In Search of Stock Market Bubbles: A Comment on Rappoport and White

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In a recent article in this JOURNAL, Peter Rappoport and Eugene N. White (hereafter R-W) conclude that, "while there is still room for skepticism [of the presence of a bubble in the boom and bust stock market of 1928/29], the traditional accounts of a bubble in the market cannot be so easily dismissed."[1] Their conclusion is not based on econometric evidence for a stock market bubble per se. Instead, it is based solely on their interpretation of the widening spread between the interest rates on brokers' loans (call and time loans collateralized by stocks and bonds) and other money market interest rates in 1928 and 1929. After speculating that this interest rate gap was formed when "lenders . . . thought stock prices might collapse during the term of a loan and jeopardize the collateral," they allege that the "high premia in the brokers' loan market therefore contain information about lenders' perceptions of a bubble in the stock market."[2] Based on their conjecture, R-W use interest rates on time stock loans and bankers' acceptances, in conjunction with a model of the brokers' loan market, to estimate the bubble component in stock prices.[3]

This comment challenges R-W's interpretation of the interest rate premia on brokers' loans during 1928/29 on three grounds. First, we show that a similar episode occurred in late 1919 and 1920, when stock prices were generally declining, quite unlike their performance during 1928/29. Second, econometric tests provide no evidence of parameter instability or structural breaks in the spread between rates on brokers' time loans and bankers' acceptances during the 1928/29 period. Finally, contrary to R-W's conjecture about bankers' perceptions of a bubble in stock prices, the relationship between the call and time brokers' loan rates during 1928/29 is inconsistent with the bubble explanation, and the interest rate premia themselves evaporated several weeks prior to the 29 October 1929 stock market collapse. Consequently, the spread between brokers' loan rates and other money market rates cannot be used to confirm the possible existence of a stock market bubble during 1928/29.

TWIN PEAKS IN SHORT-TERM INTEREST RATES: 1919/20 AND 1928/29

Figure 1 shows short-term U.S. money market interest rates weekly from 1919 through 1934. Over this 16-year period, there were two distinct episodes of relatively high money market interest rates—late 1919/20 and 1928/29. Figure 2 focuses specifically on the differences between prevailing interest rates on both overnight call and 90-day time brokers' loans and those on 90-day prime bankers' acceptances and 4-to-6 month corporate prime commercial paper from 1919 to 1934. R-W attribute the rise in these interest rate spreads in 1928/29 to bankers' recognition of a bubble in stock prices

The Journal of Economic History, Vol. 55, No. 3 (Sept. 1995). ISSN 0022-0507.

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We would like to thank Carol Thaxton, Manager, Research Library, The Federal Reserve Bank of St. Louis, for providing us with important reference sources for this study, and Chia-Shang James Chu, University of Southern California, who provided us with the software program we used for our structural break tests.

[1] Rappoport and White, "Was There a Bubble?" p. 570.

[2] Ibid., p. 550.

[3] Using the same rationale, they have recently extended their analysis to examine the performance of brokers' loans as stock options; see Rappoport and White, "Was the Crash?"

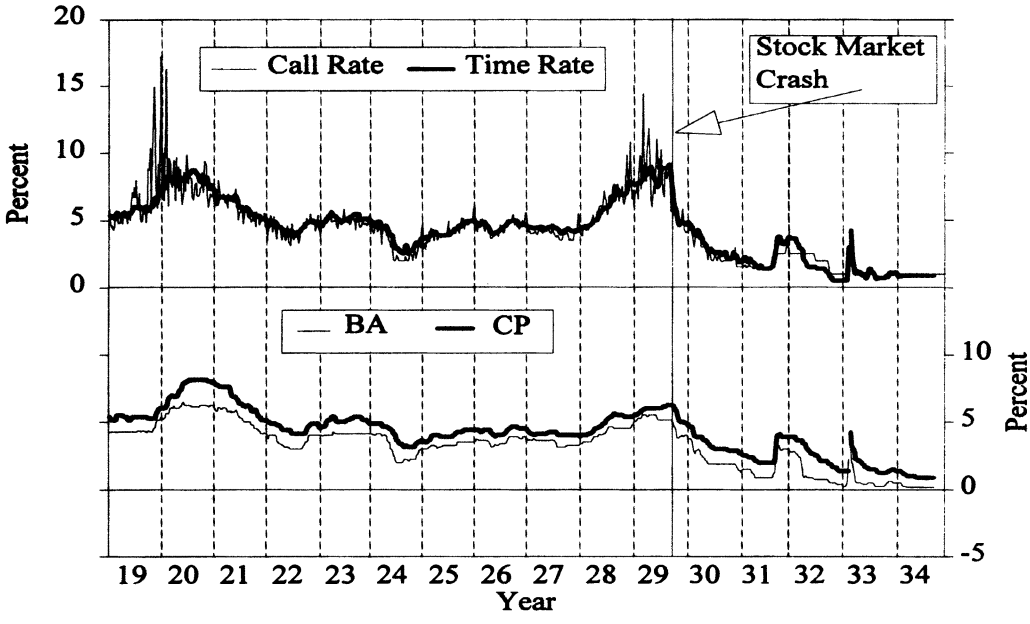

FIGURE 1

PREVAILING INTEREST RATES ON STOCK MARKET CALL AND TIME LOANS, PRIME BANKERS' ACCEPTANCES AND PRIME COMMERCIAL PAPER

Source: Board of Governors, *Banking and Monetary Statistics*, table 121.

and the consequent increase in the relative rates on brokers' loans to reflect the perceived higher risk of lending on corporate stock and bond collateral. However, Figure 2 indicates that, once again, there were two peaks in these interest rate spreads—late 1919/20 and 1928/29.

Is there a single explanation for the "twin peaks" in Figures 1 and 2? Not if R-W's stock price bubble explanation for 1928/29 is valid. Quite unlike its spectacular rise over the 1928/29 period, the Dow-Jones Stock Index peaked at 119 in early November 1919 and declined fairly steadily thereafter, reaching a level of 69 by the end of 1920. We suggest, however, that there is one explanation for both interest rate peaks shown in Figures 1 and 2. Although their stock market performances differ drastically, the 1919/20 and 1928/29 periods share one significant event in common that occurs at no other time during the 1920s: explicit Federal Reserve campaigns to reduce member-bank lending for brokers' loans during episodes of general monetary tightening. These Federal Reserve actions were responsible for the similar interest rate rises and brokers' loan premia observed in both periods.

WHAT THE FED DID: 1919/20 AND 1928/29

The Federal Reserve tightened monetary and credit conditions in both 1919/20 and 1928/29. From late 1917 until October 1919, the Federal Reserve raised its discount rate from 3.00 percent to 4.00 percent and slowed the growth of bank reserves. Then, from October 1919 to the end of 1920, the pace of monetary tightening accelerated sharply. The Federal Reserve Bank of New York raised its discount rate by 300 basis points over a 9-month period from October 1919 to June 1920, and maintained it at 7.00 percent until

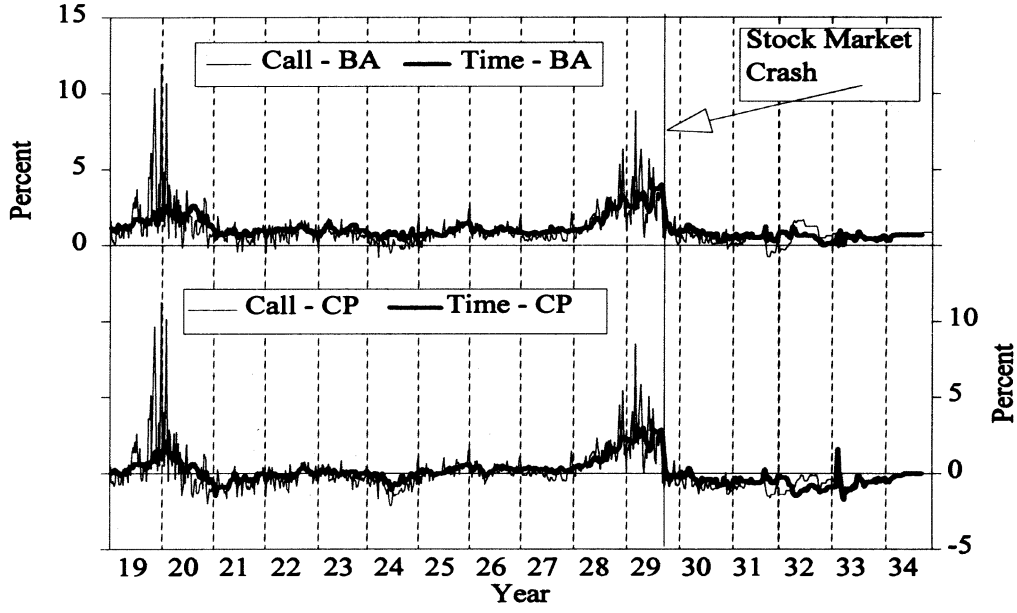

FIGURE 2

DIFFERENCES BETWEEN PREVAILING RATES ON STOCK MARKET CALL OR TIME LOANS AND BANKERS' ACCEPTANCES OR COMMERCIAL PAPER

Source: See Figure 1.

May 1921.[4] Furthermore, member bank reserves dropped from $1.9 billion in December 1919 to $1.6 billion in May 1921, a decline of 17 percent. Associated with the Fed's actions was the onset of a recession in January 1920.

Federal Reserve actions followed a similarly contractionary path from the end of 1927 to October 1929. The discount rate was raised in four stages from 3.50 percent in January 1928 to 6.00 percent in August 1929. Bank reserves, which had peaked in December 1927 at $2.5 billion, declined by fits and starts until the October 1929 stock market crash. At the end of September 1929, bank reserves totaled $2.3 billion, down 8 percent from their level in December 1927. Once again, the Fed's actions were associated with a recession that began in August 1929. Thus, rising discount rates and declining member-bank reserve growth were common to both the late 1919/20 and 1928/29 "twin peaks" episodes. These actions produced the general increases in short-term interest rates shown in Figure 1.

Contractionary Federal Reserve actions alone, of course, would not have produced the two peaks in the interest rate spreads shown in Figure 2. However, the Federal Reserve did more than simply tighten monetary and credit conditions during these two periods. It specifically sought to dissuade member banks from making loans collateralized by stocks and bonds. Contemporary financial newspaper accounts attest to the Federal Reserve's use of moral suasion and overt threats in its attempts to reduce the participation of Federal Reserve member banks in the brokers' loan market during the "twin peaks" periods. On 4 November 1919, for example, a *New York Times* article noted that "The [Federal] Reserve Bank authorities made it clear that in their opinion

[4] Because we focus on the behavior of banks and the market for brokers' loans in New York City, we use the Federal Reserve Bank of New York's discount rate on eligible paper as the relevant discount rate measure for assessing Federal Reserve policy actions.

TABLE 1
NEW YORK CITY BANKS AND THE BROKERS' LOANS MARKET: 1919/20 AND 1928/29

1919/20				1928/29			
Date	Total ($million)	Own ($million)	Own (%)	Date	Total ($million)	Own ($million)	Own (%)
28 March 1919	861	556	64.6	28 March 1928	3,825	1,121	29.3
27 June 1919	1,246	768	61.6	27 June 1928	4,178	941	22.5
26 September 1919	1,313	735	56.0	26 September 1928	4,525	850	18.8
26 December 1919	1,303	663	50.9	26 December 1928	5,091	1,109	21.8
26 March 1920	1,081	459	42.5	27 March 1929	5,649	1,071	19.0
25 June 1920	944	438	46.4	26 June 1929	5,542	1,038	18.7
24 September 1920	876	346	39.5	25 September 1929	6,761	1,024	15.1
31 December 1920	814	387	47.5	31 December 1929	3,424	1,167	34.1

Source: Board of Governors, *Banking and Monetary Statistics*, tables 140 and 141.

much credit . . . is being applied to speculative undertakings . . . and the [increase in the discount rate] has been put into effect as a corrective of the situation."[5] Similarly, on 7 February 1929, "[The] Federal Reserve Board issued a formal statement . . . declaring that it conceived it to be its duty in the 'immediate situation' to restrain the use, either directly or indirectly, of Federal Reserve credit facilities in aid of the growth of speculative credit."[6] If Federal Reserve efforts to divert credit from the brokers' loan market during these two episodes were successful, the resulting marginal shifts in the supply of loans by member banks between brokers' loans and other bank loans would produce the increase in the interest rate spreads observed in Figure 2.

Contemporary public comments by bankers, congressmen, and others, who viewed the Fed's efforts as detrimental both to the financial markets and to the general economy, suggest that these efforts had such a discernible impact on the brokers' loan market.[7] Indeed, in April 1929, a resolution was introduced in the U.S. House of Representatives to investigate the Fed's efforts to restrict brokers' loans in order to determine whether the Federal Reserve Board should be abolished.[8] This resolution stated that the Federal Reserve had implemented this policy with the deliberate purpose of forcing owners of stock listed on various Stock Exchanges to sell their holdings and that "a similar policy pursued by the Federal Reserve Board in 1919–20 depressed the value of farm lands and agricultural products in the Middle West and brought on an economic hardship from which agriculture is not yet wholly recovered."[9]

Table 1 provides evidence of the impact of the Fed's actions on bank lending in the brokers' loans markets in both periods. It shows the amount and proportion of brokers' loans made by weekly reporting New York City banks for their own accounts at the end of each quarter compared to the total brokers' loans they made for their own accounts, their correspondent banks, and other customers. As the table indicates, total brokers' loans behaved quite differently in the two periods. During the 1919/20 episode, they rose during the first three quarters of 1919 and then declined steadily thereafter. During the 1928/29 episode, however, total loans climbed steadily until the October 1929 crash, with only a slight "hesitation" in the second quarter of 1929. The difference in the

[5] *New York Times* (4 November 1919), p. 20.

[6] *New York Times* (7 February 1929), p. 1.

[7] A table with newspaper quotations from both periods attesting to the Federal Reserve's intentions and the accompanying public reaction is available from the authors upon request.

[8] *New York Times* (17 April 1929), p. 1.

[9] Ibid., p. 20.

direction of total brokers' loans stems from the earlier onset of the recession during the first period and the disparate performances of the stock market across both periods.

Despite the different paths taken by total brokers' loans, Table 1 shows that brokers' loans made by New York City banks for their own accounts followed similar paths during both periods. After the Federal Reserve accelerated both its contractionary policy stance and its antispeculative lending rhetoric in late 1919, New York City banks sharply cut brokers' loans for their own accounts before their other customers did. Furthermore, their own-account share of total brokers' loans fell sharply in early 1920 and remained well below that in 1919. This same pattern emerged in 1928/29. Following similar contractionary actions and antispeculative lending rhetoric from the Federal Reserve Bank in early 1929, brokers' loans made by New York City banks for their own accounts declined despite the surge in lending by their correspondent banks and other customers. By the third quarter of 1929, their own-account share of total brokers' loans had fallen to 15 percent.

In summary, Table 1 shows that, despite the dramatic differences in the general movements in stock prices and brokers' loans made for their other customers between the two periods, New York City banks withdrew their own funds from the brokers' loan market—in both relative and absolute terms—in 1919/20 and 1928/29. These relative shifts in the New York City banks' supply of short-term loans, from brokers' loans into other types of money market lending, produced the relative increases in the rates on brokers' loans compared to rates on other money market instruments in both periods.

PARAMETER INSTABILITY TESTS FOR INTEREST RATE SPREADS

R-W focus on the "unusual" spread between the time rate on brokers' loans and the rate on prime bankers' acceptances during 1928/29. If this spread was truly unusual, it should show a significant break in its time-series properties during 1928/29. To see if such a break occurred, we used three alternative tests for parameter instability and structural breaks—the fluctuation (FL) test, the Lagrange Multiplier (LM) test and the one-sided moving-estimates (ME^+) test—to examine the spreads between brokers' loan rates (both time and call rates) and the rates on bankers' acceptances (BA) and prime commercial paper (CP).[10] These tests are designed to determine whether there are structural breaks when the break points, if any, are unknown.[11] The ME^+ test can be

[10] The fluctuation test is described in Ploberger, Krämer, and Kontrus, "New Test." The Lagrange Multiplier test is described in Andrews, "Tests." The one-sided moving-estimates test is described in Chu, Hornik, and Kuan, "Moving-Estimates Test."

[11] The equations for these test statistics are as follows. Let y_i be the interest rate spread at time i, where $i = 1, \ldots, T$. Under the null hypothesis of no break in the interest rate spread, $y_i = \mu + \epsilon_i$. Then

$$FL = \max_{1 \le k \le T} \frac{k}{\hat{\sigma}\sqrt{T}} |\hat{y}_k - \hat{y}_T|, \text{ where } \hat{y}_k = \frac{1}{k}\sum_{i=1}^{k} y_i; \; LM = \max_{.1T < k < .9T} \left(\frac{1}{\hat{\sigma}} (k\bar{S}_k^2 + (T-k)\bar{S}_{T-k}^2) \right)$$

where

$$\bar{S}_k = \frac{1}{k}\sum_{i=1}^{k} (y_i - \hat{y}_T) \text{ and } \bar{S}_{T-k} = \frac{1}{T-k}\sum_{i=k+1}^{T} (y_i - \hat{y}_T); \; ME^+ = \max_{k=0,\ldots,T-T_w} \frac{T_w}{\hat{\sigma}\sqrt{T}} (\tilde{y}_k - \hat{y}_T)$$

where

$$\tilde{y}_k = \frac{1}{T_w}\sum_{i=k+1}^{k+T_w} y_i, \; T_w = 0.25T.$$

FL and LM are two-sided hypothesis tests for the break(s) in the mean of the interest rate spread; ME^+ is a one-sided test, where the alternative hypothesis is that there was at least one upward

TABLE 2
PARAMETER INSTABILITY TESTS FOR SELECTED WEEKLY INTEREST RATE SPREADS: 1919–1934

Test	Time Rate Minus		Call Rate Minus		Time Rate Minus Call Rate
	BA Rate	CP Rate	BA Rate	CP Rate	
FL	0.829	0.860	1.132	1.204	1.179
LM	3.244	3.385	10.229**	7.116	14.267***
ME^+	0.720	0.938	0.988	1.296*	0.943

* = Significant at the 10 percent level.
** = Significant at the 5 percent level.
*** = Significant at the 1 percent level.
Notes: FL, LM, and ME^+ represent the fluctuation, Lagrange Multiplier, and moving-estimates tests, respectively. For further details on these tests, see footnotes 10 and 11. The critical values for the FL test are 1.224, 1.36, and 1.63 for the 10 percent, 5 percent, and 1 percent significance levels, respectively. Similarly, they are 7.63, 9.31, and 12.69 for the LM test and 1.1877, 1.3039, and 1.5379 for the ME^+ test.
Source: Board of Governors, *Banking and Monetary Statistics*, table 121.

used specifically to determine whether there was a positive (upward) break in the mean spread between brokers' loan rates and other short-term rates.

Table 2 shows the relevant test statistics for these interest rate spreads using weekly data from 1919 to 1934; those marked with asterisks designate tests for which the null hypothesis of parameter stability can be rejected at the significance levels shown below the table. The test results for the time rate-bankers' acceptance rate spread are not consistent with R-W's assertion. Neither brokers' time rate spread shows statistically significant evidence of parameter instability or structural breaks in any test for the 1919 to 1934 period. There is, however, some evidence of at least one break in the call rate-bankers' acceptance rate spread (significant at the 5 percent level for the LM test) and the call rate-commercial paper rate spread (significant at the 10 percent level for the ME^+ test) during the period from 1919 to 1934.

Table 3 provides further evidence on when the brokers' call rate spreads actually "broke." The break in the call rate-bankers' acceptance rate spread (LM test) occurred during the 1919 to 1922 period, whereas the call rate-commercial paper rate spread (ME^+ test) broke in both the 1919 to 1922 period and the 1927 to 1930 period. The breaks in the 1919 to 1922 period are consistent only with the Federal Reserve explanation, whereas the break in the 1927 to 1930 period is consistent with both explanations. Thus, these structural break tests contradict R-W's stock market bubble interpretation of the behavior of the brokers' loan rate spread during 1928/29. The brokers' time loan interest rate spreads show no evidence of parameter instability or structural break from 1919 to 1934, and the breaks in the call rate spreads occur in both "twin peak" periods.

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break in the mean of the interest rate spread. In all tests, the estimator $\hat{\sigma}^2$ is a heteroskedastic and autocorrelation consistent estimator (HACE). It is computed as

$$\hat{\sigma}^2 = \frac{1}{T}\left(\sum_{i=1}^{T} (y_i - \hat{y}_T)^2 + 2 \sum_{i=1}^{T-T_L} \sum_{j=1}^{T_L} w_j (y_i - \hat{y}_T)(y_{i+j} - \hat{y}_T) \right)$$

where w_j is the quadratic spectral kernel and T_L is the optimal truncation lag. The functional forms for w_j and T_L are shown in Andrews, "Heteroskedasticity."

TABLE 3
PARAMETER INSTABILITY TESTS FOR SELECTED WEEKLY INTEREST RATE SPREADS: SELECTED PERIODS

Spread	Test	1919–1922	1923–1926	1927–1930	1931–1934
Call-BA	LM	9.537**	2.347	6.716	4.088
Call-CP	ME^{+}	1.674***	0.190	1.887***	0.000
Time-Call	LM	19.198***	3.830	4.385	6.577

* = Significant at the 10 percent level.
** = Significant at the 5 percent level.
*** = Significant at the 1 percent level.
Notes and *Source*: See Table 2.

"BAD TIMING" FOR R-W'S BUBBLE STORY

R-W's bubble explanation conflicts with the actual behavior of the relevant interest rates and their spreads prior to the October 1929 stock market crash in two key respects. First, if R-W's explanation were correct, the premia in the rates on brokers' loans should have persisted, perhaps even risen, until the stock market bubble burst on 29 October 1929. However, as Table 4 indicates, the brokers' loan rates and their premia began declining several weeks prior to the stock market crash. Indeed, three weeks before the crash in stock prices, the call loan-bankers' acceptance premium had declined to about 1.0 percent, essentially equal to its long-term average level. These declines in brokers' rate spreads prior to the actual stock market crash are inconsistent with the stock market bubble explanation.

Second, the usual "term structure" for the interest rates on brokers' loans was slightly upward sloping; that is, on average, the interest rate on 90-day time loans was slightly higher than that on overnight call loans from 1919 to 1934. The perceived bubble in stock prices, even if sighted only by New York City bankers, should have resulted in the interest rate on time loans rising further above the rate on call loans during 1928/29, as the risk of the bubble collapsing during the term of the loan was surely greater for 90-day time loans than for overnight call loans. Yet, as Tables 2 and 3 indicate, only the LM test suggests that there was a break in the spread between the time and call brokers' loan rates, and it occurred in the 1919 to 1922 period. Thus, the behavior of the brokers' rate spreads immediately prior to the 29 October 1929 stock market crash and the relationship between the time and call brokers' rates during 1928/29 contradict R-W's stock market bubble interpretation.

TABLE 4
SELECTED INTEREST RATES AND SPREADS AROUND 29 OCTOBER 1929

Date	Time Rate	Time-BA	Time-CP	Call Rate	Call-BA	Call-CP
28 September 1929	9.13	4.00	2.88	9.03	3.90	2.78
5 October 1929	9.13	4.00	2.88	8.08	2.95	1.83
12 October 1929	8.63	3.50	2.38	5.63	0.50	−0.62
19 October 1929	7.75	2.62	1.50	6.28	1.15	0.03
26 October 1929	7.25	2.31	1.00	5.35	0.41	−0.90
2 November 1929	6.00	1.37	−0.13	5.94	1.31	−0.19

Source: See Table 2.

CONCLUSION

Contemporary comments circa 1928/29 and the evidence presented here suggest that the "unusual" interest rate spread between brokers' loan rates and interest rates on other money market instruments at that time was not due to the emergence of a stock market bubble recognized by bankers alone, as R-W assert. Instead, this interest rate phenomenon, which appeared both in 1919/20 and 1928/29, resulted from a general credit squeeze initiated by the Federal Reserve combined with the Fed's specific efforts to redirect bank lending away from loans collateralized by stocks and bonds. In addition, parameter instability test results for the relevant interest rate spreads and the behavior of the spreads themselves just prior to the 29 October 1929 crash are inconsistent with R-W's bubble explanation. Thus, the proposition that bankers had perceived a stock market bubble in 1928/29 that investors then, and econometricians today, failed to observe is not supported by the evidence.

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