Frenkel, J.A. and H.G. Johnson, 1976, The monetary approach to the balance of payments (Allen and Unwin, London).
Hodgson, J.S., 1972, An analysis of floating exchange rates: The dollar–sterling rate: 1919–1925, Southern Economic Journal, Oct., 249–257.
Swoboda, K.A., 1973, Monetary policy under fixed exchange rates: Effectiveness, the speed of adjustment and proper use, Economica, May, 136–154.
Tullio, G., 1977a, Monetary equilibrium and balance of payments adjustment: Empirical tests of the U.S. and the Italian balance of payments, Ph.D dissertation (University of Chicago, Chicago, IL).
Tullio, G., 1977b, The speed of adjustment of the capital and the current accounts to money market disturbances: Some empirical findings, Unpublished paper (Bank of Italy, Rome).

European Economic Review 12 (1979) 91–100. © North-Holland Publishing Company

AN EMPIRICAL NOTE ON RELATIVE MONETARY EXPANSION AND DEPRECIATION

The Case of the Lira–Swiss Franc Exchange Rate (February 1973 – December 1976)

Giuseppe TULLIO*

Bank of Italy, Rome, Italy

Received February 1978, final version received September 1978

This note presents an empirical test of fluctuations in the spread between the lira–Swiss franc exchange rate for bank notes and cable transfers in Zurich. This spread is trendless, and since the market for Italian bank notes in Zurich is relatively small, it is virtually free from reverse causation in relation to relative monetary expansion. The tests show that relative monetary expansion is the main determinant of fluctuations in the spread.

1. Introduction

Reformulations of the classical theory of exchange rate changes, in the spirit of the monetary approach, tend to consider the exchange rate as the relative price of two monies [Frenkel (1976)]. They imply that, if equilibrium in the domestic money and financial market is disturbed by, say, an increase in the money supply, or a change in the expected rate of domestic inflation, the public forces a depreciation of the exchange rate by shifting domestic assets toward assets denominated in foreign currencies, until a new equilibrium is reached. Central to the analysis of this adjustment to the new equilibrium is the relationship between stocks and flows.

The purpose of the present study is to present some empirical tests of this theory for the lira–Swiss franc exchange rate, using monthly data from February 1973 to December 1976. February 1973 marks the beginning of the floating of the lira; however, the Bank of Italy often heavily intervened in the foreign exchange market after that date, so that the price of Italian bank notes in Zurich tended to fluctuate far more than the rate for cable

*I owe thanks to G. Basevi, J.A. Frenkel, C. d'Adda, G. De Cindio, J. Laker, P. Savona, and F. Papadia for helpful suggestions. I am also particularly indebted to an anonymous referee of this journal. The views expressed in the paper are my own and do not involve the institution to which I belong. My present address is IMF, Washington, DC.

transfers.[1] Indeed, in some months, the spread between the two rates reached levels of 15 to 20 percent (fig. 2). In this note, the spread is used as the dependent variable in an empirical test of the monetary theory of exchange rate changes.

The spread was chosen as a dependent variable because it is virtually trendless. In addition, since the market for Italian bank notes is small relative to that for cable transfers, even large monthly changes in the spread should have very little effect on either the relative inflation rate or relative monetary expansion in the same month. Thus, no reverse causation problem arises in using relative monetary expansion as the main explanatory variable.

The year 1976 saw the most turbulent changes in both exchange rates, and the general fit of the model is somewhat reduced if this year is included in the sample period. Nevertheless the tests presented here do include the year 1976.

Section 2 presents the monetary approach to flexible exchange rates in brief form, and specifies the key assumptions. Section 3 contains the empirical tests.

2. The monetary approach to flexible exchange rates

As noted above, the monetary approach to flexible exchange rates considers the exchange rate as the relative price of two moneys. When the money stocks in the two monetary areas are willingly held, there is no tendency for the exchange rate to change.

The approach assumes that a stable demand for money, which is a function of a few key variables, exists in both areas, and that arbitrage tends to equate the prices of goods (allowance being made for the different monetary units in the two countries) and the real interest rate on securities. The approach implies that the explanation of the exchange rate is the same whether or not financial markets exist or are integrated with each other. The existence of highly integrated capital markets is, however, assumed to affect the speed of adjustment of the exchange rate to a disturbance.

Some proponents of the theory can be criticized for neglecting equilibrium in financial markets in their formal analyses. Following the classical tradition, developed at a time when financial markets were presumably only rudimentary and could safely be neglected, simple versions of the monetary approach to flexible rates have failed to state explicitly that a stable demand for financial assets in both areas is also assumed and that, because of Walras' law, financial markets and the market for goods can be neglected in the formal presentation of the model.

Nevertheless, for our limited purposes it is sufficient to stick to the simple version of the monetary theory of exchange rate changes, which does not include the demand for financial assets in the formal model.[2]

Eq. (1) is a standard text-book demand for cash balances, which is homogeneous of degree one in prices and is a stable function of real income and the expected price level,

$$M_i^D = K_i P_i Y_i^{\alpha} PE_i^{-\beta} = M_i^s, \qquad i = \text{I}, \text{CH}, \tag{1}$$

where subscripts $i = \text{I}, \text{CH}$ refer to Italy and Switzerland, respectively. Y_i is real GNP, a proxy for the volume of transactions in the country (or for wealth); P_i the price level and PE_i the expected price level; and K_i is a constant. Greek letters are elasticities which, for simplicity, are assumed to be equal in the two countries.

The equality $M_i^s = M_i^D$ implies equilibrium in the money market.

Eq. (2) states that purchasing power parity is assumed to hold in the long run,

$$P_\text{I} = ex\, P_\text{CH}, \tag{2}$$

where ex is the exchange rate, expressed as the number of lira per Swiss franc. This equation reflects the second basic assumption of the monetary approach, namely that arbitrage tends to equate prices across countries. Taking natural logarithms of eqs. (1), solving for P_I and P_CH, substituting into (2) and solving for ex gives

$$\begin{aligned} \ln ex = {} & \sum_{i=0}^{n1} s_{1i}(\ln M_\text{I} - \ln M_\text{CH})_{t-i} + \sum_{i=0}^{n2} s_{2i}(\ln PE_\text{I} - \ln PE_\text{CH})_{t-i} \\ & - \sum_{i=0}^{n3} s_{3i}(\ln Y_\text{I} - \ln Y_\text{CH})_{t-i}, \end{aligned} \tag{3}$$

where the possibility of time lags has been explicitly taken into account. Eq. (3) says that the exchange rate tends to depreciate faster, the greater is the rate of relative monetary expansion, the smaller the relative rate of real growth, and the greater the difference in expected price level changes.

Using eo to indicate the lira–Swiss franc exchange rate for cable transfers in Zurich and e the market rate for banknotes (also in Zurich), an equation similar to eq. (3) can be written for both exchange rates. Assuming that the rate e reacts significantly faster to changes in its explanatory variables than the rate eo, $\ln eo$ can be subtracted from $\ln e$; making use of the well-known

[1] I am grateful to Giovanni De Cindio for first drawing my attention to this exchange rate and its higher variability relative to the official rate.

[2] For models which also formally include financial asset markets, see Dornbusch (1976), Basevi and De Grauwe (1977); for the monetary theory of the balance of payments, see Dornbusch (1975) and Rodriguez (1976) [in Frenkel and Johnson (1976)].

D

property of logarithms that $\ln(1+x)=x$, for x sufficiently close to zero, one obtains

$$\ln\left(\frac{e}{eo}\right)=\ln\left(1+\frac{e-eo}{eo}\right)=\frac{e-eo}{eo}$$

$$=K+\sum_{i=0}^{n} W_i(\ln M_{\text{I}}-\ln M_{\text{CH}})_{t-i}+\delta Z_t. \qquad (4)$$

Here, the explanatory variables other than money stocks have for simplicity been summarized in the vector Z_t, and a constant term K has been added. Note that it follows from the model that $\sum_{i=1}^{n} W_i=0$. Testing eq. (4) has an advantage over the test of an equation for $\ln e$, such as (3): it represents a test of the importance of relative monetary expansion for the more relevant cable transfers rate (eo) while at the same time the dependent variable is trendless and free from reverse causation.[3]

The hypothesis H_0 to test is that the sum $\sum_{i=0}^{n} W_i$ is not significantly different from zero, and that the weights W_i first assume positive values and then negative ones, with significant t-statistics.

The hypothesis H_0 implies that the exchange rate e is less sticky, and more sensitive to changes in $(\ln M_{\text{I}}-\ln M_{\text{CH}})$, than the rate for cable transfers, which is affected more by official intervention. Furthermore, the hypothesis H_0 is suggested by the fact that, while the market for e is presumably dominated by capital movements of an illegal nature, the bulk of the market for eo is commercial transactions which, according to the monetary approach, react with longer lags to relative monetary expansions.[4]

3. Empirical tests

For Italy the money stock chosen was M_2, because in the period in question the (post-tax) rate of return on demand deposits relative to saving deposits has changed, and because studies of the Italian balance of payments have shown that developments in the market for M_2 are more highly correlated with the balance of payments.[5] For Switzerland M_1 was preferred; changes in M_2 might be more sensitive to capital inflows from abroad and hence might be partly endogenous (even under flexible exchange rates).

Table 1 contains regressions of $(e-eo)/eo$ on the current and lagged values of $(\ln M_{\text{I}}-\ln M_{\text{CH}})$; on a seasonal dummy variable (T) for the summer flow of foreign tourists to Italy, which leads to an appreciation of the lira in the market for bank notes relative to that in the market for cable transfers; on

[3]Tests of eq. (3) for the rate e are not shown in this note; they are, however, available from the author upon request.

[4]See Swoboda (1973) and Tullio (1977b).

[5]See Tullio (1977a).

official interventions of the Bank of Italy in the foreign exchange rate market (I) and on the value of $(\ln P_{\text{I}}-\ln P_{\text{CH}})$ lagged one month.[6] The other variables are dummies reflecting periods of intense speculation on exchange rate changes for the lira.[7] Relative real income was approximated using indices of industrial production, but was never significantly different from zero. The two regressions differ only in the degree of the Almon polynomial used for the variable $(\ln M_{\text{I}}-\ln M_{\text{CH}})$. The sum of the coefficients of current and lagged $(\ln M_{\text{I}}-\ln M_{\text{CH}})$ is not significantly different from zero, as expected, whatever the degree of the Almon polynomial. The time profile of the coefficients of $(\ln M_{\text{I}}-\ln M_{\text{CH}})$ in regression 2 is shown in fig. 1. Their t-values are shown at the bottom of table 1. The regressions of table 1 show that the effect of relative monetary expansion on the spread $(e-eo)/eo$ is only eliminated, on average, after about 18 months. Such a long tag is consistent with the finding that under flexible exchange rates, the lag in the response of the Italian current account balance, to Italian excess demand for money is longer than a year.[8] The hypothesis H_0 is thus confirmed by the data.

The dummy variable T has a negative and significant coefficient, suggesting that the summer influx of tourists does indeed reduce the spread between e and eo. On the other hand, intervention by the Bank of Italy tends to significantly increase the spread by about 4 percent for every billion dollars sold in the foreign exchange market. Finally, the proxy for the relative expected price levels $(\ln P_{\text{I}}-\ln P_{\text{CH}})$ suggests that an inflation differential

[6]The variable $(\ln P_{\text{I}}-\ln P_{\text{CH}})_{t-1}$ is supposed to measure not only the relative expected price level [see eq. (1)] but also the expected depreciation of the lira. Both an increase in the relative expected price level and in the expected depreciation of the lira tend to reduce the demand for money in Italy and increase it in Switzerland. Furthermore, they tend to have a more immediate impact on the rate e than on eo, because the former is more flexible. Relative interest rate changes were also tried as a proxy for relative inflationary expectations but without success. Italian rates do not show sufficient variability from month to month, because they have been pegged throughout most of the period.

[7]Monetary policy became very restrictive and interest rates were sharply increased only in April 1974, after a long period of pegging. Since most of the large industrialized countries had already started to tighten monetary policy in the middle of 1973, the outbreak of the oil crisis generated expectations of a sharp depreciation of the lira. D_{oil} therefore assumes the value of +1 from August 1973 to March 1974. The very restrictive monetary policy started in April 1974, had by the end of the same year led to a marked improvement in the current account and this produced expectations of a smaller depreciation or a higher appreciation of the lira. D_{75} therefore assumes a value of +1 from November 1974 to March 1975. Since 1973, the period of strongest depreciation of the lira started in February 1976, after a sharp acceleration of monetary expansion in Italy at the end of 1975. At the end of January the official foreign exchange market was closed and the official rate could fluctuate almost freely. It followed that in March and April the rate eo was in a position to depreciate more quickly than predicted by the model. Finally, at the beginning of May the depreciation of both exchange rates was ended by the introduction of a deposit scheme on all imports. The dummy D_{76} therefore assumes a value of +1 in March and April, and zero otherwise. Also see the appendix which contains symbols and sources of data used.

[8]See Tullio (1977b).

Table 1

Spread between lira–Swiss franc exchange rate for banknotes (e) and cable transfers (eo) in Zurich: monthly data (February 1973–December 1976).[a]

No. of regr.	Constant	$\sum W_i$	T	I	$(\ln P_I - \ln P_{CH})_{-1}$	D_{oil}	D_{75}	D_{76}	No. of lags of Almon polyn.	Degree of polyn.	R^2C D.W.	$\bar{X}$ S.E.R.
1	−0.12 (−3.75)	−0.03 (−0.42)	−0.03 (−4.02)	0.04 (4.44)	0.33 (2.32)	0.06 (5.93)	−0.04 (−3.50)	−0.07 (−3.78)	17	2	0.82 1.60	0.0677 0.0216
2	−0.14 (−4.11)	−0.02[b] (−0.20)	−0.03 (−4.16)	0.04 (4.35)	0.35 (2.47)	0.07 (6.24)	−0.03 (2.00)	−0.07 (−3.88)	17	3	0.83 1.74	0.0677 0.0212

[a]Number in parentheses are t-statistics. $\bar{X}$ is the average of the absolute values of the dependent variable. The Almon polynomials for the variable $(\ln M_I - \ln M_{CH})$ are constrained to zero on the right.

[b]The t-values of the coefficients of the current and lagged $\ln M_I - \ln M_{CH}$ are : 4.3, 4.9, 5.5, 4.0, 1.0, −0.8, −1.9, −2.7, −3.6, −4.4, −5.4, −5.8, −5.2, −3.9, −2.8, −2.0, −1.5, −1.0.

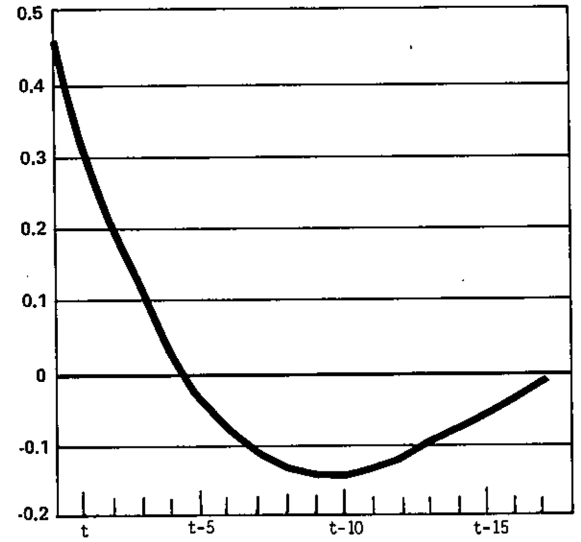

Fig. 1. Coefficients of current and lagged $\ln M_I - \ln M_{CH}$ (regression 2, table 1).

tends to significantly increase the exchange rate spread. The proxy has been lagged one month to avoid the potential (but unlikely) reverse causation between this differential and the spread.[9]

Fig. 2 shows that the fit between actual and expected values of the spread obtained from regression 2 is generally good.

4. Concluding comments

This paper has presented an empirical analysis of fluctuations in the spread between the lira–Swiss franc exchange rates in the market for bank notes and for cable transfers in Zurich. This spread has the advantage of being trendless and free from reverse causation with relative monetary expansion, due to the small size of the market for bank notes. The hypothesis under test is that the price of Italian bank notes in Zurich, being less influenced by official intervention and involving mainly illegal capital outflows reacts much faster to relative monetary expansion than the exchange rate for cable transfers, which ultimately, however, also has to adjust to relative monetary disturbances.

Formally, the hypothesis reduces to testing whether the sum of the

[9]For the rationale behind the introduction of $(\ln P_I - \ln P_{CH})$ among the independent variables, see footnote 6. In principle, if the possible (but unlikely) reverse causation between relative monetary expansion and the spread is to be avoided, the current value of $(\ln M_I - \ln M_{CH})$ should also not have been included in the regressions. We decided however to keep the current values of $(\ln M_I - \ln M_{CH})$ among the independent variables, given the large number of lags involved.

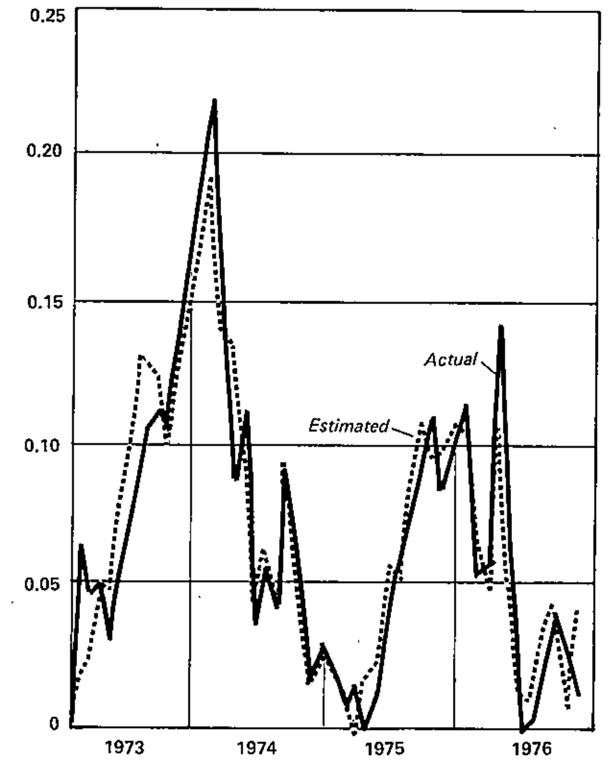

Fig. 2. Actual and estimated values of the spread between the lira–swiss franc exchange rates for banknotes and cable transfers (regression 2 of table 1, 1973-02/1976-12).

coefficients of current and lagged ($\ln M_I - \ln M_{CH}$) is insignificantly different from zero. The empirical tests, besides showing a good fit, confirm the hypothesis. The tests presented, however, have a number of shortcomings: the equation tested is a reduced form equation and the impact of real magnitudes and demand management policies other than monetary policy have been neglected. Furthermore the number of dummy variables used is relatively large, although they have been included only when the actual circumstances of the period justified this.

Appendix: Symbols and sources of data used

e = lira–Swiss franc exchange rate (banknotes) expressed as number of lire per Swiss franc, average of daily figures. *Source:* Schweizerische Nationalbank, Monatsbericht, various issues.

eo = lira–Swiss franc exchange rate (cable transfers), number of lire per Swiss franc, average of daily figures. *Source:* Schweizerische

Nationalbank, Monatsbericht, various issues.

I = gross sales of dollars in the foreign exchange market by the Bank of Italy (billions of dollars). *Source:* Unpublished series, Bank of Italy, Rome.

ln = natural logarithm.

M_{CH} = Swiss M_1. *Source:* Schweizerische Nationalbank, Monatsbericht, various issues.

M_I = Italian M_2, defined as overall deposits of commercial banks plus currency in circulation. *Source:* Banca d'Italia, Bollettino.

P_{CH} = Swiss consumer price index. *Source:* International Monetary Fund, International Financial Statistics, line 64.

P_I = Italian consumer price index. *Source:* International Monetary Fund, International Financial Statistics, line 64.

T = dummy variable for tourism in summer months, assuming the value of +1 in June, July, August and September of 1974 and 1976, of +1 in April, May, June, July, August and September of 1975 (1975 was a holy year, and tourism started earlier than usual), and zero otherwise. In June and July 1973, there was no incentive to buy Italian banknotes abroad and a very small spread appeared in August and September. It was therefore decided to leave the value T equal to zero for all months of 1973.

D_{oil} = dummy variable for negative expectations about the future of the lira, because of the outbreak of the oil crisis. Assumes the value of +1 in the period August 1973–March 1974 and zero otherwise.

D_{75} = dummy variable for positive expectations about the future of the lira due to marked improvement of the current account balance at the end of 1974 and the beginning of 1975. Assumes the value of +1 from November 1974 to March 1975.

D_{76} = dummy used for change in the reaction pattern of *eo* due to the almost free float of the lira in the foreign exchange crisis of the first half of 1976. Assumes the value of +1 in March and April 1976 and zero otherwise.

References

Basevi, G. and P. De Grauwe, 1977, Vicious and virtuous circles: A theoretical analysis and a policy proposal for managing exchange rates, Unpublished paper (University of Bologna, Bologna).

Dornbusch, R., 1975, A portfolio balance model of the open economy, Journal of Monetary Economics 1, 3–20.

Dornbusch, R., 1976, The theory of flexible exchange rate regimes and macroeconomic policy, Scandinavian Journal of Economics 78, no. 2, 255–275.

Ford, A.G., 1958, Flexible exchange rates in Argentina, 1885–1900, Oxford Economic Papers, Oct., 316–338.

Frenkel, J.A., 1976, A monetary approach to the exchange rate: Doctrinal aspects and empirical evidence, Scandinavian Journal of Economics 78, no. 2, 200–224.