The Developing Economies

The Developing Economies 54, no. 4 (December 2016): 271–91

INTEREST RATE PASS-THROUGH IN MONGOLIA

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First version received January 2016; final version accepted June 2016

This study empirically examines the interest rate pass-through of the money market interest rate to bank lending and bank deposit interest rates in Mongolia using both linear and nonlinear autoregressive distributed lag (ARDL) models. The results from the empirical analysis using data from December 2002 to September 2015 suggest that interest rate pass-through is generally weaker, slower, and asymmetric in Mongolia. The new findings provide evidence that: (i) interest rate pass-through has improved over time; (ii) the bank deposit rate has a higher long-run interest rate pass-through and slower adjustment than the bank lending rate; and (iii) there is a negative long-run asymmetric pass-through with respect to the bank lending rate and a positive long-run asymmetric pass-through with respect to the bank deposit rate.

Keywords: Interest rate pass-through; Linear and nonlinear ARDL models; Asymmetric cointegration; Asymmetric dynamics multipliers; Mongolia
JEL classification: C51, E43, E52, E58

I. INTRODUCTION

IN the early years of this century, Mongolia was one of the world's fastest growing economies as a result of large foreign direct investment (FDI) in the mining sector. FDI averaged 40% of GDP, annual growth exceeded 15% in the period 2011–12, and economic growth has averaged 9% over the past decade. However, the economy has faced sharp declines in FDI and coal exports since 2013. During the years of low FDI and coal exports, the Mongolian authorities have implemented expansionary policies with large fiscal deficits and external borrowing. As a result, public debt has risen sharply. For instance, public debt reached 76.5% of GDP in 2014 and, given ongoing deficits, it is expected to peak at 92.5% of GDP in 2017 (IMF 2015). Given the political and economic realities, the role played by fiscal policy in economic stabilization efforts has been diminishing, while the importance of monetary policy has grown. Monetary policy has been seen as a key instrument

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doi: 10.1111/deve.12112

of counter-cyclical policy, which is mainly directed at smoothing the business cycle. Smoothing the swings in economic activity is important for achieving price stability and high employment over the course of the cycle. Moreover, the Bank of Mongolia (BOM) has been considering moving toward an inflation targeting regime as the guiding framework for monetary policy. Therefore, a sound understanding of the monetary policy transmission mechanism is important for successfully implementing counter-cyclical policy and adopting an inflation targeting regime.

The interest rate pass-through process is an important part of the monetary policy transmission. The eventual impact that a change in policy rate (i.e., monetary policy stance) has on the business cycle and inflation depends on how the change is transmitted to other interest rates in the economy. In particular, the pass-through of policy-controlled interest rates[1] to retail interest rates determines the effectiveness of monetary policy. However, retail interest rates set by banks directly influence their profitability and soundness and hence financial stability (De Bondt 2005). Consequently, the interest rate setting behavior of banks plays a vital role in the transmission of monetary policy.

For the effective operation of monetary policy, the adjustment of a bank's interest rates to a change in policy-controlled interest rates should be symmetric, quick, and large enough to influence aggregate demand (Apergis and Cooray 2015). However, the literature suggests that the interest rate pass-through varies according to markets and countries as both microeconomic and macroeconomic factors affect the adjustment of retail banks' interest rates. Several studies (e.g., Cottarelli and Kourelis 1994; De Bondt 2005) have found evidence of the stickiness of bank interest rates and the sluggishness of bank responses to a change in policy-controlled interest rates. As summarized by Apergis and Cooray (2015), there are a number of factors (e.g., price leadership, imperfect information, imperfect competition, agency costs, customer-switching costs, and central bank intervention) that explain the rigidity of bank interest rates. The asymmetric adjustment of bank interest rates has been found in several countries: Australia (Lim 2001; Valadkhani and Anwar 2012; Apergis and Cooray 2015); Canada (Panagopoulos, Reziti, and Spiliotis 2010); the Eurozone (Cecchetti 1999; Favero, Giavazzi, and Flabbi, 1999); the United Kingdom (Hofmann and Mizen 2004); Italy (Gambacorta and Innotti 2007); Singapore and Malaysia (Scholnick 1996); and Hong Kong, South Korea, Indonesia, and Thailand (Yu, Chun, and Kim 2013).

Although there is no particular study focusing on the interest rate pass-through in Mongolia, some studies have estimated the relationship between bank interest rates

[1] In general, central banks steer money market interest rates (so as to keep the market rates at or near the policy rate) using their dominant influences on money market conditions. Thus, the strength of the monetary policy transmission rest on the degree and speed of the retail interest rate adjustment to changes in money market interest rates.

and policy-controlled interest rates. Batnyam, Doojav, and Łyziak (2008) estimate the bank lending rate equation as an equation of the Small Inflation Model of Mongolia and find an incomplete and sluggish adjustment of the bank lending rate in response to a change in the one-week central bank bill rate. Doojav (2011) estimates equations for bank lending and bank deposit rates as equations of the structural model of inflation in Mongolia and shows that there were significant short- and long-run relationships between the bank-lending rate and the policy rate, with no significant relationship between policy rate and bank deposit rate. Doojav (2012) also examines the determinants of the bank lending and bank deposit rates using bank-level (panel) data over the period 2003–Q1 and 2009–Q2 and finds that the money market rate was an important factor in explaining both bank lending and bank deposit rates. In particular, the study emphasizes that the money market rate has a strong and quick impact on the bank lending rate compared to the bank deposit rate. In a recent study, Doojav and Dulamzaya (2014) investigate the cost channel of monetary policy in Mongolia using a Bayesian dynamic stochastic general equilibrium (DSGE) approach and show that the pass-through of the money market rate to the bank lending rate is incomplete (i.e., the maximum pass-through was 30% of initial shock). Their study concludes that the incomplete and sluggish interest rate pass-through weakened the cost channel, and the interest rate setting behaviour of banks played an important role in the transmission of monetary policy. Bayardavaa, Batmunkh, and Chuluun (2015) analyze monetary policy transmission using vector autoregression (VAR) models and find that a change in the interbank market (IBM) rate has significantly affected the bank lending rate with time lags of 1–2 quarters.

This study differs from the existing empirical literature on the interest rate pass-through in Mongolia not only because of the difference in the sample periods but also because of the difference in the methodology. In this study, both linear and nonlinear autoregressive distributed lag (ARDL) models respectively proposed by Pesaran, Shin, and Smith (2001) and Shin, Yu, and Greenwood-Nimmo (2014) are employed. The ARDL approach has important advantages over other methodological approaches in modeling cointegration dynamics as it provides greater flexibility in relaxing the assumptions that the time series should be integrated in the same order. The nonlinear ARDL model allows a joint investigation of short- and long-run asymmetries in the interest rate pass-through and detects hidden cointegration (Shin, Yu, and Greenwood-Nimmo 2014). In this regard, this study adds to the growing literature by using data from a fast-growing developing country, Mongolia, and applies the nonlinear ARDL model in the context of the interest rate pass-through process (Greenwood-Nimmo et al. 2011; Yu, Chun, and Kim 2013; Apergis and Cooray 2015).

Thus, the objective of this study is to empirically examine the interest rate pass-through of the money market interest rate to bank lending and bank deposit interest rates in Mongolia. As a first attempt to estimate the long-run interest rate pass-through in Mongolia, this study aims to answer the following specific questions: (1) How much and how quickly is a change in the money market rate reflected in the bank lending and bank deposit rates? (2) How has the interest rate pass-through evolved over time? and (3) Is the adjustment of bank interest rates in response to a change in the money market rate asymmetric? By addressing these questions, this study contributes to the literature on the asymmetric interest rate pass-through in developing and natural resource–based economies such as Mongolia.

The rest of this study is structured as follows. Section II provides background on the operation of monetary policy in Mongolia. Section III describes the modeling of the interest rate pass-through and the data employed. Section IV provides empirical results on the estimates of interest rate pass-through. Finally, Section V concludes the study with some policy implications and directions for future research.

II. THE OPERATION OF MONETARY POLICY IN MONGOLIA

The banking sector plays an important role in the Mongolian economy as the sector accounts for 95% of the financial system's total assets. Banks therefore are the main mechanisms for the transmission of monetary policy and they serve a vital role in the creation of money supply in the economy. Like other developing and transition economies, the Mongolian banking sector faces special challenges. The banking sector is characterized by extremely short maturities on financial liabilities; thus the business loan term is short (less than two years). Volatile capital flows and domestic liability dollarization lead to exchange rate risk on banks or their customers because of underdeveloped foreign exchange hedging. Banks have relatively low capital to assets and are highly leveraged, making them more vulnerable to liquidity problems. Given the history of banks' failures, a change in public confidence for a bank quickly triggers bank runs. Accordingly, the banking sector is more likely to be subjected to domestic and external shocks.

The BOM implements independent monetary policy using the policy rate[2] as its main instrument to signal its monetary policy stance. The policy interest rate is set with the aim of influencing prices and aggregate demand in the economy. As an operating target, the policy interest rate is periodically adjusted by the Monetary Policy Committee (MPC).[3] The monetary policy operation focuses on maintaining conditions in the money market so as to keep the market rate at or near an operating

[2] In current practice, the policy rate is equal to the interest rate paid on the one-week central bank bill.

[3] The MPC was established in October 2012. According to current practice, independent members of the MPC are appointed by the governor of the BOM, but not by the parliament. The MPC discusses monetary policy proposals prepared by the BOM staff through three steps and announces its decision in official press conferences and through the public media.

target (i.e., the policy rate). Changes in the policy rate affect the IBM rate and further affect the entire structure of interest rates. By conducting open-market operations, mainly central bank bills with maturities of less than one month, the BOM controls the availability of settlement funds used to settle transactions among commercial banks and hence the market interest rate charged on overnight funds.

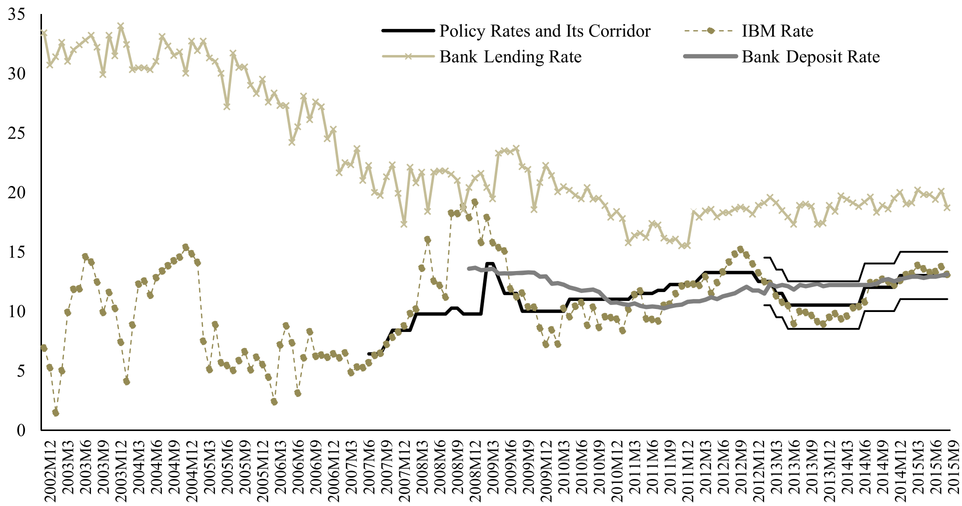
Prior to July 2007, the BOM did not announce its desired level for the money market rate, but it had announced operating targets for monetary aggregates. During that period, monetary policy operated through a mixture of open-market operations and direct controls on bank interest rates, reserve requirements, and various other balance sheet restrictions. However, the BOM affected the money market rate by operating in the market for settlement funds to achieve its operational targets, which meant that there was considerable volatility in the market rates. This operating system had some problems, including difficulty for the market and the public to distinguish between noise and a change in monetary policy. In addition, the link between the policy instruments and the operating target (i.e., monetary aggregates) and between the operating target and the ultimate target (i.e., the price stability) had been weakened as a result of financial liberalization and deregulation.

As shown in Figure 1, the spread between the bank lending rate and the IBM rate was around 20% at the beginning of the 2000s. The high bank lending rate was caused by both high bank deposit rates and a large intermediation spread (defined here as the difference between bank lending and bank deposit rates). The high and persistent inflation during the 1990s and bank failures between 1996 and 1999, driven by bad loan portfolios of state-owned banks, led to the high bank deposit rate. However, the large intermediation spread was driven by several micro and macro factors, including high nonperformance loan, high reserve requirement ratio (i.e., 14%), high market risks (measured by the volatilities of exchange rate and IBM rate), banks' cost inefficiency (measured by share of operational cost to total costs), low economic growth, and low performance of financial intermediation.

The bank lending rate decreased slightly between 2004 and 2008; however, the spread between the bank lending rate and the IBM rate remained at a high level. The decrease in the bank lending rate can be mainly explained by the surge in money supply due to FDI in the mining sector. Owing to the monetization process in the economy, inflation was relatively low in the period 2004–6. Monetary policy was still loose in this period as there was political pressure to reduce the bank lending rate. As a consequence, the spread between the bank lending rate and the IBM rate was kept at a high level until the BOM started to tighten its monetary policy to control high inflation during the period 2007–8 (i.e., average inflation was about 25% in 2008), mainly caused by high food and petroleum prices.

In July 2007, the BOM began announcing the policy rate (i.e., the desired level for the money market rate) as a new operational target of monetary policy. The impact on the money market, bank lending, and bank deposit rates of announcing the policy rate

Fig. 1. Interest Rates in Mongolia during 2002M12–2015M9



Source: *Bank of Mongolia Monthly Statistical Bulletin.*
Notes: 1. IBM = interbank market.
2. The (middle) bold black line is the policy rate. The thinner two lines around the policy rate represent the corridor of the policy rate. The thinner line above is the overnight repo rate, which is equal to "policy rate + 2%." The thinner line below is the overnight deposit rate, which is equal to "policy rate − 2%". The overnight repo and overnight deposit are standing facilities of the Bank of Mongolia used in the implementation of monetary policy.

is shown in Figure 1. Until February 2008, there was a tight link between the policy rate and the market rate. However, the money market rate surged in 2008 owing to the liquidity shortage of commercial banks driven by the economic recession during the global financial crisis (GFC). Since June 2009, the money market rate has been less volatile, with the market rate being close to the policy rate. Furthermore, moderate co-movements between the market rate and bank interest rates have been observed since 2009.

In February 2013, the MPC at the BOM decided to introduce an interest rate corridor system in order to strengthen the interest rate channel of monetary policy. The interest rate corridor around the policy rate consists of two end-of-day standing facilities (i.e., overnight repo and overnight deposit). The rate of overnight repo facility and the rate of overnight deposit facility are respectively the "ceiling" (policy rate plus two percentage points) and the "floor" (policy rate minus two percentage points) of the corridor (see Figure 1). Within this system, the monetary policy is much more transparent and easier to explain as it works directly through the short-term interest rate. Establishing the interest rate corridor system has played a vital role in maintaining the IBM rates within the desired levels.

III. MODELING OF INTEREST RATE PASS-THROUGH AND DATA

A. *Theoretical Background*

Central banks steer short-term money market rates using their dominant influences on money market conditions. The short-term money market rates may directly affect the market rates with a longer maturity. De Bondt (2005) explains the pass-through of the money market rates to bank interest rates using the cost-of-funds approach, which is based on a standard marginal cost-pricing model developed by Rousseas (1985). The approach suggests a positive relationship between money market rates and bank retail rates, which can be formalized in the following markup pricing model equation:

$$r_t^B = \alpha + \beta r_t^M, \tag{1}$$

where r_t^B is the interest rates set by banks (with $B = L, r_t^L$ is the bank lending rate; and with $B = D, r_t^D$ is the bank deposit rate), α is constant markup, β is the degree of long-run interest rate pass-through, and r_t^M is the marginal cost approximated by a policy-controlled or money market rate. If markets are perfect (i.e., full information and perfect competition) and banks are risk neutral, the parameter β would be equal to one, implying a complete interest rate pass-through or a unit interest-rate elasticity of demand for deposits and loans (De Bondt 2005). The parameter β will also be less than one if markets are imperfect (i.e., some degree of market power and asymmetric information).

B. *Empirical Model Specifications*

The linear and nonlinear ARDL models respectively proposed by Pesaran, Shin, and Smith (2001) and Shin, Yu, and Greenwood-Nimmo (2014) are used to examine the interest rate pass-through of the money market rate to the bank lending and bank deposit rates. These models have important advantages over the other existing techniques in modeling cointegration dynamics as they provide greater flexibility in relaxing the assumptions that the time series should be integrated of the same order and perform better in testing for cointegration in small samples (Romilly, Song, and Liu 2001). The nonlinear ARDL model also allows us to accurately distinguish between the absence of cointegration, linear cointegration, and nonlinear cointegration (Katrakillidis and Trachanas 2012).

Equation (1) represents the linear long-run equilibrium relationship. As shown by Pesaran, Shin, and Smith (2001), the out-of-equilibrium adjustment is best described by the error-correction process, which comes from the linear ARDL (p, q) model:

$$\Delta r_t^B = \gamma_0 + \gamma_1 t + \rho^l r_{t-1}^B + \theta r_{t-1}^M + \sum_{j=1}^{p-1} \phi_j^l \Delta r_{t-j}^B + \sum_{j=0}^{q-1} \varphi_j^l \Delta r_{t-j}^M + \varepsilon_t,$$

$$= \gamma_1 t + \rho^l \xi_{t-1} + \sum_{j=1}^{p-1} \phi_j^l \Delta r_{t-j}^B + \sum_{j=0}^{q-1} \varphi_j^l \Delta r_{t-j}^M + \varepsilon_t, \tag{2}$$

where t is the time trend, ρ^l measures the speed of adjustment, θ is the (symmetric) long-run multiplier, ϕ_j^l is the autoregressive parameter, φ_j is the short-run pass-through coefficient, $\xi_t\left(= r_t^B - \alpha - \beta r_t^M\right)$ is the error correction term where $\beta = -(\theta/\rho^l)$ and $\alpha = -(\gamma_0/\rho^l)$ are the long-run parameters in equation (1), and ε_t is an i.i.d. process with zero-mean and constant variance σ_ε^2. The current and lagged values of Δr_{t-j}^M and lagged values of Δr_t^B are used to analyze the short-run dynamics. The symbols p and q are the respective lag orders for the dependent variable. To jointly investigate the short- and long-run asymmetries in the interest rate pass-through process, the nonlinear ARDL model is also used. In the framework, the asymmetric long-run relationship is defined as:

$$r_t^B = \gamma + \beta^+ r_t^{M+} + \beta^- r_t^{M-}, \tag{3}$$

where r_t^M is decomposed as $r_t^M = r_0^M + r_t^{M+} + r_t^{M-}$, where r_0^M is the initial value of the series, r_t^M, and r_t^{M+} and r_t^{M-} are the partial sum process of positive and negative changes in r_t^M:

$$r_t^{M+} = \sum_{j=1}^{t} \Delta r_j^{M+} = \sum_{j=1}^{t} \max\left(\Delta r_j^M, 0\right), \tag{4}$$

$$r_t^{M-} = \sum_{j=1}^{t} \Delta r_j^{M-} = \sum_{j=1}^{t} \min\left(\Delta r_j^M, 0\right). \tag{5}$$

The β^+ and β^- in equation (3) are the associated asymmetric long-run pass-through parameters, indicating that bank lending/bank deposit interest rates respond asymmetrically during the rising and falling periods of the money market rate. Suppose that $|\beta^+| < |\beta^-|$ in equation (3), which suggests that the long-run effect of a unit negative change in r_t^M will reduce bank interest rate r_t^B, by a greater amount than a unit positive change would increase it. Thus, the model includes a regime-switching cointegrating relationship in which the regime transitions are governed by the sign of Δr_t^M.

Following Shin, Yu, and Greenwood-Nimmo (2014), the error-correction form of the nonlinear ARDL (p, q) model can be written as:

$$\begin{aligned}\Delta r_t^B &= \mu_0 + \mu_1 t + \rho^{nl} r_{t-1}^B + \theta^+ r_{t-1}^{M+} + \theta^- r_{t-1}^{M-} + \sum_{j=1}^{p-1} \phi_j^{nl} \Delta r_{t-j}^B \\ &\quad + \sum_{j=0}^{q-1} \left(\varphi_j^+ \Delta r_{t-j}^{M+} + \varphi_j^- \Delta r_{t-j}^{M-} \right) + \varepsilon_t, \\ &= \mu_1 t + \rho^{nl} \zeta_{t-1} + \sum_{j=1}^{p-1} \phi_j^{nl} \Delta r_{t-j}^B \\ &\quad + \sum_{j=0}^{q-1} \left(\varphi_j^+ \Delta r_{t-j}^{M+} + \varphi_j^- \Delta r_{t-j}^{M-} \right) + \varepsilon_t, \end{aligned} \tag{6}$$

where ρ^{nl} measures the speed of adjustment, θ^+ and θ^- are asymmetric long-run multipliers, ϕ_j^{nl} is the autoregressive parameter, φ_j^+ and φ_j^- are the asymmetric short-run pass-through coefficients, $\zeta_t \left(= r_t^B - \gamma - \beta^+ r_t^{M+} - \beta^- r_t^{M-}\right)$ is the error-correction term where $\beta^+ = -(\theta^+/\rho^{nl})$, $\beta^- = -(\theta^-/\rho^{nl})$, and $\gamma = -(\mu_0/\rho^{nl})$ are the associated long-run parameters in equation (3), and ε_t is an i.i.d. process with zero-mean and constant variance σ_ε^2. The symbols p and q are the respective lag orders for the dependent variable.

The linear and nonlinear ARDL procedures (i.e., bounds-testing approaches) to the long-run relationship involve two stages. The first stage is to establish a long-run relationship among the interest rates in equations (1) and (3). In the second stage, the long- and short-run coefficients of equations (2) and (6) are estimated to analyze the dynamic characteristics of the model.

As emphasized by Pesaran, Shin, and Smith (2001) and Shin, Yu, and Greenwood-Nimmo (2014), equations (2) and (6) can be estimated by standard ordinary least squares (OLS). The null hypothesis of no long-term relationship can be tested with the bounds-testing procedure. Banerjee, Dolado, and Mestre (1998) propose the t-statistics for testing the null hypothesis: $H_0 : \rho^l = 0$ for the symmetric model and $H_0 : \rho^{nl} = 0$ for the asymmetric model. Pesaran, Shin, and Smith (2001) propose an F-test of the joint null hypotheses: $H_0 : \rho^l = \theta = 0$ for the symmetric model and $H_0 : \rho^{nl} = \theta^+ = \theta^- = 0$ for the asymmetric model. The hypothesis can be examined using the standard t- and F-statistics. These statistics are respectively denoted as t_{BDM} and F_{PSS} in this study, where the letters "BDM" refer to "Banerjee, Dolado, and Mestre" and "PSS" to "Pesaran, Shin, and Smith," respectively.

However, the t- and F-tests have a nonstandard distribution and critical values are reported by Pesaran, Shin, and Smith (2001).[4] If there exists an asymmetric long-run relationship, then long- and short-run asymmetries can be examined using a standard Wald test.[5] Furthermore, the nonlinear ARDL models can be used to derive

[4] If the computed F-statistic falls outside the critical bounds, a conclusive decision can be made regarding cointegration. This conclusion remains valid irrespective of the order of integration of the regressors.

[5] The null hypotheses are $H_0 : \theta^+ = \theta^-$ for the long-run symmetry and $H_0 : \sum \varphi_j^+ = \sum \varphi_j^-$ for the short-run symmetry.

cumulative dynamic multiplier effects of a unit change in the market rate r_t^M (or r_{t-1}^{M+} and r_{t-1}^{M-}) on bank interest rates r_t^B. The symmetric and asymmetric cumulative dynamic multiplier effects can be evaluated as follows:

$$m_h = \sum_{j=0}^{h} \frac{\partial r_{t+j}^B}{\partial r_t^M},\ m_h^+ = \sum_{j=0}^{h} \frac{\partial r_{t+j}^B}{\partial r_t^{M+}},\ m_h^- = \sum_{j=0}^{h} \frac{\partial r_{t+j}^B}{\partial r_t^{M-}}, (h = 0, 1, 2, \ldots). \tag{7}$$

Notice that as $h \to \infty$, $m_h \to \beta$, $m_h^+ \to \beta^+$, and $m_h^- \to \beta^-$, where $\beta = -(\theta / \rho^l)$, $\beta^+ = -(\theta^+ / \rho^{nl})$, and $\beta^- = -(\theta^- / \rho^{nl})$ are the long-run pass-through coefficients. In other words, the ARDL models can analyze the path to a new long-run steady state from an initial equilibrium after a shock to the money market rate r_t^M.

C. *Data*

The dataset includes the monthly time series of (weighted average) bank lending rate, (weighted average) bank deposit rate, and IBM rate (i.e., the money market rate or the policy-controlled interest rate). As the policy rate does not vary much, the money market rate, which closely follows the policy rate, is used as a proxy for it. The data on the bank lending rate (r^L) and money market rate (r^M) cover the period from December 2002 to September 2015. However, the data on the bank deposit rate (r^D) are only available for the period from December 2008 to September 2015.[6] All data series are obtained from the *Bank of Mongolia Monthly Statistical Bulletin*.

In the empirical analysis, two subsamples are also considered in order to examine how interest rate pass-through (from the money market rate to the bank lending rate) changes over time. In particular, the full sample is divided into subsamples of 2002M12–2008M11 and 2008M12–2015M9. The choice of the period 2008M11 is based on the following considerations. First, although the policy rate was formally announced in July 2007, the link between the policy rate and the money market rate has been strengthened since December 2008 (see Figure 1). The main reason behind the weak link during the period from 2007M7 to 2008M12 was the liquidity shortage of the banking sector during the economic recession caused by the GFC. Second, the bank lending rate had a general decreasing trend until the end of 2008, and since then, the general trend has disappeared (see Figure 1).

6 Prior to December 2008, the BOM did not calculate the weighted-average deposit rate and published interest rate ranges of 0–1 year-time deposits.

IV. EMPIRICAL RESULTS

A. *Results of Unit Root Test*

If the order of integration of a variable is greater than one (e.g., $I(2)$ variable), then the critical bounds provided by Pesaran, Shin, and Smith (2001) and Narayan (2005) are not valid.[7] Thus, it is necessary to test for unit roots to ensure that all variables satisfy the underlying assumptions of the ARDL bounds-testing approach of cointegration before proceeding to the estimation.

As shown by Perron (1989), conventional tests for unit roots such as Dickey and Fuller (1979), Augmented Dickey-Fuller have low power in the presence of structural breaks. To overcome this problem, Perron and Vogelsang (1992) and Perron (1997) developed unit root tests, which include one endogenously determined structural break. Results of the unit root test based on "innovational outlier model" developed by Perron (1997) are presented in Table 1.

The test results indicate that interest rates in all samples are of mixed order of integration (i.e., $I(0)$ or $I(1)$). Thus, standard cointegration tests such as Johansen (1991, 1995) cannot be employed as these tests require all variables to be $I(1)$. However, the ARDL bounds-testing approach can be employed to analyze the cointegration among interest rates as the test result is the same irrespective of whether the regressors are $I(0)$ or $I(1)$ (Pesaran, Shin, and Smith 2001).

B. *Bounds Testing for Cointegration and Estimates of Interest Rate Pass-Through*

To examine symmetric and asymmetric interest rate pass-through, equations (2) and (6) are estimated, respectively. The maximum lag length in ARDL models is selected as $p = q = 12$ for all subsample estimations. To obtain the optimal lag length, 156 and 2,028 models are estimated for selecting linear and nonlinear ARDL models, respectively. Selection of an appropriate lag length for the ARDL models is based on the Schwarz Bayesian Criterion (SBC).[8] However, in some cases, the ARDL model with the selected lag length did not pass diagnostic tests. In this case, the model

[7] Their critical values are computed based on $I(0)$ or $I(1)$ variables. Narayan (2005) argues that existing critical values based on a large sample size cannot be used for small sample sizes, and therefore regenerated the set of critical values for the limited data ranging from 30 to 80 observations by employing Pesaran, Shin, and Smith's (2001) GAUSS (a programming language) code.

[8] As stated by Pesaran and Shin (1999), the SBC is generally used in preference to other criteria because it tends to define more parsimonious specifications.

TABLE 1

Results of Unit Root Test for All Series

Series	Levels		First Differences		Order of Integration
	T_b	$t_{\hat{\alpha}}$	T_b	$t_{\hat{\alpha}}$	
Sample period; 2003M1–2015M9:					
r_t^L	2008M6	–5.42**	2010M1	–18.21***	$I(0)$
r_t^M	2007M9	–3.35	2005M3	–13.71***	$I(1)$
r_t^{M+}	2008M8	–5.53**	2008M9	–12.87***	$I(0)$
r_t^{M-}	2005M2	–2.92	2005M3	–13.72***	$I(1)$
Sample period; 2003M1–2008M11:					
r_t^L	2007M1	–6.42***	2008M1	–14.24***	$I(0)$
r_t^M	2005M2	–3.97	2006M7	–7.59***	$I(1)$
r_t^{M+}	2005M2	–4.13	2005M3	–8.98***	$I(1)$
r_t^{M-}	2008M9	–4.70	2008M8	–8.63***	$I(1)$
Sample period; 2008M12–2015M9:					
r_t^L	2012M1	–6.03***	2010M4	–10.23***	$I(0)$
r_t^D	2010M10	–5.24**	2010M12	–11.54***	$I(0)$
r_t^M	2010M3	–3.37	2012M10	–13.44***	$I(1)$
r_t^{M+}	2010M3	–4.06	2010M4	–11.40***	$I(1)$
r_t^{M-}	2012M12	–3.84	2011M6	–13.93***	$I(1)$

Notes: 1. The test is performed using the t-statistics for the null hypothesis H_0: $\alpha = 1$ in the regression:

$$y_t = \mu + \theta DU_t + \beta t + \gamma DT_t + \Delta(T_b)_t + \alpha y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + e_t, \text{where } DU_t = 1$$

$(t > T_b)$, $(T_b)_t = 1(t = T_b + 1)$, and $DT_t = 1(t > T_b)t$.

2. The numbers of optimal lags (k) are based on Schwarz Bayesian Criterion (SBC).
3. Break point selections, T_b, are based on minimization of the Dickey-Fuller t-statistics, $t_{\hat{\alpha}}$.
4. Break points, T_b, t-statistics of α parameter, $t_{\hat{\alpha}}$, and the order of integration in relevant series are shown in the Table.

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

search is continued through conducting diagnostic tests on the models ranked by SBC. In the searching process, the stability of the coefficients is also assessed through the cumulative-sum and cumulative-sum-of-squares tests developed by Brown, Durbin, and Evans (1975). Then, a model, which firstly passes diagnostic tests for serial correlation and heteroscedasticity and stability tests of the coefficients at the 5% significance level, is selected. Table 2 presents the estimation results for the selected linear ARDL models.

The first panel shows the estimated ADRL model for the bank lending rate (based on the full sample, 2003M1–2015M9). In the model, two dummy variables are included to account for structural changes (i.e., significant changes in the trend) in the bank lending rate. These dummy variables are defined by:

TABLE 2

Dynamic Linear (Symmetric) Estimation of the Interest Rate Pass-Through

Sample Period 2003M1–2015M9		Sample Period 2003M1–2008M11		Sample Period 2008M12–2015M9			
$r_t^M \rightarrow r_t^L$: ARDL(2, 3) †		$r_t^M \rightarrow r_t^L$: ARDL(2, 1)†		$r_t^M \rightarrow r_t^L$: ARDL(1, 0) †		$r_t^M \rightarrow r_t^D$: ARDL(2, 0) †	
Var.	Coef. ‡	Var. ‡	Coef.‡	Var. ‡	Coef.‡	Var. ‡	Coef.‡
L_{r^M}	0.30**	L_{r^M}	0.11	L_{r^M}	0.47*	L_{r^M}	0.64**
r_{t-1}^L	–0.32***	r_{t-1}^L	–0.34***	r_{t-1}^L	–0.20***	r_{t-1}^D	–0.06**
r_{t-1}^M	0.10***	r_{t-1}^M	0.04	r_{t-1}^M	0.11**	r_{t-1}^M	0.03***
Δr_{t-1}^L	–0.26***	Δr_{t-1}^L	–0.26**	Const. ‡	2.53***	Δr_{t-1}^D	–0.23**
Δr_t^M	–0.06	Δr_t^M	–0.02			*Trend*	0.003***
Δr_{t-1}^M	–0.16**	*Trend*	–0.07***			Const.	–0.11
Δr_{t-2}^M	–0.11*	Const. ‡	14.02***				
$D0308_t$	8.08***						
$D0308T_t$	–0.07***						
Const. ‡	5.01***						
R^2	0.30	R^2	0.28	R^2	0.15	R^2	0.22
Adjusted R^2	0.26	Adjusted R^2	0.23	Adjusted R^2	0.13	Adjusted R^2	0.18
χ_{SC}^2	3.43 [0.18]	χ_{SC}^2	2.82 [0.24]	χ_{SC}^2	4.74 [0.10]	χ_{SC}^2	0.36 [0.83]
χ_{HET}^2	19.9 [0.01]	χ_{HET}^2	4.89 [0.43]	χ_{HET}^2	0.06 [0.97]	χ_{HET}^2	3.56 [0.47]
t_{BDM}	–4.97 [<0.05]	t_{BDM}	–2.99 [>0.05]	t_{BDM}	–3.24 [<0.05]	t_{BDM}	–2.41 [>0.05]
F_{PSS}	13.9 [<0.05]	F_{PSS}	3.14 [>0.05]	F_{PSS}	7.1 [<0.05]	F_{PSS}	6.94 [<0.05]

Notes: 1. The terms r_t^L, r_t^D, and r_t^M denote bank lending, bank deposit, and money market rates, respectively.

2. The term L_{r^M} denotes the long-run pass-through coefficients defined by $\hat{\beta} = -\hat{\theta}/\hat{\rho}^l$.

3. The Lagrange multiplier test is used for serial correlation (with a chi-square (χ^2) distribution with the degree of freedom being 2) and heteroskedasticity.

4. The t_{BDM} is the BDM's *t*-statistic testing the null hypothesis $H_0: \rho^l = 0$ while F_{PSS} denotes the PSS's *F*-statistic testing the null hypothesis $H_0: \rho^l = \theta = 0$ (or $\rho^l = \theta = \gamma_1 = 0$). The subscripts *SC* and *HET* stand for serial correlation and heteroskedasticity, respectively.

5. The 5% critical values for $k = 1$ (*k* is a number of optimal lags) tabulated by Pesaran, Shin, and Smith (2001) are as follows: $t_{crit} = -3.22$ and $F_{crit} = 5.73$ for the $r_t^M \rightarrow r_t^L$ models estimated using the sample 2003M1–2015M9 and 2008M12–2015M9; $t_{crit} = -3.69$ and $F_{crit} = 5.15$ for the $r_t^M \rightarrow r_t^L$ model estimated using the sample 2003M1–2008M11; and $t_{crit} = -3.69$ and $F_{crit} = 5.15$ for the $r_t^M \rightarrow r_t^D$ model estimated using the sample 2008M12–2015M9.

6. Values in brackets indicate *p*-values for the null hypotheses.

† The numbers in parentheses are the respective lag orders for the dependent variable.

‡ Var. = Variables, Coef. = Coefficients, Const. = Constant.

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

$$D0308_t \quad = \begin{cases} 1, & \text{over the period } 003\text{M1} - 2008\text{M11} \\ 0, & \text{elsewhere} \end{cases},$$

$$D0308T_t = \begin{cases} trend, & \text{over the period } 003\text{M1} - 2008\text{M11} \\ 0, & \text{elsewhere} \end{cases},$$

where *trend* is the variable, which will take values starting from 1 to 71 over the period 2003M1–2008M11 (i.e., 1 for 2003M1, 71 for 2008M11). As stated by Pesaran, Shin, and Smith (2001), it is assumed that the asymptotic theory for the bounds testing is not affected by the inclusion of the dummy variables.

For the estimation based on the full sample, both BDM's t-test and PSS's F-test results show that the null hypothesis of no linear long-run (level) relationship between the bank lending rate and the money market rate is rejected at the 5% significance level. The estimated long-run pass-through coefficient is 0.30 and it is statistically significant at the 5% significance level. The speed of adjustment coefficient, ρ^l, is estimated as -0.32, which is statistically significant. It implies that any deviation from the long-run equilibrium is corrected at a rate of 32% per month.

To examine how the interest rate pass-through of the money market rate to the bank lending rate is changed over time, the ARDL model for the bank lending rate is reestimated using subsamples 2003M1–2008M11 and 2008M12–2015M9. Estimation results are presented in Table 2. The BDM's t-test and PSS's F-test results based on the sample 2003M1–2008M11 do not support the existence of a linear long-run (level) relationship between the bank lending rate and the money market rate. In addition, the estimated short- and long-run coefficients are insignificant. This result is in line with the fact that the interest rate pass-through is relatively weak in the monetary targeting framework as the BOM was targeting monetary aggregates during most of the period.

However, the same tests based on the sample 2008M12–2015M9 do support the existence of the linear long-run relationship. The estimated long-run interest rate pass-through coefficient during the period 2008M12–2015M9 is 0.47 which is statistically significant and higher than the pass-through coefficient (0.30) obtained from the full sample estimation. The speed of adjustment coefficient, ρ^l, is estimated as -0.20, which is slightly low (compared to the full-sample result) and highly significant. These findings suggest that the recent improvement in the BOM's operational framework of monetary policy such as introducing the policy rate in July 2007 has strengthened the interest rate pass-through in Mongolia.

The interest rate pass-through from the money market rate to the bank deposit rate is estimated based on the sample 2008M12–2015M9. The estimation result is shown in the last panel of Table 2. The PSS's F-test result supports the existence of a linear long-run (level) relationship between the bank deposit rate and the money market rate.[9] The

[9] However, the BDM's t-test result does not reject the null hypothesis that there exists no linear long-run (level) relationship between the bank deposit rate and the money market rate.

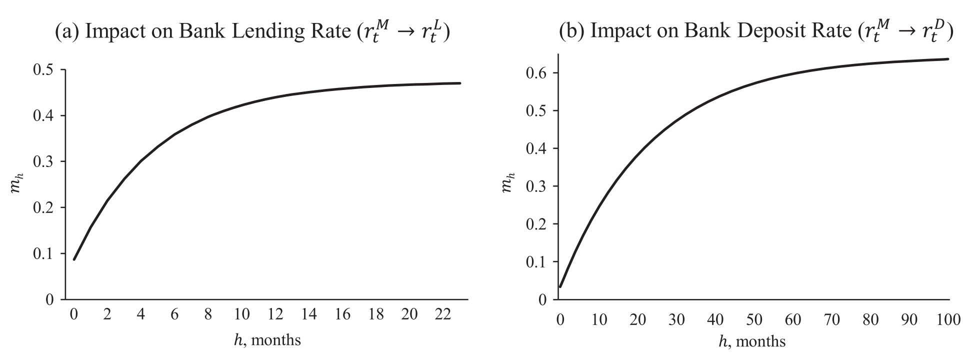
long-run interest rate pass-through coefficient is estimated as 0.64, which is relatively large and statistically significant. The estimated equilibrium correction coefficient, ρ^l, is -0.06, which is very low (compared to the bank lending rate adjustment) and significant at the 5% level.

To analyze the dynamics of the interest rate pass-through, symmetric dynamic cumulative multiplies are calculated for bank lending and bank deposit rates using the estimated ARDL models based on the sample 2008M12–2015M9. Results are shown in Figure 2.

Figure 2 shows the effects of the 1 percentage point change in the money market rate in the period 0 on the bank lending and bank deposit rates over the following months. In the impact period, the bank lending rate changes by only 0.1 percentage points, and the impact on the bank lending rate increases over time. After four months from the impact, the bank lending rate would change by 0.3 percentage points, and 50% of the adjustment toward equilibrium is achieved within three months.

However, in the case of the bank deposit rate, the interest rate pass-through is very sluggish. For instance, after five months from the impact, the bank deposit rate would change by 0.1 percentage points, and adjustment to the new equilibrium is a relatively prolonged process (about eight years). This finding may reflect the fact that the commercial banks in Mongolia do not frequently change their bank deposit rates in order to keep their market share and maintain profitability. Furthermore, deposit rates among the banks are closer to each other, as a blanket guarantee for deposits held at the banks (issued by the Government of Mongolia under the Deposit Guarantee Law) was effective between November 2008 and November 2012, and a mandatory insurance scheme for the protection of bank deposits (i.e., Deposit Insurance Law) was effective from January 2013. These results suggest that if the money market rate increases, the spread between the bank lending and bank deposit rates would rise in

Fig. 2. Symmetric Dynamic Multipliers from Money Market Rate to Retail Rates



Source: Author's calculation.

Note: The m_h is the cumulative dynamic multiplier at the h period after a change in the money market rate as explained in equation (7) in the main text.

TABLE 3

Dynamic Nonlinear (Asymmetric) Estimation of the Interest Rate Pass-Through

Sample Period 2003M1–2015M9		Sample Period 2008M12–2015M9			
$r_t^M \rightarrow r_t^L$: ARDL(2, 3, 3) †		$r_t^M \rightarrow r_t^L$: ARDL(1, 0, 0) †		$r_t^M \rightarrow r_t^D$: ARDL(2, 0, 0) †	
Var. ‡	Coef.‡	Var. ‡	Coef.‡	Var. ‡	Coef.‡
$L_{r^{M-}}$	0.30**	$L_{r^{M-}}$	0.40**	$L_{r^{M-}}$	0.57*
$L_{r^{M+}}$	0.25**	$L_{r^{M+}}$	0.31***	$L_{r^{M+}}$	0.69*
r_{t-1}^L	–0.33*	r_{t-1}^L	–0.24*	r_{t-1}^D	–0.06*
r_{t-1}^{M+}	0.08**	r_{t-1}^{M+}	0.09**	r_{t-1}^{M+}	0.034*
r_{t-1}^{M-}	0.10*	r_{t-1}^{M-}	0.11*	r_{t-1}^{M-}	0.027*
Δr_{t-1}^L	–0.26*	Const. ‡	5.48*	Δr_{t-1}^D	–0.22**
Δr_t^{M-}	–0.05				
Δr_{t-1}^{M-}	–0.19				
Δr_{t-2}^{M-}	–0.05				
Δr_t^{M+}	–0.07				
Δr_{t-1}^{M+}	–0.12				
Δr_{t-2}^{M+}	–0.15				
$D0308_t$	6.68*				
$D0308T_t$	–0.06*				
Const. ‡	7.02*				
R^2	0.30	R^2	0.17	R^2	0.21
Adjusted R^2	0.24	Adjusted R^2	0.14	Adjusted R^2	0.18
χ^2_{SC}	4.55 [0.11]	χ^2_{SC}	3.35 [0.19]	χ^2_{SC}	0.25 [0.88]
χ^2_{HET}	26.8 [0.01]	χ^2_{HET}	8.24 [0.04]	χ^2_{HET}	3.65 [0.46]
t_{BDM}	–4.70 [<0.05]	t_{BDM}	–3.56 [<0.05]	t_{BDM}	–4.49 [<0.05]
F_{PSS}	6.51 [<0.05]	F_{PSS}	5.46 [<0.05]	F_{PSS}	6.70 [<0.05]
W_{LR}	0.81 [0.37]	W_{LR}	2.9 [0.09]	W_{LR}	14.11 [0.00]

Notes: 1. The $L_{r^{M-}}$ and $L_{r^{M+}}$ denote the long-run pass-through coefficients defined by $\beta^+ = -\theta^+/\rho^{nl}$ and $\beta^- = -\theta^-/\rho^{nl}$, respectively.
2. The W_{LR} refers to the Wald test of long-run symmetry (i.e., $L_{r^{M-}} = L_{r^{M+}}$). The subscripts *SC* and *HET* stand for serial correlation and heteroskedasticity, respectively.
3. The 5% critical values for $k = 2$ (k is a number of optimal lags) tabulated by Pesaran, Shin, and Smith (2001) are as follows: $t_{crit} = -3.53$ and $F_{crit} = 4.85$ for the $r_t^M \rightarrow r_t^L$ model; $t_{crit} = -3.02$ and $F_{crit} = 3.83$ for the $r_t^M \rightarrow r_t^D$ model.
4. Values in brackets indicate p-values for the null hypotheses.

† Numbers in parentheses indicate the lag structure of the ARDL model; the first number is the number of lags for dependent variable, and the second and the third numbers are the number of lags for r_t^{M+} and r_t^{M-} variables in the model.

‡ Var. = Variables, Coef. = Coefficients, Const. = Constant.

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

the first two years, and after that, the spread would start to decrease. Compared to other countries (e.g., the long-run interest rate pass-through to bank lending/bank deposit rates are 0.85/0.87 in Australia (Lim 2001), 1.02/1.35 in Canada, 1.06/0.98

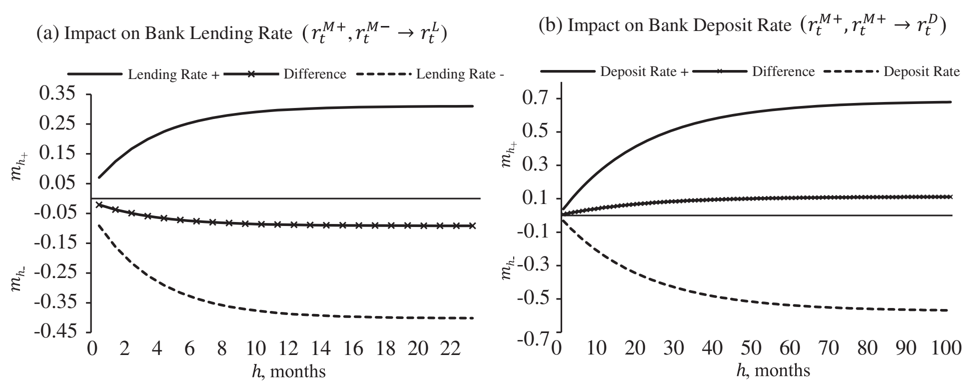
in the United States, and 0.98/0.81 in the United Kingdom (Panagopoulos, Reziti, and Spiliotis 2010), the interest rate pass-through in the Mongolian economy is weaker and slower, suggesting that there is room for enhancing interest rate pass-through in Mongolia. To investigate asymmetric interest rate pass-through, the nonlinear ARDL models for the bank lending and bank deposit rates are estimated and the results are shown in Table 3.

Results of both BDM's *t*-test and PSS's *F*-test suggest the existence of an asymmetric long-run (level) relationship between the bank lending/bank deposit rates and the money market rate in all estimated models. In the case of the bank lending rate, the Wald tests cannot reject the null hypothesis of long-run symmetry for the full sample and the test rejects the null hypothesis at the 10% level for the sample 2003M1–2015M9. The estimated long-run pass-through coefficients on $L_{r^{M-}}$ and $L_{r^{M+}}$ are 0.40 and 0.31 for the sample 2008M12–2015M9, respectively. The estimated long-run coefficients are significant.

In the case of the deposit rate equation, the null hypothesis of long-run symmetry is rejected at the 1% level. The estimated long-run pass-through coefficients on $L_{r^{M-}}$ and $L_{r^{M+}}$ are respectively 0.57 and 0.69 for the sample 2008M12–2015M9. These results suggest that a change in the money market rate has asymmetric long-run effects on both the bank lending and bank deposit rates. Figure 3 presents the asymmetric dynamic multipliers in the sample 2008M12–2015M9.

There is evidence of asymmetric interest rate pass-through. The dynamic multipliers indicate that the bank lending rate responds weakly to both an increase and decrease in the money market rate. However, the difference in the responses implies negative asymmetric pass-through with respect to the bank lending rate. Relatively quick bank lending rate adjustment is found in the case of either a positive

Fig. 3. Asymmetric Dynamic Multipliers from Money Market Rate to Retail Rates



Source: Author's calculation.

Note: The m_h is the cumulative dynamic multiplier at the h period after a change in the money market rate as explained in equation (7) in the main text.

or a negative shock to the money market rate. For instance, 50% of the adjustment toward equilibrium is achieved within two months, and convergence to the longrun equilibrium occurs within 1.5 years.

The bank deposit rate response to both positive and negative shock in the money market rate is more gradual, taking 13–14 months to achieve about 50% of the adjustment toward equilibrium. The adjustment to new equilibrium is a relatively prolonged process. The bank deposit rate strongly responds to a positive shock compared to the response to a negative shock. This implies positive asymmetric pass-through with respect to the bank deposit rate.

V. CONCLUSIONS AND POLICY IMPLICATIONS

This study has examined the interest rate pass-through of the money market rate to bank lending and bank deposit rates in Mongolia using both linear and nonlinear ARDL models. The ARDL models can capture important aspects of the interest rate pass-through adjustment, such as adjustment in the long run, the speed of adjustment to the new equilibrium, and short-term responses.

The key empirical finding of this study is that the interest rate pass-through is generally weaker, slower, and asymmetric in Mongolia. The interesting results are as follows. First, the interest rate pass-through of the IBM rate to the bank lending rate has improved over time as a result of the recent changes in the BOM's operational framework for the implementation of monetary policy.[10] The weak adjustment of the bank lending rate is in line with the existing literature in Mongolia. Second, the bank deposit rate has higher long-run interest rate pass-through and slower adjustment to the long-run equilibrium than the bank lending rate. Finally, asymmetric cointegration and the Wald tests of the long-run symmetry suggest that the long-run interest rate pass-through in the transmission of monetary policy to bank interest rates is asymmetric. In particular, there is negative asymmetry with respect to the bank lending rate and positive asymmetry with respect to the bank deposit rate. The finding on asymmetric adjustment of the bank lending rate is found only in the sample after 2008M12.

These empirical results suggest that the BOM should focus on further strengthening the interest rate channel of the monetary transmission mechanism. In particular, prior to adopting or transitioning to an inflation-targeting regime, certain measures and reforms need to be implemented for promoting a more effective interest rate pass-through. The measures and reforms may include strengthening the

[10] Estimations based on different subsamples show that the pass-through with respect to the bank lending rate appears to have changed since 2008M12 when the liquidity pressure in the domestic IBM started to ease.

operational framework of monetary policy, allowing greater exchange rate flexibility, reducing financial dollarization, lowering bank concentration, deepening financial markets, tackling fiscal dominance, and enhancing the regulatory and institutional environment.

Though these results have yielded significant insights about the interest rate pass-through in Mongolia, further studies should focus on the determinants of differences in the interest rate pass-through across banks using individual bank-based panel data, which could not be carried out in this study due to lack of appropriate data. These studies will help to uncover the factors behind the time-varying interest rate pass-through and cross-bank differences in the pass-through.

REFERENCES

Apergis, Nicholas, and Arusha Cooray. 2015. "Asymmetric Interest Rate Pass-Through in the U.S., the U.K. and Australia: New Evidence from Selected Individual Banks." *Journal of Macroeconomics* 45: 155–72.

Banerjee, Anindya; Juan Dolado; and Ricardo Mestre. 1998. "Error-Correction Mechanism Tests for Cointegration in Single-Equation Framework." *Journal of Time Series Analysis* 19, no. 3: 267–83.

Batnyam, Damdinsuren; Gan-Ochir Doojav; and Tomasz Łyziak. 2008. "Small Inflation Model of Mongolia (SIMOM)." BOM Working Paper no. 5. Ulaanbaatar: Bank of Mongolia. https://www.mongolbank.mn/documents/tovhimol/group5/simom.pdf (accessed October 15, 2015).

Bayardavaa, Bayarsaikhan; Undral Batmunkh; and Altan-Ulzii Chuluun. 2015. "Monetary Policy Transmission in Mongolia." BOM Working Paper no. 10. Ulaanbaatar: Bank of Mongolia. https://mongolbank.mn/documents/tovhimol/group10/01.pdf (accessed October 15, 2015).

Brown Robert, L.; James Durbin; and James M. Evans. 1975. "Techniques for Testing the Constancy of Regression Relations over Time." *Journal of the Royal Statistical Society Series B (Methodological)* 37, no. 2: 149–92.

Cecchetti, Stephen G. 1999. "Legal Structure, Financial Structure, and the Monetary Policy Transmission Mechanism." NBER Working Paper no. 7151. Cambridge, MA: National Bureau of Economic Research.

Cottarelli, Carlo, and Angeliki Kourelis. 1994. "Financial Structure, Bank Lending Rates, and the Transmission Mechanism of Monetary Policy." *IMF Staff Papers* 41, no. 4: 587–623.

De Bondt, Gabe J. 2005. "Interest Rate Pass-Through: Empirical Results for the Euro Area." *German Economic Review* 6, no. 1: 37–78.

Dickey, David A., and Wayne A. Fuller. 1979. "Distribution of the Estimators for Autoregressive Time Series with a Unit Root." *Journal of the American Statistical Association* 74, no. 366: 427–31.

Doojav, Gan-Ochir. 2011. "Mongoliin infliatsiin butstsiin zagvar (SMIM)" [A structural model of inflation in Mongolia]. BOM Working Paper no. 6. Ulaanbaatar: Bank of Mongolia. https://mongolbank.mn/documents/tovhimol/group6/01.pdf (accessed October 15, 2015).

———. 2012. “Ariljaanii bankuudiin zeel hadgalamjiin huund nuluulugch huchin zuils” [Determinants of bank lending and deposit rates in Mongolia]. BOM Working Paper no. 7. Ulaanbaatar: Bank of Mongolia. https://mongolbank.mn/documents/tovhimol/group7/01.pdf (accessed October 15, 2015).

Doojav, Gan-Ochir, and Batjargal Dulamzaya. 2014. “Mongoliin ediin zasag dahi mungunii bodlogiin zardliin suvag: Beisiin DSGE handlaga” [Cost channel of monetary transmission in Mongolia: A Bayesian DSGE approach]. BOM Working Paper 9, no. 2. Ulaanbaatar: Bank of Mongolia. https://mongolbank.mn/documents/tovhimol/group9/02.pdf (accessed October 15, 2015).

Favero, Carlo A.; Francesco Giavazzi; and Luca Flabbi. 1999. “The Transmission Mechanism of Monetary Policy in Europe: Evidence from Banks’ Balance Sheets.” NBER Working Paper no. 7231. Cambridge, MA: National Bureau of Economic Research.

Gambacorta, Leonardo, and S. Innotti. 2007. “Are There Asymmetries in the Response of Bank Interest Rates to Monetary Shocks?” *Applied Economics* 39, no. 19: 2503–17.

Greenwood-Nimmo, Matthew; Tae-Hwan Kim; Yongcheol Shin; and Till van Treeck. 2011. “Fundamental Asymmetries in US Monetary Policymaking: Evidence from a Nonlinear Autoregressive Distributed Lag Quantile Regression Model.” http://www.greenwood-economics.com/(MG)QT2.pdf (accessed October 15, 2015).

Hofmann, Boris, and Paul Mizen. 2004. “Interest Rate Pass-Through and Monetary Transmission: Evidence from Individual Financial Institutions’ Retail Rates.” *Economica* 71, no. 281: 99–123.

International Monetary Fund (IMF). 2015. “Mongolia: The 2015 Article IV Consultation-Staff Report; Press Release; and Statement by the Executive Director for Mongolia.” IMF Country Report no. 15/109. Washington, DC: IMF.

Johansen, Søren. 1991. “Estimation and Hypothesis Testing of Cointegration Vectors on Gausian Vector Autoregressive Models.” *Econometrica* 59, no. 6: 1551–80.

———. 1995. *Likelihood-Based Inference in Cointegrated Vector Autoregressive Models*. Oxford: Oxford University Press.

Katrakillidis, Constantinos, and Emmanouil Trachanas. 2012. “What Drives Housing Price Dynamics in Greece: New Evidence from Asymmetric ARDL Cointegration.” *Economic Modelling* 29, no. 4: 1064–69.

Lim, Guay C. 2001. “Bank Interest Rate Adjustments: Are They Asymmetric?” *Economic Record* 77, no. 237: 135–47.

Narayan, Paresh Kumar. 2005. “The Saving and Investment Nexus for China: Evidence from Cointegration Tests.” *Applied Economics* 37, no. 17: 1979–90.

Panagopoulos, Yannis; Ioanna Reziti; and Aristotelis Spiliotis. 2010. “Monetary and Banking Policy Transmission through Interest Rates: An Empirical Application to the USA, Canada, the UK and the Eurozone.” *International Review of Applied Economics* 24, no. 2: 119–36.

Perron, Pierre. 1989. “The Great Crash, the Oil Price Shock, and the Unit Root Hypothesis.” *Econometrica* 57, no. 6: 1361–401.

———. 1997. “Further Evidence on Breaking Trend Functions in Macroeconomic Variables.” *Journal of Econometrics* 80, no. 2: 355–85.

Perron, Pierre, and Timothy J. Vogelsang. 1992. “Nonstationarity and Level Shifts with an Application to Purchasing Power Parity.” *Journal of Business and Economic Statistics* 10, no. 3: 301–20.

Pesaran, M. Hashem, and Yongcheol Shin. 1999. “An Autoregressive Distributed Lag Modelling Approach to Cointegration Analysis.” In *Econometrics and Economic Theory* *in the 20th Century: The Ragnar Frisch Centennial Symposium*, edited by Steinar Strøm. Cambridge: Cambridge University Press.

Pesaran, M. Hashem; Yongcheol Shin; and Richard J. Smith. 2001. "Bounds Testing Approaches to the Analysis of Level Relationships." *Journal of Applied Econometrics* 16, no. 3: 289–326.

Romilly, Peter; Haiyan Song; and Xiaming Liu. 2001. "Car Ownership and Use in Britain: A Comparison of the Empirical Results of Alternative Cointegration Estimation Methods and Forecasts." *Applied Economics* 33, no. 14: 1803–18.

Rousseas, Stephen. 1985. "A Markup Theory of Bank Loan Rates." *Journal of Post Keynesian Economics* 8, no. 1: 135–44.

Scholnick, Barry. 1996. "Asymmetric Adjustment of Commercial Bank Interest Rates: Evidence from Malaysia and Singapore." *Journal of International Money and Finance* 15, no. 3: 485–96.

Shin, Yongcheol; Byungchul Yu; and Matthew Greenwood-Nimmo. 2014. "Modelling Asymmetric Cointegration and Dynamic Multipliers in a Nonlinear ARDL Framework." In *Festschrift in Honor of Peter Schmidt: Econometric Methods and Applications*, edited by Robbin C. Sickles and William C. Horrace. New York: Springer.

Valadkhani, Abbas, and Sajid Anwar. 2012. "Interest Rate Pass-Through and the Asymmetric Relationship between the Cash Rate and the Mortgage Rate." *Economic Record* 88, no. 282: 341–50.

Yu, Byungchul; Sun Eae Chun; and Jongchai Kim. 2013. "Some Evidence on the Asymmetric of Interest Rate Pass-Through in Asian Economies." *Korea and the World Economy* 14, no. 2: 207–33.