A Note on the Expectations Hypothesis at the Founding of the Fed

Authors	Clemens J.M. Kool, and Daniel L. Thornton
Working Paper Number	2000-004C
Citable Link	https://doi.org/10.20955/wp.2000.004
Suggested Citation	Kool, C.J., Thornton, D.L.; A Note on the Expectations Hypothesis at the Founding of the Fed, Federal Reserve Bank of St. Louis Working Paper 2000-004. URL https://doi.org/10.20955/wp.2000.004

Published In	Journal of Banking & Finance
Publisher Link	https://doi.org/10.1016/j.jbankfin.2004.05.009

A NOTE ON THE EXPECTATIONS HYPOTHESIS AT THE FOUNDING OF THE FED

Clemens J.M. Kool and Daniel L. Thornton

November 2003

Abstract

One of the most influential tests of the expectations hypothesis is Mankiw and Miron (1986), who found that the spread between the long-term and short-term rates provided predictive power for the short-term rate before the Fed's founding but not after. They suggested that the failure of the expectations hypothesis after the Fed's founding was due to the Fed's practice of smoothing short-term interest rates. We show that their finding that the expectations hypothesis fares better prior to the Fed's founding is due to the fact that the test they employ tends to generate results that are more favorable to the expectations hypothesis during periods when there is extreme volatility in the short-term rate.

JEL Classification: E40, E52
Key Words: expectations hypothesis; power of the test; Fed's founding; measurement error.

Clemens J.M. Kool [c.kool@econ.uu.nl] is Professor of Finance and Financial Markets at the Utrecht School of Economics, University of Utrecht, the Netherlands, and Daniel L. Thornton [thornton@stls.frb.org] is Vice President and Economic Advisor at the Federal Reserve Bank of St. Louis. The views expressed here are the authors' and do not necessarily reflect the views of the Board of Governors of the Federal Reserve System or the Federal Reserve Bank of St. Louis. We would like to thank Robert Rasche for helpful comments and Stephen Majesky and Tom Pollmann for valuable research assistance.

1. Introduction

One of the most influential tests of the expectations hypothesis is Mankiw and Miron (1986), henceforth MM, who "confirm the failure of the expectations theory using recent data" but "find that the expectations theory works much better during some previous monetary regimes. In particular, for data prior to the founding of the Federal Reserve, the slope of the yield curve has substantial predictive power for the path of the short rate."[1] Specifically, they find that the spread between the long-term rate and the short-term rate explains a significant portion of the long-term change in the short-term rate before the Fed's founding but not after. They conjecture that the failure of the expectations hypothesis (EH) after 1914 resulted from the Fed smoothing interest rates.

We show that MM's finding is due to the fact that the test they employ tends to generate results that are more favorable to the EH during periods when there is extreme volatility in the short-term rate. When this feature of the test is accounted for, the results obtained are essentially no different before the founding of the Fed than after. Specifically, we show that MM's finding that the spread between the long-term and short-term rates explains a significantly large portion of long-term changes in short-term rates is due to three observations when the short-term rate was unusually volatile. All three of these observations occurred during the financial panic of 1907 and are subject to measurement error.

The outline of the paper is as follows. In Section 2 we summarize MM's test procedure. We show that the test they use tends to generate results that are favorable to the EH when the EH does not hold and that this tendency becomes stronger the more variable the short-term rate is relative to the long-term rate. A detailed reevaluation of MM's 1890-1914 results is undertaken in Section 3. The conclusions are presented in Section 4.

2. The Test of the Expectations Hypothesis

The EH can be thought of as the equilibrium condition that binds a long-term, *n*-period interest rate, r_t^n, and a sequence of expected future levels of a short-term, *m*-period rate up till *n*-*m* = (*k*-1)*m* periods in the future, where *k* = *n*/*m* is an integer. That is,

(1) $$r_t^n = (1/k)\sum_{i=0}^{k-1} E_t r_{t+mi}^m + \theta.$$

(1) states that the *n*-period rate is equal to the average of the market's expectation at the beginning of period *t*, E_t, of the series of *m*-period rates over the term of the *n*-period rate plus a constant risk premium, θ.[2]

The test of the EH that MM employ is derived by assuming that expectations are rational, i.e.,

(2) $$E_t r_{t+mi}^m = r_{t+mi}^m + \eta_{t+mi},$$

where $\eta_{t+mi} \sim iid(0, \sigma_\eta^2)$. (2) is then substituted into (1) to yield

(3) $$r_t^n = (1/k)\sum_{i=0}^{k-1} r_{t+mi}^m + (1/k)\sum_{i=0}^{k-1} \eta_{t+mi} + \theta.$$

The EH is normally not tested using (3) because the interest rates are unit root or, perhaps more correctly, near-unit-root processes. Rather, a variable, Z_t, is subtracted from both sides of the above equation such that the resulting variables are stationary. Subtracting Z_t from both sides of (3) and rewriting yields

(4) $$(1/k)\sum_{i=0}^{k-1} r_{t+mi}^m - Z_t = -\theta + (r_t^n - Z_t) - \omega_t,$$

where $\varpi_t = (1/k)\sum_{i=0}^{k-1} \eta_{t+mi}$.

The conventional test of the expectations theory is obtained by *parameterizing* (4) as

---

[1] MM (1986, p. 213).

(5) $$(1/k)\sum_{i=0}^{k-1} r_{t+mi}^{m} - Z_t = \alpha + \beta(r_t^n - Z_t) + \varpi_t$$

The ordinary least-squares estimate of β is

(6) $$\hat{\beta} = \frac{\sum_{t=1}^{T}[(1/k)\sum_{i=0}^{k-1}(\bar{r}_{t+mi}^{m} - \bar{Z}_t)(\bar{r}_t^n - \bar{Z}_t)]}{\sum_{t=1}^{T}(\bar{r}_t^n - \bar{Z}_t)^2},$$

where the bar indicates that the variable is adjusted for the mean. Note that if the null hypothesis is true, i.e.,

(7) $$r_t^n = (1/k)\sum_{i=0}^{k-1} r_{t+mi}^{m} + (1/k)\sum_{i=0}^{k-1} \eta_{t+mi}^{m},$$

$E\hat{\beta} = 1$, independent of the choice of Z_t.

2.1 *Estimates of β When the EH Does Not Hold*

While hypothesis tests are frequently derived under the maintained hypothesis (e.g., the Dickey-Fuller unit root test), tests so derived may have low power because they admit a very limited number of alternative data-generating processes.[3] Indeed, they may not admit the true data-generating process. More importantly for our analysis, because (1) will not describe the true data-generating process for the long-term rate and the short-term rate when the EH does not hold, estimates of β need not equal zero when the EH is false. Moreover, because $\hat{\beta}$ depends on the variance of Z_t and the covariance between Z_t and r_t^m and r_t^n, the results will be sensitive to the choice of Z_t. In the EH hypothesis testing literature, $Z_t \equiv r_t^m$. With this choice of Z_t, it is easy to show that estimates of β will be positive even when the EH does not hold.

[2] Shiller, Campbell, and Schoenholtz (1983) argue that (1) is exact in some special cases and that it can be derived as a linear approximation to a number of nonlinear expectations theories of the term structure.
[3] The evolution of such tests is to widen the array of admissible possibilities under the alternative. This has happened in the unit-root-testing literature, e.g., Perron, 1989.

The intuition for this result is easily illustrated with a simple, albeit extreme, example. Specifically, assume that the long-term and short-term rates are generated by independent stochastic processes, i.e.,

$$r_t^n = \mu^n + \varepsilon_t^n$$
(8)
$$r_t^m = \mu^m + \varepsilon_t^m,$$

where ε_t^n and ε_t^m are independent *iid* stochastic processes with zero means and variances, σ_n^2 and σ_m^2, respectively. Substituting r_t^m for Z_t and rewriting (5) as

(9) $$(1/k)\sum_{i=1}^{k-1} r_{t+mi}^m - ((k-1)/k)r_t^m = \alpha + \beta(r_t^n - r_t^m) + \varpi_t \ ,$$

it is easy to show that

(10) $$\underset{N\to\infty}{P\lim}\,\hat{\beta} = \frac{(k-1)/k}{1+\delta^{-1}} > 0\,,$$

where $\delta = \dfrac{\sigma_m^2}{\sigma_n^2}$. Note that $\underset{N\to\infty}{P\lim}\,\hat{\beta}$ is positive even when the long-term and short-term rates are independent. For example, if $k = 2$ and the short-term rate is twice as variable as the long-term rate, $\underset{N\to\infty}{P\lim}\,\hat{\beta} = .33$. Furthermore, $\hat{\beta}$ tends to get larger as k and δ increase.

2.2 Generalizing the Result

The fact that $\hat{\beta}$ tends to be positive when the EH does not hold can be illustrated more generally, by parameterizing (3) before the short-term rate is subtracted from both sides, i.e.,

(11) $$(1/k)\sum_{i=0}^{k-1} r_{t+mi}^m = \beta r_t^n - (1/k)\sum_{i=0}^{k-1} \eta_{t+mi} - \theta.$$

Subtracting r_t^m from both sides of (11) and parameterizing, yields

(12) $$(1/k)\sum_{i=0}^{k-1} r_{t+mi}^m - r_t^m = \alpha + \beta(r_t^n - r_t^m) + (\beta - 1)r_t^m + \omega_t\,.$$

Note that (12) reduces to (5) if and only if $\beta = 1$, i.e., only if the EH is true. Hence, if (5) is estimated but the EH is not true, the expected value of the least-squares estimator, $\hat{\beta}$, is equal to

$$(13) \qquad E\hat{\beta} = \beta + (\beta - 1) E \frac{\sum (\bar{r}_t^n - \bar{r}_t^m)\bar{r}_t^m}{\sum (\bar{r}_t^n - \bar{r}_t^m)^2} - E \frac{\sum \varpi_t (\bar{r}_t^n - \bar{r}_t^m)}{\sum (\bar{r}_t^n - \bar{r}_t^m)^2},$$

where the bar denotes that the variable has been adjusted for the mean. The second term on the right-hand side of (13) is zero only when β = 1. This term does not disappear in large samples, i.e.,

$$(14) \qquad \underset{N \to \infty}{P\lim} \hat{\beta} = \beta + (\beta - 1) \left[\frac{\sigma_{nm} - \sigma_m^2}{\sigma_n^2 - 2\sigma_{nm} + \sigma_m^2} \right].$$

Noting that $\sigma_{nm} / \sigma_n^2 = \rho\delta$, where ρ is the coefficient of correlation between r_t^n and r_t^m, (14) can be rewritten as

$$(15) \qquad \underset{N \to \infty}{P\lim} \hat{\beta} = \beta + (\beta - 1) \left[\frac{\rho\delta^{1/2} - \delta}{1 - 2\rho\delta^{1/2} + \delta} \right].$$

The bracketed term in (15) can be either positive or negative; but it is strictly negative when the short-term rate is more variable than the long-term rate, i.e., $\delta > 1$—a fundamental prediction of the EH. Hence, this test will tend to generate positive estimates of β even when the EH does not hold. Moreover, $\hat{\beta}$ will tend to be larger the larger the variance of the short-term rate relative to the variance of the long-term rate.

3. MM's 1890-1914 Results Revisited

3.1. MM's Evidence

MM estimate (5) (with $Z_t = r_t^m$) using both monthly and quarterly data, but they present results only for the quarterly data. In MM's application, r^m is the rate on 3-month time loans, r_t^3, and r^n is the rate on 6-month time loans, r_t^6, both at New York banks. These rates are presented in

Figure 1 for the period 1890-1958.[4] Estimates of (5) using monthly and quarterly data, respectively, are presented in panels A and B of Table 1 for MM's subperiods. The results using monthly data are very similar to the quarterly results—which are identical to MM's. For the remainder of the paper, only results using monthly data are presented.[5]

Based on their results, MM argue that the EH performs well during the 1890-1914 period and conclude (MM, p. 217)

> "athough data from this period do not fully confirm the expectations theory, the slope of the yield curve does contain substantial information on the path of the short rate."

Support for the EH is considerably weaker after 1914. Not only is $\hat{\beta}$ much smaller after the Fed's founding (indeed, negative after 1933), but the estimates of $\overline{R}^2$ suggest that the rate spread explains none of the long-term change in the short-term rate.

3.2. The Variability of the 3-month Rate

Figure 1 shows that during the period 1890.01-1914.12 the 3-month rate exhibits periods of high volatility, both absolutely and relative to the 6-month rate. This is particularly true when the yield curve is inverted, which is the case for 32 observations. In these instances, the yield curve inverts because short-term rates increase relative to the long-term rate. When the 32 observations of the inverted yield curve are deleted, the variance of the 3-month rate declines by nearly 40 percent (from 2.23 percent to 1.42 percent). In contrast, the variance of the 6-month rate is essentially unchanged, declining from 1.08 percent to 1.04 percent. These observations also have a relatively large affect on ρ. The estimate of ρ is 0.94 when these observations are deleted and 0.87 when

[4] We would like to thank Mankiw and Miron for providing us with the data. Their source is Andrew (1910) for the period 1890-1909. For the period 1910-1958, they collected the data independently from the *Commercial and Financial Chronicle.*

[5] The qualitative conclusions of this paper are the same with quarterly data.

they are not. These observations increase δ and reduce ρ, suggesting that they could account for the larger estimate of β prior to the Fed's founding.

3.3. The Financial Panic of 1907

Within the group of inverted yield curve observations, the financial panic of 1907 stands out. For the three months of the financial panic—1907.11, 1907.12, and 1908.01—the 3-month rate rose dramatically relative to the 6-month rate, causing the yield curve to invert. The spread between the 6-month and 3-month rates widens to –800, –300, and –400 basis points during these three months, respectively. In all other months for the full sample, the absolute value of the spread was, at most, 200 basis points (once, in August 1914). The results in Section 2 suggest that MM's finding may be particularly sensitive to these observations.

3.3.1 Measurement Issues

Since the essence of the EH is the market's ability to predict the future level of the short-term rate, there is no particular reason to believe that the EH should fare better when the short-term rate increases dramatically and temporarily relative to the long-term rate. Nevertheless, some analysts might object to deleting these observations solely for this reason. Consequently, it is important to note that these three observations are also subject to measurement error. The existence of measurement problems in MM's data is well documented (James, 1978, Fishe and Wohar, 1990, and Mankiw, Miron, and Weil, 1987, 1990). For one thing, from 1890 to 1933, a usury provision in the National Banking Act prohibited national banks from charging a higher rate than that fixed by state law or 7 percent if no state law existed (James, 1978, pp. 79-88). The State of New York had a usury law that set the ceiling on various interest rates, including those on time loans, at 6 percent. Consequently, the 3- and 6-month rates did not exceed 6 percent before 1903 and the 6-month rate was frequently at the 6 percent level for months at a time.

Fishe and Wohar (1990) have identified other specific measurement problems with MM's interest rates. Specifically, they (Fishe and Wohar, 1990, p. 968) note that these rates

> "do not always represent market transactions. There were many months in which no business was conducted in the loan market, primarily because of financial panic or distress, and in these months only a 'nominal' loan rate was reported. The nominal rate was arbitrarily set at the usury ceiling in New York, which was 6 percent over this period."

Fishe and Wohar conduct an independent investigation of a major data source, the *Commercial and Financial Chronicle* (*C&FC*)—a popular business magazine of the time. They use Andrew (1910) as their source up to 1908 and the *C&FC* for the period thereafter. Andrew's convention was to report the average weekly rate on time loans of different maturities from *C&FC* for weeks ending on Friday. Andrew also indicates dates on which (1) no transaction occurred at the quoted rate, (2) an unknown commission was paid in addition to the legal rate of 6 percent when the ceiling rate was reported, or (3) one of the two rates was not reported.[6] When one or more of these circumstances arise, Fishe and Wohar identify the observation as being subject to measurement error. Using this criterion, Fishe and Wohar identify the observations on 1907.11 and 1907.12 as being subject to measurement error.

There is also a measurement problem with the January 1908 observation that has been overlooked. Andrew's weekly data are averages of daily data for weeks ending Friday. Andrew's usual practice is to report for the month of January the weekly average for the full week ending Friday even if only the last day of the week occurred in January. For some unknown reason,

[6] It seems unlikely that Fishe and Wohar have identified all observations that are subject to measurement error. It also seems unlikely that the *C&FC* reported all cases where no business was conducted or where a commission was paid. Moreover, James (1978) indicated that banks frequently required borrowers to maintain a compensating balance to raise the effective rate, but the *C&FC* did not report instances of banks requiring compensating balances. Finally, Andrew (1910) frequently presents rate ranges rather than a specific rate. When this occurred, MM and Mankiw, Miron, and Weil (1987) used the mid-point of the quoted range. The ranges tend to be much wider (in some cases 400 basis points) when interest rates are at or above the usury limit. Consequently, observations when the rates are at or above 6 percent tend to be less precise than when rates are below 6 percent. For all of these reasons, potential for measurement problems exists whenever one or the other of the rates is at or above the usury limit.

Andrew deviated from this practice in 1908. In January 1908, Andrew's observation for the week ending January 3 is the daily average for only two days, January 2 and 3.[7] This is the only instance where Andrew split the reporting week in this fashion. On both of these days the 3-month rate was reported at 10 percent and the 6-month rate was at the usury limit of 6 percent. The following week both rates were reported at their usury ceiling levels. Hence, these rates were either unreported or effective only for a very short period. In any event, the January 1908 rate on 3-month time loans used by MM is not representative of the monthly average rate.

3.3.2 The Effect of Extreme Observations on MM's Results

While all of the observations that exhibit sharp changes in the 3-month rate relative to the 6-month rate can affect MM's results, it is instructive to focus on the three very extreme observations during the financial panic of 1907. Table 2 reports estimates of (5) for the period 1890.01-1914.12, excluding and including these three observations. These results reveal the importance of these observations to MM's results. While deleting these three observations has a relatively small effect on the estimate of β, $\overline{R}^2$ drops dramatically—by nearly half. The effect of these observations on the $\overline{R}^2$ occurs because these observations have a very large effect on the total sum of squares, TSS, but very little effect on the residual sum of squares, RSS. This is illustrated in Figure 2, which shows a scatter plot of the independent variable and dependent variable, along with the estimated regressions with and without these three observations. The regression line excluding these observations nearly falls on the line with these observations. Therefore, the RSS is nearly the same whether these observations are included or excluded. The TSS is considerably larger when these observations are included, however. As a result, including these observations gives the impression that the rate spread explains a relatively large proportion of the variation in the long-term change in the short-term rate.

[7] Likewise, the rate reported for the last week of 1907 is based on the average for the last two days of 1907.

3.4. The Effect of the High-Variance Observations on MM's Results

Even the estimate of $\overline{R}^2$ of 20 percent exaggerates the predictive power of the rate spread. The reason is that observations when the variance of the 3-month rate is high cause a shift in the mean of the dependent variable. The effect of this is shown in Table 3, which reports estimates of (5) over various partitions of the data. The first column of Table 3 shows the estimates for the 234 months when the 3-month and 6-month rates were unequal. As one would expect, the estimates of β and $\overline{R}^2$ are not affected by deleting the observations when the rate spread was zero. The estimates are very sensitive to whether the yield curve is positively sloped or inverted, however. When the yield curve is positively sloped (202 observations), the results are nearly identical to those for the period 1915.01-1933.12—the estimate of β drops to 0.42 and the spread accounts for only 4 percent of the variation in the long-term change in the short-term rate. Hence, this test provides no support for the EH over periods when the yield curve was positively sloped.

When the yield curve is inverted, however, the test appears to provide stronger support for the EH, in that the estimate of β is 0.66 (though significantly different from 1) and the rate spread "explains" about 78 percent of long-term changes in the short-term rate. In this case, however, the apparent support for the EH is due solely to the three months during the financial panic of 1907. When these observations are deleted, as in the fourth column of Table 3, the evidence for the EH vanishes. The estimate of β drops to 0.21 and is not significantly different from zero, and the rate spread explains none of the long-run change in the short-term rate.

Figure 3, which presents the estimated regression lines corresponding to the regressions in the second and fourth columns of Table 3 and the estimated regression from Table 2, illustrates what accounts for the marked change in the results. The estimate of β tends to be larger when the yield curve is inverted because the average level of the dependent variable, $(1/2)(r_{t+3}^3 - r_t^3)$, and the independent variable, $(r_t^6 - r_t^3)$, tend to be negative when the short-term rate spikes up one month and returns to the previous month's level the next. The reverse is also true. The left- and right-hand sides of (5) tend to be positive when the short-term rate declines sharply one month only to return to the previous month's level the next. Hence, the estimate of β increases because the short-term rate is more variable and not because of a marked change in the market's ability to predict the short-term rate.

3.5. Accounting for Extreme Observations and the Inverted Yield Curve

The importance of the effects of these extreme observations and the inverted yield curve on the conclusion that the EH fared better before the Fed's founding than after is illustrated in Table 4. The first column of Table 4 presents estimates of (5) where the yield spread is partitioned into (1) the three extreme observations, $(r_t^n - r_t^m | fp)$; (2) the 297 remaining observations, $(r_t^n - r_t^m | nfp)$; and (3) a dummy variable, *dum*, which equals one when the yield curve is flat or inverted and zero otherwise. The estimate of β drops to 0.34 when the effects of the extreme observations and the inverted yield curve are accounted for. Moreover, the yield spread for the 297 remaining observations has virtually no explanatory power. This is seen by comparing the estimates in column 2 with the estimates in column 1. The estimate of $\overline{R}^2$ drops only slightly when the rate spread is deleted, suggesting that the spread has little predictive power for the long-term change in the short-term rate. Indeed, comparing the estimates in the first column of Table 4 with those in the second column of Panel A in Table 1 shows that MM's conclusion, that the EH works better before the Fed's founding than after, is nearly entirely due to the fact that the test they use tends to generate results that are favorable to the EH when the short-term rate changes markedly relative to the long-term rate. This conclusion is tested formally by estimating (5) over the period 1890.01-1933.12, allowing for the separate effects of the rate spread pre- and post-1915. Indeed, the estimate of the coefficient post-1915 is somewhat larger and about as precisely estimated; however, the null hypothesis that the estimates of β pre- and post-1915 are equal cannot be rejected once the effects of the extreme observations and the inverted yield curve are accounted for. The F-statistic is 1.31. Hence, when the effect of increased volatility of the 3-month rate is accounted for, there is no more evidence supporting the EH before the Fed's founding than after.

4. Conclusions

Mankiw and Miron (1986) find that the EH is less-soundly rejected before the founding of the Fed than after. They argue that their finding is due to the marked change in interest rates from a stationary process to a near random walk at about this time. They attribute both the change in the stochastic process of interest rates and the failure of the EH to the Fed's policy of smoothing interest rates.

We show that Mankiw and Miron's conclusion—that the EH fares better prior to the Fed's founding than after—is due to the fact that the test they employ tends to generate results that are more favorable to the EH when the short-term rate is more variable than the long-term rate. The effect is particularly strong when there are unusually large changes in the short-term rate relative to the long-term rate. Specifically, we show that MM's conclusion is due largely to three extreme observations in the short-term rate during the financial panic of 1907. When the effect of these observations is accounted for, this test does not generate results that are more favorable to the EH before the Fed's founding than after. While extreme observations sometimes provide the most useful information, this is not the case here. Not only is there no reason to suspect that the market's ability to predict the short-term rate—the essence of the EH—improves when there are large, temporary changes in the short-term rate, but these observations are subject to measurement error, which makes their use suspect.

While there is no doubt that the behavior of interest rates changed sometime after the Fed's founding, these findings tend to weaken the case for MM's conjecture that the change in the behavior of interest rates that occurred about the time of the Fed's founding was due to a policy of interest rate smoothing. What accounts for the marked change in the behavior of interest rates at about the time of the Fed's founding is a topic of future research. Our analysis also leaves open the broader question of the relative importance of the EH before and after the Fed's founding. Given that the results are sensitive to the test used and marked change in the behavior of interest rates, answering the question may be extremely difficult.[8]

[8] To see that the results are sensititive to the test, we test the EH before the Fed's founding by estimating the parameterized version of (3). The estimate of the slope coefficient on the moving average of the 3-month rate is $\beta = 0.975$ and $\overline{R}^2 = 0.673$. Moreover, the hypothesis that $\beta = 1$ is not rejected, suggesting that EH held before the Fed's founding. If, however, one tests the EH by testing restrictions implied by the EH on a VAR consisting of the 3- and 6-month rates using the Lagrange multiplier test proposed recently by Bekaert and Hodrick (2001), the Lagrange multiplier statistic is 101.37. The EH is easily rejected.

REFERENCES:

Andrew, A.P., 1910. *Statistics for the United States 1867-1909*. Government Printing Office, Washington D.C.

Bekaert, G. and R. J. Hodrick, 2001. "Expectations Hypotheses Tests," *Journal of Finance* 54, 1357-94.

Fishe, R.P.H., Wohar M., 1990. "The Adjustment of Expectations to a Change in Regime: Comment," *The American Economic Review* 80, 968-976.

James, J.A, 1978. *Money and Capital Markets in Postbellum America*, Princeton University Press; Princeton.

Mankiw, N.G., Miron, J.A., 1986. "The Changing Behavior of the Term Structure of Interest Rates," *Quarterly Journal of Economics* 101, 211-28.

Mankiw, N.G., Miron, J.A., Weil, D.N., 1987. "The Adjustment of Expectations to a Change in Regime: A Study of the Founding of the Federal Reserve," *The American Economic Review* 77, 358-374.

Mankiw, N.G., Miron, J.A., Weil, D.N., 1990. "The Adjustment of Expectations to a Change in Regime: Reply," *The American Economic Review* 80, 977-979.

Perron, P., 1989. "The Great Crash, The Oil Price Shock, and the Unit Root Hypothesis," *Econometrica* 57, 1361-1401.

Shiller, R.J., Campbell, J.Y., Schoenholtz, K.L., 1983. "Forward Rates and Future Policy: Interpreting the Term Structure of Interest Rates," *Brookings Papers on Economic Activity*, 173-217.

TABLE 1 The Predictive Power of the Spread

	Panel A: Monthly data			
Period	1890-1914	1915-1933	1934-1951	1951-1958
Constant	-0.24	-0.07	0.06	0.04
	(0.06)	(0.05)	(0.03)	(0.02)
$r_t^n - r_t^m$	0.67	0.42	-0.23	-0.34
	(0.04)	(0.16)	(0.13)	(0.24)
$\overline{R}^2$	0.38	0.04	0.06	0.02
D.W.	0.81	0.70	0.77	0.49
s.e.	0.66	0.41	0.07	0.12
Number of Obs	300	228	207	93
	Panel B: Quarterly data			
Period	1890-1914	1915-1933	1934-1951	1951-1958
Constant	-0.29	-0.06	0.06	0.04
	(0.06)	(0.07)	(0.04)	(0.03)
$r_t^n - r_t^m$	0.76	0.42	-0.25	-0.33
	(0.06)	(0.20)	(0.16)	(0.26)
$\overline{R}^2$	0.40	0.03	0.06	-0.01
D.W.	2.06	1.88	1.77	1.73
s.e.	0.59	0.42	0.07	0.13
Number of Obs	100	76	69	31

Newey-West HAC standard errors are reported in parentheses.

TABLE 2 The Effect of the Financial Panic of 1907

Sample	Financial Panic deleted	Financial Panic included
Constant	-0.23	-0.24
	(0.07)	(0.06)
$r_t^n - r_t^m$	0.64	0.67
	(0.09)	(0.04)
$\overline{R}^2$	0.20	0.38
D.W.	0.78	0.81
s.e.	0.66	0.66
N	297	300

Newey-West HAC standard errors are reported in parentheses.

TABLE 3 The Slope of the Yield Curve: 1890.01-1914.12

Sample	$r_t^n \neq r_t^m$	$r_t^n > r_t^m$	$r_t^n < r_t^m$	$r_t^n < r_t^m$
Constant	-0.17	-0.01	-0.23	-0.41
	(0.04)	(0.10)	(0.12)	(0.13)
$r_t^n - r_t^m$	0.64	0.42	0.66	0.21
	(0.06)	(0.13)	(0.05)	(0.16)
$\overline{R}^2$	0.42	0.04	0.78	0.01
D.W.	0.82	0.78	0.89	0.64
s.e.	0.63	0.64	0.55	0.47
N	234	202	32	29

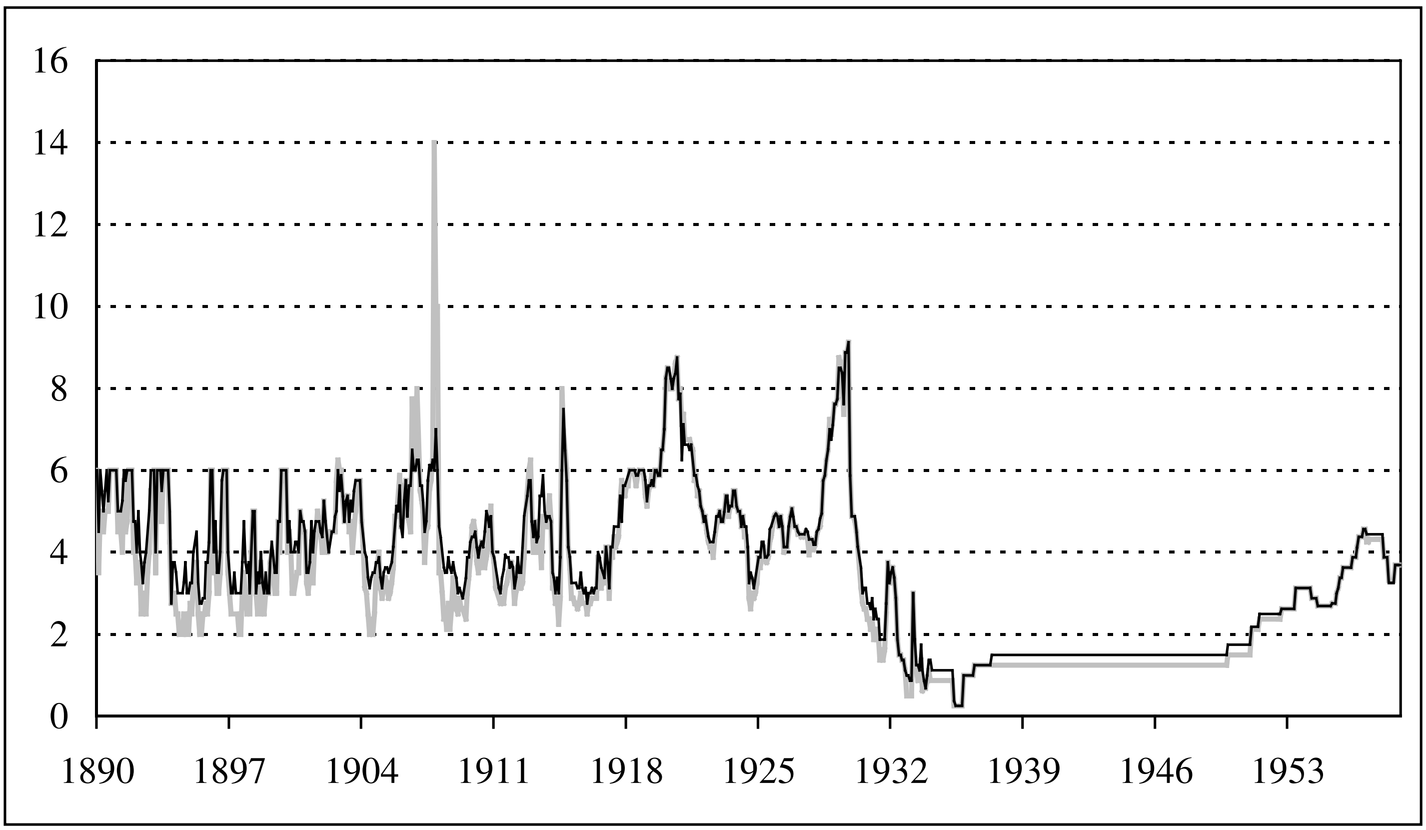
Newey-West HAC standard errors are reported in parentheses.

TABLE 4 Another Look at the Effect of the Financial Panic of 1907

	1890.01-1914.12	1890.01-1914.12	1890.01-1933.12
Constant	0.04	0.26	-.02
	(0.08)	(0.06)	(0.08)
dum	-0.45	-0.72	-.16
	(0.12)	(0.10)	(0.10)
$r_t^n - r_t^m \vert nfp$	0.34	--	0.43
	(0.09)	--	(0.10)
$r_t^n - r_t^m \vert fp$	0.67	0.66	0.71
	(0.03)	(0.03)	(0.03)
$r_t^n - r_t^m \vert$post-1914	--	--	0.66
	--	--	(0.17)
$\overline{R}^2$	0.41	0.39	0.32
D.W.	0.87	0.95	0.78
s.e.	0.65	0.65	0.57
N	300	300	528

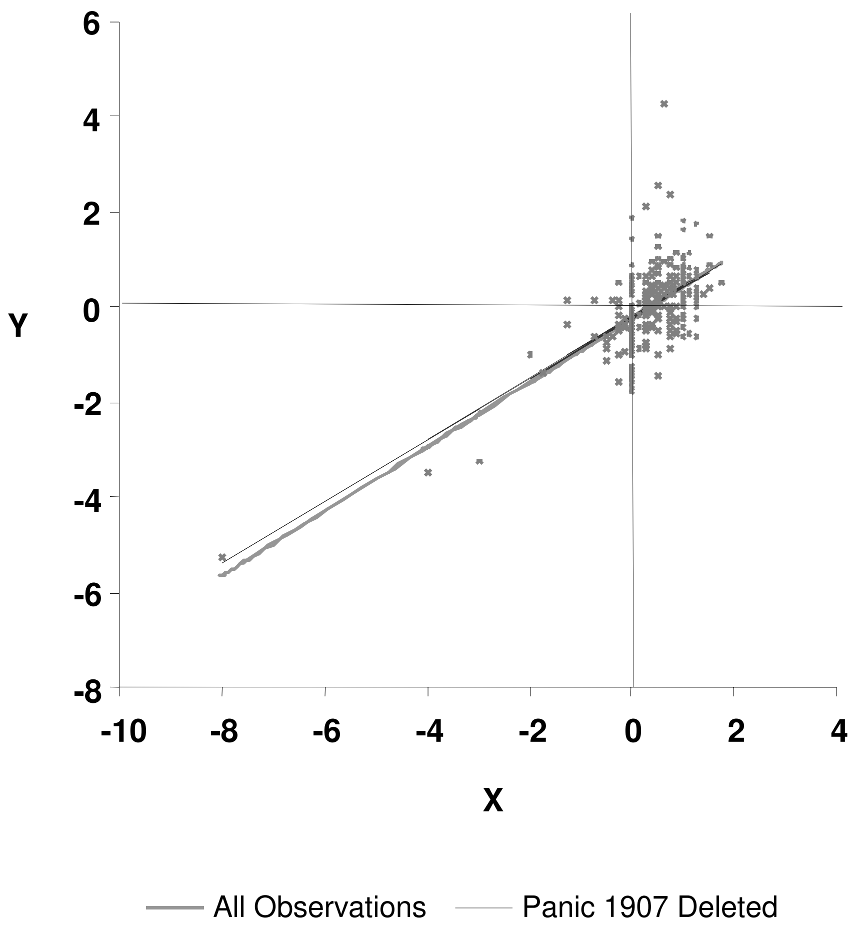
Newey-West HAC standard errors are reported in parentheses.

Figure 1: Nominal Interest Rates on Time Loans
(1890.01 - 1958.12)



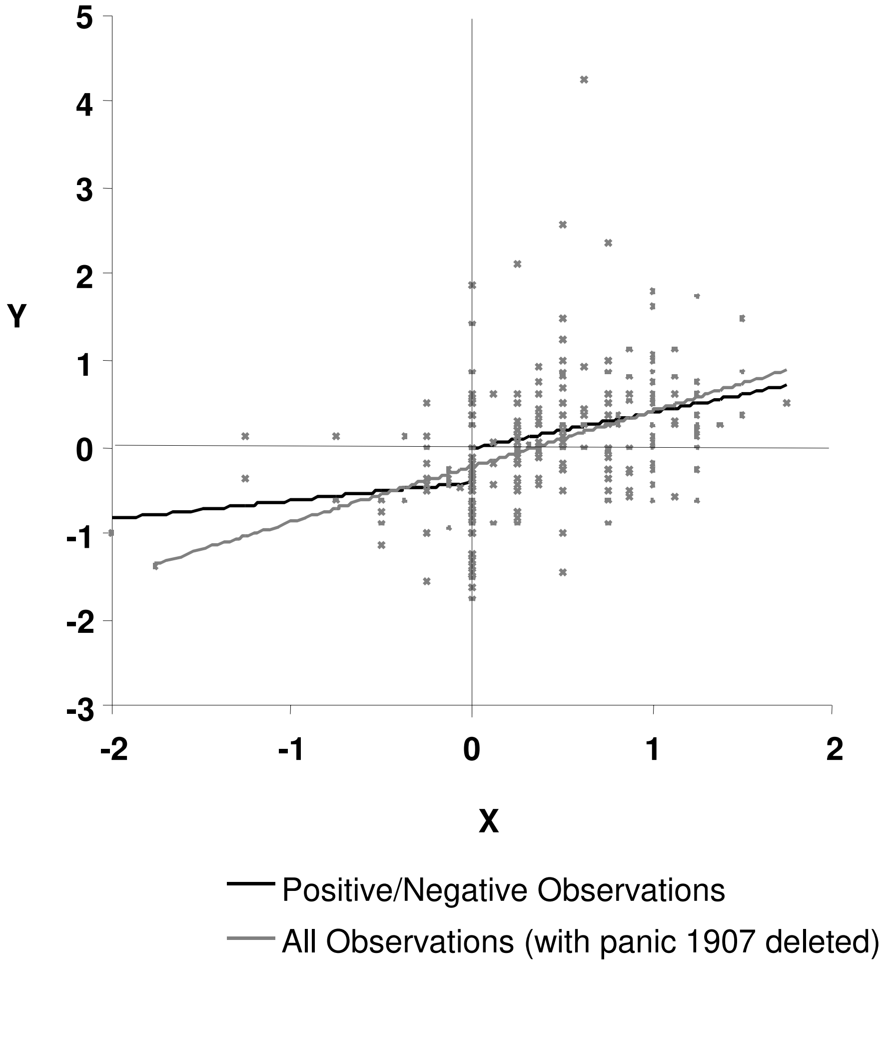
Gray – 3-month rate
Black – 6-month rate

Figure 2: The Effect of the Financial Panic Oservations



$$X_t = (r_t^6 - r_t^3) \qquad Y_t = \frac{1}{2}(r_{t+3}^3 - r_t^3)$$

Figure 3: **The Effect of the Inverted Yield Curve Observations**



$$X_t = (r_t^6 - r_t^3) \qquad Y_t = \frac{1}{2}(r_{t+3}^3 - r_t^3)$$