# Further Evidence on Greenspan's Conundrum

*Cletus C. Coughlin* and *Daniel L. Thornton*

During his February 2005 congressional testimony, Alan Greenspan identified what he termed a conundrum. Despite the fact that the Federal Open Market Committee (FOMC) had increased the federal funds rate 150 basis points since June 2004, the 10-year Treasury yield remained essentially unchanged. Greenspan considered several explanations for his observation but rejected each. Thornton (2018) showed that the relationship between the 10-year Treasury yield and the federal funds rate changed in the late 1980s, many years prior to Greenspan's observation. Moreover, he showed that the relationship changed because the FOMC began using the federal funds rate as its policy instrument. The federal funds rate moved only when the FOMC changed its target for it, while, in contrast, the 10-year Treasury yield continued to respond to news as before. As a consequence of this change in the FOMC's operating procedure, the correlation between changes in the funds rate and the 10-year Treasury yield declined—effectively to zero. There is no obvious reason that the U.S. experience should be unique. Hence, we explore the experiences of two other countries that implemented a policy of targeting a short-term rate. We find that, as in the United States, the correlation between the policy rate and the long-term sovereign bond yield declined effectively to zero for both the Bank of England and the Reserve Bank of New Zealand after they began using a short-term rate as their policy instrument. (JEL E43, E52, E58)

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## 1 INTRODUCTION

During his February 2005 congressional testimony, Alan Greenspan noted that despite the fact that the Federal Open Market Committee (FOMC) had increased the federal funds rate 150 basis points since June 2004, the 10-year Treasury yield remained essentially unchanged. He posited several possible explanations for what he believed was the aberrant behavior of long-term Treasury yields. Rejecting each in turn, he called it a conundrum.

Not surprisingly, Greenspan's observation and ruminations stimulated much research. Several researchers (Backus and Wright, 2007; Kim and Wright, 2005; Rosenberg, 2007; Rudebusch and

Cletus C. Coughlin is an emeritus economist of the Federal Reserve Bank of St. Louis and a senior research fellow at the Sinquefield Center for Applied Economic Research at St. Louis University. Daniel L. Thornton, a former vice president and economic advisor at the Federal Reserve Bank of St. Louis, is president of D.L. Thornton Economics, LLC.

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Wu, 2007; and Smith and Taylor, 2009) investigated possible changes in the 10-year yield. Each of these articles generated declining estimates of the 10-year Treasury term premium; however, none were able to explain why the term premium declined. Thus, the apparent aberrant behavior of the 10-year Treasury yield remained a conundrum.

Thornton (2018) took a different approach. Rather than assuming the conundrum began at about the time Greenspan observed it, he investigated when it began. He found that the relationship between the 10-year Treasury yield and the federal funds rate changed in the late 1980s, with the most likely date being May 1988. Based on previous research, he hypothesized that the change in behavior occurred when the FOMC began using the federal funds rate as its policy instrument. Once the FOMC began this practice, the federal funds rate moved only when the FOMC changed its target for it. In contrast, the 10-year Treasury yield continued to respond to news as before. The correlation between the federal funds rate and the 10-year Treasury yield declined to zero. This is because the FOMC changed its target for the funds rate infrequently. Thornton (2018) called this the funds-rate-targeting hypothesis (FRTH).

This research is motivated by the fact that if the FRTH is correct, other central banks should have had a substantial decline in the correlation between their policy rate and sovereign long-term bond yield when they began using a short-term rate as their policy instrument. Simply stated, the experiences of other countries adopting interest rate targeting should be similar to that of the United States. This article examines the experiences of the Bank of England (BOE) and of the Reserve Bank of New Zealand (RBNZ). We use these countries because they implemented a policy of targeting a short-term rate as their policy rate, and we have sufficient data to see whether their experiences are comparable with that of the United States.[1]

The remainder of the article is in four sections. Because the FRTH is not the only possible explanation for the disconnect between the federal funds rate and the 10-year Treasury yield, Section 2 is used to summarize alternative hypotheses. To provide a foundation for our analysis, Section 3 reviews Thornton's (2018) methodology, analysis, and findings. Section 4 investigates the impact of the BOE and the RBNZ, respectively, adopting a policy-rate-targeting regime. Section 5 presents the summary and conclusions.

## 2 COMPETING HYPOTHESES

Thornton (2018) found that once the FOMC began using the funds rate as its policy instrument, the federal funds rate moved only when the FOMC changed its target for it. In contrast, the 10-year Treasury yield continued to respond to news as before. As a consequence, the correlation between changes in the funds rate and changes in the 10-year Treasury yield declined to zero.

However, the FRTH is not the only possible explanation for the disconnect between the federal funds rate and the 10-year Treasury yield. For example, Goodfriend (1993) suggested market participants believed the FOMC would not permit inflation to accelerate. If Goodfriend is correct about Fed credibility, long-term Treasury rates would not move with increases in the federal funds rate when rate increases were prompted by inflation scares. Thornton (2018) termed this the inflation expectation hypothesis (IEH).

Another explanation for Greenspan's conundrum requires the behavior of the federal funds rate to become more predictable. In this case, the 10-year Treasury yield would change in advance

**Bank of Canada**

On February 22, 1996, the Bank of Canada (BOC) announced that it would implement monetary policy by targeting its overnight rate and set its bank rate at the top of its operating band for the overnight rate. The BOC bank rate is the minimum rate of interest the BC charges financial institutions on overnight loans. The overnight rate is the rate at which major financial institutions borrow and lend overnight funds among themselves. The overnight rate is analogous to the federal funds rate; the bank rate is analogous to the Fed's primary credit rate. The BOC made those choices to make its policy intentions clearer. However, Borio (1997, p. 25) suggests the BOC began using the overnight rate as its policy instrument in June 1994 when it announced "an explicit 50 basis point operating band, communicated and validated by the offer to enter into repurchase transactions at those rates."

Unfortunately, data on the overnight rate are only available beginning January 1, 1996. Consequently, it is impossible to determine whether there was a dramatic change in the relationship between the overnight rate and the Canadian 10-year government bond yield after the BOC began using the overnight rate as its policy instrument.

of the FOMC's action, not when the FOMC changed its federal funds rate target. This hypothesis can be termed the policy predictability hypothesis (PPH).

Thornton (2018) performed a battery of tests on the competing hypotheses. These tests effectively ruled out the IEH and the PPH while providing strong support for the FRTH. Let's take a closer look at the methodology, analyses, and findings that support the FRTH.

## 3 THORNTON'S (2018) METHODOLOGY AND ANALYSIS

Thornton (2018) used both statistical evidence and documentary evidence to examine the FRTH. Let's begin with the key statistical evidence.

To determine when the break in the relationship between changes in the federal funds rate and changes in the 10-year Treasury yield occurred, Thornton (2018) estimated the following simple regression:

$$\Delta T10_t = \alpha + \beta \Delta FF_t + \varepsilon_t, \tag{1}$$

where $\Delta T10$ and $\Delta FF$ denote the change in the 10-year Treasury yield and in the federal funds rate, respectively; $\alpha$ and $\beta$ denote constant parameters; and $\varepsilon$ denotes a random error with a zero mean and a constant variance. This equation was estimated using a rolling regression with a window of 33 months over the period January 1983 through March 2007. The window size was determined by the number of months from July 2004, the month of the first increase in the FOMC's funds rate target, to March 2007. The starting date was chosen because Thornton (1988 and 2006) found that the FOMC began paying more attention to the federal funds rate in late 1982. The end date was chosen so the results would not be affected by the 2007-09 Financial Crisis. Thornton (2018) found that estimates of $\bar{R}^2$, which had been fluctuating around 25 percent, dropped to zero in the mid-1990s.

While the preceding analysis illustrates the decline in the correlation between the policy rate and the long-term Treasury yield, it does not date precisely when the change occurred. To date the time of the change more accurately, Thornton (2018) used the Andrews (1993) supremum test to identify the most likely date of the change. The test indicated May 1988 as the most likely date.

Believing the change may have occurred because the FOMC started using the federal funds rate as its policy instrument at about that time, Thornton (2018) turned to the verbatim transcripts of FOMC meetings and found documentary evidence supporting his conjecture. Poole, Rasche, and Thornton (2002) also support the conjecture. They looked at the "Credit Markets" column of the *Wall Street Journal* published at least two days before the FOMC changed the federal funds rate target and found that May 9, 1988, was the first time market participants were aware the policy action had been taken. Hence, the change in the relationship between the 10-year Treasury yield and the overnight federal funds rate was more likely not due to the "aberrant behavior" of the 10-year yield as Greenspan and others assumed, but rather due to a change in the behavior of the federal funds rate.

## 4 TESTING THE FRTH FOR ENGLAND AND NEW ZEALAND

If the FRTH is correct, the relationship between changes in a central bank's key interest rate and changes in long-term yields should have weakened substantially when the BOE and the RBNZ each began using those key rates as their policy instrument. Fortunately for our analysis, the timing of when these central banks made the change is well documented, as it is critical for establishing a causal relationship between the change in the implementation of monetary policy and the change in the relationship between changes in the policy rate and changes in the long-term yield. Because these banks are targeting other interest rates, not the federal funds rate, a more accurate term for the hypothesis under investigation is the interest-rate-targeting hypothesis (IRTH).

### *4.1 The BOE*

Like the Federal Reserve, the BOE targeted monetary aggregates until the late 1970s. Finding that monetary aggregates were increasingly less reliably connected to output and inflation, the BOE shifted its emphasis to a broad range of economic indicators.[2] The BOE's key rate is the bank lending rate. As with the Fed, the BOE increased the emphasis on the bank lending rate in conducting monetary policy over time. However, during the 1980s the BOE had an exchange rate target that constrained monetary policy. The exchange rate further constrained monetary policy in 1990 when the United Kingdom entered the European Exchange Rate Mechanism. In 1992, the BOE noted that economic conditions in Europe had created tension between setting the interest rate to maintain the exchange rate and setting it as required for the domestic economy. The United Kingdom withdrew from the European Exchange Rate Mechanism in September 1992, and the BOE began using the bank lending rate to implement monetary policy.

The IRTH suggests the BOE's adoption of the bank lending rate as its policy instrument should have produced a marked change in the relationship between changes in the 10-year gilt yield and changes in the policy rate around late 1992. Figure 1 shows for the United Kingdom the estimates of $\bar{R}^2$ from a 50-month rolling regression of changes in the BOE's policy rate and changes in the 10-year yield government bond yield for the period January 1972 through June 2007.[3] The data are plotted on the first month in the sample; the vertical line denotes October 1992. Similar to the Fed, when the BOE began using the bank lending rate as its policy instrument, the relatively strong and statistically significant relationship between changes in the 10-year yield and changes in the BOE's policy rate declined sharply and virtually vanished in late 1992. The fact that the correlation declined

## Figure 1

**50-Month Adjusted *R*-Squared Estimates from a Rolling Regression of the Change in the 10-Year Gilt Yield on the Change in the BOE's Policy Rate, January 1972 to June 2007**

NOTE: The data are plotted on the first month in the sample; the vertical line denotes October 1992.

SOURCE: BOE and authors' calculations.

to zero is a consequence of the fact that, like the FOMC, the BOE changed its target infrequently. This dating was confirmed by the Andrews (1993) break point test, which found October 1992 as the most likely date of the break in the relationship between the BOE's policy rate and the 10-year gilt yield.

### *4.2 The RBNZ*

Until the mid-to-late 1990s, the RBNZ used an eclectic approach to implementing monetary policy (Huxford and Reddell, 1996). In March 1997, the RBNZ proposed implementing policy by targeting the overnight cash rate; however, the policy was not implemented until March 1999. Again, if the IRTH is correct, there should be a marked change in the relationship between the cash rate and the 10-year government bond yield at about that time.

Figure 2 shows for New Zealand the estimates of $\bar{R}^2$ from a 50-month rolling regression of the change in the overnight cash rate and the change in the 10-year government bond yield for the period January 1986 through May 2012.[4] The data are plotted on the first month in the sample, and the vertical line denotes March 1999. There is a relatively weak and variable relationship between changes in the cash rate and changes in the 10-year yield prior to March 1999. This date was confirmed by the Andrews (1993) test, which determined March 1999 as the most likely date of the change. However, consistent with the IRTH, the estimate of $\bar{R}^2$ dropped to zero a few months before

## Figure 2

**50-Month Adjusted *R*-Squared Estimates from a Rolling Regression of the Change in the New Zealand 10-Year Government Bond Yield on the Change in the RBNZ Cash Rate, January 1986 to May 2012**

NOTE: The data are plotted on the first month in the sample; the vertical line denotes March 1999.

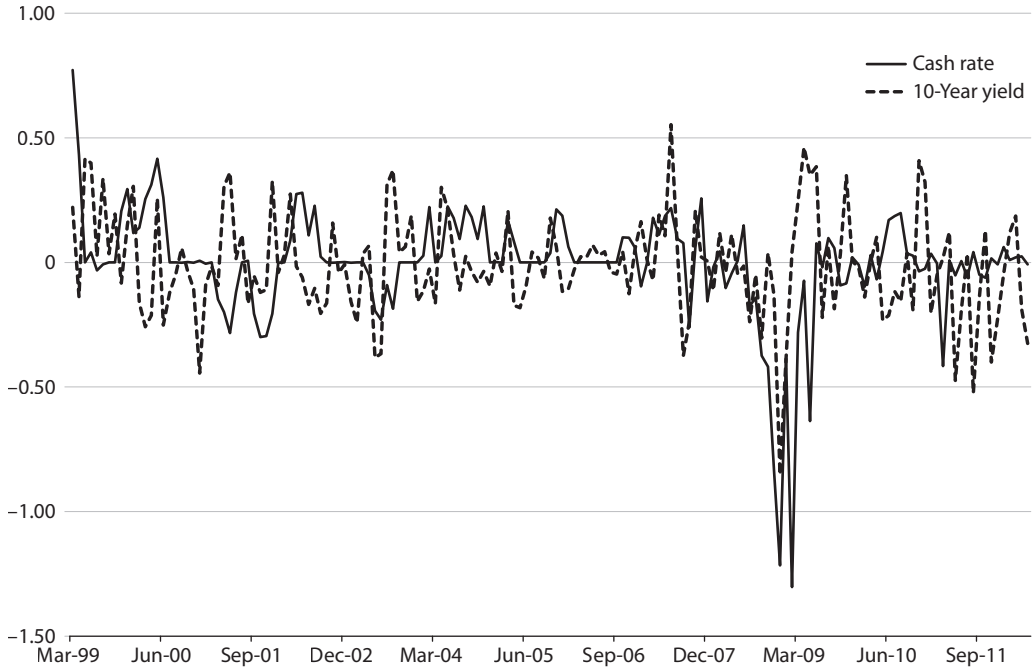
SOURCE: RBNZ and authors' calculations.

March 1999. It began to increase in mid-July 2003, peaking at over 40 percent in December 2004 before declining dramatically and returning to essentially zero by March 2008.

This dramatic rise and fall in the estimate of $\bar{R}^2$ is entirely due to five observations from September 2008 through January 2009 and to the fact that ordinary least squares is very sensitive to outliers. Figure 3 shows the change in the cash rate and the change in the 10-year yield from March 1999 through May 2012. The two rates moved independently except for the five noted observations, when the rates moved together. When the equation is estimated over the period March 1999 through May 2012, the relationship is weak; the estimate of $\beta$ is 0.13 with a $t$-statistic of 1.25 and $\bar{R}^2$ of 0.015. The relationship is even weaker when the five observations are deleted. The estimates of $\beta$ and $\bar{R}^2$ are –0.05 and –0.003, respectively. Hence, as was the case for the Fed and the BOE, the correlation fell to zero—and for the same reason: It occurred after the RBNZ began using the cash rate as its policy instrument. The dramatic change occurred just as the IRTH predicted. Just as with the Federal Reserve and the BOE, the weak but statistically significant relationship between the policy rate and the 10-year government bond yield vanished when the RBNZ began using its policy rate—the cash rate—as its policy instrument.

## Figure 3

**New Zealand 10-Year Government Bond Yield and RBNZ Cash Rate, March 1999 to May 2012**




SOURCE: RBNZ.

## 5 CONCLUSION

Thornton (2018) examined the explanatory power of the funds-rate-targeting hypothesis to explain what became commonly known as Greenspan's conundrum. He demonstrated that the breakdown in the correlation between changes in the federal funds rate and changes in 10-year Treasury yields was due entirely to the FOMC's adoption of the federal funds rate as its policy instrument.

We extend his line of reasoning by exploring the impacts of the adoption of interest rate targeting by the Bank of England and the Reserve Bank of New Zealand. In each case, the adoption of interest rate targeting is found to be closely related in time to a substantial breakdown in the relationship between the targeted interest rate and the long-term sovereign bond yield. Moreover, the date of the adoption of interest rate targeting varies across countries, so the date of the breakdown of the relationship between the policy rate and the long-term sovereign bond yield associated with interest rate targeting varies across countries. Hence, Thornton's explanation for Greenspan's conundrum is not limited to the United States, but rather has general applicability. ■

## NOTES

[1] See the boxed insert regarding the Bank of Canada's use of a short-term rate as its policy rate.

[2] Bank of England (1995).

[3] A 50-month window was used because the sample period was larger and could more easily accommodate a longer window. However, the results were not sensitive to other sizes of the window, such as 30 and 40 months.

[4] Once again, the use of 30- and 40-month rolling regressions produced similar results.

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