The Adjustment of Expectations to a Change in Regime: A Study of the Founding of the Federal Reserve

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The founding of the Federal Reserve System in 1914 led to a substantial change in the behavior of nominal interest rates. We examine the timing of this change and the speed with which it was effected. We then use data on the term structure of interest rates to determine how expectations responded. Our results indicate that the change in policy regime was rapid and that individuals quickly understood the new environment they were facing.

How the economy reacts to a major change in the policy regime is an issue of widespread disagreement. At one extreme, some economists (for example, Thomas Sargent, 1982, 1983) suggest that if a change in regime is sufficiently credible, the economy will move quickly to the new rational expectations equilibrium. Yet others (John Taylor, 1975; Benjamin Friedman, 1979; Christopher Sims, 1982) argue that instant credibility is unlikely and that rational individuals should typically be expected to learn gradually about the new stochastic environment. This disagreement over how quickly economic agents perceive a change in their environment naturally leads to disagreement over the short-run impact of policy changes.

This paper is a case study of one particular change in regime—the introduction of the Federal Reserve System at the end of 1914. We use data on the term structure of interest rates to estimate how quickly individuals came to understand the new stochastic environment in which they were operating. Since long-term interest rates in part reflect expectations of future short-term interest rates, term structure data allow us to infer how expectations adapted to this change in regime.

In Section I we provide a brief historical overview of the introduction of the Federal Reserve System. Our emphasis in particular is on the prevailing view of the impact of the Fed prior to its beginning of operations. Such historical evidence is by its nature difficult to interpret and highly controvertible. Our reading of the historical record, however, is that observers during 1914 expected the Fed to effect a major change in the economic forces determining interest rates.

We document in Section II that a substantial change in the stochastic process of short-term interest rates did indeed occur. In the period from 1890 to 1910, short rates were quickly mean-reverting and highly seasonal. By contrast, in the period from 1920 to 1933, short rates were much more persistent; indeed, they were close to a random walk. There is little doubt that there was a major change in the stochastic process generating interest rates.

In Section III we examine the relation between long-term (six-month) and short-term (three-month) interest rates. Since the long rate incorporates an expectation of a future short rate, a change in the stochastic process generating short rates should alter the relation between long and short rates. In other words, as Robert Lucas's (1976) critique suggests, the parameters of traditional term structure equations relating long rates to short rates (for example, Franco Modigliani and Richard Sutch, 1966) should not remain invariant across regimes. In par-

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ticular, since shocks to the short rate were less persistent in the 1890–1910 period than in the 1920–33 period, the long rate should be less responsive to the short rate in the earlier period. We find that the relation between six-month and three-month rates did in fact change in the way suggested by expectations-based theories of the term structure.

We examine in Section IV the timing of the change in regime. Using switching-regression techniques, we estimate that the most likely date for the change in the stochastic process of the short rate is between December 1914 and March 1915. This estimate, which uses only interest rate data, coincides almost exactly with the date at which the Federal Reserve began operation. We consider the possibility that the change in regime was gradual, but find instead that it occurred essentially all at once.

In Section V we study how quickly financial market participants perceived the change in regime. Our inferences are based on the premise that long-term interest rates depend on individuals' *perception* of the stochastic process the short rate is following. If there was a substantial lag in individuals' recognition of the change in their environment, then the relation between long rates and short rates should have changed long after the change in regime itself took place. By contrast, we find that the change in the relation between the six-month rate and the three-month rate roughly coincided with the change in regime. This finding suggests that financial market participants quickly understood the stochastic processes generated by the new policy regime and that, at least for this historical episode, the convergence to the new rational expectations equilibrium was quite rapid.

We conclude in Section VI. The evidence from the founding of the Fed suggests that a major change in a policy regime, backed with the establishment of new and powerful institutions, can be understood very quickly by financial market participants. It would of course be imprudent to extrapolate directly this single historical episode to the evaluation of other sorts of policy proposals. This episode does illustrate, however, the potential for rapid adjustment of agents' expectations in the face of substantial and widely believed changes in the continuing policy rule.

I. Historical Overview

The year 1914 witnessed two crucial events in the world of finance:[1] the creation of an important new institution, the Federal Reserve System, and the elimination of an old one, the classical gold standard.[2] In the sections that follow, we provide econometric evidence that there was a substantial change in regime and that this change was understood by financial market participants at the time. Our goal in this section is to show that such a conclusion is historically plausible; indeed, it is suggested by the literature of the time. After describing briefly the events surrounding the passage of the Federal Reserve Act and the opening of the Reserve Banks, we show that the relevant economic actors were aware that a regime change was taking place and had a rough idea of how the new regime would differ from the old.

The proximate cause of the founding of the Fed was the financial panic of 1907, which severely disrupted the economy and was widely blamed for the 1907–08 reces-

[1]The year 1914 also saw the outbreak of World War I. Our estimates of the stochastic process followed by the short-term interest rate indicate that the short rate followed essentially the same process in the 1915–18 period as in the 1919–33 period. It appears, therefore, that the war was not itself the major factor in the regime change examined here. Truman Clark (1986) has recently called into question whether the change in the behavior of interest rates at this time was due to the founding of the Federal Reserve, noting that a similar change took place in other countries as well. Clark provides no alternative explanation, however. While our econometric results below point to the founding of the Fed rather than the abandonment of the gold standard as the likely cause of the regime change, our analysis of the adjustment of expectations does not rely on the Fed being the source of the change.

[2]The classical gold standard effectively came to an end at the outbreak of World War I at the beginning of August 1914. During the period 1919–31, most countries expected to return to a fully operational gold standard and several resumed specie payments for limited periods. Overall, however, the period was not very similar to the classical gold standard era.

sion. In 1908, Congress passed the Aldrich-Vreeland Act, the most important result of which was creation of the National Monetary Commission. This group of legislators, academics, and bankers published a report in 1910 that discussed in enormous detail the positive and negative features of the United States' and foreign financial systems; the report served as a major impetus to the founding of the Fed. The Federal Reserve Act passed into law on December 23, 1913. The presidents of the banks met for the first time in July of 1914, and discussed the organization the system would take; the banks officially opened for business on November 16, 1914.

It is hard to believe that any change of regime was more widely perceived than the founding of the Federal Reserve. Paul Warburg, a well-known investment banker and advocate of the creation of the Fed, specifically applied the metaphor of a change in political regime, calling the Fed's founding "the Fourth of July in the economic life of our nation."[3] *The New York Times* for November 16, 1914, editorialized that "the starting of the Federal Reserve system, although incompletely, opens a new era in which 'old statistics do not count'" (p. 8). We could not hope for a more precise description of how an economic actor should respond to structural change.

The precise manner in which the Fed would operate was of course not known by financial market participants. The discussion in the report of the National Monetary Commission, however, makes clear that at least one essential function of the Fed was to operate a discount mechanism that would provide credit in times of excess demand, thereby dampening interest rate fluctuations and decreasing the frequency of bank failures. The day before the opening of the Fed, Secretary of the Treasury William McAdoo announced:

> The opening of these banks marks a new era in the history of business and finance in this country. It is believed that they will put an end to the annual anxiety from which the country has suffered for the last generation about insufficient money and credit to move the crops each year, and will give such stability to the banking business that extreme fluctuations in interest rates and available credits which have characterized banking in the past will be destroyed permanently.[4]

The financial press also believed that the introduction of the Fed would initiate an "elastic" currency and credit system.[5] No longer would interest rates have to move over such a great range to match the supply and demand for credit.

The evidence indicates strongly that financial market participants understood the intentions of the new institution. What we are unable to extract from the historical record is whether businessmen at the time of the Fed's founding expected it to accomplish its assigned tasks, or, alternatively, how long they expected the Fed would take to reach full operation. We can determine, however, that within a year of the opening of the Fed, popular opinion was that, as far as stabilization of the credit market was concerned, the Fed had accomplished all that it had set out to do. "What has thus far been done has been effectual in rendering stable and more uniform rates of discount prevalent throughout the country," wrote "Washington Notes" in the *Journal of Political Economy* (1915, p. 994; no author listed). On the subject of whether the Fed was wholly responsible for the year of ease in the credit markets that had followed its founding, *The*

[3] *Literary Digest*, November 27, 1915, quoting Warburg at the time of the founding.

[4] *The New York Times*, November 16, 1914, p. 1.

[5] *The Wall Street Journal* wrote, "The periodical convulsions in the money market for some time past had indicated clearly that there was something wrong with the currency medium of exchange of the country which was shown to be the lack of elasticity of circulation" (November 16, 1914, p. 1). *The New York Times* wrote, "When the new regime is fully operative, the currency volume will rise and fall with bank deposits, which will rise and fall with the course of trade" (November 16, 1914, p. 8).

New York Times wrote:

> Few will contend that the favorable progress of the year is altogether due to the betterment of the conditions of banking and of commercial credit through the operation of the Reserve system. Fewer still will contend that the system did nót reenforce the forces making for recovery in ways that hardly anybody foresaw. No doubt the extremely easy money market assisted, but the money market would hardly have been so easy without the certainty that there would be no currency-scarcity under the Federal system.
> [November 17, 1915, p. 10]

II. The Stochastic Process of the Short Rate

The historical evidence presented above suggests that the behavior of short-term interest rates was a key feature of the change in regime associated with the founding of the Federal Reserve System. It is therefore natural to focus on this variable when studying the transition from the old regime to the new one.[6] The interest rate series that we examine here is the three-month time loan rate available at New York City banks for the first week of each month during the period from 1890 to 1933.[7] New York was already the major financial center of the country at this time. As John James (1978, pp. 61–64) reports, most loans in bank portfolios were short term and most loans in New York were fixed maturity. We are thus examining here the rates on an important form of short-term commercial credit. Since there was no significant Treasury bill market until the early 1930's, it is one of the principal short-term rates in the economy.

Table 1 shows the autocorrelations of the short rate during two different sample periods.[8] The first ends clearly before the changes that led to the new regime, while the second begins several years after the changes had occurred (as well as after the end of World War I). We present the autocorrelations for both the level of the rate and its first difference. The standard deviation of the short rate, both in levels and first differences, is provided at the bottom of the table.

TABLE 1–AUTOCORRELATIONS OF THE SHORT RATE

	1891–1910		1921–33	
	Level	Change	Level	Change
First	0.75	−0.18	0.95	0.03
Second	0.60	0.12	0.89	0.03
Third	0.39	−0.21	0.84	−0.10
Fourth	0.28	−0.04	0.79	0.09
Fifth	0.19	−0.05	0.74	0.12
Sixth	0.12	−0.09	0.67	0.05
Seventh	0.10	−0.01	0.60	−0.03
Eighth	0.09	−0.09	0.54	0.02
Ninth	0.11	0.01	0.48	−0.09
Tenth	0.13	0.00	0.44	0.00
Eleventh	0.14	0.08	0.38	−0.01
Twelfth	0.13	0.13	0.33	0.05
Standard Deviation	1.54	1.08	1.94	0.51

Note: The approximate standard errors for the autocorrelations are 0.06 for the 1890–1910 sample and 0.08 for the 1921–33 sample.

For the 1891–1910 period, the first autocorrelation of the level of the short rate is 0.75, and the autocorrelations die out fairly quickly. Seven out of the first eight autocorrelations of the change in the short rate are negative, indicating that the short rate was at least partly mean-reverting. For the 1921–33 period, the first autocorrelation of the level is close to one and the autocorrelations die out very slowly. All the autocorrelations of the change in the short rate are small for this later period.

The regression results in Table 2 confirm the impressions given by Table 1. We show, for the two sample periods, regressions of

[6] Our focus here on the nominal short rate and the term structure of nominal interest rates is not meant to imply that real interest rates are unimportant. The expectations theory implies a change in the relation between long and short nominal rates even if, as Robert Shiller (1980) suggests, the stochastic process for real rates did not change.

[7] This data set is described in the Data Appendix and is examined in Mankiw and Miron (1986a).

[8] We end the second sample in 1933 because in that year the Glass-Steagall Act introduced a variety of banking regulations. The results would be essentially the same if we ended the second period before the beginning of the Great Depression in 1929.

TABLE 2—REGRESSION OF SHORT RATE ON LAGGED SHORT RATE[a]

	Dependent Variable: r_{t+1}			
	1890–1910	($T=252$)	1920–1933	($T=168$)
Constant	1.01 (0.18)	0.03 (0.29)	0.09 (0.09)	0.05 (0.16)
r_t	0.75 (0.04)	0.77 (0.04)	0.97 (0.02)	0.98 (0.02)
$D2$		1.05 (0.29)		0.34 (0.19)
$D3$		0.90 (0.29)		−0.10 (0.19)
$D4$		0.55 (0.29)		−0.16 (0.19)
$D5$		0.60 (0.29)		−0.07 (0.19)
$D6$		0.77 (0.29)		−0.06 (0.19)
$D7$		1.10 (0.29)		0.17 (0.19)
$D8$		1.44 (0.29)		0.16 (0.19)
$D9$		1.30 (0.29)		0.12 (0.19)
$D10$		1.46 (0.29)		−0.12 (0.19)
$D11$		0.71 (0.29)		−0.12 (0.19)
$D12$		1.10 (0.29)		0.17 (0.19)
$\bar{R}^2$	0.57	0.62	0.94	0.94
s.e.e.	1.00	0.94	0.52	0.51
D-W	2.09	2.20	1.92	1.91

[a]Standard errors are shown in parentheses.

the short rate on its own lagged value, including and excluding seasonal dummies. In the earlier period, the coefficient on the lagged short rate is significantly less than one, again indicating that the short rate was mean-reverting. Also, the seasonal dummies enter strongly significantly in the first period.[9] In the later period, the coefficient on the lagged short rate is close to one and the seasonal dummy variables do not enter significantly, suggesting that the short rate is close to a random walk. These results demonstrate that the process for the short rate was very different after the founding of the Federal Reserve and the abandonment of the gold standard.

III. The Short-Rate Process and the Term Structure of Interest Rates

In this section we examine the implications of expectations-based theories of the term structure for a traditional term structure equation, such as that suggested by Modigliani and Sutch. As the Lucas critique suggests, one should not expect such an equation to remain invariant when there is a fundamental change in the stochastic process generating short rates. We show that the parameters of a reduced-form equation estimated over the two regimes considered in the previous section did in fact change in the way one would have predicted.

A. *Theory*

Let r_t be the three-month yield and R_t be the six-month yield. Consider a reduced-form equation relating the longer-term rate to the short rate:

$$R_t = \alpha + \beta r_t + \varepsilon_t, \tag{1}$$

where α and β are parameters and ε_t is a random error. Equation (1) is the simplest version of the Modigliani-Sutch equation. This sort of equation, often with additional lags, is used for policy analysis both in large-scale models such as the MPS model (as noted by Olivier Blanchard, 1984) and in smaller-scale simulation models (for example, Richard Clarida and B. Friedman, 1984).

Expectations-based theories of the term structure relate the long-term rate to current and expected future short-term rates. With monthly data,

$$R_t = \tfrac{1}{2}(r_t + E_t r_{t+3}) + \theta_t, \tag{2}$$

where E_t denotes the expectation conditional on information available at time t and θ_t denotes the term premium. On the basis of the evidence discussed above, let us suppose the short rate follows a first-order autore-

[9]The seasonal fluctuations in interest rates, which are not of primary importance for the issues we address in this paper, are discussed in Milton Friedman and Anna Schwartz (1963, pp. 292–96), Shiller (1980), Miron (1986), Clark (1986), and Mankiw and Miron (1986b).

gressive process.[10] That is, ignoring the constant and seasonal dummies for simplicity,

$$r_{t+1} = \rho r_t + \nu_{t+1}. \tag{3}$$

Equations (2) and (3) imply that

$$R_t = \tfrac{1}{2}(1+\rho^3) r_t + \theta_t. \tag{4}$$

The standard expectations theory of the term structure, which is the hypothesis that the term premium is constant, thus implies a restriction across equations (1) and (3). In particular, it implies that

$$\beta = \tfrac{1}{2}(1+\rho^3). \tag{5}$$

The more persistent are shocks to the short rate (higher ρ), the greater is the response of the long rate to the short rate (higher β).

If the term premium θ_t is constant through time, as the expectations theory assumes, then equation (4) has no error. More generally, however, if the term premium varies but is uncorrelated with the short rate, then equation (4) has an error but this error does not change the restriction in equation (5). Since the restriction in equation (5) is much more general than the expectations theory, the abundant evidence against the expectations theory (for example, Robert Shiller, John Campbell, and Kermit Schoenholtz, 1983; Mankiw and Miron, 1986a,b) is not directly relevant to this restriction.

Once one interprets the error in the Modigliani-Sutch equation as the term premium, however, there is no reason to suppose it is serially uncorrelated. Below we quasi-difference equation (1) to correct for serial correlation. As long as the term premium is uncorrelated with the short rate at leads and lags, the restriction in equation (5) continues to hold.

We can now see the implications of a change in the stochastic process generating the short rate. Since the dynamic process of the short rate (equation (3)) changed from 1890–1910 to 1920–33, there should have been a change in the parameter of the Modigliani-Sutch relation (equation (1)). In particular, since shocks to the short rate became more persistent, the long-term interest rate should have become more responsive to the short-term interest rate.

B. *Evidence*

Tables 3 and 4 present estimates of equation (1) for the two sample periods considered in Section II. In Table 3 we use the level of long and short rates, while in Table 4 we use quasi-differenced data in order to account for serial correlation. The filter we use is $(1-0.5\,L)$, which is suggested by the Durbin-Watson (D-W) statistic of the regression in levels and appears to leave the residual approximately serially uncorrelated. The coefficient estimates we obtain with quasi-differenced data are not qualitatively very different from those we obtain with the raw data. We hereafter restrict our attention to the results with quasi-differenced data.

These results show clearly the effects of regime changes predicted by Lucas. In particular, the relation between long rates and short rates changed when the process for short rates changed in the way that the expectations theory predicts. The coefficient in the Modigliani-Sutch regression increased from 0.47 to 0.93 between the two periods. At least by the time period covered in our second sample, agents had come to understand that a new, more persistent, process for the short rate was in effect, and they had altered their behavior accordingly.[11]

[10] The assumption implicit here is that individuals have no information in forecasting the short rate other than the variables included in this equation. This assumption is obviously a strong one and can only be justified as an approximation. One test is to include the long rate in the forecasting equation, since the long rate would reflect any additional information on the future short rate. For the 1890–1910 period, the long-rate coefficient is statistically significant but the improvement in fit is very small: the standard error of estimate falls by only .027 (2.7 basis points). For the 1920–33 period, the long-rate coefficient is not statistically significant. Hence, the assumption that agents have little information additional to that in our posited forecasting equation appears empirically plausible.

[11] Stanley Fischer writes,

"It is indeed remarkable that the Lucas policy evaluation critique has triumphed without any detailed

TABLE 3—REGRESSION OF LONG RATE ON SHORT RATE[a]

	Dependent Variable: R_t			
	1890–1910	($T=252$)	1920–1933	($T=168$)
Constant	2.05 (0.09)	1.91 (0.15)	0.37 (0.03)	0.32 (0.05)
r_t	0.59 (0.02)	0.60 (0.02)	0.94 (0.01)	0.94 (0.01)
$D2$		−0.02 (0.16)		0.04 (0.06)
$D3$		0.05 (0.16)		0.02 (0.06)
$D4$		0.07 (0.16)		0.06 (0.06)
$D5$		0.06 (0.16)		0.05 (0.06)
$D6$		0.02 (0.16)		0.06 (0.06)
$D7$		0.27 (0.16)		0.03 (0.06)
$D8$		0.35 (0.16)		0.16 (0.06)
$D9$		0.20 (0.16)		0.11 (0.06)
$D10$		0.23 (0.16)		0.05 (0.06)
$D11$		−0.08 (0.16)		0.01 (0.06)
$D12$		−0.01 (0.16)		−0.03 (0.06)
$\bar{R}^2$	0.76	0.76	0.99	0.99
s.e.e	0.51	0.50	0.17	0.17
D-W	1.11	1.14	1.08	1.07

[a]See Table 2.

TABLE 4—REGRESSION OF LONG RATE ON SHORT RATE: QUASI DIFFERENCED[a]

	Dependent Variable: $(1-0.5\,L)R_t$			
	1890–1910	($T=251$)	1920–33	($T=168$)
Constant	1.25 (0.06)	1.24 (0.12)	0.19 (0.03)	0.18 (0.05)
$(1-0.5\,L)r_t$	0.48 (0.03)	0.47 (0.03)	0.94 (0.01)	0.93 (0.01)
$D2$		−0.13 (0.14)		0.03 (0.06)
$D3$		0.05 (0.14)		0.00 (0.06)
$D4$		0.01 (0.14)		0.04 (0.06)
$D5$		−0.04 (0.14)		0.01 (0.06)
$D6$		−0.09 (0.14)		0.03 (0.06)
$D7$		0.20 (0.14)		−0.01 (0.06)
$D8$		0.20 (0.14)		0.14 (0.06)
$D9$		0.06 (0.14)		0.03 (0.06)
$D10$		0.17 (0.14)		−0.01 (0.06)
$D11$		−0.12 (0.14)		−0.02 (0.06)
$D12$		0.02 (0.14)		−0.04 (0.06)
$\bar{R}^2$	0.58	0.58	0.98	0.98
s.e.e.	0.44	0.44	0.15	0.15
D-W	2.10	2.09	2.20	2.22

[a]See Table 2.

The results, however, are not completely consistent with the simple theory discussed above. While the sort of parameter drift observed is in line with that predicted by theory, the point estimates of the coefficient in the Modigliani-Sutch equation are somewhat different than predicted. The short-rate equation in Table 2 predicts a coefficient of 0.73 for the 1890–1910 period and 0.97 for the 1920–33 period, in contrast to the actual estimates of 0.47 and 0.93. Thus, for the earlier period, the point estimate is quite different from what the theory predicts.

Table 5 presents joint estimates of the two equations imposing the cross-equation restriction in equation (5). The estimate of the parameter in the Modigliani-Sutch equation is 0.61 for the 1890–1910 period and 0.94 for the 1920–33 period. Not surprisingly, these estimates are between those in Table 4 and those implied by Table 2. A formal likelihood ratio test of the cross-equation restriction between the short-rate equation and the Modigliani-Sutch equation rejects that restriction for the 1890–1910 period, but not for the 1920–33 period.[12]

empirical support beyond Lucas's assertion that macroeconometric models in the 1960s all predicted too little inflation in the 1970s. The general point made by the critique is correct and was known before it was so eloquently and forcefully propounded by Lucas. That the point has been empirically relevant, however, is something that should have been demonstrated rather than asserted" (1983, p. 271).

The evidence from the founding of the Fed provides such a demonstration.

[12]Under the assumption that the error in the Modigliani-Sutch equation is the term premium and independent of the error in the short-rate equation, the joint

TABLE 5—JOINT ESTIMATION IMPOSING CROSS-EQUATION RESTRICTION[a]

	1890–1910	($T=251$)	1920–33	($T=168$)
Dependent Variable	r_{t+1}	$(1-0.5\,L)R_t$	r_{t+1}	$(1-0.5\,L)R_t$
Constant	0.84	0.90	0.03	0.17
	(0.40)	(0.17)	(0.14)	(0.05)
r_t	0.61		0.96	
	(0.03)		(0.01)	
$(1-0.5\,L)r_t$		0.61		0.94
		(0.02)		(0.01)
$D2$	0.83	0.02	0.45	0.04
	(0.41)	(0.20)	(0.18)	(0.09)
$D3$	0.72	0.09	0.02	0.00
	(0.52)	(0.20)	(0.20)	(0.08)
$D4$	0.37	0.07	−0.05	0.05
	(0.44)	(0.22)	(0.24)	(0.06)
$D5$	0.37	0.07	0.03	0.01
	(0.46)	(0.23)	(0.22)	(0.06)
$D6$	0.50	0.02	0.04	0.03
	(0.43)	(0.20)	(0.22)	(0.07)
$D7$	0.84	0.30	0.27	−0.01
	(0.46)	(0.21)	(0.21)	(0.08)
$D8$	1.22	0.25	0.26	0.14
	(0.41)	(0.23)	(0.22)	(0.06)
$D9$	1.19	0.05	0.23	0.03
	(0.42)	(0.22)	(0.20)	(0.07)
$D10$	1.39	0.15	−0.02	−0.01
	(0.40)	(0.22)	(0.18)	(0.06)
$D11$	0.70	−0.17	−0.02	−0.02
	(0.39)	(0.19)	(0.22)	(0.06)
$D12$	1.03	0.06	0.28	−0.04
	(0.42)	(0.20)	(0.30)	(0.06)
$\bar{R}^2$	0.60	0.54	0.94	0.98
s.e.e	0.99	0.49	0.51	0.16
D-W	1.75	2.39	1.92	2.23
Likelihood Ratio Test − $\chi^2(1)$	39.8		0.8	

[a]See Table 2.

This statistical rejection of the cross-equation restriction appears attributable to the assumption that the term premium is uncorrelated with the short-term interest rate. To illustrate directly the covariation between the term premium and the short rate, we can regress the excess holding return on long bonds, $(R_t - 0.5(r_t + r_{t+3}))$, on the short rate, r_t, adjusting the standard errors for the moving average residual. The coefficient on the short rate is −.11 with a t-statistic of 1.84 in the 1890–1910 period and −0.1 with a t-statistic of 0.35 in the later period. Hence, covariation between the term premium and the short rate appears to account for the statistical rejection in the early period.[13] While this covariation invalidates the cross-equation restriction in equation (5), a more persistent short rate (higher ρ) nonetheless

log likelihood is the sum of the two individual log likelihoods. We maximize the joint log likelihood by numerical optimization. We do not impose here cross-equation restrictions on the month dummies, which allows for the possibility of a seasonal term premium.

[13]Measurement error in the short rate is observationally equivalent to a negative covariation between the term premium and the short rate. While there is clearly some measurement error in these data, since the interest rates are the midpoint of a reported range of typically 12.5–25 basis points, we suspect that the measurement error is not sufficiently great to explain the results reported in the text.

leads, *ceteris paribus*, to a more responsive long rate (higher β). It is in this weaker sense that the evidence is consistent with the theory presented above.

IV. The Timing of the Change in Regime

In this section we try to pin down the timing of the change in the stochastic process for the three-month interest rate. We begin by determining the most likely date for the change in regime, conditional on the assumption that the change occurred all at once. We then consider the possibility that the change in regime occurred gradually over time.

A. *Step Switching*

Suppose that the process for the short rate obeyed

$$r_{t+1} = \kappa_o + \rho_o r_t + \nu_{t+1}, \qquad t = 1, \ldots, T_s - 1$$

$$r_{t+1} = \kappa_n + \rho_n r_t + \nu_{t+1}, \qquad t = T_s, \ldots, T$$

where T_s is the switch date (the first period of the new regime). Our goal is to estimate T_s. The procedure we use is the maximum likelihood procedure suggested by Stephen Goldfeld and Richard Quandt (1976) and recently applied by John Huizinga and Frederic Mishkin (1986) to the stochastic process followed by real interest rates. Assuming normal errors, the log likelihood function for this model is

$$\log L = -\frac{T}{2}\log(2\pi) - (T_s - 1)\log(\sigma_o^2) - (T - T_s + 1)\log(\sigma_n^2) - \frac{1}{2}\sum_{t=1}^{T_s-1}\left(\frac{\nu_{t+1}^2}{\sigma_o^2}\right) - \frac{1}{2}\sum_{t=T_s}^{T}\left(\frac{\nu_{t+1}^2}{\sigma_n^2}\right)$$

where σ_o^2 and σ_n^2 are the error variances in the old and new regimes. We can determine the maximum likelihood value for T_s by computing the maximum likelihood estimates of the parameters for all possible T_s's and then choosing the value of T_s with the maximum likelihood.

Table 6 shows the log likelihood of various possible switch dates around the maximum likelihood switch date.[14] According to these results, the most likely date of the new regime is December 1914 when month dummies are excluded, but February 1915 when month dummies are included. Remember that the Federal Reserve System opened for operation on November 16, 1914. This econometric estimate of the date of the new regime is thus very close to the date an historical account would suggest.

To judge the degree of confidence one should have in these point estimates of the date the new regime began, we calculate the posterior odds ratio for alternative switch dates. If one has diffuse priors (i.e., one considers all possible switch dates equally likely), then the ratio of the likelihood values for different switch dates produces the posterior odds ratio. The posterior odds ratio is the ratio of subjective probabilities of different switch dates conditioning on the data.[15]

Table 6 shows, for a range of possible switch dates, the posterior odds ratio of that date as a switch date compared to the maximum likelihood date. The months from December 1914 to March 1915 are all highly probable as the date of the regime change. The relative odds for the dates before December 1914 or after May 1915, however, are extremely low. Hence, although we cannot be certain of the exact date of the switch, we can conclude with a high degree of confidence that the date for the switch was

[14] We have searched over all possible switch dates 1890–1933, but only report values around the global maximum. Since the coefficient estimates are essentially the same as those in Table 2, we do not report them here.

[15] We view this posterior odds ratio as a simple metric for judging how flat or steep is the likelihood function. Note that for each switch date, the remaining parameters are chosen to maximize the likelihood. An alternative calculation (see, for example, Donald Holbert, 1982) would be to posit a prior joint distribution over all the parameters, to use the likelihood function to yield a posterior joint distribution over all the parameters, and then to integrate out the remaining parameters, to produce the posterior marginal distribution for the switch date. In our application, since the most likely values of the remaining parameters vary very little over plausible switch dates, we believe this latter calculation would produce similar conclusions.

TABLE 6—SWITCH DATE FOR SHORT-RATE EQUATION
($r_{t+1} = \kappa + \rho r_t$)

	Excluding Month Dummies		Including Month Dummies	
Date	$-\log L$	Posterior Odds Ratio	$-\log L$	Posterior Odds Ratio
1914:1	613.2	.000	576.3	.000
2	611.3	.000	573.8	.000
3	611.8	.000	574.1	.000
4	612.2	.000	574.6	.000
5	612.7	.000	574.9	.000
6	612.9	.000	575.2	.000
7	613.0	.000	575.2	.000
8	583.1	.005	546.2	.004
9	582.3	.011	545.0	.013
10	582.7	.007	545.1	.012
11	583.0	.006	545.6	.007
12	577.8	1.000	540.9	.803
1915:1	578.1	.741	540.9	.741
2	578.0	.819	540.6	1.000
3	578.8	.368	541.1	.631
4	579.5	.183	541.8	.304
5	580.2	.091	542.5	.160
6	581.0	.041	543.1	.084
7	581.7	.020	543.7	.045
8	582.3	.011	544.5	.021
9	583.0	.006	545.4	.009
10	583.7	.003	546.3	.004
11	584.4	.001	547.3	.001
12	585.1	.001	548.0	.001

Note: $\log L$ is the log of the likelihood function. The posterior odds ratio is the probability that the switch occurred at that date relative to the probability that the switch occurred at the date with the highest likelihood; this calculation is based on the estimated likelihood value and diffuse priors.

within a few months after the beginning of the Federal Reserve System.

Since the posterior odds ratio for any potential switch date before December 1914 is very low, the change in the stochastic process for short rates is more likely attributable to the founding of the Fed than to the abandonment of the gold standard.[16] The gold standard was suspended at the outbreak of World War I in August 1914. The results in Table 6 indicate that the months between the beginning of the war and the introduction of the Fed are more consistent with the old regime than with the new regime. A casual examination of the data easily explains this result. Between November 1914 and December 1914, the short-term interest rate fell from 6 to $4\frac{1}{8}$ percent. If the new (random walk) regime had already been in effect, such an event would have been very unusual: it would have required approximately a four standard deviation shock. Under the old (mean-reverting) regime, such an event was much less atypical: it required approximately a one-standard-deviation shock. Hence, these data imply that it is very unlikely that the new regime began before December 1914.[17]

[16] We do not intend to suggest that the abandonment of the gold standard was completely irrelevant. If the gold standard had continued in effect, the Fed may have been less able to affect nominal interest rates.

[17] If the single observation of the November–December drop in the short rate is excluded, we are unable to distinguish between the abandonment of the gold standard and the founding of the Fed as the cause of the regime change.

B. *Logistic Switching*

Our second procedure for determining the timing of the change in the process for short rates is to estimate a time-varying parameter model that allows the coefficients of the short-rate equation to change gradually over time, rather than moving instantaneously from the old to the new values as in the switching regression above. Specifically, we assume that the parameters of the short-rate equation follow a logistic curve. That is, the short-rate process is

$$r_{t+1} = \kappa_t + \rho_t r_t + \nu_{t+1},$$

while the parameters for this process change as

$$\kappa_t = (1 - L(t))\kappa_o + L(t)\kappa_n,$$

$$\rho_t = (1 - L(t))\rho_o + L(t)\rho_n,$$

$$\sigma_t^2 = (1 - L(t))^2\sigma_o^2 + L(t)^2\sigma_n^2,$$

where $L(t) = e^{\alpha+\delta t}/(1 + e^{\alpha+\delta t})$. All the parameters of the short-rate process adjust continuously together.

The parameters α and δ determine when the regime change occurs. In particular, at $t = -\alpha/\delta$, $L(t) = 1/2$ and the logistic curve has its inflection. At this date, the short-rate process is an equal mix of the old and the new regimes.

The parameter δ determines the rate at which the parameters change from their old values to their new values. Since $L(t)$ reaches one only asymptotically, the parameters approach their new values asymptotically. To judge the speed of the change in regime, define the dates $t(1/4)$ and $t(3/4)$ implicitly as

$$L(t(1/4)) = 1/4;\ L(t(3/4)) = 3/4.$$

Then $t(3/4) - t(1/4)$ is the period of time it takes for the parameters to make one-half of the adjustment (from one-fourth new regime to three-fourths new regime). Straightforward algebra shows that

$$t(3/4) - t(1/4) = \log(9)/\delta.$$

Hence, the parameter δ is inversely related to the rate of adjustment between regimes. The limit of the logistic curve ($\delta \to \infty$) is the step function, so this time-varying parameter model includes our earlier model as an extreme case.

Table 7 presents results for the logistic time-varying parameter specification of the short-rate process. The parameters are estimated with maximum likelihood assuming normal error (see Goldfeld and Quandt). We estimate the short-rate process both excluding and including month dummies. To reduce the computational problem, when month dummies are included, their coefficients are set equal to the values estimated for the old and new regimes as presented in Table 2.

Since the rate of adjustment is the key parameter here, we present the results for various rates of adjustment, choosing the remaining parameters to maximize the likelihood function. For each rate of adjustment, we present the maximum likelihood switch date ($L(T_s) = 1/2$), the maximum likelihood value achievable with that rate of adjustment, and the posterior odds ratio for that rate of adjustment relative to the maximum likelihood rate of adjustment.

The results in Table 7 indicate that either the step function ($\delta = \infty$) or a very steep logistic curve has the highest likelihood value. Since the implied switch dates for these curves are in the first few months of 1915, these steep logistic curves closely approximate the step function considered above. The likelihoods of less steep logistic curves, however, are much lower. We can conclude with a high degree of confidence that most of the change in regime occurred in less than one year.

V. Learning about the Change in Regime

In Section III we demonstrated that, at least after a period of several years, agents had correctly responded to the new stochastic process for the short rate. Here we estimate how quickly this response occurred. As in our treatment of the short-rate process, we examine both step switching and logistic switching.

The relationship between long rates and short rates depends on agents' perception of their environment. Suppose, for example,

TABLE 7—LOGISTIC SWITCHING FOR THE SHORT-RATE EQUATION
($r_{t+1} = \kappa + \rho r_t$)

Months for 1/2 of Switch (δ)		Switch Date	$-\log L$	Posterior Odds Ratio
Excluding Month Dummies				
0.0	(∞)	1914:12	577.8	1.000
1.0	(2.197)	1915:1	578.2	.670
2.0	(1.099)	1915:2	577.9	.905
3.0	(0.732)	1915:1	578.1	.741
6.0	(0.366)	1915:4	579.2	.247
12.0	(0.183)	1915:8	582.0	.015
24.0	(0.092)	1916:7	584.7	.001
36.0	(0.061)	1916:0	585.4	.001
48.0	(0.046)	1916:2	586.6	.000
60.0	(0.037)	1917:3	587.8	.000
Including Month Dummies				
0.0	(∞)	1915:2	542.8	.670
1.0	(2.197)	1915:2	542.4	1.000
2.0	(1.099)	1915:2	542.4	.990
3.0	(0.732)	1915:2	542.5	.896
6.0	(0.366)	1915:4	543.9	.230
12.0	(0.183)	1915:7	547.6	.006
24.0	(0.092)	1916:10	549.6	.001
36.0	(0.061)	1916:0	551.1	.000
48.0	(0.046)	1916:1	553.1	.000
60.0	(0.037)	1917:2	554.7	.000

Note: $\log L$ is the log of the likelihood function for the set of parameters that maximizes the likelihood for the value of δ. The posterior odds ratio is the probability of that value of δ relative to the probability of the value of δ with the highest likelihood; this calculation is based on the estimated likelihood value and diffuse priors.

that even after the stochastic process for the short rate had changed to the more persistent process, agents had believed that the old mean-reverting process for the short rate was still in effect. (Such a situation might arise if agents had applied standard regression techniques to recent data to estimate the short-rate process.) In this case, fluctuations in the short rate would have been perceived as more transitory than they truly were. The long rate, which depends on the expected short rate, would have responded to the short rate as under the old regime. In other words, if perceptions adjusted gradually to the new regime, then the change in the empirical relationship between long and short rates should lag the change in the short rate process.

A. *Step Switching*

Table 8 presents a log likelihood of the Modigliani-Sutch equation for a range of possible switch dates around the maximum likelihood date.[18] The maximum likelihood switch date is December 1914 when month dummies are excluded and October 1914 when month dummies are included. The posterior odds ratio of all dates from October 1914 to January 1915 are fairly high. We can state with a high degree of confidence that the Modigliani-Sutch equation changed within a few months of the date the process for the short rate changed, even though we cannot be confident about the exact date. The data strongly support the conclusion that agents quickly understood that the introduction of the Fed had changed the stochastic environment in which they were operating.

[18]The coefficient estimates are essentially the same as those in Table 4.

TABLE 8—SWITCH DATE FOR THE MODIGLIANI-SUTCH EQUATION
$(1-0.5\,L)R_t=\alpha+\beta(1-0.5\,L)r_t$

	Excluding Month Dummies		Including Month Dummies	
Date	$-\log L$	Posterior Odds Ratio	$-\log L$	Posterior Odds Ratio
1914:1	159.0	.000	144.3	.000
2	159.3	.000	144.7	.000
3	160.3	.000	145.4	.000
4	161.2	.000	146.3	.000
5	162.4	.000	147.4	.000
6	162.5	.000	147.4	.000
7	162.6	.000	147.6	.000
8	161.0	.000	145.7	.000
9	110.0	.000	89.4	.000
10	83.8	.549	62.4	1.000
11	83.6	.670	62.9	.589
12	83.2	1.000	62.4	.951
1915:1	84.9	.183	64.1	.177
2	85.5	.100	64.7	.096
3	86.8	.027	65.8	.034
4	87.9	.009	66.8	.012
5	88.3	.006	67.3	.007
6	89.2	.002	68.0	.004
7	90.1	.001	69.0	.001
8	91.4	.000	70.9	.000
9	91.6	.000	71.8	.000
10	93.1	.000	73.6	.000
11	94.5	.000	75.4	.000
12	95.3	.000	76.1	.000

Note: See Table 6.

B. *Logistic Switching*

We present estimates of the logistic model for the Modigliani-Sutch equation in Table 9.[19] Both excluding and including month dummies, the maximum likelihood estimate for the time it took for the parameters to move halfway is one month, and the implied switch date is November 1914. The posterior odds ratios presented in the table show that adjustment periods of several months are reasonably likely, but that an adjustment period of six months or longer is highly improbable.

This result, that the participants in financial markets reacted quickly and properly to the change in the stochastic process of the short rate within a few months, is striking. It is clear that agents could not have estimated the new process for the short rate in just a few months. Our results suggest, nonetheless, that they had a good understanding of exactly what the new regime would be like. This finding is particularly dramatic because the new regime was not the sort of event for which there were many past observations from which to draw inferences.

Indeed, the data are consistent with an even stronger conclusion. We can see from the results that the Modigliani-Sutch equation may have changed before the process for the short rate changed. This finding suggests that agents anticipated the effects of the introduction of the Fed and modified their behavior accordingly, even before the Fed actually existed. If agents knew in October that the process for short rates would change in December, then the long rate implied by the expectations theory should have incorporated this fact. As we discuss in Section I, the Act establishing the Fed was passed in 1913, and the announcement of

[19]We again reduce the computational problem by using the estimates in Table 4 for the month dummies.

TABLE 9—LOGISTIC SWITCHING FOR THE MODIGLIANI-SUTCH EQUATION
$(1-0.5\,L)R_t=\alpha+\beta(1-0.5\,L)r_t$

Months for 1/2 of Switch (δ)		Switch Date	$-\log L$	Posterior Odds Ratio
Excluding Month Dummies				
0.0	(∞)	1914:12	83.2	.741
1.0	(2.197)	1914:11	82.9	1.000
2.0	(1.099)	1914:12	83.8	.407
3.0	(0.732)	1915:1	84.3	.247
6.0	(0.366)	1915:3	85.8	.055
12.0	(0.183)	1915:5	89.9	.001
24.0	(0.092)	1915:8	96.7	.000
36.0	(0.061)	1916:11	95.2	.000
48.0	(0.046)	1916:10	96.5	.000
60.0	(0.037)	1916:12	98.5	.000
Including Month Dummies				
0.0	(∞)	1914:11	65.9	.538
1.0	(2.197)	1914:11	65.3	1.000
2.0	(1.099)	1914:12	66.3	.353
3.0	(0.732)	1915:1	66.9	.200
6.0	(0.366)	1915:3	68.7	.034
12.0	(0.183)	1915:5	73.8	.000
24.0	(0.092)	1915:7	83.2	.000
36.0	(0.061)	1917:1	84.1	.000
48.0	(0.046)	1917:1	85.2	.000
60.0	(0.037)	1916:11	87.3	.000

Note: See Table 7.

the opening of the Fed occurred in July 1914. Thus, as a matter of history, agents did know when the Fed would begin operations. It is not implausible that agents also understood in advance the impact the Fed would have on the pattern of interest rates.

VI. Conclusion

The picture that emerges from this study is that of a remarkably fast adjustment of expectations and behavior in the face of a major change in the economic policy regime. We of course cannot determine exactly the timing and rate of adjustment to the new regime. Nonetheless, it would be difficult to reconcile these data with the hypothesis that agents observed the new regime for many months before responding to it.

Several caveats are in order. First, by looking only at term structure data, we are able to examine only the expectations of a relatively small group: New York financiers and businessmen who participated in the time loan market. Indeed, it may not even be necessary that all members of this group held the correct expectation right away; arbitrage by a well-informed subset might have produced the results we find. One should be cautious in applying our findings to situations in which the relevant expectations are those of a larger or less sophisticated group of economic actors.

Second, the implications of the regime change that we study, at least for short-term credit markets, were not difficult to predict. Since interest rate stability was one of the announced targets of Fed policy, no one should have been surprised that the stochastic process of short rates did in fact change. In many other cases of regime changes, the crucial expectations are those of nontarget variables. In these cases, the relevant economic actors must have an implicit or explicit model of the economy, which complicates their problem of understanding the new regime.

Finally, we note that observers in 1914 could have had a high degree of confidence that the Federal Reserve System would function as had been announced in advance. There was only modest political opposition

TABLE A1—THREE-MONTH INTEREST RATE

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1890	6.000	3.500	5.000	4.500	4.500	5.000	5.000	5.000	6.000	6.000	6.000	6.000
1891	6.000	4.500	5.000	4.500	4.000	5.750	4.500	4.750	6.000	6.000	6.000	4.000
1892	4.000	3.250	3.750	3.500	2.500	2.500	3.000	2.500	3.500	4.000	5.500	5.000
1893	6.000	3.500	6.000	5.500	6.000	4.750	6.000	6.000	6.000	6.000	4.250	2.750
1894	3.000	3.000	2.500	2.500	2.000	2.000	2.000	2.500	2.500	2.000	2.000	2.750
1895	2.500	3.250	3.250	3.750	2.500	2.000	2.000	2.500	2.500	2.750	2.500	3.000
1896	6.000	6.000	3.500	4.000	3.000	3.000	3.500	5.000	6.000	6.000	6.000	3.500
1897	3.000	2.500	2.500	2.500	2.500	2.500	2.000	2.000	3.000	3.500	3.000	2.500
1898	3.000	2.500	4.000	5.000	5.000	3.000	2.500	2.500	3.750	2.750	2.500	3.000
1899	3.000	3.000	3.750	4.000	3.500	3.000	3.000	4.750	4.000	6.000	5.750	6.000
1900	6.000	4.000	4.500	4.000	3.000	3.000	3.250	3.500	3.500	5.000	4.750	4.500
1901	4.500	3.250	3.000	3.500	4.250	3.250	4.000	4.375	5.000	4.750	4.500	4.000
1902	5.250	4.500	4.000	4.250	4.500	4.500	4.500	4.500	5.750	6.250	6.000	6.000
1903	5.250	4.750	5.250	5.375	4.500	4.750	4.000	4.500	5.000	5.750	5.750	5.750
1904	4.750	4.125	3.125	3.000	2.500	2.000	2.375	2.000	2.500	3.500	3.750	4.000
1905	3.125	2.875	3.125	3.375	3.250	2.875	3.000	3.250	3.625	4.875	4.875	5.375
1906	5.875	4.625	5.625	5.500	5.750	4.875	4.750	4.500	7.750	6.000	6.750	8.000
1907	6.750	5.500	5.250	5.000	3.750	4.500	4.625	5.500	5.750	6.250	14.000	10.00
1908	10.00	3.500	3.500	3.000	2.375	2.500	2.125	2.750	2.125	2.625	3.375	2.875
1909	2.625	2.500	2.875	2.625	2.625	2.500	2.375	3.000	3.375	3.875	4.625	4.750
1910	4.500	3.750	3.500	4.000	4.250	3.625	3.625	3.875	4.125	4.688	5.125	4.000
1911	3.750	3.125	3.000	2.875	2.750	2.875	2.750	3.125	3.250	3.500	3.625	3.750
1912	3.375	2.750	3.063	3.625	3.250	3.125	3.250	3.875	5.000	5.500	6.000	6.250
1913	5.000	4.000	4.750	4.250	4.000	4.375	3.625	4.875	4.625	4.625	5.000	5.375
1914	4.750	3.125	3.125	2.750	2.875	2.250	2.875	8.000	7.000	6.500	6.000	4.125
1915	3.625	2.875	2.875	2.750	2.750	2.625	2.750	3.000	2.750	2.750	2.750	2.500
1916	2.750	2.750	2.875	2.875	2.875	2.875	3.875	3.375	3.125	3.375	3.250	4.125
1917	3.750	2.875	4.125	3.875	4.375	4.125	4.250	4.375	5.250	5.750	5.500	5.375
1918	5.625	5.625	6.000	6.000	6.000	5.875	5.625	5.875	6.000	6.000	6.000	5.875
1919	5.375	5.125	5.500	5.625	5.875	5.625	6.000	6.000	5.875	5.875	6.500	6.500
1920	7.000	8.250	8.500	8.000	8.250	8.000	8.250	8.625	8.750	7.750	8.000	7.125
1921	7.375	6.750	6.750	6.750	6.625	6.875	6.500	5.750	5.875	5.375	5.500	5.125
1922	5.000	4.750	4.875	4.500	4.250	4.125	4.125	3.875	4.375	4.625	4.875	5.000
1923	4.750	4.750	5.000	5.375	5.125	4.875	5.125	5.125	5.500	5.500	5.125	5.000
1924	5.000	4.625	4.875	4.375	4.375	3.875	2.875	2.625	3.000	2.875	3.000	3.250
1925	3.875	3.625	3.875	4.125	3.875	3.750	3.875	4.250	4.375	4.625	4.875	4.938
1926	4.875	4.625	4.875	4.625	4.000	4.125	4.125	4.500	4.875	5.063	4.750	4.625
1927	4.625	4.438	4.438	4.375	4.375	4.438	4.500	4.313	3.938	4.313	4.250	4.063
1928	4.188	4.438	4.563	4.625	4.938	5.750	5.875	6.250	6.500	7.250	6.875	7.250
1929	7.625	7.625	7.750	8.750	8.625	8.375	7.375	8.875	8.875	9.125	6.000	4.875
1930	4.875	4.750	4.500	4.125	3.625	3.125	2.750	2.625	2.625	2.375	2.375	2.125
1931	2.375	1.875	2.125	2.125	1.875	1.375	1.625	1.375	1.625	2.500	3.750	3.250
1932	3.500	3.625	3.375	2.875	1.875	1.500	1.500	1.375	1.375	1.125	0.500	0.500
1933	0.500	0.500	3.000	1.500	1.125	0.875	0.875	1.375	0.625	0.688	0.688	0.875

to the new institution and no apparent benefits to the Fed in not fulfilling the expectations it had created. Our study does not speak directly to the problem of achieving credibility for an optimal but time-inconsistent policy.

The primary implication of all these caveats is that many particular circumstances facilitated the rapid adjustment of expectations to the regime change studied here. We therefore cannot be certain whether this phenomenon is to be found more generally. But the creation of the Federal Reserve does illustrate the surprising speed with which financial market participants can at times respond to a major change in the economic policy regime.

DATA APPENDIX

The data used in this paper are the time loan rates available at New York banks during the first week of the month from 1890 to 1933. In 1910, the National Monetary Commission compiled these data from 1890