UNIVERSITY OF CALIFORNIA, BERKELEY

Department of Economics

Berkeley, California 94720

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REAL EXCHANGE RATE BEHAVIOR UNDER ALTERNATIVE INTERNATIONAL MONETARY REGIMES: INTERWAR EVIDENCE

Barry Eichengreen

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1. Introduction

One of the most disturbing features of the system of floating but managed exchange rates which has prevailed since 1973 is the surprising degree of real exchange rate volatility. This observation, common even among journalists and politicians, has served as a focal point for the attention of economists. For example, Mussa (1986) contrasted the behavior of real exchange rates in the period of predominantly fixed nominal exchange rates prior to 1973 and in the subsequent period of managed floating. He confirmed that the variability of real rates was significantly greater during the period of floating nominal rates, and that the increased variability of nominal rates was the proximate source of the increased variability of real rates. The reason for interest in such findings is apparent: if the increased variability of real rates reflects an increased incidence of deviations from equilibrium relative prices, then systems of floating exchange rates may have welfare costs not anticipated by their early advocates.

Unfortunately, the generality of the findings of Mussa and others derived from the experience of recent decades is not entirely clear. Rather than yielding general conclusions about the operating properties of fixed and flexible exchange rate regimes, recent experience may tell us more about the particular shocks to which the international monetary system was subjected and about the special features of Bretton Woods and of the post-Bretton-Woods nonsystem. It is conceivable, for instance, that the relative stability of real exchange rates under Bretton Woods reflects a peculiar absence of supply-side shocks in the two decades immediately following World War II. The instability of real exchange rates following the dissolution of Bretton Woods may likewise reflect a peculiar sequence of macroeconomic shocks: OPEC I, OPEC II, and Reagan budget deficits. Alternatively, it is conceivable that the relative stability of real exchange rates under Bretton Woods reflects the beneficent effects of a system of pegged but adjustable rates, in contrast to systems of immutably fixed rates like the textbook gold standard. The instability of real exchange rates following the dissolution of Bretton Woods may likewise reflect the detrimental effects of a system of managed floating, in contrast to systems of freely floating exchange rates.

One way to probe the generality of these findings is to analyze the relationship of real exchange rate behavior to nominal exchange rate regimes in different historical periods. In this paper I analyze real exchange rate behavior under the three international monetary regimes that prevailed during the interwar years: free floating in the early 1920s, pegged and essentially unadjustable exchange rates in the late 1920s, and managed floating in the early 1930s. I consider the experiences of ten European countries and the United States. Not only does the methodology differ from Mussa's but so do the questions asked. Here I am concerned with three distinct if related questions. First, what was the variability of real exchange rates under these three international monetary regimes? Second, what was the association between the variability of real and nominal rates? Third, when real exchange rates were disturbed, what was the speed of convergence to equilibrium under the alternative international monetary regimes?

2. International Monetary Regimes, 1922-1936

Anyone who attempts to analyze the properties of alternative international monetary regimes is immediately confronted by the gap between textbook models of international monetary systems and historical experience. Rather than being demarcated by distinct beginning and end points, the transition between regimes is often gradual. Rather than neatly incapsulating the features of a theoretical model of fixed or floating rates, actual international monetary systems often combine features of different models. While these problems prevail in the interwar period as in any other, it is relatively straightforward to break the two decades between the wars into three distinct international monetary regimes.

The period through 1926 can be fairly characterized as one of freely floating nominal rates. In the spring of 1919, the support operations that had stabilized the British pound and French franc against the U.S. dollar during the latter part of World War I were terminated, and these and other currencies were permitted to float against one another. Of the major currencies, only the dollar remained pegged to gold. A distinguishing characteristic of this period was the virtual absence of exchange-market intervention by the monetary authorities. Those few cases of intervention which occurred --notably by the Bank of France in 1923 and 1925 -- were exceptions to the rule (Eichengreen, 1982). Toward the end of the period, the European currencies were pegged to gold and the dollar at intervals, starting with Sweden and followed by Germany, Britain and finally France in December 1926.

The years from 1927 through 1931 comprise the gold-exchange standard era. The major European currencies remained pegged against one another from

France's de facto stabilization at the end of 1926 until Britain's forced departure from gold in September 1931 (for details, see Eichengreen, 1985). While pegging operations did not preclude small variations in bilateral rates (mostly within the gold points), these were of negligible proportions. Transactions in foreign currency were freely permitted at official rates. The major exception occurred in the summer of 1931, when Germany experienced a balance-of-payments crisis and responded with the imposition exchange control. Still, this period is fairly characterized as one of unified, fixed exchange rates.

Following Britain's departure from the gold standard in 1931, some two dozen other countries devalued their currencies. By early 1932, Britain, the Commonwealth and Dominions, Japan, and the Scandinavian and Latin American nations had all reverted to floating rates. But in contrast with the early 1920s, floating was managed, usually through the active intervention of specially constituted Exchange Equalization Funds. In 1933, the U.S. joined the list of countries whose currencies were floating if managed; in 1935 Belgium joined. The German and Italian currencies were regulated by exchange control. Only the members of the gold bloc (France, the Netherlands, Poland and Switzerland) continued to peg their currencies against gold and one another until France's devaluation in September 1936.

While all such periodizations are approximate, the interwar years can fairly be said to offer three international monetary regimes whose operating properties may be compared: free floating through 1926, fixed rates through August 1931, and managed floating through August 1936.

3. Real Exchange Rate Variability and the Speed of Convergence

Tables 1-3 analyze the behavior of bilateral exchange rates against the British pound. As in any analysis of bilateral rates, a benchmark currency is required; for the interwar period sterling and the dollar are the logical candidates. Here I consider rates against sterling. While the choice of sterling as the benchmark currency has minimal implications for comparisons of exchange rate stability across periods, it has significant implications for rankings of exchange rate stability across countries within periods. Specifically, countries which made a practice of pegging to sterling will appear to have had more stable exchange rates than would be the case were the dollar rate or an effective exchange rate used in place of sterling. Hence cross-country comparisons within periods must be interpreted with caution.

I consider the behavior of nine European currencies and the U.S. dollar. In the early 1920s Germany is omitted, however, due to the exceptional difficulty of measuring real exchange rates in a period of hyperinflation and currency reform. The countries included experienced at most moderate rates of inflation or deflation; it is to such countries that the generalizations in this paper should be thought to apply. Real exchange rates are measured as the ratio of foreign wholesale prices, converted to sterling by the bilateral rate, relative to British wholesale prices. Monthly data (monthly averages wherever possible) are drawn from the League of Nations' Monthly Bulletin of Statistics, supplemented by Tinbergen (1934) and Methorst (1938).

I consider first the behavior of nominal exchange rates. Since the regimes are defined according to the behavior of nominal rates, it follows that their variability should differ across periods. But the extent of the difference is striking. Nominal rates were almost four times as volatile (measured by their standard deviation) during the free float of the early 1920s as during the managed float of the early 1930s. Similarly, under the 1930s managed float, nominal rates were four times as volatile as under the pegged rate system of the late 1920s. Clearly, there was a significant difference in the extent of nominal-exchange-rate variability under these alternative exchange rate regimes.

I consider next the standard deviation of real exchange rates in the three periods. That standard deviation averages 6.46 under floating in the early 1920s, 2.79 under fixed rates in the late 1920s, and 5.18 under managed floating in the early 1930s. (These and other cross-country averages cited in the text are simple arithmetic means.) This is striking confirmation that the variability of real exchange rates was positively associated with the freedom of the float. Moreover, when nominal rates were floating, there was a positive correlation between the variability of nominal rates and the variability of real rates. Looking across countries, in both the early 1920s and early 1930s, the correlation between the standard deviation of nominal rates and the standard deviation of real rates is positive and significantly greater than zero at the 99 per cent confidence level. In both periods of floating, nominal exchange rate variability was a significant source of real exchange rate variability. This was not the case, however, during the gold-exchange standard era. For this period there is no strong association between the variability of nominal and real exchange rates. Looking across countries, the correlation between the standard deviations of the two variables, while positive, is only significant at levels below 70 per cent.

Table 1: Real Exchange Rate Behavior Under Floating, 1922-1926

Country	Standard Deviation	Time Trend	Convergence Regression: Constant	Convergence Regression: Lagged Real Rate	Convergence Regression: Time Trend	R^2
Belgium	8.74	0.42 (0.04)	36.11 (10.40)	0.66 (0.10)	0.13 (0.05)	.80
Denmark	4.74	-0.17 (0.03)	18.03 (8.26)	0.82 (0.08)	-0.04 (0.02)	.78
Finland	4.12	0.03 (0.73)	14.88 (5.69)	0.83 (0.06)	0.02 (0.02)	.76
France	8.01	0.38 (0.03)	34.95 (10.11)	0.64 (0.11)	0.14 (0.05)	.80
Italy	9.49	0.29 (0.06)	8.91 (6.36)	0.92 (0.06)	-0.01 (0.03)	.85
Netherlands	4.26	0.14 (0.03)	10.58 (6.55)	0.90 (0.07)	0.01 (0.02)	.85
Norway	9.23	-0.14 (0.07)	8.69 (5.56)	0.93 (0.05)	-0.05 (0.03)	.88
Sweden	6.02	0.32 (0.02)	26.22 (9.78)	0.75 (0.10)	0.07 (0.03)	.92
USA	3.33	0.01 (0.03)	8.79 (5.18)	0.91 (0.05)	0.01 (0.01)	.84

Notes: Standard errors in parentheses. Monthly data are used. All real exchange rates indices are normalized to 100 in January 1922. The standard deviation and time trend are calculated for the period January 1922-December 1926. The sample period for the convergence regression is February 1922-December 1926 to allow for the lagged variable.

Differences in the stability of nominal exchange rates do not provide the entire explanation for differences in the stability of real exchange rates across periods, however. There are also striking differences in the speed with which real exchange rates converged to their equilibrium levels when perturbed by nominal exchange rate movements or price level shocks. To analyze the speed of convergence I estimate variants of the following model (see also Frankel, 1986). The change in the real exchange rate is hypothesized to depend on the deviation of the current rate R_t from its equilibrium level R^*_t:

$$(1) \qquad (R_t - R_{t-1}) = \theta(R^*_{t-1} - R_{t-1})$$

where θ is the speed of convergence. I consider the case where R^* is a linear function of time ($R^*_t = \alpha + \beta$*TIME), which nests the case where R^* is constant ($\beta = 0$). Then:

$$(2) \qquad R_t = \alpha\theta + (1-\theta)R_{t-1} + \beta\theta TIME$$

If convergence is completed within the period, the coefficient on R_{t-1} should be zero. If convergence requires additional time, that coefficient should significantly exceed zero. If the real exchange rate has a unit root, that coefficient should equal one.

Regressions are run using ordinary least squares. Standard t-statistics are constructed to test for coefficients greater than zero, and Dickey-Fuller tests for lagged dependent variables less than one. In every case, whatever the exchange-rate regime, the coefficients on R_{t-1} significantly exceed zero at the 99 per cent confidence level. Equally, in every case but one (Denmark

Table 2: Real Exchange Rate Behavior Under the Gold-Exchange Standard, 1927-1931

Country	Standard Deviation	Time Trend	Convergence Regression: Constant	Lagged Real Rate	Time Trend	R^2
Belgium	2.08	-0.09 (0.01)	22.98 (9.16)	0.77 (0.09)	-0.02 (0.01)	.78
Denmark	1.09	-0.01 (0.01)	63.72 (12.94)	0.36 (0.13)	-0.01 (0.01)	.14
Finland	4.04	-0.18 (0.02)	6.67 (5.59)	0.93 (0.06)	-0.02 (0.01)	.92
France	2.21	-0.05 (0.02)	22.52 (8.84)	0.77 (0.09)	-0.01 (0.01)	.65
Germany	3.56	-0.20 (0.01)	18.58 (8.02)	0.81 (0.08)	-0.04 (0.02)	.96
Italy	3.06	0.07 (0.02)	16.14 (7.04)	0.83 (0.07)	0.02 (0.01)	.76
Netherlands	3.94	0.19 (0.02)	13.29 (5.02)	0.85 (0.05)	0.05 (0.01)	.94
Norway	3.13	-0.11 (0.02)	11.77 (6.60)	0.89 (0.06)	-0.02 (0.01)	.87
Sweden	2.05	-0.02 (0.02)	6.99 (6.00)	0.93 (0.06)	-0.01 (0.01)	.81
USA	2.72	-0.14 (0.01)	22.76 (8.91)	0.77 (0.09)	-0.03 (0.01)	.88

Notes: Standard errors in parentheses. Monthly data are used. All real exchange rates indices are normalized to 100 in January 1927. The standard deviation and time trend are calculated for the period January 1927-August 1931. The sample period for the convergence regression is February 1927-August 1931 to allow for the lagged variable.

under the gold-exchange standard), it is impossible to reject the hypothesis that this coefficient equals one. Yet the coefficient estimates display patterns, both across countries and over time, that have plausible interpretations within the convergence-to-equilibrium paradigm but would seem impossible to interpret within the unit-root framework. Hence I discuss the results in terms of convergence to equilibrium. Under the free float of the early 1920s, on average 18 per cent of any deviation from the equilibrium real exchange rate was eliminated within a month. Under the gold-exchange standard, the comparable figure was 28 per cent; under the managed float of the early 1930s, it was 20 per cent. Just as there is a positive association between the stability of nominal rates and the stability of real rates across regimes, there is, more surprisingly, a positive association between the stability of nominal rates and the speed with which real exchange rates converged to their equilibrium levels. Thus, real rates were relatively stable under the gold-exchange standard both because nominal rates were stable and because the speed of convergence was high. By contrast, real rates were relatively unstable during the period of freely floating exchange rates that preceded the return to gold both because nominal rates were volatile and because the speed of adjustment was low. One might speculate that faster convergence under more stable nominal exchange rates reflected less uncertainty about the equilibrium level of real exchange rates.

If the negative association between the variability of real and nominal exchange rates on the one hand and the speed of convergence on the other is robust, one would expect to observe it within each period when looking across countries as well as in comparisons across periods. This is generally the case. Regressing the speed of convergence (one minus the coefficient on the lagged dependent variable) on a constant and the standard deviation of the real exchange rate for each cross section of countries yields a negative slope coefficient for two of three cross sections. The coefficient estimate is more than three and a half times its standard error for the early 1930s, more than two and a half times for the late 1920s. The exception is the early 1920s, when the slope coefficient is positive if small, with a coefficient estimate little more than half its standard error. Plotting the data reveals that the absence of a negative correlation between real exchange rate variability and speed of convergence for this period is due entirely to the exceptional behavior of France and Belgium. While these two countries had the most variable real exchange rates, they also exhibited the fastest rates of convergence. Of the countries in the sample, these two experienced the highest and most variable rates of inflation and nominal depreciation. It is tempting to speculate that the usually high degree of inflation and nominal exchange rate depreciation experienced by these countries altered the manner in which domestic prices were set and the frequency with which they were adjusted, and that the more frequent adjustment of domestic prices facilitated the process of real exchange rate convergence. If this is correct, then the relationship between real exchange rate variability and speed of convergence identified here holds only in periods of relatively moderate inflation.

Since the findings of this analysis are striking, it is important to note their limitations. Confirming that differences across periods in the standard deviation of real exchange rates are statistically robust will require additional tests to establish the constancy of those standard deviations

Table 3: Real Exchange Rate Behavior Under Managed Floating, 1932-1936

Country	Standard Deviation	Time Trend	Convergence Regression Constant	Convergence Regression Lagged Real Rate	Convergence Regression Time Trend	R^2
Belgium	8.12	0.35 (0.05)	18.29 (8.18)	0.81 (0.08)	0.08 (0.04)	.82
Denmark	4.66	0.03 (0.04)	17.97 (7.78)	0.83 (0.07)	-0.01 (0.02)	.71
Finland	3.04	0.16 (0.01)	33.01 (9.70)	0.65 (0.10)	0.07 (0.02)	.85
France	2.15	0.01 (0.02)	33.49 (10.41)	0.66 (0.10)	0.01 (0.01)	.43
Germany	8.28	-0.45 (0.03)	9.87 (7.57)	0.90 (0.07)	-0.04 (0.04)	.95
Italy	4.76	-0.23 (0.03)	21.81 (8.86)	0.79 (0.08)	-0.05 (0.03)	.85
Netherlands	5.17	-0.12 (0.04)	10.36 (6.84)	0.90 (0.07)	-0.01 (0.02)	.82
Norway	2.42	0.05 (0.02)	24.68 (8.78)	0.76 (0.08)	0.01 (0.01)	.64
Sweden	1.15	0.01 (0.02)	24.74 (9.09)	0.76 (0.09)	-0.01 (0.01)	.59
USA	12.09	0.46 (0.08)	7.62 (4.99)	0.94 (0.05)	0.01 (0.04)	.93

Notes: Standard errors in parentheses. Monthly data are used. All real exchange rates indices are normalized to 100 in January 1932. The standard deviation and time trend are calculated for the period January 1932-August 1936. The sample period for the convergence regression is February 1932-August 1936 to allow for the lagged variable.

within periods. Similarly, establishing that greater real exchange rate variability had real economic costs will require additional work to construct an expected real exchange rate and thereby measure unanticipated variability. Finally, observing a correlation between real and nominal exchange rates does not definitively establish causation. It could be that the real shocks to which exchange rates were subjected varied significantly across periods, and that these real shocks, rather than the degree of nominal exchange rate flexibility, account for the differing behavior of real rates. In other words, definitive conclusions will require a full structural model of the equilibrium real exchange rate toward which the current rate converges. Indeed, the entire notion of an equilibrium exchange rate toward which the current rate converges requires further substantiation, since it is rarely possible to reject the hypothesis of a unit root. Still, the close correspondence between this paper's results for the interwar period and the findings of other investigators concerned with the experience of recent years creates a presumption that more than a peculiar constellation of real shocks accounts for the divergent behavior of real exchange rates under the alternative nominal exchange rate regimes.

4. Conclusion

The evidence presented in this paper generalizes the findings of investigators of post-World-War-II exchange rate systems. Comparing interwar monetary systems, regimes characterized by greater nominal exchange rate stability were also characterized by greater real exchange rate stability. This was true both because movements in nominal rates perturbed real rates to a lesser extent under pegged and managed rate systems and because, once perturbed, real rates converged to their equilibrium levels more quickly when nominal rates were relatively stable.

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