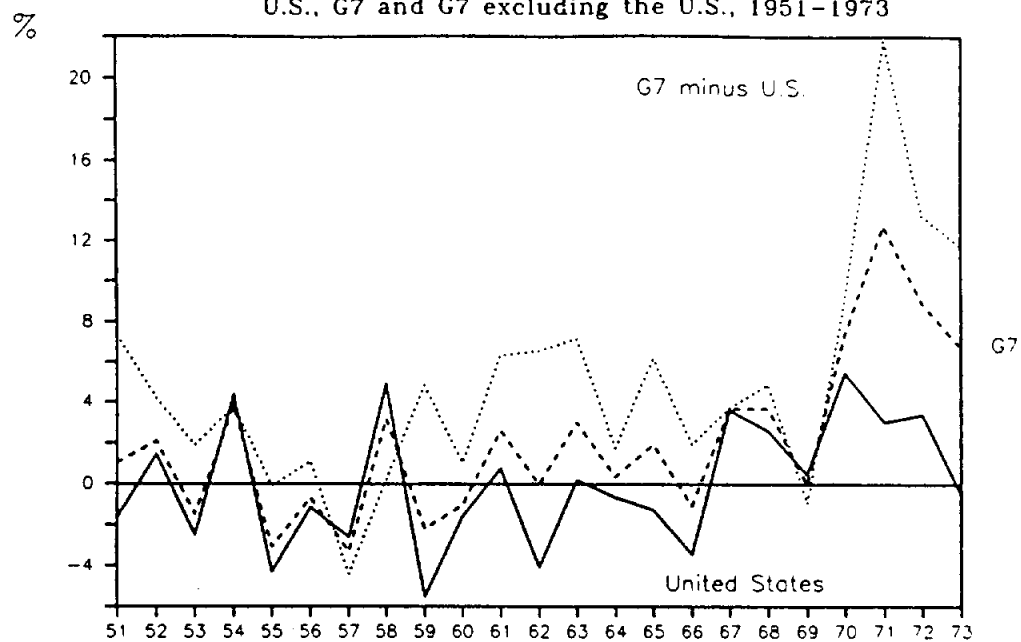


Figure 21: Money (M1) growth less real output growth in the U.S., G7 and G7 excluding the U.S., 1951-1973



Appendix Table 1: Supply (Permanent) and Demand (Temporary) Shocks: 1880-1989
 Annual Data: Standard Deviations of Shocks (%); Dispersion of shocks across countries(%)

	Gold Standard		World War I		Interwar		World War II		Bretton Woods	
	1883-1913	1914-1918	1919-1939	1940-1945	1946-1970	D	S	D	S	
United States	2.37	4.77	4.27	9.36	6.74	6.32	2.22	7.10	3.69	5.72
United Kingdom	3.09	3.09	4.34	4.32	6.18	5.23	5.59	7.15	2.42	2.47
Canada	1.01	2.80	6.47	6.45	6.28	8.01	2.31	6.68	2.67	2.73
Italy	4.79	5.00	10.60	8.50	11.56	6.46	18.29	4.92	8.15	5.80
G4	2.24	3.53	4.53	6.83	6.73	4.67	2.49	5.91	2.67	4.33
G4*	2.10	3.30	4.30	6.64	6.35	5.12	1.98	6.30	2.76	4.38
Dispersion	2.69	4.30	3.87	7.03	4.15	5.50	5.62	6.96	2.82	3.40

Bretton Woods (Preconvertible) 1946-1958
 Bretton Woods (Convertible) 1959-1970
 Floating Exch. 1973-1989
 Post WW-II 1946-1989

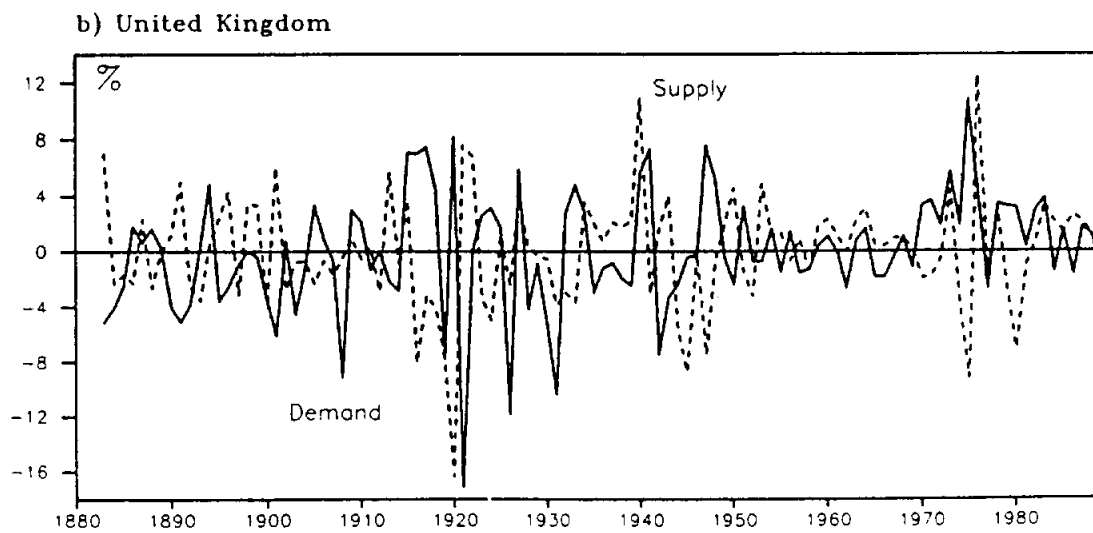
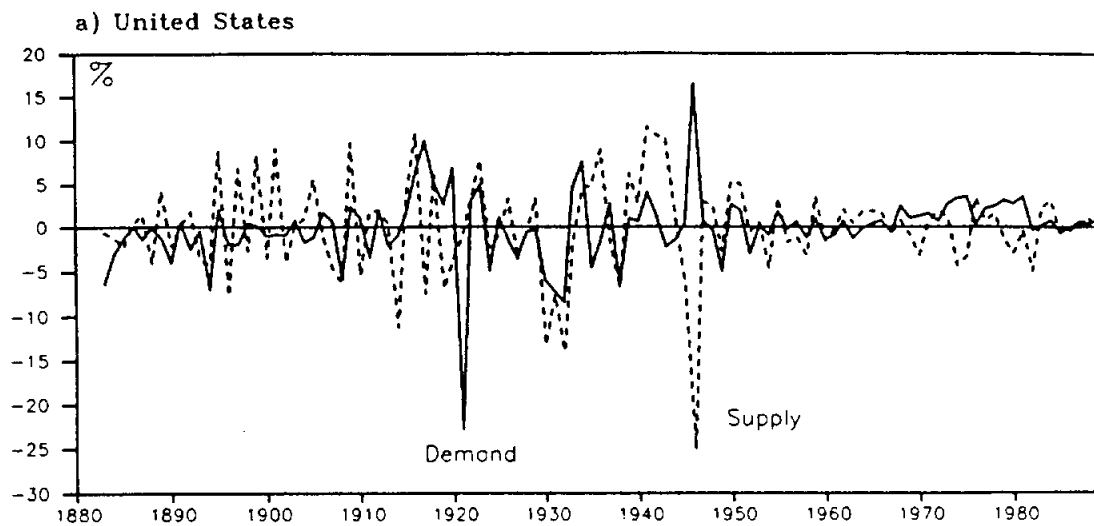
	Bretton Woods (Preconvertible) 1946-1958		Bretton Woods (Convertible) 1959-1970		Floating Exch. 1973-1989		Post WW-II 1946-1989	
	D	S	D	S	D	S	D	S
United States	5.07	7.77	1.15	1.87	1.46	2.47	2.93	4.55
United Kingdom	2.96	3.18	1.71	1.32	3.27	4.81	2.85	3.49
Canada	3.65	3.55	0.97	1.56	2.41	2.71	2.59	2.75
Italy	10.98	7.95	2.71	2.21	3.43	2.63	6.78	5.01
G4	3.66	5.87	0.95	1.50	1.41	2.56	2.25	3.61
G4*	3.79	5.89	0.90	1.48	1.56	2.37	2.34	3.59
Dispersion	3.93	4.60	1.61	2.10	2.07	2.05	2.57	2.79

G4 : G4-aggregate data
 G4* : Weighted average of individual country shocks; The weights are calculated as the share of each country's National Income in the the Total Income in the G4 countries, where the G.N.P./G.D.P. data are converted to dollars using the actual exchange rate.

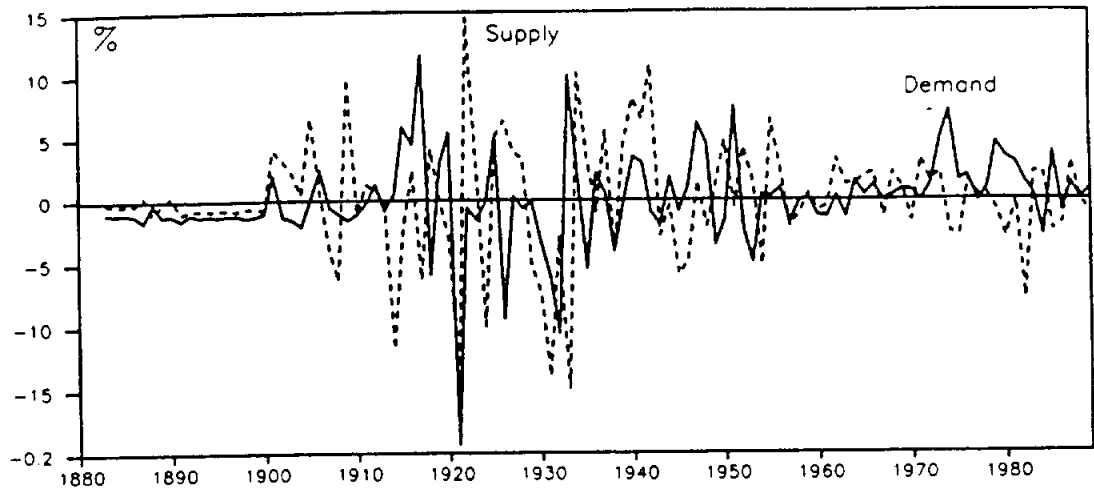
$$\text{Dispersion} = \sum (\text{weight}_i (\text{shock}_i - \bar{\text{shock}})^2)^{0.5}$$

for $i = \text{United States, United Kingdom, Canada, Italy}$

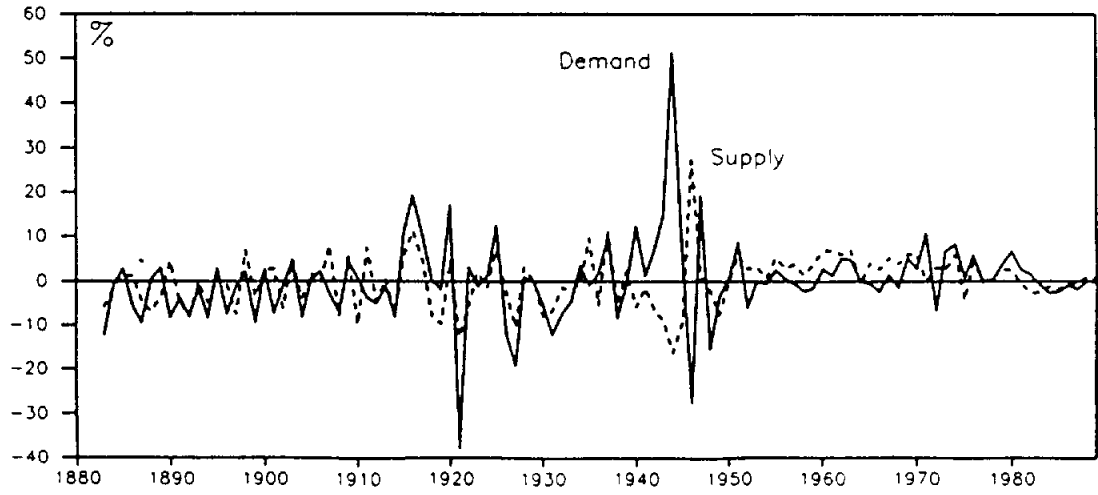
Appendix Figure 1: Supply and Demand Shocks, 1880-1989,
Including the War Years
Annual Data



c) Canada



d) Italy



e) G4

