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THE FLUCTUATIONS OF THE PRICE OF ITALIAN BANKNOTES IN ZURICH: AN ECONOMETRIC ANALYSIS (FEBRUARY 1973 – DECEMBER 1975)

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GIUSEPPE TULLIO*

'They looked at the antics of exchange rates and attributed them to the machinations of speculators – exactly as the politicians and the public did in France and Germany after 1919 [...]. They were most of them what may be termed naively critical of business and of the doings of merchants – as public opinion always was and is (SCHUMPETER, 1954, p. 344).'

I. INTRODUCTION

Reformulations of the classical theory of exchange rate changes[1] tend to consider changes in exchange rates as monetary phenomena in the sense that the money market is the proper framework to analyze how real and monetary factors interact to determine the equilibrium exchange rate. They imply that if the equilibrium of the domestic money and financial market is disturbed by, say, an increase in the money supply or by a change in the expected rate of domestic inflation, the public brings about a depreciation of the exchange rate

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1. The classical theory of exchange rate determination is best known as the purchasing power parity theory. There is however another version of the classical theory; this emphasizes the 'direct' effect of monetary expansion on the balance of payments or the exchange rate and is the one to which Italian classical writers seem to adhere. The 'direct' effect is central to modern formulations of the theory which can be therefore considered as conceptually closer to the Italian classical tradition than to the English one.

by shifting domestic assets into assets denominated in foreign currencies until a new equilibrium is reached.

The purpose of this paper is to present some empirical tests of the above theory for the monthly exchange rate of the lira from February 1973 to December 1975[2].

The exchange rate used as the dependent variable in the present econometric tests is the price of Italian banknotes in Zurich. This was preferred to the official rate for a number of reasons:

(1) Month to month changes in that variable reflect official intervention by the Bank of Italy less than do changes in the official rate or the Swiss-franc price of Italian banknotes in Milan; they therefore reflect better changes in the few explanatory variables which the theory emphasizes.
(2) The reverse causation problem between dependent and independent variables is avoided, at least in part, since the market for Italian banknotes in Zurich is small relative to the official market and even large fluctuations of that rate should have very little impact on variables like the Italian price level or the expected rate of domestic inflation.

The plan of the work is as follows: in *Section II* a standard model in the spirit of the monetary approach to flexible exchange rates[3] is very briefly specified, while in *Section III* the empirical tests are presented. Concluding comments are contained in *Section IV*.

One of the most interesting implications of the analysis is that a market which is commonly thought of as relatively small and hence subject to the influence of political panics and speculative assaults has reacted in the period in question in a predictable manner to just a few underlying economic variables.

II. THE MODEL

The two basic assumptions of the monetary approach to flexible exchange rates are that there exist stable demand functions for money

2. February 1973 marks the beginning of the floating of the lira.
3. See J.A. FRENKEL, 1975.

in the two areas one considers and that arbitrage tends to equate the prices of goods between the areas in the long run. Making use of the first assumption, one can write two standard text-book COBB-DOUGLAS demand functions for money[4].

$$M_I^D = P_I K_I y_I^{\alpha} \pi_I^{-\beta} = M_I^S \qquad (1)$$

$$\alpha, \beta > 0$$

$$M_{CH}^D = P_{CH} K_{CH} y_{CH}^{\alpha} \pi_{CH}^{-\beta} = M_{CH}^S \qquad (2)$$

where M is the money stock, P is the general price level, K is a constant, y is real income and π is the expected rate of inflation. Superscripts D and S refer to quantities demanded and supplied, while subscripts I and CH refer to Italy and Switzerland respectively.

Finally α and β are elasticities which are supposed to be equal in the two countries for simplicity.

The equality between the quantity demanded and supplied in (1) and (2) reflects the long run tendency of the money markets to move towards equilibrium.

The second assumption allows one to write:

$$e = \frac{P_I}{P_{CH}} \qquad (3)$$

where e is the price of Italian banknotes in Zurich.

Taking logarithms of (1) and (2), solving for P_I and P_{CH} and substituting into (3) one obtains:

$$\ln e = \sum_{i=0}^{n} w_i (\ln M_I - \ln M_{CH})_{t-i} + \beta (\ln \pi_I - \ln \pi_{CH}) + \alpha (\ln y_{CH} - \ln y_I) \qquad (4)$$

where the variable $(\ln M_I - \ln M_{CH})$ has been lagged to take account of the fact that the speed of adjustment of the exchange rate to relative money supply shocks is not instantaneous. Equations (1), (2) and (3) imply that

4. The COBB-DOUGLAS form has been chosen having in mind the empirical application of *Section III*.

$$\sum_{i=1}^{n} w_i = 1$$

which is the main hypothesis to be tested in the next section.

Equation (4) is not incompatible with a 'direct' effect of relative monetary expansion on the exchange rate, where by 'direct' effect it is meant that monetary expansion does not work through previous changes in the price levels as the purchasing power parity maintains.

This feature of modern reformulations of the classical theory is particularly suited to empirical tests of the lira-franc exchange rate for a number of reasons:

(a) the supply of Italian banknotes to the market in question probably involves to a very large extent capital movements (of an illegal nature, given the existing laws);
(b) the exchange rate is a much more flexible price than that of the average good included in the consumer price index, and;
(c) foreign exchange dealers possess special skills in forecasting future developments of the whole economy and have access to information which the average dealer in the goods market does not have.

The 'direct' effect of a monetary expansion on the exchange rate is clearly expressed in the following observation by FERDINAND GALIANI: '[...] and if this change occurred in an island separated from any trade with foreigners, the "old ideas"[5] would change very slowly. The existence of trade, however, means that the first to change is the exchange rate, the thermometer of countries; if it did not change one country would absorb the other countries "money" (GALIANI, 1750, p. 85, vol. 11).'

In the next section empirical tests of equation (4) and the equations derived from (4) by differentiating with respect to time are presented.

5. 'Old ideas' can be safely interpreted as the expected and/or the actual price level. The change Galiani has in mind is an increase in the face value of coins with unchanged metal content.

III EMPIRICAL ESTIMATES

Table 1 contains tests of equation (4) for the lira-franc exchange rate[6] for banknotes in Zurich. The period of estimation is 1973-02/1975-12. For the variable $(\ln M_I - \ln M_{CH})$ the symbol x has been used.

M_{CH} is currency plus demand deposit (M_1). M_1 was preferred to M_2 in the case of Switzerland since changes in M_2 might reflect more than changes in M_1 capital inflows from abroad and hence they might be partly endogenous (even under flexible exchange rates). For Italy M_2 was used[7] because in the period in question the relationship between the net of taxes rate of return on demand and savings deposits changed, and because in some studies on the Italian balance of payments M_2 has always shown a higher correlation with the balance of payments[8]. The ALMON polynomials used for the monetary aggregates are of second order and are constrained to zero on the right. M_I and M_{CH} have been lagged up to 7 months but coefficients referring to quarter $t-i$ for $i>2$ are never significantly different from zero and coefficients refferring to quarter $t-2$ are usually insignificant. It seems therefore that the effect of monetary expansion on the exchange rate analysed exhausted itself within 2 months. The sum of the coefficients of the variable x are generally not significantly different from 1 as predicted by the theory.

In regressions 3 and 4 the logarithms of the M_I and M_{CH} have been separated. Also, when considered in isolation, the sum of their coefficients is not significantly different from 1 and -1 respectively. The relative real income, which was approximated by using the indices of industrial production did not yield a significant coefficient.

6. The dependent variable is an average of daily figures, obtained from the monthly bulletin of the Swiss National Bank. It should be noticed that the high R^2's might be partly due to the fact that both $\ln e$ and $(\ln M_I - \ln M_{CH})$ are subject to some common time trend. However if the time trend is eliminated by running the regressions with the variables expressed in percentage changes (see *Table 2* below) the basic conclusions derived from *Table 1* remain unaffected.

7. Italian data are all obtained from the *IFS*, unless otherwise indicated. See *Appendix 1* for the symbols and sources of data used.

8. See TULLIO, 1977.

However a constant term has been added in order to reflect the impact of neglected variables. As proxy for the relative expected inflation $\ln z$ and $\ln sf$ were used alternatively, where

$$z = \frac{\pi_I}{100} + 1 \Big/ \frac{\pi_{CH}}{100} + 1$$

and π indicates the actual rate of inflation and sf is the lira-franc 3 month forward discount. The addition of 1 to $\pi/100$ is due to the fact that the logarithm of negative numbers does not exist[9].

The coefficients of $\ln z$ and $\ln sf$ have the expected positive sign. The coefficient of $\ln z$ implies an elasticity of the exchange rate with respect to the inflation differential of about 0.03–0.04 which is not an implausible value for the elasticity of demand for money with respect to the expected inflation rate (the 'β' in equation 4). The coefficient of '$\ln sf$' yields a somewhat lower value of β (0.01).

In order to assess the seasonal effect of tourism on '$\ln e$' a dummy variable ($D.T.$) was added to the explanatory variables. $D.T.$ assumes the value of $+1$ in June, July, August and September of 1974 and 1975, $+1$ in April and May of 1975 (1975 was a holy year) and 0 otherwise. The summer months of 1973 assume a zero value because the spread in favor of Italian banknotes was too small to induce European tourists to incur the risk of loss or theft of banknotes. It should also be noted that Italian law prohibits foreign tourists from importing Italian banknotes. In addition the spread was relatively a new phenomenon and maybe partly still unknown to many foreign tourists in 1973. Nevertheless the variable $DT1$ has also been used. It assumes a value of $+1$ also in the summer months of 1973 (see regression 2).

The introduction of $D.T.$ which is highly significant and with the right sign, eliminates the autocorrelation of the residuals (compare regression 2 with the others of *Table 1*).

The regressions of *Table 1* are surprisingly satisfactory if one considers that Italy was not subject to a hyperinflation and that the ex-

9. It would be preferable not to constrain the additive constant to 1 as in FRENKEL (1975). However the alteration of the functional form which arises from this constraint is not crucial for the purposes of this paper.

Table 1

Italian lira – Swiss franc exchange rate; market for banknotes in Zurich (natural logarithms; monthly data 1973–02/1975–12)

No. of reg.	Constant term	ln x	ln x_{-1}	ln x_{-2}	ln x_{-3}	Σln x	ln z	ln sf	DT	DT1	R²C	DW	SER	e
1	4.85 (175.68)	0.75 (3.59)	0.28 (22.41)	−0.00 (0.03)	−0.10 (0.95)	0.93	+1.42 (2.19)	–	−0.06 (5.15)	–	0.95	1.72	0.028	–
2	4.95 (88.68)	0.39 (1.53)	0.23 (9.76)	0.11 (0.92)	0.04 (0.30)	0.78	+1.30 (1.70)	–	–	−0.02 (1.61)	0.75	1.88	0.029	0.52
3	6.46 (1.36)	ln M_I: 0.83 (2.57)	0.29 (12.72)	−0.04 (0.24)	−0.13 (0.86)	0.96	–	0.01 (1.32)	−0.07 (4.13)	–	0.94	1.95	0.030	–
		ln M_{CH}: −0.92 (2.91)	−0.33 (2.18)	0.02 (0.10)	0.13 (1.02)	−1.11								
4	7.60 (1.80)	ln M_I: 0.89 (3.06)	0.29 (13.81)	−0.07 (0.50)	−0.16 (1.17)	0.95	+1.41 (1.97)	–	−0.06 (4.45)	–	0.94	1.85	0.029	–
		ln M_{CH}: −0.82 (2.66)	−0.36 (2.68)	−0.07 (0.50)	0.05 (0.38)	−1.21								

Number in parenthesis are t-statistics.
ALMON polynomials are all of 2nd order and constrained to zero on the right.
e is the coefficient of autocorrelation of residuals. Correction for autocorrelation was performed by the COCHRANE-ORCUTT iterative technique.

change rate we are trying to explain is commonly considered as volatile and subject to speculation[10].

Figure 1 shows the actual and estimated values obtained from regression 1. The price of one Swiss franc in Zurich is higher than the model predicts in the first month of 1974, probably because the oil crisis had induced the market to anticipate large depreciations of the lira since Italian monetary authorities did not show a clear intention to change their monetary policy. In april 1974, when interest rates were increased sharply, actual and estimated values again converged.

In order to check the robustness of the theory presented, we have tested the model again using percentage changes instead of the natural logarithms of the variables (see *Table 2*).

A dot above a variable indicates a percentage change. The variable *x* has the same meaning as before and *D* is a dummy capturing the sharp change in interest rate policy of April 1974 (the dummy assumes the value of +1 in april 1974 and 0 otherwise).

Without the dummy *D* no drastic change in the sum of the coefficients of the variable $\dot{x}$ occurs (compare regression 5 with regression 6).

Table 2

Percentage changes of lira Swiss franc – exchange rate; monthly data: 7302/7512

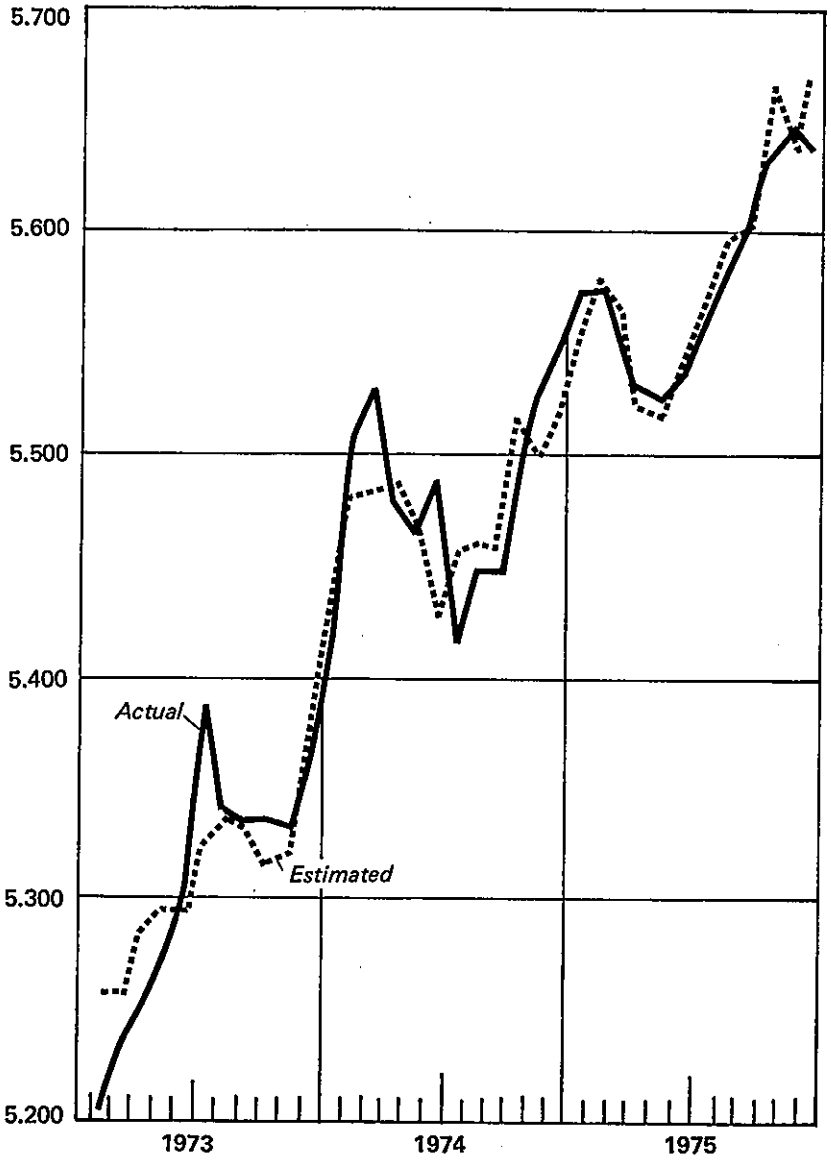
No. reg.	$\dot{x}$	$\dot{x}_{-1}$	$\dot{x}_{-2}$	$\dot{x}_{-3}$	$\Sigma\dot{x}$	D	R²	R²C	DW	SER
5	0.51 (1.74)	0.25 (2.27)	0.08 (0.53)	0.00 (0.00)	0.84	–	0.15	0.10	1.66	3.53
6	0.47 (1.70)	0.32 (2.92)	0.20 (1.22)	0.09 (0.62)	1.08	−7.67 (2.14)	0.26	0.19	1.76	3.36

Number in parenthesis are t-statistics.
Average of the absolute values of the dependent variable = 2.86.
ALMON polynomials are all of 2nd order and constrained to zero on the right.

10. Considering that data on monetary aggregates are published on average with a lag of about 2 months, which is also the lag of 'ln e' on 'ln x' we found in *Table 1*, the tests do not exclude that the market for Italian banknotes in Zurich might be efficient in a semi-strong form.

Figure 1

Natural logarithm of the price of one Swiss franc in Zurich (ln e). Actual and estimated values obtained from regression 1



IV. CONCLUDING COMMENTS

In order to avoid misunderstandings it seems appropriate to make it clear that the monetary theory of the balance of payments and of exchange rate determination is not a theory which emphasizes only monetary variables and neglects real variables. The term 'monetary' implies merely that the money market is the most appropriate market for analysing how monetary and real factors interact to determine the balance of payments or the exchange rate. The absence of a real variable in this econometric test stems from the particular exchange rate analysed, an exchange rate which involves mostly capital movements, and from the choice of monthly data to which we were compelled by the shortness of the lira fluctuation period. The variability of real income (or of productivity) was therefore probably too small to affect the portfolio balance of the two areas in a measurable way.

Despite the absence of real variables the regressions presented are satisfactory since monetary aggregates and expected inflation rates are significantly different from zero and the sum of the coefficients of relative monetary expansion does not seem to be significantly different from 1.

This study seems to indicate that one ought to be very careful in attributing wide fluctuations of exchange rates to 'wicked speculation', even for relatively small foreign exchange markets like the market for Italian banknotes in Zurich. One ought to observe the movements of the underlying economic variables before making a final judgment.

The empirical tests presented seem also to indicate that if one does not want to isolate Italy from the rest of the world, there is only one method to stop the export of banknotes (and capital outflows in general): control the money stock in relation to growth in real income at home and monetary expansion net of real growth abroad[11].

11. In this connection the following sentence by VILFREDO PARETO criticizing the overissue of paper currency by governments is worth quoting: 'After all, this operation is allowed only to governments; if private citizens devote themselves to this activity the law punishes them. It's like with gambling: it is moral when like in Italy or in Austria the government gets a profit, it is immoral when private citizens hold the bank. This all proves that public morals are far behind private morals (PARETO, 1896, page 335).'

APPENDIX 1

Symbols and sources of data used

$D.T.$ = dummy for effect of summer tourism. Assumes the value of +1 from june to september of 1974, and from april to september of 1975 (Holy year) and zero otherwise.

$D.T.$ = alternative dummy for effect of summer tourism. Assumes the value of +1 also from june to september of 1973.

e = Price of one Swiss franc in terms of Italian banknotes in Zurich, average of daily figures. Source: Swiss National Bank, monthly bulletin, which reports $1/e$.

M_{CH} = Stock of Swiss M_1; Source: Swiss National Bank, monthly bulletin.

M_I = Stock of Italian M_2; calculated as the sum of notes and coins and total bank deposits. Source: Bollettino and Supplemento, Bank of Italy.

sf = lira-swiss franc 3 months forward rate, in percent per annum, calculated as the sum of the lira-dollar and the dollar-swiss franc 3 months forward discounts. Source: Bank of Italy.

x = M_I/M_{CH}. It follows that $\ln x = (\ln M_I - \ln M_{CH})$.

y = real income, approximated by the indeces of industrial production. Source: Bank of Italy and IMF, International Financial Statistics.

z = $\left(\frac{\pi_I}{100}+1\right) \Big/ \left(\frac{\pi_{CH}}{100}+1\right)$.

It follows that $\ln z = \left(\frac{\pi_I}{100}+1\right) - \ln\left(\frac{\pi_{CH}}{100}+1\right)$.

See below for the meaning of π_I and π_{CH}.

π = Inflation rate, measured by the rate of change of consumer prices. Source: IMF, International Financial Statistics, line 64.

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SUMMARY

The paper contains empirical tests of the monetary approach to exchange rate determination for the price of Italian banknotes in terms of Swiss francs quoted in Zürich. The exchange rate was chosen because it is less influenced by government intervention than the official rate. In addition, there is little reverse causation between the chosen exchange rate and its explanatory variables due to the small size of the market analyzed. The tests indicate that the exchange rate analyzed adjusted in only two months to relative rates of monetary expansion between Italy and Switzerland. This fast adjustment is not implausible considering that the market involves to a large extent illegal capital outflows from Italy. Since data on monetary aggregates are published on average with a lag of about two months, the tests do not exclude that the market considered was efficient in a semi-strong form. The price of Italian banknotes in Zürich was also significantly affected by relative inflationary expectations and by seasonal factors connected with the inflow of foreign tourists to Italy.

ZUSAMMENFASSUNG

Die Arbeit testet ökonometrisch die monetäre Theorie der Wechselkurse für den Kurs italienischer Banknoten in Zürich. Der Gebrauch dieses an Stelle des offiziellen Wechselkurses hat zwei Vorteile: erstens wird er durch die Interventionen der Zentralbanken Italiens und der Schweiz weniger stark beeinflusst; zweitens bestehen praktisch keine Rückkoppelungseffekte (*reverse causation*) zwischen dem Wechselkurs und seinen Bestimmungsgrössen, weil der Markt für italienische Banknoten in Zürich relativ klein ist. Die Tests zeigen, dass sich der analysierte

Wechselkurs schon nach ungefähr zwei Monaten an die monetäre Entwicklung Italiens und der Schweiz anpasste. Diese schnelle Anpassung ist nicht unplausibel, denn der illegale Kapitalexport aus Italien hat oft in Form von Banknoten stattgefunden. Wenn man bedenkt, dass die Geldmengengrössen im Durchschnitt mit ungefähr zwei Monaten Verspätung veröffentlicht werden, schliessen die Tests nicht aus, dass der Markt für italienische Banknoten in Zürich nach Markteffizienzkriterien fast effizient ist *(semi-strong efficiency)*. Der Preis für italienische Banknoten in Zürich wurde, der Theorie entsprechend, auch durch die Inflationserwartungen in den zwei Ländern beeinflusst. Schliesslich erwiesen sich saisonale Einflüsse, bedingt durch Touristenströme, als signifikant.

RÉSUMÉ

Cet article présente une analyse économétrique de la théorie monétaire des taux de change appliquée au prix des billets de banque italiens à Zurich. On a préféré de choisir ce taux de change à la place du taux officiel parce qu'il est moins influencé par les interventions des banques centrales. En outre, il n'y a presque pas de causalité bidirectionnelle *(reverse causation)* entre le change choisi et ses principales variables explicatives car le marché en question est relativement restreint. L'analyse économétrique indique que le taux de change a suivi les expansions monétaires de la Suisse et de l'Italie en l'espace d'environ deux mois. Une adaptation si rapide du taux de change n'est pas surprenante étant donné qu'il y a souvent eu en Italie des fuites illégales de capitaux sous forme de transports de billets de banque. Il faut également tenir compte du fait que les données monétaires sont publiées en moyenne avec un retard de deux mois; les tests économétriques n'excluent donc pas l'hypothèse que le marché analysé est semi-efficace dans le sens de la théorie des marchés efficaces *(semi-strong efficiency)*. De plus, le prix des billets de banque italiens à Zurich a aussi subi l'influence des taux d'inflation des deux pays comme le prévoit la théorie monétaire et enfin le tourisme étranger en Italie a eu une influence saisonnière en faveur de la lire.