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MARKET PERCEPTIONS OF FEDERAL RESERVE POLICY AND THE WEEKLY MONETARY ANNOUNCEMENTS*

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In October 1979 the Federal Reserve altered its operating procedures emphasizing control of the growth rate of the money stock. Was the Fed able to gain credibility in the market? The paper investigates this question by examining the reactions of spot and expected future exchange rates, foreign interest rates, and long-run domestic forward interest rates to the weekly Federal Reserve announcements of *M-1*, both before and after October 1979. The empirical evidence points out that the Fed did gain credibility, but was unable to establish full credibility. The market reactions are consistent with the hypothesis that market participants attached a positive probability to the event that the Fed may at some point in the future abandon its money stock targets.

1. Introduction

An empirical regularity that attracted the attention of many academic economists in recent years is the reaction of short-term interest rates to the weekly Federal Reserve announcements of the money stock. As table 1 shows, many authors have reported a statistically significant positive correlation between the change in short-term interest rates after the announcement of *M-1*, and the unanticipated component of *M-1*. Some authors have also stressed that this correlation became stronger after October 1979, when the Federal Reserve reaffirmed its commitment to its money stock targets and abandoned the Federal Funds rate as the daily instrument of monetary control.

The announcement of *M-1*, which until recently was made at 4:15 p.m. every Friday, refers to the fiscal week that ends on Wednesday, nine days earlier. Therefore, the actual change in *M-1* is not the cause of the strong reaction of short-term interest rates. Markets react to the new information contained in the announcement of *M-1*. Some components of *M-1* are already announced. The monetary base and its components are announced a week earlier. Thus,

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the announcement of *M-1* provides new information about the monetary base multiplier. This implies that the surprise about money supply is not a surprise about discretionary actions taken by the Fed; these were revealed in the levels of non-borrowed and borrowed reserves a week earlier. The surprise is due to a shock originating in the banking system. Similarly the surprise about money demand is about the demand deposits and the other checkable deposits component of *M-1*, but not about currency.

The two main hypotheses that have been advanced in the literature to explain the reaction of short-term interest rates differ in their interpretation of the informational content of the unanticipated component of *M-1*. The first hypothesis presumes that markets perceive the unanticipated shock in *M-1* as a persistent money demand shock. Under this hypothesis, money supply shocks are perceived as temporary because the Fed has credibility, i.e., markets expect the Fed to stick to its announced *M-1* targets and not allow persistent deviations from these targets. A persistent positive money demand shock that will not be validated, together with the assumption that prices are rigid in the short-run, leads market participants to expect an increase in future real short-term interest rates. This drives real short-term interest rates up immediately after the announcement.[1] I call this hypothesis the 'expected liquidity' hypothesis.

The second hypothesis presumes that the unanticipated component of *M-1* is interpreted as a persistent shock on the growth rate of the money supply. The Federal Reserve lacks credibility in the market, i.e., markets do not expect the Fed to counteract a shock in the banking system that affects the growth rate of the money supply. This together with the assumption that prices are flexible in the short-run,[2] leads to a change in the inflation premium embodied in short-term interest rates. I call this hypothesis the 'inflation premium' hypothesis.[3]

Distinguishing which hypothesis is consistent with the data is interesting because it provides evidence on the lack or presence of Federal Reserve credibility in the market place. The Federal Reserve has been criticized that it did not follow a stable policy after October 1979, contrary to its own claims.

[1] For an illustrative model, see my working paper version, or a simpler model by Nichols, Small and Webster (1983).

[2] Short-run price flexibility is not necessary for short-term interest rates to embody an inflation premium effect. In models where prices are instantaneously rigid and inflationary expectations rational, an unanticipated change in money growth will, on impact, change short-term interest rates in the same direction. I am indebted to André Burgstaller for bringing this to my attention.

[3] Interestingly, the two-week lagged reserve accounting provides a third seemingly independent explanation of the reaction of the very short-term interest rates. The announcement of demand deposits (or *M-1*) provides a signal on the aggregate amount of required reserves during the fiscal (settlement) week of the announcement. If *M-1* is larger than anticipated, markets realize that during the next three working days the federal funds market will be tighter than they thought. The expectation of an increase in the fed funds rate drives it up instantaneously. This explanation is a special case of the expected liquidity hypothesis.

According to its critics, the Fed was, therefore, unable to establish credibility and was responsible for the high levels of long-term interest rates.[4] In this paper, I attempt to draw some conclusions about the issue of credibility. Although there has been a lot of research in the area of money announcements, as table 1 reveals, only a few authors have so far attempted to distinguish the two hypotheses.

Engel and Frankel (1984) utilized the reaction of exchange rates to distinguish the two alternative hypotheses. A small-country model with perfect capital mobility, secular inflation, and price stickiness in the short-run [see Frankel (1979)] predicts that a positive unanticipated *M-1* disturbance appreciates the dollar if the expected liquidity hypothesis is correct; and depreciates the dollar if the inflation premium hypothesis is correct. Their empirical evidence on the reaction of the West German mark supports the expected liquidity hypothesis. Similar evidence is provided by Cornell (1982), who examined more currencies.[5]

Cornell in another paper (1983a) uses the reaction of long-term bonds to distinguish the two hypotheses. He argues that prices are perfectly flexible in the long-run, so there is no long-run liquidity effect. Therefore, a positive long-term bond reaction implies an inflation premium effect. He finds a strong reaction in the long-term bond markets. He concludes that the evidence from exchange rate markets and the long-term bond markets is contradictory and presents a puzzle open to further investigation.

In the present paper I attempt to resolve the puzzle presented by Cornell. I extend the empirical evidence in three ways: First, I use forward interest rates instead of long-term interest rates. Long-run forward interest rates provide a better way of assessing the existence of an inflation premium effect because they are not influenced by short-run liquidity considerations. Secondly, I use the reactions of expected future exchange rates as well. This is the most natural way of extending the work of the previous authors. Expected future exchange rates may distinguish among the two hypotheses, adding an additional time dimension to the exchange rate reactions that complements the information in long-term interest rates. And thirdly, I directly examine the reaction of foreign interest rates.

The empirical evidence of section 2 does confirm Cornell's results that, taken in isolation, neither hypothesis is consistent with the data. Subsequently, in

[4]See a *Wall Street Journal* editorial on July 29, 1982 by Allan Meltzer.

[5]More recently, Frankel and Hardouvelis (1983) argued that flexible commodity prices, like exchange rates, react in opposite directions under the two hypotheses. During the post-October 1979 time period, the change in commodity prices after the announcement of *M-1* is negatively correlated with the unanticipated component of *M-1*. This is consistent with the expected liquidity hypothesis and rejects the inflation premium hypothesis. Pearce and Roley (1982) analyzed the reaction of stock prices to the announcement of *M-1*. They found a negative correlation. This evidence is consistent with the expected liquidity hypothesis but does not necessarily reject the inflation premium hypothesis.

Table 1

Academic literature on market responses to weekly Federal Reserve announcements of the money stock.

Market	Authors	Correlation of money surprise with change in market variable after the announcement of the money stock[a]	
		Before Oct. 1979	After Oct. 1979
Short-term interest rates	Conrad, Cornell, Girton-Natress, Hardouvelis, Roley	(+)*	(+)**
	Berkman, Grossman, Naylor, Urich-Wachtel	(+)*	
	Engel-Frankel, Urich		(+)**
Long-term interest rates	Cornell, Girton-Natriess	(+) or (0)	(+)*
Forward interest rates	Hardouvelis	(0) for $t \leq 2$ (+)* for $2 < t \leq 24$ (0) for $t > 24$	(+)** for $t \leq 60$ (0) for $t > 60$
	Shiller et al.		(+)** for $t \leq 84$ (0) for $t > 84$
Foreign interest rates	Hardouvelis		(+)* for $t \leq 6$ (+) for $6 < t \leq 12$ (0) for $t > 12$
Spot price of foreign currencies	Hardouvelis	(+) or (0)	(−)*
	Cornell, Engel-Frankel		(−)*
Expected price of foreign currencies 5 years later	Hardouvelis	(+)	(+)*
Commodity prices	Frankel-Hardouvelis	(+)	(−)*
Stock prices	Berkman, Lynge, Cornell	(−)	
	Cornell, Pearce-Roley		(−)*

[a](a) The positive sign (+) and negative sign (−) refer to the sign of the slope coefficient when the dependent variable is regressed on the unanticipated component of *M-1*. (0) means the coefficient is zero.

(b) Single asterisk implies the coefficient is statistically significant at the 95% level. Double asterisk implies the reaction coefficient is also strong in an economic sense.

(c) t denotes time measured in months.

section 3 I offer an alternative hypothesis which is a combination of the above two and appears to be consistent with the data. Then I perform some tests of the new combination hypothesis. Section 4 presents a brief summary, the conclusions, and possibilities for future research.

2. Empirical evidence

The market reactions to the weekly monetary announcements provide the closest analogy to a controlled experiment that one can make using economic data. The unanticipated weekly change in *M-1* may be interpreted as an exogenous variable that causes financial variables to change after the announcement of *M-1*. It is the difference between the actual change in *M-1*, which occurred nine days earlier and is by definition predetermined, and the forecasted change in *M-1*, which comes from a survey conducted before the announcement and is, therefore, predetermined. Thus, the usual simultaneity problem that plagues most econometric work is not present here.

2.1. Data

The sample covers the period from February 7, 1980 to June 21, 1982. The period from October 6, 1979 to February 6, 1980 was not included in order to allow the markets to adjust to the new regime. Furthermore, in February 1980 the Fed changed the dating of its announcements, which altered the nature of the new information provided by the announcement of the seasonally adjusted *M-1*. Whenever the *M-1* announcement was not made on a Friday or when Friday or Monday were holidays and the markets did not open, observations were dropped from the sample. The sample contains approximately one hundred and fifteen observations.

The proxy for the expected weekly change in the seasonally adjusted *M-1* comes from a survey conducted by the Money Market Services Incorporated of San Francisco every Tuesday morning. This survey forecast has been investigated by a number of researchers [Grossman (1981), Cornell (1983a), Engel and Frankel (1984), Urich and Wachtel (1981)], who conclude that it incorporates all the available information and that it outperforms model-based forecasts of the weekly change in *M-1*. An additional convenient feature of the survey is that it parallels the Fed's revisions of the definition of the narrow monetary aggregates. (In February 1980 the Fed began publishing *M1-B* and in January 1982 a new version of *M-1*.)

The interest rate data are daily closing yields (3:30 p.m. E.S.T.) of Treasury bills, notes and bonds. All data are equivalent yields comparable to a 365-day government bond, purchased at par, and bearing a coupon equal to the quoted yield. They were provided by the Data Resources Incorporated. The forward interest rates were constructed from these yields using simple geometric

averages.[6] The spot exchange rate data are closing selling rates (3:00 p.m. E.S.T.) of the New York market collected from the *Wall Street Journal*. The expected future spot exchange rates were constructed from the spot exchange rates (opening rates in New York), the domestic and foreign interest rates (mid-morning interbank rates in London, LIBOR), and the assumption that open interest rate parity holds.[7] The data were provided by DRI.

2.2. Estimation results

Table 2 presents the empirical results on domestic short- and long-term forward interest rates. The dependent variables are the Friday to Monday differences in the closing yields. The yields are expressed in percentage terms. We observe that they react very strongly to the unanticipated weekly percentage change in *M-1*, $UM(t-2)$.[8] For example, when *M-1* increases unexpectedly by 1%, the annual yield on a one-month Treasury bill one month ahead increases by 45 basis points. The reaction coefficients peak after three months and then decline. The one-day federal funds rate reacts very strongly, which implies that the lagged reserve accounting explanation of footnote 3 is correct. The announcement of demand deposits provides a signal to the banks on how tight the federal funds market will be during the current fiscal week. But the most striking feature of the results is the strong reaction of forward interest rates up to five years in the future. These reactions overwhelmingly reject the expected liquidity hypothesis. It is hard to imagine that a liquidity effect can last for five years.[9] It is also hard to imagine that markets expect the Fed to wait for three or more years before it counteracts deviations from its *M-1* targets. The positive reaction of long-run forward interest rates is, however, consistent with the inflation premium hypothesis.

[6] For example, the annualized ten-year forward rate twenty years ahead, $i_{20,10}$, was computed as follows: $i_{20,10} = -100 + (100 + i_{30})^3/(100 + i_{20})^2$, where i_{30} and i_{20} are the annualized yields to maturity of a thirty- and a twenty-year Treasury bond.

[7] The expected spot exchange rates five years ahead were constructed as follows: $E_t ex_{t+5} = ex_t((100 + {}_5i_t)/(100 + {}_5i_t^*))^5$, where ex_t denotes the level of the exchange rate (price of foreign currency in U.S. dollars), E_t denotes expectation conditional on information available at t, and ${}_5i_t$ and ${}_5i_t^*$ are annualized yields of five-year domestic and foreign bonds expressed in percentage terms. Note that we may add a risk premium without affecting our results, as long as it does not vary systematically with the unanticipated component of *M-1*.

[8] $UM_{t-2} = 200((M_{t-2} - RM_{t-3} - DM_{t-2}^{mms})/(M_{t-2} + RM_{t-3}))$, where M refers to the originally announced *M-1*, *RM* to the revised *M-1* one week later, and DM^{mms} to the median forecast of the weekly change in *M-1* provided by the Money Market Services. The Fed announces simultaneously $M(t-2)$ and $RM(t-3)$. $RM(t-3) - M(t-3)$ is part of the forecast error but it is not included in $UM(t-2)$. This may bias the reported coefficients downward. It turns out the bias is small. Pearce and Roley (1982) also find no substantial differences between the two measures in the reaction of stock prices. Similarly, if between Tuesday morning and Friday afternoon markets gain some useful information in predicting $DM(t-2)$, the reported coefficients may be biased downward. Again, this bias is minimal. Roley (1983) reached the same conclusion.

[9] Roley and Walsh (1983) claim they can explain these reactions by an expected liquidity effect, but assume prices to be sticky in the long-run.

Table 2

The reaction of short-term T-bill and long-term T-bond forward rates to the announcement of *M-1*; sample: weekly, February 15, 1980 to November 16, 1982.[a]

Dependent variable	Independent variable			$\bar{R}^2$	$D-W$
	Const.	$UM(t-2)$			
1-day Fed Funds	0.035	0.382*		0.077	2.64
	(0.057)	(0.106)			
1-month T-bill	0.104*	0.235*		0.066	1.96
	(0.038)	(0.071)			
1-month T-bill	0.031	0.450*		0.131	1.94
1 month ahead	(0.051)	(0.095)			
1-month T-bill	0.029	0.398*		0.060	2.11
2 months ahead	(0.068)	(0.126)			
3-month T-bill	0.096*	0.345*		0.150	2.16
3 months ahead	(0.036)	(0.067)			
6-month T-bill	0.009	0.240*		0.097	1.95
6 months ahead	(0.032)	(0.059)			
1-year bond	0.047	0.235*	0.234*	0.102	2.08
1 year ahead	(0.030)	(0.056)	(0.060)		
1-year bond	−0.013	0.172*	0.161*	0.043	2.16
2 years ahead	(0.033)	(0.063)	(0.069)		
2-year bond	0.070*	0.133*	0.114*	0.059	1.91
3 years ahead	(0.022)	(0.042)	(0.048)		
5-year bond	0.041*	0.039	−0.022	0.005	1.83
5 years ahead	(0.015)	(0.029)	(0.030)		
10-year bond	0.039*	0.058	−0.004	0.011	2.02
10 years ahead	(0.019)	(0.036)	(0.056)		
10-year bond	0.018	0.084*	0.079	0.034	1.76
20 years ahead	(0.018)	(0.034)	(0.156)		

[a](a) Standard errors are in the parentheses.

(b) Asterisk denotes statistical significance at the 95% level.

(c) All interest rates are equivalent yields to a one-year government bond, purchased at par, and bearing a coupon equal to the quoted yield. They are expressed in percentage terms.

(d) The dependent variables are the Friday to Monday differences in the closing rates (3:30 p.m.), with some exceptions noted below in (g).

(e) $UM(t-2)$ is the unanticipated weekly percentage change of *M-1* for the fiscal week that ended two weeks before the announcement.

(f) The Durbin–Watson ($D-W$) is included only for completeness.

(g) In this table only, all 144 sample observations are included in the regressions. First, postponed announcement dates are included. These were in 1980: July 7, Dec. 1, 22, 29; in 1981: Jan. 5, July 6, Nov. 30, Dec. 28; and in 1982: Jan. 4, Sept. 6, Nov. 15. The dependent variables are the change from the announcement date closing to the next market close. Second, the following additional Fridays or Mondays were market holidays – in 1980: Feb. 18, April 4, May 26, Sept. 1; in 1981: April 17, May 25, Sept. 4, Oct. 9; in 1982: Feb. 12, May 24, Oct. 8. For missing Mondays I used the following Tuesday closing rates, and for Fridays, the previous Tuesday closing rates.

(h) The second column of coefficients under $UM(t-2)$ comes from a regression of forward rates calculated by the linear approximation method of Shiller et al. (1983) at a level of linearization of 12.8%, the sample average of the twenty-year bond yield. This method correctly discounts future bond coupon payments, but as seen above, does not make a substantial difference in our results.

Table 3 presents the empirical results on the spot and expected future spot exchange rates five years ahead. The exchange rate is defined as the price of foreign currency in U.S. dollars. A negative reaction coefficient implies appreciation of the dollar. The dependent variables are the changes after the announcement in the logarithms of the exchange rates. For the spot exchange rates the change is from Friday at 3:00 p.m. (E.S.T.) to Monday at 3:00 p.m. For the expected spot exchange rates five years ahead the change is from Friday morning to Tuesday morning. Six different currencies are utilized: the British pound, the Canadian dollar, the French franc, the Japanese yen, the West-German mark, and the Swiss franc. In the spot markets the dollar appreciates against all currencies when $UM(t-2)$ is positive. This implies that markets anticipate the real rate of interest to adjust in the United States.

Table 3

The reaction of spot and expected future spot exchange rates to the announcement of *M-1*; sample: weekly, February 15, 1980 to June 25, 1982.[a]

Dependent variable	Spot rates				Expected spot rates 5 years ahead			
	Indep. variable				Indep. variable			
	Const.	UM_{t-2}	$\bar{R}^2$	$D-W$	Const.	UM_{t-2}	$\bar{R}^2$	$D-W$
British pound	−0.152 (0.093)	−0.024 (0.162)	0.00	1.98	−0.113 (0.184)	0.855* (0.295)	0.09	2.08
Canadian dollar	−0.064* (0.025)	−0.054 (0.044)	0.01	1.86	−0.097 (0.088)	0.915* (0.156)	0.23	1.96
French franc	−0.126 (0.096)	−0.249 (0.167)	0.01	2.02	−0.199 (0.206)	0.783* (0.362)	0.04	2.05
Swiss franc	−0.071 (0.102)	−0.521* (0.178)	0.07	1.84	−0.073 (0.123)	0.657* (0.205)	0.06	2.10
Japanese yen	−0.073 (0.090)	−0.375* (0.158)	0.04	2.01	0.079 (0.119)	0.710* (0.212)	0.08	1.88
W. German mark	−0.157 (0.090)	−0.461* (0.158)	0.07	1.93	−0.173 (0.126)	0.451* (0.223)	0.03	1.92

[a](a) Standard errors are in the parentheses.
(b) Asterisk denotes statistical significance at the 95% level.
(c) The exchange rates are defined as the prices of foreign currencies in U.S. dollars.
(d) The spot exchange rates are closing rates in the New York market (3:00 p.m.). The dependent variables are the Friday to Monday changes in the logarithms of the spot exchange rates.
(e) The expected spot exchange rates five years ahead are morning rates in New York. They were constructed from opening spot exchange rates, opening five-year Euro-dollar bond rates, and opening five-year Euro-market bond rates denominated in foreign currencies under the assumption that open interest rate parity holds. The dependent variables are the Friday to Tuesday changes in the logarithms of the expected spot exchange rates five years ahead.
(f) For easiness of exposition, the dependent variables are multiplied by 100.
(g) Five-year Euro-bond rates for Japan and Canada were not available. In the construction of the Japanese and Canadian expected exchange rates five years ahead we assumed that these interest rates do not react to the announcement of *M-1*.

Table 4

The reaction of foreign Euro-market forward interest rates to the announcement of the United States money stock; sample: weekly, February 15, 1980 to June 25, 1982.[a]

Country	Dependent variable	Independent variable		$\bar{R}^2$	$D-W$
		Const.	$UM(t-2)$		
France	6-month rate	0.003 (0.107)	0.138 (0.190)	0.00	2.01
	6-month rate 6 months ahead	−0.025 (0.104)	0.159 (0.184)	0.00	1.84
	4-year rate 1 year ahead	−0.019 (0.054)	−0.105 (0.094)	−0.00	2.01
	5-year rate	−0.015 (0.049)	−0.056 (0.088)	−0.01	2.07
Great Britain	6-month rate	−0.016 (0.029)	0.144* (0.053)	0.05	1.68
	6-month rate 6 months ahead	−0.019 (0.028)	0.078 (0.053)	0.01	2.12
	4-year rate 1 year ahead	0.015 (0.021)	0.018 (0.040)	−0.007	2.25
	5-year rate	0.007 (0.016)	0.037 (0.031)	0.004	2.06
Switzerland	6-month rate	−0.021 (0.027)	0.128* (0.048)	0.05	1.83
	6-month rate 6 months ahead	0.007 (0.045)	0.134 (0.081)	0.02	1.32
	4-year rate 1 year ahead	0.035* (0.018)	−0.043 (0.032)	0.007	2.39
	5-year rate	0.027 (0.014)	−0.008 (0.014)	−0.008	2.32
West Germany	6-month rate	−0.006 (0.021)	0.089* (0.039)	0.04	1.84
	6-month rate 6 months ahead	0.003 (0.028)	0.053 (0.050)	0.01	1.45
	4-year rate 1 year ahead	−0.002 (0.017)	−0.004 (0.031)	0.00	1.86
	5-year rate	−0.003 (0.014)	0.026 (0.026)	0.00	1.78
United States	5-year rate	0.005 (0.020)	0.219* (0.063)	0.09	1.68

[a](a), (b), (c) and (e) as in table 2.

(d) The dependent variables are the Friday to Tuesday differences in the mid-morning London interbank offered rates (LIBOR).

(f) Observations were dropped from the sample if Friday or Tuesday were market holidays.

This is consistent with the expected liquidity hypothesis, and rejects the inflation premium hypothesis. The second set of columns in table 3 show the reactions of expected spot exchange rates five years into the future. Since the expected spot exchange rates were constructed using an expected arbitrage condition (Open Interest Rate Parity), the information they provide is a combination of the information contained in spot exchange rates, five-year domestic interest rates, and five-year foreign interest rates. Yet, under the assumption that markets reach their long-run equilibrium five years after the announcement, the reaction of the constructed expected future spot exchange rates provide information on whether it is the real component or the inflation premium component of future spot interest rates that changes. Their positive correlation with $UM(t-2)$ is consistent with the inflation premium hypothesis, but is inconsistent with any hypothesis that claims that the real rate of interest adjusts five years into the future.

Finally, for completeness, I present the reaction of the term structure of foreign interest rates. Table 4 shows that the five-year foreign Euro-bond rates do not react to the announcement of the US money stock. Only the US five-year Euro-bond rate reacts strongly to the announcement of *M-1*. However, there is a statistically significant positive reaction of foreign short-term interest rates. This is an interesting independent piece of evidence, consistent with the expected liquidity hypothesis that the real US rate of interest adjusts.[10] It also reveals that during the 1980–82 period markets were aware that foreign governments were taking measures against capital mobility by partially aligning their short-term interest rates with the US short-term interest rates. The reactions of foreign short-term interest rates are not as strong as the domestic interest rate reactions, however, for otherwise spot exchange rates would not have reacted.

3. Is there a consistent explanation of the market reactions?

The evidence of section 2 reveals that neither the expected liquidity hypothesis nor the inflation premium hypothesis, when taken in isolation, is consistent with the data. Yet, the presence of an expected liquidity effect is plausible. It is a fact that during the 1980–82 period the Fed kept the growth rate of *M-1* approximately within targets. [See Tinsley et al. (1982).] As the following regression equation shows, the Fed adjusted non-borrowed reserves, its instru-

[10]The reactions of foreign short-term interest rates alone do not necessarily reject the inflation premium hypothesis. Under an extreme version of the inflation premium hypothesis, an expected future expansion in the growth rate of the US money supply implies a corresponding expansion in the growth rate of the world money supply, which affects the expected inflation rates in foreign countries and, consequently, their short-term interest rates. However, the absence of a positive reaction of foreign long-term interest rates rejects this extreme version of the inflation premium hypothesis.

ment, in a way that counteracted innovations in *M-1*.[11] For the sample period from February 1980 to June 1982, there is a statistically significant negative correlation between the weekly change in non-borrowed reserves, *DNBR*, and past unanticipated weekly changes in *M-1*, *DME*,

$$DNBR_t = \underset{(0.048)}{0.130^*} - \underset{(0.080)}{0.570^*}\, DNBR_{t-1} + \underset{(0.020)}{0.045^*}\, DME_{t-2} - \underset{(0.021)}{0.045^*}\, DME_{t-3}$$
$$- \underset{(0.021)}{0.045^*}\, DME_{t-4} - \underset{(0.021)}{0.059^*}\, DME_{t-5}, \qquad \bar{R}^2 = 0.47,$$

where the numbers in the parentheses are standard errors, and the asterisks denote statistical significance at the five-percent level.[12] In contrast, the corresponding regression results for the sample period from October 1977 to September 1979 do not show a strong negative correlation,

$$DNBR_t = \underset{(0.103)}{0.035} - \underset{(0.099)}{0.390^*}\, DNBR_{t-1} + \underset{(0.057)}{0.034}\, DME_{t-2} - \underset{(0.057)}{0.067}\, DME_{t-3}$$
$$- \underset{(0.056)}{0.012}\, DME_{t-4} - \underset{(0.055)}{0.017}\, DME_{t-5}, \qquad \bar{R}^2 = 0.11.$$

Since the Fed counteracted innovations in *M-1* during the 1980–82 period, the reactions of long-run forward interest rates and expected future exchange rates appear puzzling. Any new proposed hypothesis should, therefore, aim at resolving this puzzle and, simultaneously, should be consistent with the fact that there was an attempt by the Fed to keep the growth rate of *M-1* within targets. A hypothesis which accomplishes these tasks is a combination of the expected liquidity and the inflation premium hypotheses. Since the two hypotheses are not mutually exclusive, a combination of the two is a natural generalization. If prices are rigid in the short-run and flexible in the long-run, and if markets attach a small positive probability on the event that the Fed will abandon its announced targets, then short-term interest rates react due to both effects, spot exchange rates are dominated by the expected liquidity effect, and as the time horizon increases, the impact of the expected liquidity effect diminishes to zero and long-term interest rates as well as expected future spot exchange rates react solely because of the presence of the inflation premium effect.[13]

The combination hypothesis does not imply that markets expect the Fed not to accommodate in the short-run, but accommodate in the long-run. It simply

[11] Lindsey (1981) provides similar evidence using a graph of non-borrowed reserves and *M-1*.

[12] The strong positive correlation of $DME(t-2)$ with $DNBR(t)$ during the post-October 1979 period is due to lagged reserve accounting that forces the Fed to validate shocks in demand deposits. The same correlation does not appear as strong before October 1979 because during this period $DME(t-2)$ was not a good measure of the innovation in demand deposits. The announcement of demand deposits for the large commercial banks (Statistical Release H.4.2) was made on Wednesday and the survey on market expectations of *M-1* on Thursday.

[13] See an illustrative model in my working paper version.

Table 5

The reaction of short-term T-bill and long-term T-bond (forward) rates to the announcement of *M-1*: sample: weekly, October 6, 1977 to October 4, 1979.[a]

Dependent variable	Independent variable		$\bar{R}^2$	$D-W$
	Const.	UM_{t-2}		
1-day Fed Funds	−0.001	0.009	0.00	1.89
	(0.009)	(0.021)		
1-month T-bill	0.028*	−0.034	0.01	2.21
	(0.011)	(0.025)		
1-month T-bill 1 month ahead	−0.005	0.034	0.00	1.89
	(0.021)	(0.047)		
1-month T-bill 2 months ahead	0.094*	0.211*	0.08	1.85
	(0.033)	(0.072)		
3-month T-bill 3 months ahead	0.010	0.040*	0.04	1.74
	(0.008)	(0.017)		
6-month T-bill 6 months ahead	0.022*	0.031	0.02	2.13
	(0.009)	(0.020)		
1-year bond 1 year ahead	0.015	0.036*	0.07	2.04
	(0.036)	(0.017)		
1-year bond 2 Years ahead	−0.004	0.035	0.01	2.08
	(0.016)	(0.035)		
2-year bond 3 years ahead	−0.001	−0.003	0.00	1.84
	(0.007)	(0.017)		
5-year bond 5 years ahead	0.006	0.003	0.00	1.73
	(0.006)	(0.013)		
10-year bond 10 years ahead	−0.007	−0.009	0.00	2.33
	(0.005)	(0.010)		

[a](a), (b), (c), (e) and (f) as in table 2.
(d) The dependent variables are the Thursday to Friday differences in the closing yields (3:30 p.m. E.S.T.)
(g) Observations were dropped from the sample when Thursday or Fridays were market holidays.

states that as long as they suspect there is a chance the Fed will partly accommodate monetary shocks in the future, they react in a weighted average fashion placing a positive weight on the event that money growth targets will change. The high variability in the growth rate of *M-1*, the Reagan administration's contradictory fiscal and monetary policies that led to expectations of future massive deficits and subsequent fears of a possible future monetization of the debt, and market participants' past experience with the Fed's unpredictability, indicate that there were grounds for suspicion of a future abandonment of the monetary targets. Whether or not these suspicions turn out to be correct *ex post* is immaterial. Our concern is about how markets perceived monetary policy, not if their perceptions were correct.[14]

[14]This point is missed by a number of authors who claim that the presence of an inflation premium effect is rejected by the absence of a strong positive correlation between the (expected) growth rate in *M-1* and past innovations in *M-1*.

Table 6

The reaction of spot and expected future spot exchange rates to the announcement of *M-1*; sample: weekly October 6, 1977 to October 4, 1979.[a]

Dependent variable	Spot rates				Expected spot rates 5 years ahead			
	Indep. variable				Indep. Variable			
	Const.	UM_{t-2}	$\bar{R}^2$	$D-W$	Const.	UM_{t-2}	$\bar{R}^2$	$D-W$
British pound	−0.013 (0.043)	0.065 (0.096)	0.00	2.00	0.058 (0.131)	0.280 (0.288)	0.00	2.47
Canadian dollar	0.028 (0.270)	0.023 (0.060)	0.00	2.43	−0.030 (0.094)	0.183 (0.206)	0.00	2.22
French franc	−0.053 (0.044)	−0.060 (0.098)	0.00	1.88	−0.013 (0.120)	0.095 (0.264)	0.00	2.11
Swiss franc	0.035 (0.084)	0.090 (0.187)	0.00	1.88	0.055 (0.185)	0.387 (0.404)	0.00	2.12
Japanese yen	−0.103 (0.061)	−0.061 (0.137)	0.00	1.67	−0.013 (0.142)	0.001 (0.312)	0.00	1.96
West German mark	−0.008 (0.042)	0.113 (0.094)	0.01	1.99	0.045 (0.125)	0.394 (0.273)	0.01	2.02

[a](a), (b), (c), (e), (f) and (g) as in table 3.
(d) The dependent variables are the Thursday to Friday differences in the logarithms of the exchange rates. Both spot exchange rates and expected spot exchange rates five years ahead are opening rates (10:00 a.m. E.S.T.) in the New York market.

A way to test the presence of an inflation premium effect is to examine the pre-October 1979 period. Before October 1979 the Fed followed interest rate targets more closely, and its instrument of monetary control was the federal funds rate. The Fed was able to control short-term interest rates but could not control long-term interest rates. Shocks on the textbook IS curve were forcing the Fed to inject or withdraw reserves at a higher rate and were, therefore, affecting inflationary expectations, long-term interest rates, and exchange rates. Shocks on the textbook LM curve were automatically counteracted and did not affect the inflation premium. Overall, whenever *M-1* is larger (smaller) than anticipated, we ought to observe an increase (decrease) in long-run forward interest rates and a depreciation (appreciation) of the dollar.

Table 5 presents the reaction of the term structure of domestic interest rates from October 6, 1977 to October 5, 1979. Not surprisingly, interest rates of maturity up to two months did not react to the announcement of *M-1*. However, after two months there is a strong reaction which lasts for two years. While this may be evidence of an inflation premium effect, the reaction coefficients are much smaller than the ones presented in table 2. Table 6 presents similar qualitative evidence. Spot exchange rates and expected spot exchange rates tend to depreciate after a positive unanticipated shock in *M-1*,

but the reactions are neither strong nor statistically significant.[15] A way to reconcile the different magnitudes of the market reactions before and after October 1979, is to assume that nominal shocks (shifts in the LM curve originating in the banking system), which had no effect prior to October 1979, are the ones that cause such strong reactions after October 1979. While before 1979 only IS shocks had an effect on the markets, after October 1979 both IS and LM shocks affected the market reactions. Can shocks in the banking system affect the growth rate of the money supply for at least five years? This may not be unreasonable with the recent expansion in financial innovations. However, there is need for further investigation and testing.[16]

4. Summary and conclusion

Studying the reaction of financial markets to the weekly announcements of *M-1* provides a unique opportunity to test the hypothesis that the Federal Reserve gained credibility in the market after it changed its operating procedures in October 1979. The announcement of *M-1* is unambiguously a causal variable as opposed to actual changes in *M-1* that are influenced by prices, interest rates, and other variables.

The post-October 1979 spot exchange rate and foreign short-term interest rate reactions show that the Fed did gain substantial credibility. Whenever *M-1* is larger (smaller) than anticipated, the dollar appreciates (depreciates) and foreign short-term interest rates increase (decrease) because markets expect the real US rate of interest to increase (decrease). Real US interest rates are expected to increase (decrease) when markets believe the Fed will stick to its announced *M-1* targets, i.e., when the Fed has credibility. This is because markets expect the Fed to cause a future contraction (expansion) in liquidity by not validating persistent positive (negative) money demand shocks. In contrast, before October 1979 when *M-1* was larger than anticipated, the dollar tended to depreciate (and vice versa), which implies that markets changed their inflationary expectations expecting the Fed to validate shocks on (the growth rate of) the money supply. The change of market perceptions on Fed policy has, therefore, been dramatic. Additional supporting econometric evidence shows that after October 1979 changes in non-borrowed reserves, the

[15] Similar qualitative evidence was recently found by Frankel and Hardouvelis (1983) on the reaction of flexible commodity prices. The reaction sign before October 1979 is different from the reaction sign after October 1979, namely positive. Frankel and Hardouvelis offer the same combination hypothesis to explain these reactions. In addition, they construct a measure of credibility based on the reaction of commodity and currency prices during the 1977–1982 period.

[16] Cornell (1983b) advances two additional hypotheses to explain the market reactions to the announcement of *M-1*. However, neither hypothesis is directly aimed at resolving the core puzzle of the strong post-October 1979 reaction of long-term interest rates.

Fed's instrument of monetary control, are negatively correlated with lagged innovations in *M-1*. This implies that the Fed does attempt to counteract deviations from its targets.

While the Fed managed to increase its credibility in the market, the evidence from the reaction of long-run forward interest rates and expected future exchange rates points out that the Fed was unable to gain full credibility. Whenever *M-1* is larger than anticipated, long-run forward interest rates increase; and vice versa. This cannot be due to a liquidity effect because prices are flexible in the long-run and because the Fed does not wait for more that two years to counteract deviations from its *M-1* targets. Also, contrary to the spot exchange rate reactions, the dollar is expected to depreciate five years later. A plausible explanation is that inflationary expectations change. That is, although markets know the Fed is presently serious about its monetary targets, they remain suspicious that it may abandon them in the future. If they attach a small probability weight on the event that in the future shocks on the growth rate of *M-1* will not be fully counteracted, long-run forward interest rates and expected future exchange rates will move according to the evidence. Thus, an inflation premium effect can coexist with an expected liquidity effect, although it is dominated by the latter in the short-run market reactions.

The inflation premium effect is present in the pre-October 1979 reactions of long-run forward interest rates and expected future exchange rates, but it is not very pronounced. Before October 1979 one might intuitively expect stronger market reactions due to changes in inflationary expectations than after October 1979, when the Fed became more serious about its monetary targets and inflation. However, because the federal funds rate used to be the instrument of monetary control, nominal shocks originating in the banking system (shocks in the textbook LM curve) had only a minor effect on inflationary expectations and interest rates. They were automatically counteracted. It may be the case that due to the rapid development of financial innovations, it is these shocks that cause the strong post-October 1979 long-run market reactions.

Future research should focus on the question of why after October 1979 long-term interest rates react so strongly to the weekly announcements of *M-1*. This *is* the puzzle. If the presence of an inflation premium effect does not seem plausible because weekly fluctuations in *M-1* are mostly noise [see Pierce (1981)], alternative hypotheses ought to be developed that appear more plausible, and additional tests should be constructed that can discriminate between the alternative hypotheses. Two hypotheses, which *in combination* with the expected liquidity hypothesis may explain the data, are the following: (i) The strong reaction of long-run forward interest rates is due to changes in inflation risk. Markets are preoccupied about inflation, thus an unanticipated positive shock on *M-1* increases the inflation risk while a negative shock decreases it. (ii) Long-term interest rates simply overreact to the weekly money stock announcements and, thus, there exist unexploited profit opportunities.

Additional tests can be developed by examining the same market reactions to the announcement of non-borrowed reserves, the Fed's instrument. This is a rare opportunity to be pursued next, because after October 1979 non-borrowed reserves can be identified as a pure supply variable.

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