Inflation under the Bretton Woods System: The Spillover Effects of U.S. Expansionary Policies

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This paper examines the transmission effects of U.S. expansionary policies on inflation in the G7 countries under the latter years of the Bretton Woods system. Using quarterly data and structural vector autoregressions, this paper investigates the extent of inflation variability due to U.S. aggregate supply and aggregate demand impulses in major industrial countries. Empirical results show that a sizable proportion of inflation variability in these countries can be attributed to U.S. shocks. A brief discussion follows concerning the breakdown of Bretton Woods and implications for the design and functioning of international monetary arrangements. (JEL F33, E33, N10)

Introduction

The Bretton Woods system was inaugurated in 1944 with the signing of the Articles of Agreement of the International Monetary Fund. The system called for fixed exchange rates against the U.S. dollar which was pegged to gold. Member countries held their international reserves in U.S. dollars and in gold, making the U.S. dollar a principal reserve asset. Most countries maintained the official par values of their currencies by intervening in the foreign exchange market.[1] Bretton Woods was characterized by extensive capital controls. Current account transactions were inconvertible until 1958 while controls remained in place for capital account transactions for the entire period. Since the dollar was a reserve asset, other countries accumulated U.S. dollars through U.S. balance of payments deficits.

A commonly held view is that expansionary domestic programs in the U.S. and increases in defense spending due to the Vietnam War brought inflation. In order to maintain fixed exchange rates, other countries had to accommodate U.S. expansionary policies by intervening in the foreign exchange market and increase their money supply by importing U.S. inflation.

Figure 1 presents the U.S. current account balance and the official settlements balance for the 1960-72 period. With the exception of 1968-69, the U.S. had a deficit in its official settlements balance from 1958 until the end of Bretton Woods.[2] Some argued that the U.S. balance of payments deficits did not pose a problem in that the rest of the world voluntarily held dollars because of their valuable service flow — the deficit was demand-determined [Bordo, 1993].

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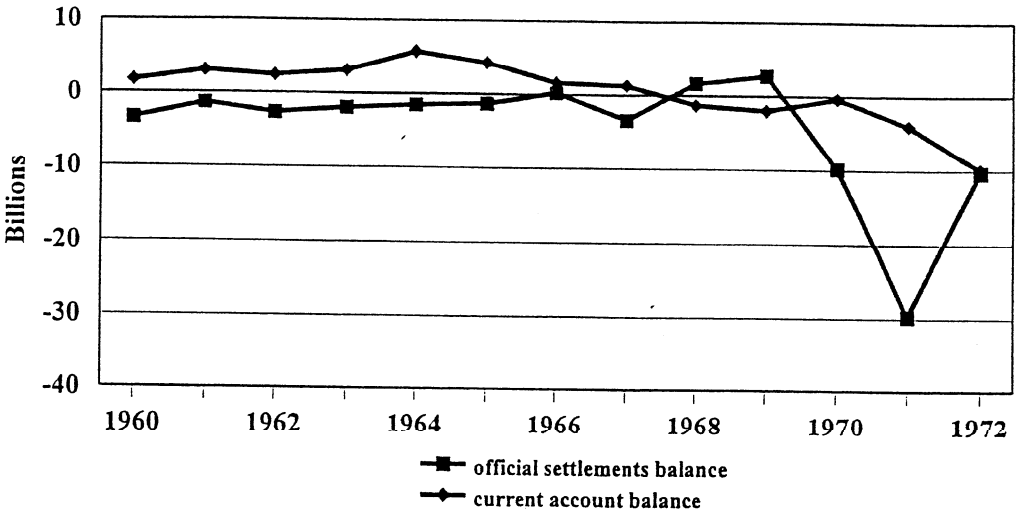
FIGURE 1
U.S. International Transactions: 1960-72



Source: *Economic Report of the President* [1978].

Figure 1 shows that the U.S. did not have a major current account deficit until 1970. The balance of payments deficit was perceived to be a problem by the U.S. monetary authorities because of the implications for confidence. As official dollar liabilities increased abroad, the fear that these dollars would be converted to gold was a real possibility. At the same time, the official gold price of $35 per ounce had restrained world gold production while industrial demand for gold was growing.

Combined with accelerated U.S. inflation rates (as shown below), the confidence problem resulted in a two-tier gold market in 1968 where only foreign central banks were allowed to buy gold at the official rate of $35 per ounce. Meanwhile, U.S. expansionary policies continued partly because there was little pressure on the U.S. (*via* reductions in gold holdings) to reduce its monetary growth rates. France did attempt to put pressure on the U.S. by threatening to convert French holdings of U.S. dollars into gold, but such a move would bring a collapse of the system. The U.S. also initiated a number of international arrangements such as swaps and capital controls to prevent the conversion of dollar liabilities into gold [Meltzer, 1991]. The European countries perceived the U.S. balance of payments deficits to be a major problem because the U.S. did not have to adjust its domestic economy to external deficits as the Federal Reserve routinely sterilized dollar outflows. Germany viewed the U.S. as exporting inflation to surplus countries while France resented U.S. financial dominance and the seigniorage they believed the U.S. was earning on its outstanding dollar liabilities [Bordo, 1993].

Table 1 presents inflation rates for the G7 countries for the last decade of Bretton Woods and correlations of inflation rates with inflation in the U.S. It is evident that inflation in the U.S. accelerated in the last half of the 1960s and seems to exhibit some strong correlations with inflation in other major industrial countries, notably Canada,

France, Japan, and the U.K. Since inflation in other countries could also influence inflation in the U.S., it is important to investigate the extent of inflation due to pure U.S. expansionary policies.

TABLE 1
Annual Inflation Rates in G7 Countries under Selected Bretton Woods Years

Year	Canada	France	West Germany	Italy	Japan	U.K.	U.S.
1961-65	1.6	3.8	2.8	4.9	6.2	3.5	1.3
1966	3.8	2.7	3.6	2.3	5.1	3.9	2.9
1967	3.5	2.7	1.7	3.7	4.0	2.5	2.9
1968	4.1	4.5	1.5	1.4	5.3	4.7	4.2
1969	4.5	6.5	1.9	2.7	5.2	5.4	5.4
1970	3.3	5.2	3.5	4.9	7.7	6.3	5.9
1971	2.8	5.5	5.2	4.9	6.3	9.5	4.3
1972	4.8	6.2	5.6	5.7	4.9	7.1	3.3
ρ (1961-72)	0.75	0.56	0.12	-0.27	0.04	0.61	—
ρ (1966-72)	-0.11	0.64	-0.13	0.08	0.77	0.40	—

Notes: Inflation is measured as the annual percentage change in consumer prices. ρ is the correlation of inflation with inflation in the U.S. for the indicated period.
Source: *Economic Report of the President* [1978].

This paper investigates the transmission of U.S. expansionary policies on inflation in the G7 countries. Using structural vector autoregressions (VAR) within the context of an aggregate supply to aggregate demand (AS/AD) model and quarterly data, this paper investigates the extent of inflation variability in major industrial countries due to U.S. supply and demand impulses. Variance decomposition analysis can then shed light on whether or not U.S. supply and demand policies were responsible for inflation in industrial countries under Bretton Woods. This paper also tries to assess repercussion effects on the U.S. by investigating the effects of foreign shocks on U.S. inflation.

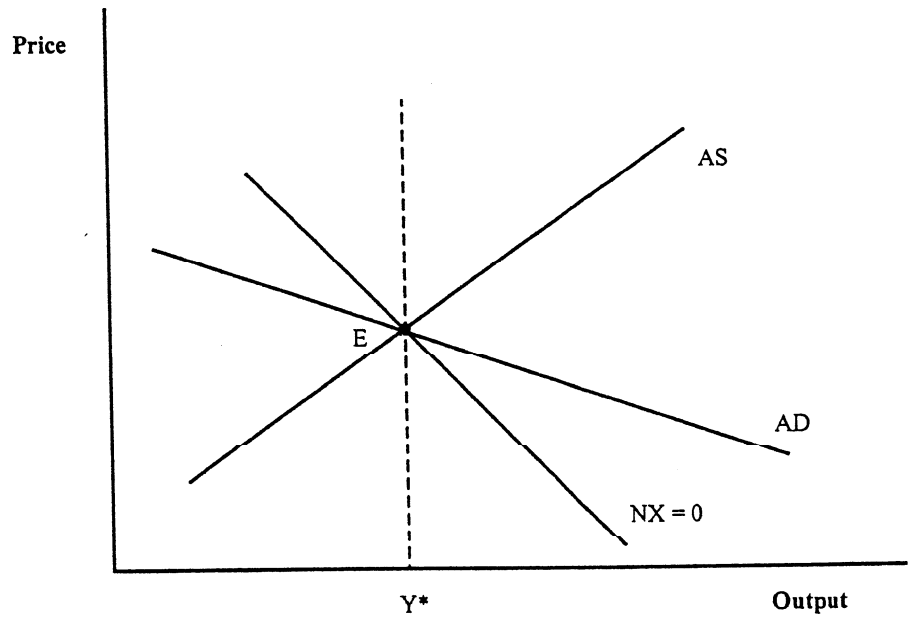
To preview the results, U.S. demand shocks seem to explain a sizable proportion of inflation variability in France and Japan and to a lesser extent in Germany and Italy. Results also show that the repercussion effects were relatively small, implying that most inflation interdependence under Bretton Woods was due to impulses originating in the U.S. The next section discusses macroeconomic adjustment under Bretton Woods using a simple AS/AD framework and the identification methodology. This paper then presents

empirical results and discusses the breakdown of Bretton Woods along with implications for the design and functioning of international monetary arrangements.

Theoretical Framework and Methodology

This section illustrates macroeconomic adjustment and interdependence under fixed exchange rates using the familiar AS/AD framework. The framework represents a middle ground between market-clearing approaches and models based on nominal inertia and rigidities and is commonly used in literature [Bayoumi and Eichengreen, 1994]. To understand the key elements of macroeconomic equilibrium in an open economy, consider Figure 2.

FIGURE 2
Macroeconomic Equilibrium in an Open Economy



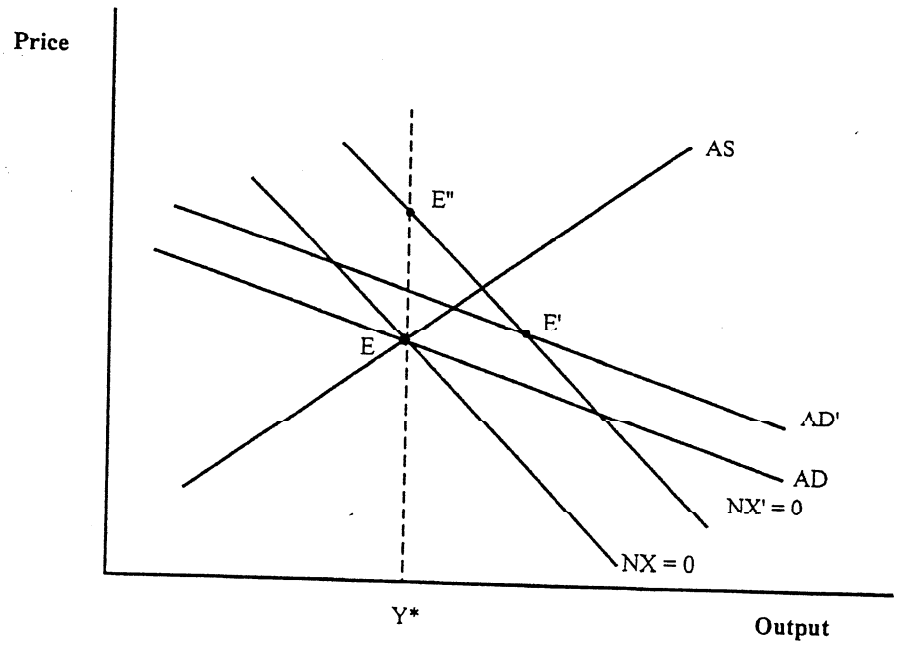
The AD curve is downward-sloping in the price-output space and is drawn for a given level of foreign prices given nominal money stock, fiscal policy, and a fixed exchange rate. The downward slope reflects declining aggregate expenditures at higher domestic price levels for two reasons. An increase in the domestic price level reduces real money balances and increases the interest rates, thus lowering aggregate spending. Moreover, with a fixed exchange rate, an increase in domestic prices shifts demand away from domestic goods toward foreign goods and reduces exports, thus lowering the demand for domestic goods.[3] The trade balance equilibrium NX = 0 schedule is downward-sloping as well. An increase in domestic income increases imports and worsens the trade balance, necessitating a decline in domestic prices. The NX schedule is drawn for a given foreign

price level and foreign income. It is assumed that the NX schedule is steeper than the AD curve.

A positively sloped short-run AS curve is consistent with a wide variety of macroeconomic models including the sticky-wage rational expectation models of Fischer-Gray and the imperfect information models of Lucas-Barro. While demand shocks may have expansionary effects in the short run, it is assumed that such shocks are neutral in the long run. Thus, output is determined by supply-side factors in the long run. In the figure, macroeconomic equilibrium is obtained at point E where AD clears output at the full employment level of output (Y*) and trade balance is in equilibrium.

Adjustment to external shocks under fixed exchange rates can be illustrated using the same framework. Consider the effects of a U.S. demand expansion which results in higher U.S. overall prices. This affects macroeconomic equilibrium of trade partners of the U.S. Figure 3 illustrates the effects of a foreign (U.S.) price shock on domestic (German) macroeconomic equilibrium.

FIGURE 3
Macroeconomic Adjustment to External Shocks



From the perspective of Germany, an increase in foreign (U.S.) prices increases the competitiveness of German goods and the NX curve shifts to the right to NX′. With higher demand for German exports and a fixed exchange rate, the AD curve shifts to the right to AD′ and output increases. Higher output increases imports but not enough to match exports. A short-run equilibrium is obtained at E′ where there is over-employment and a trade surplus. The trade surplus implies that the supply of foreign exchange is larger than the demand for foreign exchange, inducing the German Bundesbank to buy

excess U.S. dollars to maintain parity. This increases the domestic high-powered money and, unless the dollar purchase is sterilized, the German money stock increases. The increase in German money stock shifts the German AD curve upward to the right.

On the AS side, employment above the natural level increases wages and causes the AS to shift to the left. Thus, the short-run AS curve and the AD curve both shift upward in the direction of point E″ (not shown). The process continues until an internal and external balance is achieved at point E″. Notice that a foreign (U.S.) supply shock that increases foreign income transmits to the domestic country in the same way. To the extent that it is idiosyncratic (U.S.-specific), it increases the demand for domestic goods and the NX and AD schedules both shift upward. Domestic shocks can be analyzed in a similar fashion. In order to achieve internal and external equilibrium simultaneously, the authorities may need to use a combination of expenditure switching and reducing (or increasing) policies. The important point is that under fixed exchange rates, an imbalance in one country is likely to spill over to other countries. Hence, fixed exchange rates are conducive to negative policy externalities.

Data and Methodology

The framework above implies that domestic and foreign (U.S.) demand shocks have no long-run effect on domestic or foreign output.[4] Since domestic shocks can transmit to the U.S. as well, it is important to jointly estimate the AS/AD model. In the following, a structural VAR in U.S. output (y^{US}), domestic output (y), the U.S. price level (p^{US}), and the domestic price level (p) is estimated where all variables are expressed in logarithms. Output is measured by the real gross domestic product (GDP) index (except for Germany and Japan where it is real gross national product) and prices are measured by the consumer price index. The data are quarterly from 1958:1 (roughly the beginning of the convertibility period) through 1973:1.[5] Due to unavailability, quarterly data for 1958-59 GDP for France are simulated using industrial production.

Before outlining the identification methodology, stationarity properties of the data must be investigated. The Kwiatkowski-Phillips-Schmidt-Shin tests indicate that output can be characterized as a unit root process. The data point to unit roots for the price levels as well. While inflation rates seem stationary for Japan, France, Italy, and Germany, the test statistic for stationarity is on the borderline at the 5 percent level for the U.S. and at the 2.5 percent level for Canada and the U.K. As a benchmark model, it is assumed that inflation and output growth are stationary. Hence, vector $\Delta X_t = [\Delta y_t^{US} \Delta y_t \Delta p_t^{US} \Delta p_t]'$ is a stationary process.[6] A model with a unit root in inflation will also be estimated to assess the sensitivity of results.

Consider four types of orthogonal shocks that are the sources of the observed movements in vector $\Delta X_t = [\Delta y_t^{US} \Delta y_t \Delta p_t^{US} \Delta p_t]'$ where ε_s^{US} is U.S. supply shocks, ε_s is domestic supply shocks, ε_d^{US} is U.S. AD shocks, and ε_d is domestic AD shocks. The system can be written as an infinite moving average process:

$$\begin{vmatrix} \Delta y_t^{US} \\ \Delta y_t \\ \Delta p_t^{US} \\ \Delta p_t \end{vmatrix} = \begin{vmatrix} a_{11}(L) & a_{12}(L) & a_{13}(L) & a_{14}(L) \\ a_{21}(L) & a_{22}(L) & a_{23}(L) & a_{24}(L) \\ a_{31}(L) & a_{32}(L) & a_{33}(L) & a_{34}(L) \\ a_{41}(L) & a_{42}(L) & a_{43}(L) & a_{44}(L) \end{vmatrix} \begin{vmatrix} \varepsilon_{st}^{US} \\ \varepsilon_{st} \\ \varepsilon_{dt}^{US} \\ \varepsilon_{dt} \end{vmatrix}, \quad (1)$$

where $a_{ij}(L)$ are infinite polynomials in the lag operator L. The time paths of the effects of the four shocks on the growth rates of output and inflation are given by the coefficients in the $a_{ij}(L)$ polynomials. For example, coefficient $a_{ij}^{(k)}$ in the $a_{ij}(L)$ polynomial is the response of variable i to a unit shock in ε_{jt} after k periods. It is also assumed that $a_{ij}(1)$ represents the sum of all the moving average coefficients and gives the cumulative effect of ε_{jt} on variable i over time. In order to identify the shocks, the following restrictions are imposed:

1) U.S. AD shocks have no long run effects on domestic and U.S. output. This is equivalent to $a_{13}(1) = a_{23}(1) = 0$ in (1).
2) Domestic AD shocks have no long-run effect on domestic output or U.S. output. This is equivalent to $a_{14}(1) = a_{24}(1) = 0$ in (1).
3) Domestic AD and AS shocks have no contemporaneous effects on U.S. prices. This is equivalent to $a_{32}^{(0)} = a_{34}^{(0)} = 0$ in (1).

The long-run demand neutrality implied in the first and second points is commonly used in literature and serves to distinguish demand shocks from supply shocks [Blanchard and Quah, 1989; Gali, 1992]. While the restrictions in the third point have no theoretical basis, they are consistent with the notion that the U.S. is a large country. U.S. prices are assumed to be independent of innovations in foreign shocks within the time frame of a quarter. Moreover, with the U.S. dollar being the key currency under Bretton Woods, the U.S. exercised a considerable degree of policy autonomy, making feedback effects on U.S. prices from other countries within one quarter quite unlikely.

Empirical Results

A VAR of the form $\Delta X_t = [\Delta y_t^{US} \Delta y_t \Delta p_t^{US} \Delta p_t]'$ with seasonal dummies is estimated for Canada, France, West Germany, Italy, Japan, and the U.K. with four lags. Residual diagnostics indicate that four lags are sufficient to remove serial correlation from residuals in all cases. Moreover, a dummy variable for France is included to capture political disturbances that led to a significant decline in output in the second quarter of 1968. In order to assess the feedback effects from the rest of the world on U.S. policy, a VAR of the form $\Delta X_t^{US} = [\Delta y_t^{US} \Delta y_t^{W} \Delta p_t^{US} \Delta p_t^{W}]'$ is estimated where the superscript W refers to the rest of the world. The rest of the world output, y_t^W, and prices, p_t^W, are constructed as the geometric average of the output and price series for Canada, France, West Germany, Italy, Japan, and the U.K. (the G6 countries). The weights are based on the multilateral trade volume in U.S. dollars in 1965 for the respective countries

[*Economic Report of the President*, 1978]. The use of multilateral trade weights is an appropriate measure since capital controls under Bretton Woods is likely to have made international trade a major medium for the transmission of macroeconomic shocks.

As a first step, residuals are orthogonalized to conform to the identification scheme presented above and variance decomposition of inflation is presented in Table 2. The results for U.S. and world inflations are from the model $\Delta X_t^{US} = [\Delta y_t^{US} \Delta y_t^{W} \Delta p_t^{US} \Delta p_t^{W}]'$.

TABLE 2
Variance Decomposition of Inflation
(Percent of Inflation Forecast Error Variance)

Steps	ε_s^{US}	ε_s	ε_d^{US}	ε_d	ε_s^{US}	ε_s	ε_d^{US}	ε_d
	Canada				**Japan**			
1	64.1	28.8	5.4	1.7	19.0	16.9	48.4	15.8
4	55.4	32.0	7.9	4.7	18.6	16.4	44.3	20.7
8	52.5	34.7	8.0	4.7	18.4	16.4	43.6	21.6
16	49.8	36.5	9.6	4.1	18.4	16.4	43.5	21.6
24	49.1	36.9	10.0	4.0	18.5	16.4	43.5	21.6
	France				**U.K.**			
1	0.0	14.0	84.1	1.9	1.9	95.2	0.5	2.4
4	1.0	12.8	81.9	4.3	37.1	50.2	9.3	3.5
8	4.9	12.9	73.3	8.9	45.0	33.5	13.9	7.5
16	10.4	11.8	67.1	10.7	52.0	26.6	15.9	5.6
24	11.6	11.6	65.8	10.9	54.0	24.9	16.2	5.0
	West Germany				**U.S.**			
1	3.7	83.2	12.6	0.5	88.0	0.0	12.0	0.0
4	6.5	75.3	14.3	4.0	74.7	0.7	8.3	16.3
8	5.4	65.0	19.5	10.1	76.2	3.0	7.3	13.5
16	6.1	62.3	20.1	11.5	75.5	6.3	5.8	12.4
24	6.6	61.8	19.8	11.8	75.4	7.2	5.3	12.1
	Italy				**World**			
1	3.0	54.0	37.4	5.5	6.1	44.5	40.7	8.6
4	3.2	61.9	25.9	8.9	8.7	45.7	33.7	12.0
8	3.8	66.0	20.0	10.2	12.5	42.5	32.2	12.9
16	3.5	69.5	17.8	9.3	16.3	40.6	30.3	12.8
24	3.4	70.1	17.3	9.1	18.1	39.8	29.4	12.7

The table indicates a sizable transmission effect of U.S. policies in that most inflation variability in major industrial countries is due to U.S. shocks. Specifically, at the 24th quarter forecasting horizon, 43.5 percent of inflation in Japan and 65.8 percent of inflation in France is due to U.S. demand shocks. At short-term forecasting horizons, the percentage is higher. In West Germany, up to 20 percent of inflation is due to U.S. demand shocks while, in Italy, 37 percent of the short-term variation in inflation is due to U.S. demand shocks. Notice also that the pattern of responses to U.S. demand shocks exhibits some diversity. The difference in persistence also shows that there was asymmetry in the response to U.S. shocks.

When U.S. demand shocks seem to have a negligible impact on inflation, as in Canada and the U.K., then the effect of U.S. supply shocks is substantial. Assuming that the identification scheme adopted here is asymptotically valid, then U.S. shocks seem to have had a fundamental impact on inflation elsewhere. Recall that inflation in Canada, Japan, France, and the U.K. was highly correlated with inflation in the U.S. in some subperiods under Bretton Woods. Inflation in these countries seems to have been largely due to disturbances originating in the U.S. Thus, correlations evident in the raw data seem to be due to U.S. shocks. Moreover, variance decomposition of inflation in the world proxied by the weighted average of the G6 countries (G7 minus the U.S.) indicates that a sizable proportion of inflation in the rest of the world can be attributed to U.S. shocks, specifically demand shocks. To the extent that the weighted average of price and output series constructed from the G6 countries is a good proxy for the rest of the world, the results are compatible with the view that U.S. policies were a major source of inflation elsewhere in the world.

Notice that variance decomposition results for U.S. inflation indicate that U.S. demand shocks do not account for the preponderance of the variability of U.S. inflation under Bretton Woods. Indeed, demand shocks in the rest of the world account for a higher proportion of inflation variability in the U.S. than U.S. demand shocks. This is compatible with the view that as the reserve currency country, the U.S. did not have to adjust its domestic economy to its balance of payments problems. As noted by Bordo [1993], the U.S. inflation was less (on a gross national product weighted average basis) than that of the rest of the G7 countries before 1968. While the U.S. sterilized dollar outflows, the rest of the world could not afford to do the same. Moreover, because of its role as the reserve currency, the U.S. dollar was voluntarily held because of its value as a liquid asset.

Even if U.S. inflation is not explained primarily by U.S. demand shocks, a given shock may account for a different variation in inflation across countries. If slopes of the short-run AS, AD, and NX curves are different, then a given shock will have a different impact on prices in different countries. As for the size of the demand shocks, Table 3 presents the standard deviation of domestic demand shocks for the sample period.

Canada and Japan seem to have the highest incidence of domestic demand shocks followed by Italy and France. Notice that the incidence of U.S. demand shocks is not as pronounced as compared to that of other major industrial countries. Finally, the incidence of U.S. demand impulses seems much higher than the incidence of demand impulses

obtained by taking a weighted average of the G6 countries (world). This may stem from the fact that the pool that proxies the world contains deficit countries such as the U.K. as well as traditionally surplus countries such as West Germany and Japan. Since a given shock will have differential effects on these countries, the net incidence of demand impulses in the pooled data can be expected to be lower.

TABLE 3
Standard Deviation of Demand Shocks

Country	Standard Deviation
Canada	0.0332
France	0.0170
West Germany	0.0096
Italy	0.0179
Japan	0.0283
U.K.	0.0117
U.S.	0.0148
World	0.0036

Finally, an aggregate model, $\Delta Y_t^{US} = [\Delta y_t^{US} \Delta y_t^{W} \Delta^2 p_t^{US} \Delta^2 p_t^{W}]'$, with a unit root inflation is estimated for the U.S. and the rest of the world as unit root tests of inflation were not conclusive for some countries. Although U.S. demand shocks explain a smaller percentage of inflation as compared to the benchmark model, U.S. demand shocks still account for 26.5 percent of inflation in the rest of the world at the first quarter forecasting horizon. At the 24th quarter forecasting horizon, U.S. supply shocks account for 18.9 percent and demand shocks account for 16.8 percent of inflation in the rest of the world. Overall, U.S. shocks still account for a sizable proportion of inflation variability under this specification.

Conclusion

The debate on exchange rate regimes and exchange rate stability has reemerged as an important policy issue after floating for more than two decades. Partly revitalized by moves toward monetary union in Europe, design and functioning of international monetary arrangements is an important policy issue facing global economies. This paper tries to evaluate a particular aspect of the functioning of a recent historical monetary regime, Bretton Woods, by focusing on the role played by the system leader, the U.S.,

in the transmission of inflation. This paper tries to provide empirical evidence regarding the incidence and effects of U.S. supply and demand shocks under Bretton Woods on inflation in the G7 countries using the structural VAR methodology. Variance decomposition results show that a sizable proportion of inflation in major industrial countries can be attributed to U.S. shocks, particularly demand shocks. Notably in France, Japan, and Italy, a major proportion of inflation can be attributed to U.S. demand expansions.

Beyond confirming that the U.S. contributed substantially to inflation elsewhere, this paper shows that U.S. demand shocks had markedly different effects on different countries. The difference in persistence shows that there was asymmetry in the response to U.S. demand shocks. This asymmetry may also have contributed to the collapse of Bretton Woods.

Since the U.S. dollar was a major reserve asset under Bretton Woods, it served as high-powered money for the U.S. as well as other countries. The asymmetries inherent in the adjustment between the U.S. and the rest of the world implies that U.S. monetary growth contributed substantially to monetary growth elsewhere. Since the U.S. could sterilize reserve flows while other countries could not, there is evidence that a major source of inflation under Bretton Woods was the U.S. monetary growth [Swoboda and Genberg, 1982; Bordo, 1993]. Work by Darby et al. [1983] showed that the key mechanism for the transmission of inflation was the classical price specie flow mechanism and capital flows. As the dollar reserves considerably grew in the rest of the world, it became increasingly difficult to sterilize them. This increased monetary expansion in the rest of the world and may have contributed to the collapse of the system.

The U.S. monetary growth in the 1960s reflected a preference shift toward full employment over price stability [Niehans, 1976] and increases in financing requirements due to social programs and the Vietnam War contributed to U.S. monetary expansion. Bordo [1993] shows that changes in the monetary base in the U.S. in the 1960s is highly correlated with the government's budget deficit. When policymakers in the U.S. faced a choice between responding to domestic policy objectives or the requirements of an international monetary system, they opted for the former, and the incipient speculative pressures brought the system to an end. Unless international monetary arrangements include provisions for adequate liquidity and credible commitment mechanisms, negative policy externalities are likely to strain the system.

Footnotes

1. The exception is that the Canadian dollar floated between 1950 and 1962.
2. It is possible to date the collapse of the Bretton Woods period to the closing of the gold window in August 1971. However, some extend the period until the general float in March 1973. To preserve degrees of freedom, this paper follows the latter interpretation.
3. Throughout the discussion, it is assumed that the Marshall-Lerner condition holds.
4. Demand shocks may not be neutral if they affect the real exchange rate. For identification purposes, it is assumed that such effects are minor compared to supply shocks.

5. All data are from the CD-ROM edition of the *International Financial Statistics* except for the 1958-59 GDP data for Germany and Italy which are from Moore and Moore [1985].
6. Tests of cointegration using the Engle-Granger procedure reveal no evidence of cointegration between price levels in individual countries and the U.S. price level.

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