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Monetary Transmission: The Federal Funds Rate and the London Interbank Offered Rate (LIBOR)

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Abstract

This paper examines the effectiveness of a monetary transmission mechanism from the federal funds rate to the London Interbank Offered Rate (LIBOR). In particular, the paper employs a co-integration and vector error correction models to examine the degree and the direction of pass-through from the federal funds rate to the LIBOR. Two sub-periods are selected, 1987:02-1994:01 and 1994:02-2002:05, in order to examine this relationship. Results indicate a significant co-integration relationship between the federal funds rate and the LIBOR for the first and second periods. However, in the second period, the two variables adjust differently to a deviation from equilibrium.

JEL classifications: E00, E3, E4, E5, E6, F3, F4, G1, G2, N1, N2

Keywords: Federal Funds Rate; London Interbank Offered Rate (LIBOR); Interest Rate Pass-Through; Monetary Policy Transmission; Vector Error Correction (VEC) Model; Co-integration Vector Analysis

1. Introduction

Monetary policy impacts the economy through a number of transmission channels. In recent years, the Federal Reserve has increasingly focused on the federal funds rate (FFR) – the interest rate on overnight loans of bank reserves from one bank to another – as the primary instrument of monetary policy. Thus, a

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large amount of literature has emerged examining the relationship between the federal funds rate and market interest rates (see, Calem & Mester, 1995 and Scholnick, 1999).

This paper extends the research of Atesoglu (2003; 2005), Payne (2006) and Nishiyama (2007) by examining the relationship between the Federal Funds Rate (FFR) and the London Interbank Offered Rate (LIBOR). The LIBOR is a benchmark rate that leading international banks charge each other for short-term loans (Kiff, 2012). As Mishkin (2015) states:

> "One of the key transmission channels of monetary policy is the exchange rate. A tightening of monetary policy, for example, raises U.S. interest rates relative to those abroad, thereby inducing upward pressure on the foreign exchange value of the dollar. An appreciation of the dollar, in turn, restrains exports (because the price of U.S. goods rises when measured in foreign currencies) and stimulates imports (because imports become cheaper in dollar terms). The resulting decrease in net exports implies a reduction in aggregate demand. In addition, an appreciation of the dollar that leads to a decline in import prices also helps restrain overall U.S. inflation…"

However, if foreign interest rate, the LIBOR in this paper, moves quickly in tandem with the domestic interest rate, the FFR in this paper, then this foreign channel is weak. That is, if foreign interest rates respond in the same direction and magnitude as the domestic one, then the effects of the international channel would be minor.

This paper employs the co-integration and vector error correction models in order to empirically examine the relationship between the federal funds rate and the LIBOR (see Engle & Granger, 1987; Heffernan, 1997). Following Atesoglu (2003; 2005) two sub-periods are selected for examining this relationship. The first period spans from 1987:02 until 1994:01 and the second from 1994:02 to 2002:05. These periods are chosen because they represent two distinct policy regimes exercised by the Fed. Since the purpose of this paper is to investigate a case study of a specific change in monetary policy that occurred in February 1994, it is appropriate to concentrate only on data around this particular change.

This paper quantifies the direction and degree of pass-through between the policy rates (the FFR) to foreign lending rates (the LIBOR**).** This paper studies both the short and long term effects of this relationship.

Additionally, this paper contributes to the ongoing debate between Post Keynesian economists about whether the structuralist or horizontalist perspectives offer the best explanation for the endogeneity of the money supply. As Payne (2006) and Palley (1991) explain, the structuralist hypothesis maintains that loan supply is influenced by the Federal Reserve's policies and is positively associated with bank lending determined by both loan demand and supply. On the other hand, the horizontalist approach asserts that the Federal Reserve determines the short-term cost of funds with banks placing a markup over the federal funds rate in the provision of loans. As a result, the loan supply schedule is horizontal with loan demand determining the amount of bank lending.

The remainder of the paper is organized as follows. Section II reviews the literature. Section III presents the data, methodology, and results. Section IV offers concluding remarks.

2. Literature Review

Monetary policy impacts the economy through a variety of monetary transmission mechanisms. The federal funds rate is the principle focus of the literature on monetary transmission since it remains the main tool through which the Federal Reserve conducts monetary policy. There exists extensive literature that studies the relationship between the federal funds rate and other financial market instruments.

Recent examples include Rosen (2002) who studies bank deposit rates, and Atesoglu (2003) who analyzes the monetary transmission from the federal funds rate to the Prime Rate. Atesoglu (2005) also

investigates the relationship between the FFR and long-term interest rates. Hofmann and Mizen (2004) use evidence from retail interest rates of individual financial institutions to explore the monetary transmission mechanism. In a sequence of papers, Sander and Kleimeier (2004; 2006) and de Bondt (2005) study the transmission mechanism in euro-zone retail banking. Payne (2006) and Payne and Waters (2008) investigate the response of the conventional mortgage rate to the federal funds rate.

With the exception of Payne (2006), the literature uses two sub-periods, 1987:02-1994:01 and 1994:02-2002:05. These sub-periods are chosen by Atesoglu *op.cit*. Because in February 1994, the Fed changed the way it conducted monetary policy by explicitly announcing its target for the FFR. This change marked an important shift in the way monetary policy was implemented. Thus, this paper uses the same sub-periods. The second sub-period begins in February, 1994, when, as stated above, the Fed began making its target for the FFR public. Before February 1994, the target for FFR was less transparent. The literature regarding monetary transmission maintains that changes in federal funds rate targeting policy at the beginning of the second period increased the pace with which changes in the FFR are transmitted to other interest rates. The change improved the effectiveness of monetary policy. Payne (2006) uses the same starting date of 1987:02 but extends the time range to 2005:06.

Atesoglu (2003; 2005) and Payne (2006) employ Johansen co-integration and vector error correction modeling methods to ascertain the relationship between the FFR and various domestic interest rates. They examine two principle measures. The first is the co-integration coefficient that measures the degree of pass-through between the FFR and the second rate. The second measure is the error correction term, which reveals the lagged residual of the estimated co-integration equation and thus indicates the directional causality between the two interest rates (see, Newey & West, 1994). Complete pass-through occurs if the co-integration coefficient is equal to unity, while incomplete pass-through occurs if the co-integration coefficient is less than one. Both Atesoglu (2003) and Payne (2006) find a high degree of pass-through from the FFR onto other interest rates.

The literature on monetary transmission concerns itself mainly with the ongoing debate between Post Keynesian economists proposing diverging explanations to the endogeneity of the money supply, e.g., Rosen (2002), Atesoglu *op. cit*. (2003), and Payne (2006). The principle approaches are the structuralist and the horizontalist. Conclusions that reveal an asymmetric error correction model indicate unidirectional causality in monetary transmission and support the horizontalist view. Atesoglu (2003; 2005) and Payne (2006) reveal a stable long-term relationship and unidirectional causality between the FFR and other interest rates for the second sub-period.

Atesoglu (2003) examines the relationship between the federal funds rate and the Prime Rate during the two periods: 1987:02-1994:01 and 1994:02-2002:05. The results from both periods demonstrate a positive co-integration relation indicating a pass-through from the federal funds rate to the Prime Rate. However, Atesoglu (2003) points to several differences between the two periods. The results from the first period reveal a bi-directional causality between the FFR and the Prime Rate while the second period displays a unidirectional causality that runs from the FFR to the Prime Rate. Moreover, the margin between the federal funds rate and the Prime Rate is more volatile in the first period than the second one. Furthermore, the data for the second period reveal that an upward shift occurs in the markup of the Prime Rate over the FFR.

Atesoglu (2005) explores the relationship between the FFR and long-term interest rates, including the yields on both AAA corporate bond and the 30-year Treasury bond. The findings reveal a co-integrated relationship between the FFR and long-term interest rate. Atesoglu (2005) draws a division between the effects of the long-term interest rates in the short-term versus the long-term, a distinction that he does not make in his earlier paper (Atesoglu, 2003). Atesoglu (2005) demonstrates that in the short run the FFR does not have much effect on long-term interest rates, i.e., the first 12 months. In contrast with Atesoglu (2003), the peak effect from changes in the FFR occurs after about 30 months. The conclusion indicates that while there is an effect on long-term interest rates in the long run, the impact is smaller in the short run. Moreover, Atesoglu (2005) shows that despite moving together in the long run, the spreads between

AAA bond yield and the FFR, as well as the spread between 30-year Treasury bonds and the FFR, are quite volatile compared to the spread between the Prime Rate and the FFR found in (Atesoglu, 2003).

Payne (2006) studies the relationship between the federal funds rate and the fixed mortgage rate. He finds co-integration relationships between both rates and an incomplete, unidirectional pass-through. Compared to Atesoglu (2003, 2005), the co-integration coefficient is significantly different from unity for the relationship between the FFR and the fixed mortgage rate than for the relationship between the FFR and the Prime Rate or the long-term interest rate. Similar to Atesoglu (2005), Payne (2006) analyzes the relationship between the FFR and the fixed mortgage rate distinguishing between short and long-term effects. The findings by Payne (2006) dovetail Atesoglu (2005) by showing that the error correction model indicates a less significant relationship between the mortgage rate and federal funds rate in the short run, with the mortgage rate displaying a larger adjustment in the long run.

Researchers also study the relationship between the LIBOR and monetary policy. Fuertes and Heffernan (2009) find a sluggish adjustment of loan and deposit rates to changes in the LIBOR for the United Kingdom (UK). Ahmad, Aziz and Rummun (2013) study the relationship between the LIBOR and four other UK retail interest rates. The authors find evidence of incomplete pass-through in the short run but fairly complete pass-through in the long run.

The current paper is the first study to investigate the pass-through of the Federal Reserve's policy changes to non-domestic interest rates (see Mishkin, 2009). The LIBOR in this paper represents the non-domestic foreign interest rate.

3. The Data, Methodology and Results

This paper investigates the relationship between the FFR and the LIBOR before and after a major change in the disclosure by the Fed of its target for the FFR. Beginning in February 1994, the Fed clearly announced its target for the FFR, while prior to that date, the target was opaque.

3.1. Data

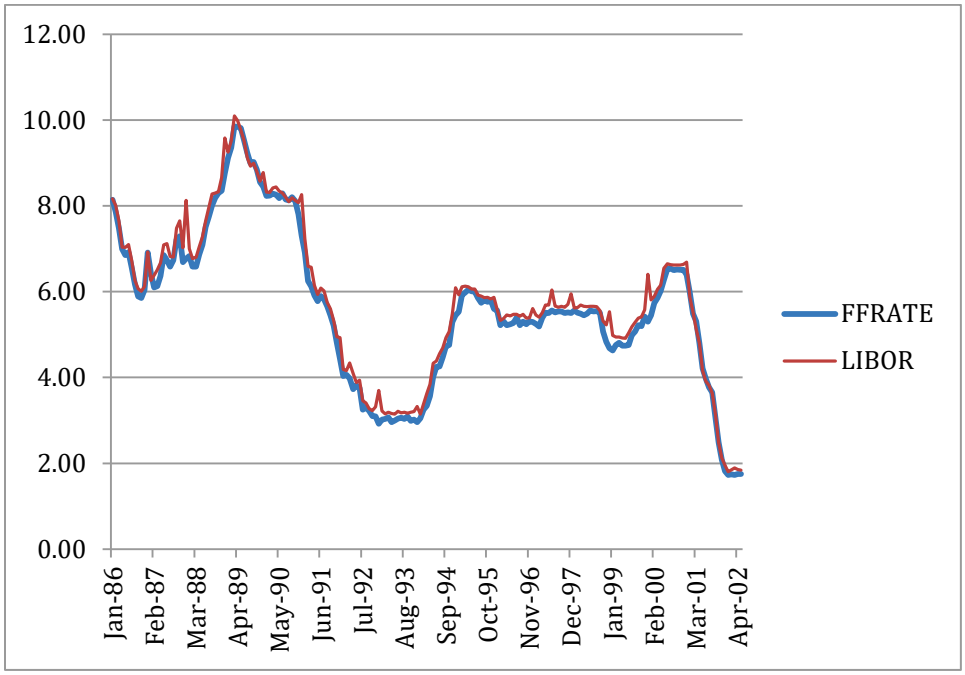

Figure 1: The FFR and LIBOR

The data consist of monthly time series of two interest rates, the federal funds rate and the LIBOR. The data for the federal funds rate and the LIBOR are obtained from the Federal Reserve Economic Data (FRED), a database maintained by the Federal Reserve Bank of St. Louis. The entire period under study spans from February, 1987 until May, 2002. Figure 1 shows that the two interest rates closely move together.

3.2. Unit Root Tests

Table 1A reports the Augmented Dickey-Fuller (ADF) tests for the FFR and the LIBOR for the two periods (see Dickey & Fuller, 1979). When estimated in the level of the variables, the unit-root tests reject the assumption of not having a unit root, implying that the relationships among the various variables, if analyzed in the level, are spurious. Table 1B presents the Phillips-Perron (1998) unit-root tests reaching the same conclusions. Similar tests show that once each series is differenced, both FFR and LIBOR have no unit roots, i.e., each series is stationary.

Table 1A: Unit Root Tests - Augmented Dickey-Fuller (ADF)

Variable	Period 1		Period 2	
	t-Statistic	Probability*	t-Statistic	Probability*
FFR	-0.208229	0.9323	-1.888726	0.3364
LIBOR	0.081148	0.9625	-1.872510	0.3440

*MacKinnon (1996) one-sided p-values.

Null Hypothesis Variable has a unit root.

Test critical values: 1% level -3.50, 5% level -2.89, 10% level -2.58.

Table 1B: Unit Root Tests – Phillips-Perron

Variable	Period 1		Period 2	
	t-Statistic	Probability*	t-Statistic	Probability*
FFR	-1.55828	0.503	-1.12479	0.704
LIBOR	-0.07493	0.948	-1.09373	0.716

*MacKinnon (1996) one-sided p-values.

Null Hypothesis Variable has a unit root.

Test critical values: 1% level -3.50, 5% level -2.89, 10% level -2.58.

3.3. Granger-Causality Tests

Table 2 presents the results of the Granger-Causality tests using the first differences of the variables, since the levels of the variables are non-stationary. The table shows that, for the two periods examined, the direction of causality is from FFR to LIBOR.

Table 2: Pairwise Granger Causality Tests

Null Hypothesis	Period 1	Period 1	Period 2	Period 2
	F-Statistic	Prob.	F-Statistic	Prob.
ΔLIBOR does not Granger Cause ΔFFR	1.09324	0.3661	1.75788	0.1442
ΔFFR does not Granger Cause ΔLIBOR	5.84329	0.0004	11.2163	2.00E-07

Since Granger-Causality tests do not capture the whole dynamic features of the variables and since they are non-stationary in their levels, the use of the Vector Error Correction (VEC) model is appropriate. Table 3 presents the results for the VEC. The paper utilizes VAR-based co-integration tests using the methodology developed in Johansen (1991; 1995). For Period 1, spanning from 1987:02 – 1994:01, there is a negative and significant co-integration relationship between the FFR and the LIBOR. The integration coefficient is -0.99 indicating an almost complete pass through from the FFR to the LIBOR. The error correction term is not significant for ΔFFR but is significant for ΔLIBOR, where Δ represents the first difference. This suggests that the LIBOR adjusts in response to the FFR to maintain the long run tandem relationship.

For Period 2, from 1994:02 until 2002:05, the equilibrium equation has a significant coefficient of -1, again indicating that in the long run the two variables move jointly. However, the two variables adjust differently to deviations from equilibrium: The coefficient on ΔLIBOR is not significant, indicating that the LIBOR is not adjusting to a deviation from the long run equilibrium. The coefficient for ΔFFR is 0.5 and highly significant. This implies that 50 percent of the deviation from equilibrium is completed within a month and that the FFR follows the LIBOR.

Table3: Estimation results of the error correction model

Sample Period: 1987:02-1994:01				
	Intercept	Federal Funds Rate	Error Correction Term	R^2
OLSQ	0.272 (3.880)**	0.990 (92.996		0.99
Johansen	-0.240	-0.994 (73.178)**		
ΔFFR			0.044 (0.330)	
ΔLIBOR			-0.737 (3.840)**	
Sample Period: 1994:02-2002:05				
	Intercept	Federal Funds Rate	Error Correction Term	R^2
OLSQ	0.125 (1.695)	1.010 (0.014)**		0.98
Johansen	-0.166	-1.002 (-60.884)**		
Delta FF			0.509 (4.278)**	
Delta LIBOR			-0.222 (-1.422)	

** Significant at 1% level

4. Concluding Remarks

This paper extends the research of Atesoglu (2003; 2005), Payne (2006) and Nishiyama (2007) by examining the relationship between the Federal Funds Rate and the London Interbank Offered Rate**.** Whereas Atesoglu (2003) analyzes the monetary transmission from the federal funds rate to the Prime Rate and Atesoglu (2005) investigates the relationship between the FFR and U.S. long-term interest rates, this paper focuses on the relationship with an external interest rate, namely the LIBOR. Using Vector

Error Correction (VEC) model the paper finds that long term equilibrium equations exist for the two studied periods. Surprisingly, the paper finds that in the first period the LIBOR adjusts quickly to changes in the FFR, while in the second period, after the policy of the FED became more transparent, the FFR adjusted to changes in LIBOR. These findings cast doubt over the ability of the Fed to influence the economy through an international channel.

These findings are in contrast to results reported by Atesoglu (2003; 2005) with respect to the Prime rate and long-term interest rates (AAA corporate bond rate and 30-year U.S. Treasury Note rate), and the results reported by Payne (2006) with respect to U.S. Mortgage Rates. In contrast, the conclusions of this paper are that the international channel is weak. In other words, it seems that the Fed has weaker effect on the foreign interest rate.

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