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Flexible Exchange Rates in
Historical Perspective

Peter Bernholz

INTERNATIONAL FINANCE SECTION
DEPARTMENT OF ECONOMICS
PRINCETON UNIVERSITY

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There were no marks to be had in Strasbourg . . . so we changed some French money in the railway station at Kehl. For 10 francs I received 670 marks. Ten francs amounted to about 90 cents in Canadian money. That 90 cents lasted Mrs. Hemingway and me for a day of heavy spending and at the end of the day we had 120 marks left!

*Ernest Hemingway*¹

. . . and thus hordes [of Bavarians] went over [to Salzburg] with wives and children to indulge in the luxury of guzzling as much beer as their bellies could hold. . . . But the happy Bavarians did not know that a terrible revenge was approaching. For when the [Austrian] crown stabilized and the mark plummeted downward in astronomical proportions, the Austrians went over [to Bavaria] from the same railway station in their turn. The same performance began a second time, but in the opposite direction.

*Stefan Zweig*²

1 INTRODUCTION

After many industrialized countries moved to flexible exchange rates in 1973, nearly all economists were caught by surprise when exchange rates were not only very volatile but for months and years were out of line with purchasing-power parities. Around 1976, for example, large undervaluations developed for the British pound and the Italian lira, while the Swiss franc and the German mark became overvalued (see Table 8 in Chap. 9). (Whenever I speak of under- or overvaluation, I mean the following: Let e be the spot exchange rate in domestic currency units per unit of foreign currency, p the domestic price level, p^* the foreign price level, and a a constant resulting from transport costs, import duties, higher prices of services because of higher per capita incomes, etc. Then absolute purchasing-power parity holds if $p = ep^* + a$. Using hats to indicate rates of change, relative purchasing-power parity is defined as $\hat{p} = \hat{e} + \hat{p}^*$. The first equation implies the second if $a = 0$ but not vice versa. Relative under- or overvaluation of the domestic currency as compared with some basic period is present if $\hat{e} \cong \hat{p} - \hat{p}^*$. Under- or overvaluation develops if the exchange rate moves upward or downward from the base period faster than the difference between the changes in the domestic and foreign price levels. This phenomenon has been referred to as "overshooting" in the theoretical literature on foreign exchange rates.)

I am grateful to Ronald McKinnon, Charles Kindleberger, and John Bilson for their comments.

¹ *Toronto Daily Star*, 1921. Quoted by Fergusson (1975, p. 92).

² Zweig (1944, pp. 336-337), my translation. I owe the reference to Zweig to R. Gann, The Hoover Institution, Stanford University.

The unexpected exchange-rate fluctuations and trends posed a problem for economists, and, not surprisingly, several dynamic models were developed to explain this overshooting compared with purchasing-power parities (see, e.g., Dornbusch, 1976; Calvo and Rodriguez, 1977; Niehans, 1977).

It is not my purpose to discuss these models or the econometric models that were estimated following them (see, among others, Artus, 1976; Driskill, 1981; and Bernholz and Kugler, 1980). The empirical base for econometric work is still somewhat narrow, since flexible exchange rates were not introduced in most industrialized countries until 1973. It should therefore be helpful to look instead at experiences with flexible exchange rates in earlier periods and for different countries and at the analyses by contemporaneous Continental European economists who studied the relationships of flexible exchange rates (often aptly described at that time as inconvertible paper currencies) to gold and silver currencies. The results are remarkable:

1. The phenomenon of overshooting was common to all the periods and currencies considered, from the mid-eighteenth century up to the twentieth century.

2. Purchasing-power parity more or less reasserted itself in the long run, but the long run sometimes meant ten to twenty years.

3. In all the cases considered, a higher inflation rate in one country relative to its trading partners led to an undervaluation of its currency. The exchange rate depreciated faster than the difference between the changes in domestic and foreign price levels. The degree of undervaluation was usually roughly correlated to the size of the difference between the inflation rates.

4. Undervaluation vanished either when the country with the undervalued currency ended its faster monetary expansion or when it inflated its currency beyond hope (which usually led to hyperinflation).

5. In most cases, exchange rates and relative price levels (domestic divided by foreign) rose more slowly than relative money supplies. Only in the last phases of very large growth in the domestic money supply (especially during hyperinflations) did relative prices and, to a lesser degree, exchange rates increase more rapidly.

6. Nearly all these results were well known to several economists who studied these phenomena at the time and showed remarkable insight into their nature.

In what follows, historical events and contemporary economists' interpretations of them are presented chronologically, in order to make clear the perspectives available to those economists. The discussion neglects the works of English economists, especially at the time of the Napoleonic Wars when the British pound became inconvertible. Not only have the contributions of Thornton, Ricardo, Tooke, and others been widely discussed and appre-

ciated, but these economists did not analyze the phenomenon of overshooting or the events related to it.

The measurement of overshooting presents two inherent difficulties—the selection of a price index and the selection of a base period. The choice of the index could affect the findings. For example, overshooting might appear when measured by a cost-of-living index but be absent when measured by a wholesale-price index. In the earlier historical cases, there was no choice: only one index was available and sometimes only one important price (such as rye flour in the case of Russia). When different indices were available, however, overshooting was found to be present whichever index was used. It was most pronounced when wage and salary indices were used; it was smaller with wholesale-price indices than with cost-of-living or consumer-price indices. The selection of an adequate base period proved to be easier than expected. An exceptionally rapid increase in the money supply—often at the start of a war or a revolution—always marked a clear historical break that could be used to choose a base year.

2 THE SCHOOL OF SALAMANCA IN THE SIXTEENTH CENTURY

Strong movements in exchange rates are usually thought of only in connection with the use of paper currency or demand deposits. But exchange-rate movements have occurred in other situations. First, there have been fluctuations in exchange rates between coins minted from different metals, like gold, silver, and copper, when the relative prices of these metals changed. For example, from the evidence presented by Cipolla (1952, esp. pp. 13-26), it appears that phases of under- and overvaluation occurred in the state of Milan between 1580 and 1700, when token money minted from different metals for different denominations was the most important medium of exchange for daily domestic transactions, while gold and silver moneys were used for all international transactions. The parities between token money and gold and silver moneys were neither legally fixed nor kept fixed in fact by the monetary authorities. Exchange rates between them were therefore flexible, with consequences similar to those described below for paper money. Second, exchange rates between coins of the same nominal value and the same metal have changed when the metal content was changed. Finally, and most important for monetary and exchange-rate theory, coins minted from the same metal with the same metal content have traded at fluctuating rates when they were in different locations, as happened in the sixteenth century.

At the end of the fifteenth century, gold and silver began to flow from Spanish America to Seville and from there flowed slowly to Santiago de Compostela, to France, and to Flanders. As Grice-Hutchinson (1952, pp. 52-58) has pointed out, this development led to the first formulation of the purchasing-power-parity theorem by theologians at the School of Salamanca in Spain. In 1556 one of these theologians, Martin de Azpilcueta Navarro, described the process as follows:

Still later, when the money of a particular country came to be worth less there than abroad (as today nearly all the gold and silver of Spain is worth less in Spain than in Flanders and France), there came into being the art of exchange, which is the art of giving and taking one kind of money in exchange for another. In this way money began to pass from places where it was worth less to those where it was worth more. Thus, in our own day many people have greatly increased their fortunes by carrying to Flanders and France ducates of two, four, and ten, some in kegs as though they were olives, others in barrels hidden in the wine, on each of which they make a big profit; and they bring merchandise from abroad which

is worth little there and here much . . . (translated by Grice-Hutchinson, 1952, p. 90).

So much for the facts. Here is Navarro's explanation:

Now, we maintain that the value of the two monies may diverge for one of eight reasons: . . . Seventh, because of scarcity and need. . . . As to the seventh respect which causes money to rise or fall in value (namely, whether it is scarce and greatly needed, or abundant), money is worth more when and where it is scarce than where it is abundant.

Second, and of great importance, that all merchandise becomes dearer when it is in great demand and short supply, and that money insofar as it may be sold, bartered, or exchanged by some other form of contract, is merchandise and therefore also becomes dearer when it is in great demand and short supply.

Third, that (other things being equal) in countries where there is a great scarcity of money all other saleable goods, and even the hands and labor of men, are given for less money than where it is abundant. Thus we see by experience that in France, where money is scarcer than in Spain, bread, wine, cloth, and labor are worth much less. And even in Spain, in times when money was scarcer, saleable goods and labor were given for very much less than after the discovery of the Indies, which flooded the country with gold and silver (translated by Grice-Hutchinson, 1952, pp. 91-95).

There is no need to add much to these quotations, since they clearly amount to a formulation of the purchasing-power-parity theorem in its absolute version. Navarro states that the price level p in Spain is higher than the level p^* in France, and this causes the values of the two moneys to diverge. In this context, divergence refers to the rate of exchange between coins of the same gold or silver content. If no divergence were present, the exchange rate between two gold or two silver coins would be 1. Now, setting $a = 0$ in the formula $p = ep^* + a$, so that $e = p/p^*$, a divergence of e from 1 will occur if $p \neq p^*$. This is exactly what Navarro asserts.

Navarro's formulation is correct but raises one problem. We know from the theory of the pure gold standard that when there is sufficient competition exchange rates should not move beyond the limits given by the gold-export and gold-import points. We must therefore conclude from the quotations above that one or both of two phenomena were responsible for the high discounts on gold and silver in Seville as compared with France and Flanders: (1) Transportation costs and risk were substantial and competition was not too pronounced in the sixteenth century; (2) gold arbitrage from Spain to France and Flanders took a long time, so that the constant inflow of gold and silver from America kept them plentiful in Spain. In the former case, there would be a big spread between the gold-export and gold-import

points. In the latter case, a disequilibrium exchange rate might persist for a long time, with the rate in Flanders or France remaining above the gold-export point for Seville. Both explanations seem reasonable at first glance. If the latter explanation is valid, however, we would expect to find discrepancies from purchasing-power parity. We will see that such discrepancies can be identified in later episodes.

3 EXCHANGE-RATE THEORY IN EIGHTEENTH-CENTURY SWEDEN

During the eighteenth century, the Swedish Riksbank began to issue daler bank notes. The quantity in circulation was kept within certain limits from 1745 to 1755, but began to increase rapidly when Sweden entered the Seven Years' War in 1756. It grew from 6.9 million dalers in 1745 to 13.7 million in 1755, then surged to 20.9 million in 1756 and to 44.6 million in 1762. With the end of the war in 1763 and a change in government in 1765 from the inflationary Hat Party to the deflationary Cap Party, the amount decreased rapidly to 32.2 million in 1768. In 1777, bank notes, which had been inconvertible since 1745, became convertible into specie again, and the era of the Swedish paper daler came to an end. (For a full account, see Eagley, 1971, on which my summary relies.)

As we would expect, prices increased and the daler depreciated strongly during the first half of the period. The movements were reversed during the second half (see Figure 1). Three conclusions are immediately obvious. First, the money supply rose faster than the exchange rate, and the exchange rate rose faster than the price level. As I have used the exchange rate on Hamburg to measure the depreciation of the daler, and Hamburg was on a pure silver standard, it is safe to take p^* as constant. Purchasing-power parity would then require \hat{e} to equal \hat{p} , but \hat{e} is larger than \hat{p} . Thus our second conclusion is that the Swedish inflation produced an undervaluation of the daler. Finally, when the money supply decreased, the exchange rate on Hamburg fell more rapidly than the general price level, eliminating the undervaluation of the daler and restoring relative purchasing-power parity after thirteen years. We will find these same patterns in all similar cases that we look at later.

The hero of this story from the point of view of economic theory was the contemporary Swedish economist, P. N. Christiernin. Let us see what he had to say about the phenomena emphasized in my introduction. Writing in 1761, Christiernin saw quite clearly that the depreciation of the paper daler was caused by the growth of the money supply:

The current trend of the price of foreign exchange in Sweden must originate in factors unique to the domestic scene since we find examples of such a rapid and uninterrupted rise neither in earlier times nor in other lands. In other countries, the exchange rate cannot rise higher than the cost of exporting specie. . . . But here in Sweden the price of foreign exchange rises uninterruptedly. We cannot set a boundary above which it may not rise. . . . In terms of silver and gold, the exchange rate is about the same (translated by Eagley, 1971, p. 62).

The proposal has been made to lower the price of foreign exchange and the price of specie in terms of bank notes by increasing the bank-loan rate of interest, thereby reducing the amount of bank notes in circulation. This measure would doubtless appreciate the value content of the monetary unit . . . (p. 92).

Christiernin was well aware of the dynamic adjustment process initiated by a change in the money supply:

If money which had once been in circulation is drained abroad or hoarded in a chest, it is clear that that portion of goods and services that loses its market must also disappear from the market because of permanently reduced demand. . . . The population and its industriousness must then subsequently diminish until the scarcity of commodities sets them into equilibrium with the money supply circulating in the economy. Because of this, the community suffers more when a portion of the money supply is withdrawn from circulation than if the money had never come into circulation in the first place. In view of the fact that bank notes are the main component in our money supply, they could not be reduced without causing the same changes and dislocations . . . (pp. 86-87).

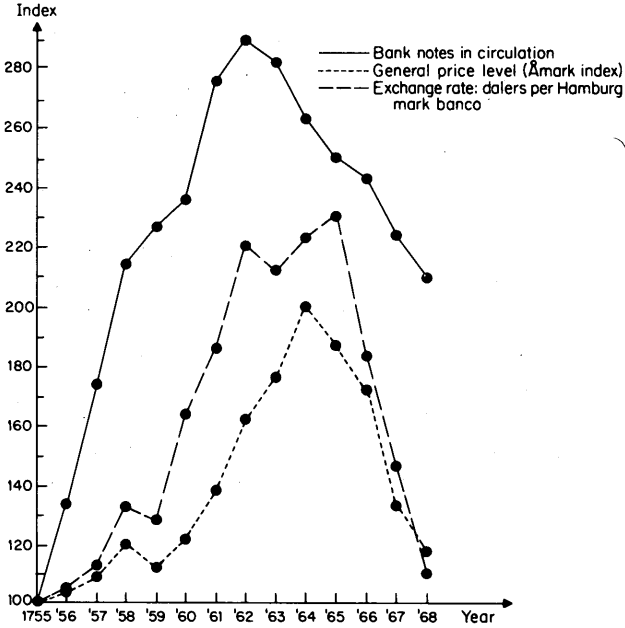
Christiernin does not seem to have known or reinvented the purchasing-power-parity theorem, but he came rather close in this formulation: "Goods are bought and sold between nations as if the exchange rate did not exist. Pig iron in Stockholm is sold for just as many daler at home as abroad—regardless whether the exchange rate is high or low" (p. 82). Unfortunately, we cannot decide from Christiernin's writings whether he had in mind the law of one price or the more general purchasing-power-parity theorem. To complicate matters, Christiernin makes this statement:

The high price of foreign exchange occasions high prices of foreign exchange for only imports and exports. Accordingly, those who have exportable commodities benefit, while those who consume imported goods suffer. . . . From all this it is clear that the increase in the exchange rate tends to increase exports and decrease imports and in the process automatically turns the balance of trade from deficit to equilibrium. When the high exchange rate makes foreign finished or unfinished goods . . . more expensive in Sweden, domestic producers begin to supply the market. Because a high exchange rate raises the price of all imported goods, it must increase the export of all types of goods and work. On the other hand, the high exchange rate cannot help but reduce the import of foreign goods (pp. 84-85).

Here we seem to have a contradiction. If the purchasing-power-parity theorem were true, the domestic price level should have risen by the same percentage as the exchange rate, affording no stimulus to exports and no discouragement of imports. Or was Christiernin trying to say that purchasing-power parity holds in a kind of long-run equilibrium while dealing, in the quotation above, with a dynamic short-term or medium-term equilib-

FIGURE 1

INDICES OF MONEY SUPPLY, PRICES, AND EXCHANGE RATE IN SWEDEN, 1755-68



SOURCE: Eagley (1971, Appendices A-C, pp. 115-117).

rium? As the context does not seem to support this interpretation, it would be best to conclude that Christiernin did not spot the contradiction or did not see clearly the way to resolve it.

If we impose a dynamic interpretation on the last quotation, we would expect to find an undervaluation of the Swedish currency, stimulating exports and discouraging imports. If Sweden was close to purchasing-power parity in 1755, the data in Figure 1 conform to expectation; the daler appears to have been undervalued from 1755 through 1765. It is obvious in any case that the daler was undervalued for some significant part of the period, because the exchange rate rose so much faster than the price level, while foreign prices were stable. Note that the exchange rate rose in almost every year of this period, and that the difference between the rise in the exchange rate and the rise in the price level became greater and greater until 1762. The difference decreased only after the exchange rate fell, and it increased once more after the exchange rate rose again. These regularities can hardly be due to pure chance.

The years 1765 to 1768 show a similar pattern. The exchange rate fell

more than the price level, and the difference between them increased in every year except 1767. The undervaluation of the Swedish currency vanished, and there was even a small overvaluation (which may have been eroded in the following year). In the long run, after thirteen years, purchasing-power parity had been restored.

Christiernin can be said to have predicted the developments of the latter phase from 1765 to 1768 or, if you prefer, from 1762 to 1768:

. . . however damaging a further increase in the exchange rate would be, a reduction in the price of foreign exchange would not only be without actual benefit but, more important, would have the worst possible consequences for commerce and industry throughout our nation. . . . When the currency is appreciated in terms of specie, not all prices fall immediately. People continue for a long time to demand the old price for their products, despite the change in the metallic content of our monetary unit. There are instances of this in other countries and in Sweden in 1633 and in 1719. . . .

It is easy for prices to adjust upward when the money supply increases, but to get prices to fall has always been more difficult. No one reduces the price of his commodities or his labor until the lack of sales necessitates him to do so. Because of this workers must suffer want and the industriousness of wage earners must stop before the established market price can be reduced. . . .

The price impact of a reduction in the money supply is not uniform: Not all prices fall; not all prices fall at the same time; and after the reduction, relative prices are not the same (pp. 90-91).

Again, we find a very clear understanding of exchange-rate and price dynamics. Christiernin saw that prices are stickier than exchange rates, and that some prices are stickier than others. He realized that this is especially true for a downward price movement, which must thus be preceded by a depression. Elsewhere he argued that a revival of economic activity would be the first consequence of an increase in the money supply, and that prices would not rise until later. He saw, too, the asymmetry between the consequences of an expansion and a contraction of the money supply. But there is no formulation of the purchasing-power-parity theorem as being valid in the long run and no prediction of increasing undervaluation during a monetary expansion and of its disappearance during the subsequent monetary contraction.

4 THE FRENCH ASSIGNAT DURING THE REVOLUTION

During the French Revolution, paper money was introduced in France. Like the daler, this ill-fated currency apparently experienced an undervaluation soon after its introduction. Let me quote the French historian, M. A. Thiers:

The fall of the assignat began at the exchange, against the numeraire [gold coins] and all nonfixed assets. Then it spread to goods, which became dearer in the shops and the markets. But the prices of goods did not rise as rapidly as the numeraire, because the markets are far from the exchange, because they are not as sensitive, and also because merchants cannot pass information around as rapidly as brokers who are together in one hall. Therefore, the difference that has developed at the exchange develops elsewhere only after a more or less extended period; the 5-franc assignat that has a value of only 2 francs at the exchange is still worth 3 in the market, and the arbitrageurs thus have the difference necessary for speculation (Thiers, 1825, Vol. 5, pp. 172-173, my translation).

The assignat,¹ of course, never recovered, and Thiers does not tell us whether the prices of goods ever caught up with those of coins. Nor does he refer to exchange rates in the quotation above. But we can safely assume that exchange rates moved in unison with the value of gold coins (see the Russian example of Chap. 5) because most foreign countries were on a pure gold or silver standard.

The case of the French assignat differs from that of the Swedish daler in that the quantity of assignats was never stabilized. Instead, a runaway inflation developed, which led to the abolition of the assignat and of its successor, the mandat. The French experience with paper money during the Revolution was much more like the hyperinflations of the 1920s in several European countries. It is therefore worth looking into it more closely.

The figures in the middle section of Table 1 show that from October to December 1795 the indices of the prices of the gold coin and the Dutch currency rose from 100 to 262 and 375, respectively, much more rapidly than the index of the price of wheat, which rose only to 190. This widened a gap that had opened earlier. According to Falkner (1924, p. 54), from 1790 to September 1795 the general price index for twenty-four goods had already risen from 100 to 3,400 but the index for gold coins had risen faster, from 100 to 4,483. From December 1795 to March 1796, however, the index of the wheat price rose more rapidly, from 100 to 410, while the

¹ "Assignat" was used as a general expression for paper money. Its name stems from the fact that the French assignat originally assigned to its holder the right to buy confiscated church property. The French assignat was denominated in francs (1 franc = 1 livre).

TABLE 1
MONEY SUPPLY, PRICES, PRICE OF GOLD, AND EXCHANGE RATE IN FRANCE, 1789-96

Date	Assignats in Circulation		Price of Quintal of Wheat		Price of Gold Livre		Exchange Rate	
	Billions of Paper Livres	Index	Paper Livres	Index	Paper Livres per Gold Livre	Index	Paper Livres per Dutch Currency Unit	Index
(Index: 1790 = 100)								
1789	0.1	30	—	—	1.03	96	—	—
1790	0.4	100	—	—	1.07	100	196	100
1791	1.2	295	—	—	1.17	109	220	112
1792	1.7	436	—	—	1.53	143	301	154
1793	3.2	808	—	—	2.58	240	349	178
1794	6.4	1,598	—	—	3.14	293	—	—
1795	12.9	3,235	—	—	15.11	1,409	9,259	4,728
1796	34.2	8,550	—	—	256.41	23,910	37,500	18,150
1795—Aug.	14.5	3,635	—	—	36.76	3,428	7,143	3,648
Sept.	16.1	4,019	—	—	48.08	4,483	7,143	3,648
Oct.	17.9	4,470	—	—	73.53	6,857	6,667	3,404
(Index: Oct. 1795 = 100)								
1795—Oct.	17.9	100	122	100	73.53	100	6,667	100
Nov.	20.5	114	155	127	129.87	177	14,286	214
Dec.	23.3	130	232	190	192.31	262	25,000	375
(Index: Dec. 1795 = 100)								
1795—Dec.	23.3	100	232	100	192.31	100	25,000	100
1796—Jan.	27.6	118	600	259	217.39	113	33,333	113
Feb.	33.9	145	738	318	285.71	149	33,333	113
Mar.	36.0	154	950	410	277.78	144	50,000	200

SOURCE: Falkner (1924, Tables 3-5, 9, 10, 12, pp. 36-49, 57).