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The Empirical Study of Interest Rate Pass-Through in Cambodia: An Error Correction Model

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ABSTRACT

The error correction model was used to explore the influence of domestic and international interest rates, proxied by the 6-Month and 1-Year SIBOR, on the borrowing interest rate of bank. The primary goal of this study was to determine the pass through from the predicted borrowing rate to the lending rate. The empirical findings of this study confirmed the existence of a long-run relationship between the borrowing rate and its explanatory variables, as evidenced by the two-step co-integration test. Domestic and foreign interest rates have a substantial long-run influence on the borrowing rate. Short-term borrowing rate changes were also impacted by changes in market interest rates and SIBOR rates. The predicted borrowing rate from co-integration equation had a positive significant impact on the lending rate claimed that there had a pass through from foreign to domestic lending rate.

Keywords: ECM, Interest rate pass through, Borrowing rate, Market Rate, SIBOR.

INTRODUCTION

The loan provided by the banks and MFIs to the private sectors played a vital role in increasing the economic growth in Cambodia. Cambodia Securities Exchange (CSX) was founded to provide the opportunity for investors, both domestic and foreign investors to invest and trade stocks, bonds, and derivatives. The monthly CSX's market capitalization is estimated to be KHR 9,727.82 billion in the last 22 months (CSX, 2021). Although CSX has been founded almost 11 years, the gathering of the investment capital remains heavily dependent on the banking sector which was divided into three categories commercial banks, specialized banks, and micro-finance institutions (MFIs). The major function of the banks is to collect saving from people with excess money and provides loan to those who need money or capital. Additionally, based on the generic function mentioned above, banks function as money exchange agents and provide payment and settlement services. The decisions for consumption and investment made by the investors, both households and firms are driven by interest rate changes by banks and other financial intermediaries. Banks and MFIs use several means to collect funds to offer loans to the public. Some of the most common sources for banks and MFIs to collect funds are from collecting deposits by issuing financial instruments such as commercial paper, certificates of deposit (CD), and bonds, especially the deposit from foreign banks.

In 2020, the ratio of private credit to GDP and the ratio of gross saving to GDP in Cambodia is 27.41% and 139.94%, respectively (ADB, 2021). The loan provided by banks and MFIs to the public is commonly collected from the deposit, shareholder's equity, and loan that banks and MFIs borrowed from other financial institutions, especially from institutions abroad. The study about the pricing of retail banking products, deposit, and loan is very important and required a comprehensive study, especially the interest rate pass-through. Therefore, this study aims to investigate whether Cambodia retail banking products can receive a pass-through rate from foreign banks or not. SIBOR is adopted as the proxy of the foreign interest rate. In this research, the pass-through refers to the volatility of SIBOR which is reflected by the changes in the retail rates in the short and potentially in the long run. The interest rate pass-through had never been studied before in Cambodia. Thus, the empirical results from this study can be used by the policymakers at the central bank to formulate the necessary policies such as reserved requirement ratio and refinancing rate, or regulations including capital flow restriction in order to protect and prevent external shocks which can potentially increase the domestic interest rate. Given that the increase in the domestic interest rate can be obstructive to investment in Cambodia, and slow the economic growth.

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LITERATURE REVIEW

The degree of pass-through to lending rate across countries was first studied by (Cottarelli & Kourelis, 1994). The study attempted to measure and compare the degree of pass-through to lending rate across 31 countries sampling both developed and developing countries. The single equation error-correction model (ECM) was adopted to quantify the dynamics of the retail rate adjustment following the change in the market interest rate. The result indicated that in the long run, the pass-thorough coefficient was 0.97 with a range of 0.75 to 1.25. Suggesting that the impact coefficient is highly correlated with the structure of the financial system including the barrier to entry to the banking industry, the share of private ownership, constraint to the international capital movement and financial liberalization, and the existence of negotiable short-term instrument issued by the firm. Similarly, (Borio & Fritz, 1995) also applied the aforementioned economistic method to investigate the relationship between the monetary policy rate, money market rate, and the lending rate for a group of OECD countries. The study found that the point estimate of the long-run response of loan rate to money market rate range between 0.8 to 1.1 across a number of countries. The study also suggested that Great Britain, the Netherlands, and Canada exhibited a high short-run coefficient which was above 0.7. Meanwhile, Spain, Japan, Italy, and Germany showed the highest degree of interest rate stickiness. Yet, in the long run, the pass-through appeared more homogenous across countries and approached closer to one. The authors argued that the differences in the result for different countries are perhaps due to the types of lending rates of each individual country. A similar study conducted by (Moazzami, 1999) also found the degree of competitiveness affects the stickiness of interest rates in both the U.S and Canada. A higher pass-through degree was founded for the case of Canada during the 70s and 80s. In contrast, over the first half of the nineties, the pass-through degree appeared to be the opposite. The study indicated that in the short-run the pass-through rate converged around 0.4 for both the U.S and Canada. The author outlined that these variations were due to the more competitive environment of the U.S banking system, while the Canadian banking system appeared to be sluggish after the nineties.

Likewise, (Mojon, 2000) adopted a similar method to estimate the degree of pass-through for lending and deposit in five European nations. The study attempted to reveal the possible asymmetries in the pass-through rate among the five European nations including Belgium, Germany, France, Netherland, and Spain. The study delineated that the volatility of the money market negatively affected the pass-through of lending rate while competition among banks and direct finance resulted in a faster adjustment of lending rate when the market was falling relative to the deposit rate. On the other hand, when the market rate increased, the asymmetry in the degree of pass-through was identified. As a result, the pass-through to lending rate was concluded to be larger when the money market rate increased rather than decreased. In contrast, the deposit rate was true in the opposite of the conclusion thereof. Another similar study conducted by (Cheung, Chinn, & Fujii, 2004) measure the bank loan rate stickiness in China, Hong Kong, Taiwan, the U.S, Japan, and Singapore. The study adopted the same approach as used by (Cottarelli & Kourelis, 1994). The result indicated the heterogeneity of the long-run effect ranged from -0.148 to 0.985. Meanwhile, the speed of adjustment was founded range from -0.04 to -0.36. The authors concluded that the stickiness in bank loan rates was potentially driven by the portfolio differences of the projects undertaken by banks in each of those nations, resulting in the increases in the agency cost, and cost of screening and monitoring as well as the degree of regulation in each nation, especially in China.

For decades, many researchers have argued that a bank will adjust its rate only if the optimal rate differs from the current rate and the revenues from adjusting the rate exceed the costs. Such costs may occur from various sources, leading to several explanations as to why the retail interest rates are sticky. Proposed by (Stiglitz & Weiss, 1981), claimed that the asymmetric information between banks and borrowers can result in adverse selection and moral hazard, which consequently reduces the bank's expected return. The authors stated that generally, borrowers were likely to accept a higher rate than the optimal rate, causing the latter to perform poorer than the average credit risks. As a result, the existing borrowers were more likely to take a risker project when facing such a higher rate. Evidently, (Winker, 1999) applied the marginal cost pricing model with asymmetric information to investigate the lending rate change in Germany. The study indicated that in the long run, the lending rate changed in accordance with the market rate, while it is not applicable for the short-run due to the adverse selection issue. Additionally, the study

also applied the switching cost to explain the slow speed of adjustment of the lending rate in comparison to the deposit rate. Another study was conducted by (Bondt, 2002). The study attempted to measure the retail rate pass-through of whole European nations by pairing the deposit and lending of different maturities with the government bond yield of similar maturities. The finding suggested although the pass-through was incomplete in the short run, the pass-through of most lending rates was completed in the long run. Moreover, the research also found that ever since the introduction of the Euro, the adjustment speed became quicker. Furthermore, the author also concluded that such a phenomenon was due to the higher degree of competition, and the decline in the switching cost and asymmetric information costs in Eurozone nations since January 1999.

Besides the evidence of the heterogeneity mentioned above, (Cottarelli & Kourelis, 1994) and (Mojon, 2000) also claimed the volatility of the market rate also affects the degree of the pass-through. The researchers believed that the higher the volatility, the higher the interest rate uncertainty which could potentially lower the degree and the speed of adjustment. Given that banks will perceive the high volatility of the market rate as temporary and try to smooth out the interest rate. In addition, (Sander & Kleimeier, 2003) attempted to explore the "menu costs" preventing banks from adjusting their rates simultaneously. Those administrative costs consisted of, for instance, labor, computing, and notification costs. The study found that the adjustment of bank rate was subject to the size of the market rate variation and banks' intentions. For example, to maintain a long-term relationship with their customers, banks may reluctant to constantly increase the loan rates though justified by the movement of the cost of funds. Additionally, the interest rate was not the only measure banks can undertake to react to the variation in the market rate. Other dimensions such as collateral, commitment, and fees, all can be factors affecting the true loan pricing.

In the past decades, numerous different studies found the significant asymmetric in the stickiness of upward and downward movements of bank rates. Those researches suggested that the pass-through to lending rate was higher in the periods of increasing marketing rate than in the period of decreasing market rate. (Hannan & Berger, 1991) and (Neumark & Sharpe, 1992), for instance, aimed to explore deposit rate setting that were guided by the theory of price stickiness existing in the goods market. The study found that the bank concentration and the present of the switching cost to consumer resulted in the asymmetry of pass-through. In addition, (Mojon, 2000) in the investigation of five European countries also demonstrate the evidence of asymmetry in the adjustment of lending and deposit rate.

According to (Saechour, 2000), fluctuations in the Bangkok interbank offer rate, minimum loan rate, and bond buyback rate were influenced by changes in liquidity, inflation, the economy, and politics. According to the findings, the Bangkok interbank offer rate had a significant positive connection coefficient with the minimum loan rate and bond buyback rate in the previous month. Furthermore, after financial liberalization, the international interest rate had a stronger impact on the Bangkok interbank offer rate. Furthermore, (Piyavongpinyo, 2002) investigated the impact of monetary policy on bank balance sheets via two key monetary transmission channels: interest rates and bank lending. Short-term interest rates: loan rate and deposit rate in all sizes of banks responded positively to changes in repurchase rate according to interest rate channel, according to empirical results from the SURE technique. Only a few bank loans responded favorably to changes in the repurchase rate in the bank lending channel. The author found that the sole channel that had a major impact on bank balance sheets during the study period was interest rates and that the authority should stress a monetary policy based on this transmission mechanism.

Under one key assumption that banks' retail lending rate were allowed to vary across the regions, a study of imperfect interest rate pass-through was carried out. This research integrated the behavior of five economic agent: household, financial intermediary, intermediate-goods firms, final-goods firms, and the central bank. In the intermediate-goods market, wage had to be paid at the start of the period, (Christiano & Eichenbaum, Liquidity effects and the monetary transmission mechanism, 1992), (Christiano, Eichenbaum, & Evans, Nominal rigidities and the dynamic effects of a shock to monetary policy, 2005), (Ravenna & Walsh, 2006). Social welfare reduced dramatically when the volatility of average loan rate rise due to incomplete pass-through from the policy rate to retail loan rates. The central bank had to balance between stabilizing inflation and output gap and average fluctuation of retail rate, (Kobayashi, 2008). The result of a research study showed that the interest rate pass-through

were symmetry, sluggish, and incomplete, (Chong, 2010), (Kopecky & Van, 2012). It had been found that the adjustment of reserve requirement ratio would not help improve the transmission on monetary policy via interest rate channel in China because of the marketization of banking system, (Hou & Wang, 2013). But the ownership structure of banks had a significant impact on banks' lending rate, (Fungacova, 2016). The empirical investigation in the European Zone indicated a complete interest rate pass-through before the Global Financial Crisis, but the opposite result was found after the crisis period, (Hristov, 2014).

Monthly time series data from July 2004 to June 2014 were employed in an error correction model to measure the degree of interest rate pass-through in Vietnam. The results of this research indicated that the speed of adjustment of interest rates was rather slow. It took three months for money market rate and six months for retail interest rates to adjust back to long-run equilibrium due to short-run dynamic shock, (Thao & Trang, 2015). After the 1997 Asian Financial Crisis, an error correction model was employed aimed to investigate the interest rate pass-through in the banking system of Hong Kong, Indonesia, Singapore, Taiwan, Thailand, and Korea. This research adopted the marginal cost-pricing model, which indicated the impact of market interest rate on banks' retail rate. The demand elasticity of deposits and lending determined the scale of the slope coefficient of market rate which pass-through the retail rate. The policy rate, the interest rate in the bond market, especially, the foreign interest rates were not taken into account. Banks' retail rate was just relied on the short and long-term deposit rates. Monthly time series data were applied over the period between January 1997 and May 2007. The empirical result of this paper showed that the pass-through rate was delayed when banks adjusted market rate to bank retail rates. The levels of pass-through in the medium and long term were also depended on different type of the maturity of the deposit rates. This research had further revealed that lending rate was less vary than deposit rate, (Hsu, 2017).

The performance assessment of transmission mechanism of monetary policy through interest rate channel was conducted in Indonesia. This study focus only on the first stage of the transmission known as the interest rate pass-through (IRPT). The estimation of the magnitude of the level of the IRPT, an error correction model was adopted over monthly time series data between January 2010 and December 2015. The banking rate was written as a function of money market rate so called the policy rate, inflation rate, Return on Asset (ROA), and the ratio of operational cost to operational revenue (BOPO). The estimated results of this study showed that the speed of adjustment of the deposit rate was slower than the lending rate, but the degree of pass-through of the lending rate was lesser than the deposit rate. All of these results had changes when controlling for ROA, Inflation rate, and BOPO, (Hasanah, 2018). The pass-through between monetary policy rate (MPR) and retail interest rates was also conducted using error correction model in Nigeria. Structural break was taken into account in this research. Regarding the co-integration result, there was a long-run relationship between MPR and two retail rates, prime lending rate and saving deposit rate. The incomplete pass-through between retail rates and MPR existed, (Mordi, Adebiyi, & Omotosho, 2019).

Repo or Treasury bills were proxy as policy rate, while interbank, lending and deposit rates were determined to be bank interest rates in Rwanda. The measurement of how fast the interest rate pass-through in the short and long term was conducted using a non-linear error correction model which derive from the Autoregressive Distributed Lags (ARDL) model, over the period between January 2008 and December 2017. The estimated method was Ordinary Least Square (OLS). The empirical result of this study indicated that the pass-through was weak. The asymmetric adjustment process existed depending on the reaction of interbank and deposit rates in response to positive or negative shock of the policy rate, (Rutayisire, 2020). Two different types of co-integration tests, linear and non-linear, were adopted to investigate the interest rate pass-through (IRPT) mechanism in Turkey. The period of the study covering from January 2011 to March 2021. The dependent variable was weighted average of bank lending rate in TRY and the independent variables was overnight lending rate or Interbank Repo/Reverse Repo Market. The degree of pass-through was measured by the slope coefficient of the independent variable. The estimated coefficient of IRPT was less than unity as indicated by linear cointegration test, while it was greater than unity when applying non-linear cointegration test, (Gok & Bulut, 2021).

METHODOLOGY

TA long-run model is developed to investigate about a long-term relationship between dependent and independent variables. In order to define which interest rates, domestic or foreign interest rate, explain the borrowing interest rate (BR) of commercial and specialized banks the most in Cambodia, a multiple regression model is run where BR is set as the dependent variable while the market interest rate (MR), 6-Month and 1-Year Singapore Interbank Offered Rate (SIBOR), are determined to be explanatory variables or independent variables (See Equation (1)). β_0, β_1, β_2, β_3 and ε_t are slope coefficients and residual term, respectively. The commercial banks which have excessed reserve can open a fixed deposit account at the National Bank of Cambodia and it will be paid two-third of the SIBOR, thus, the rate is defined as the fundamental rate. This is the reason that SIBOR is used as a proxy of foreign interest rate in this study.

$$BR_t = \beta_0 + \beta_1 MR_t + \beta_2 SIBOR6M_t + \beta_3 SIBOR1Y_t + \varepsilon_t \quad (1)$$

Giving a research question, does borrowing interest rate effect lending interest rate in Cambodia?, therefore, to answer to the research question, the predicted BR in equation (1) is included in equation (2) and the control variable of this model is the market interest rate.

$$LR_t = \phi_0 + \phi_1 MR_t + \phi_2 BR_t + e_t \quad (2)$$

Where ϕ_0, ϕ_1, and ϕ_2 are parameters to be estimate and the error term of the regression is denoted as e_t. All parameters in equation (1) and (2) are estimated using Fully Modified Ordinary Least Square (FMOLS). The unit root test is performed for each data series since all data are time series data. In addition, the Engle-Granger (EG) two-steps co-integration test is also carried out to check the long-run relationship between variables under study. Thereafter, to further investigate the short-run relationship of the borrowing and lending interest rate with respect to its explanatory variables, especially, to predict the speed of adjustment parameter, the error correction models (ECM) or short-run dynamic models are established (See Equation (3) and (4)).

$$\Delta BR_t = \theta + \gamma\left(BR_{t-1} - \hat{\beta}_{1,FMOLS} MR_{t-1} - \hat{\beta}_{2,FMOLS} SIBOR6M_{t-1} - \hat{\beta}_{3,FMOLS} SIBOR1Y_{t-1}\right) + \sum_{i=1}^{n} \delta_i \Delta MR_{t-i} + \sum_{i=1}^{n} \eta_i \Delta SIBOR6M_{t-i} + \sum_{i=1}^{n} \kappa_i \Delta SIBOR1Y_{t-i} + \mu_t \quad (3)$$

$$\Delta LR_t = \theta + \lambda\left(LR_{t-1} - \hat{\phi}_{1,FMOLS} MR_{t-1} - \hat{\phi}_{2,FMOLS} BR_{t-1}\right) + \sum_{i=1}^{n} \nu_i \Delta MR_{t-i} + \sum_{i=1}^{n} \omega_i \Delta BR_{t-i} + \epsilon_t \quad (4)$$

There are two keys sample parameters to be predicted, γ and λ, all of them measuring the speed of adjustment of BR and LR short-run dynamic model, respectively. The optimal lags length of the two models are determined using the Akaike Information Criterion (AIC). The lower the AIC, the better the model. The period of this study is covered from January 2007 to January 2019. The borrowing, lending, and market interest rate are extracted from the National Bank of Cambodia database. The SIBOR are collected from the Bloomberg terminal.

EMPIRICAL RESULT

There are five indicators borrowing interest rate, market interest rate, 6-Month and 1-Year Singapore Interbank Offered Rate, and lending interest rate are integrated in both short-run dynamic and long-run model. Over the period of the study, between January 2007 and January 2019. The total sample size is 145 observation. As indicated in Table I, the average rates are 4.67%, 2.86%, 1.06%, 1.21%, and 13.54% for BR, MR, SIBOR6M, SIBOR1Y, and LR, respectively. Each data series are not distributed as normal distribution due to the probability of the calculated Jarque-Bera each is less than significant level of 1%.

Table I. Descriptive Statistics

	BR	MR	SIBOR6M	SIBOR1Y	LR
Mean	4.675637	2.869137	1.063242	1.211516	13.54055
Median	4.440000	2.512819	0.750000	0.937500	11.91806
Maximum	6.380000	4.776667	3.412540	3.412540	17.15000
Minimum	4.230000	2.262529	0.413060	0.558080	10.48150
Std. Dev.	0.542073	0.688883	0.673690	0.660285	2.255136
Skewness	1.960134	1.420403	1.342337	1.224568	0.324410
Kurtosis	5.849925	3.820180	4.501513	4.073394	1.244283
Jarque-Bera	141.9222	52.82155	57.16634	43.20058	21.16705
Probability	0.000000	0.000000	0.000000	0.000000	0.000025
Sum	677.9673	416.0248	154.1702	175.6699	1963.379
Sum Sq. Dev.	42.31342	68.33660	65.35554	62.78067	732.3319
Observations	145	145	145	145	145

Before conducting co-integration test, the Augmented Dickey-Fuller (ADF) unit root test is applied to each data series. The ADF test consists of three different models, model With Constant, model With Constant

and Trend, and model Without Constant and Trend. Firstly, the test is performed at level of each time series. If a unit root does exist, the series will be transformed to first difference and the test is applied again. Among the five indicators under investigation, SIBOR6M and SIBOR1Y are stationary at 1%, 5%, and 10% at all models except model With Constant and Trend for SIBOR1Y, which is insignificant. In contrast, all of the data series are stationary at first difference at all models of the ADF test.

Table II. Unit Root Test, Augmented Dickey-Fuller (ADF) Test

	At Level					
		BR	MR	SIBOR6M	SIBOR1Y	LR
With Constant	t-Statistic	-2.2986	-1.9162	-3.6783	-3.2916	-1.2178
	Prob.	0.1739	0.3241	0.0054	0.0171	0.6659
		n0	n0	***	**	n0
With Constant & Trend	t-Statistic	-2.9360	-2.8328	-3.2367	-2.8619	-1.7037
	Prob.	0.1545	0.1882	0.0815	0.1781	0.7449
		n0	n0	*	n0	n0
Without Constant & Trend	t-Statistic	-0.4941	-1.0039	-2.8027	-2.3087	-1.3794
	Prob.	0.5005	0.2820	0.0053	0.0207	0.1553
		n0	n0	***	**	n0
	At First Difference					
		d(BR)	d(MR)	d(SIBOR6M)	d(SIBOR1Y)	d(LR)
With Constant	t-Statistic	-3.5663	-3.2558	-10.2581	-10.8978	-14.0226
	Prob.	0.0076	0.0189	0.0000	0.0000	0.0000
		***	**	***	***	***
With Constant & Trend	t-Statistic	-3.5528	-3.2437	-11.3001	-11.9084	-14.0001
	Prob.	0.0377	0.0803	0.0000	0.0000	0.0000
		**	*	***	***	***
Without Constant & Trend	t-Statistic	-3.5716	-3.2151	-10.2346	-10.8877	-13.9090
	Prob.	0.0004	0.0015	0.0000	0.0000	0.0000
		***	***	***	***	***

Notes: (*)Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1%. and (no) Not Significant

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

Using Fully Modified Least Squares (FMOLS) method, the bank's borrowing interest rate is positively significant explain by market interest rate and 1-Year SIBOR at 1% significant level, while it is negatively influence by 6-Month SIBOR. In this research, a two-step co-integration test which was developed by Engle and Granger in 1987, is carried out. In the first step, the sample parameters derived from the FMOLS method are adopted in order to predict the residual series of the long-run model of BR. In the second step, the unit root test is applied to the predicted residual or error terms. If the error term is stationary, it is concluded that there has a long-run relationship between the dependent variable, BR, and the independent variables, MR, SIBOR6M, and SIBOR1Y. In the next step, a short-run dynamic model or so-called error correction model (ECM) is established to investigate a short-run relationship between variables in the model, especially, to estimate a speed of adjustment which measured how fast the interest rate adjust back toward long-run equilibrium.

Table III. Co-integration Equation, BR

Dependent Variable: BR

Method: Fully Modified Least Squares (FMOLS)

Sample (adjusted): 2007M02 2019M01

Included observations: 144 after adjustments

No cointegrating equation deterministics

Long-run covariance estimate (Bartlett kernel, Newey-West fixed bandwidth = 5.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
MR	1.170383	0.094548	12.37876	0.0000
SIBOR6M	-6.577768	1.438129	-4.573836	0.0000
SIBOR1Y	6.834493	1.453218	4.703005	0.0000
R-squared	0.235232	Mean dependent var	4.675745	
Adjusted R-squared	0.224384	S.D. dependent var	0.543964	
S.E. of regression	0.479064	Sum squared resid	32.35976	
Long-run variance	0.871770			

The ADF unit root test for all models are applied over the residual series generated from the estimated result of Table III. The results of the test indicated that the series is non-stationary of has a unit root. Fortunately, the series has no unit root when Phillips-Perron unit root test is employed since the null hypothesis: RESID01 has a unit root is rejected at 5% significant level as indicated in Table IV.

Table IV. Unit Root Test, Residual Terms of BR

Null Hypothesis: RESID01 has a unit root

Exogenous: None

Bandwidth: 6 (Newey-West automatic) using Bartlett kernel

			Adj. t-Stat	Prob.*
Phillips-Perron test statistic			-2.212435	0.0264
Test critical values:	1% level		-2.581233	
	5% level		-1.943074	
	10% level		-1.615231	

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

As referring to the two-step co-integration test, since all of the data series are co-integrated or have long-run relationship, therefore, an error correction model is established. The estimated method of the model is Ordinary Least Square (OLS), but to avoid the heteroscedasticity and autocorrelation problems which might produce large standard errors as well as small t-statistics of the predicted parameters, the heteroskedasticity and autocorrelation consistent (HAC) standard errors and covariance (Bartlett kernel, Newey-West fixed bandwidth = 5.0000) method is applied. In addition, Schwarz Information Criterion (SIC) determines the optimal lag-lengths of the model. The smaller the SIC, the better the model. Based on this criterion, the optimal lags of ECM is three. The estimated result of the model is shown in Table V. The Wald F-statistic is 6.30 and the probability of the test is 0.0000 which less than 1% level, which concluded that all variables in the model are jointly explain the change of the borrowing rate. The speed of adjustment parameter has a correct sign, but statistically insignificant. In addition, the estimated slope coefficients revealed that the change of the market interest rates at all lags are 0.205750, 0.244805, and 0.272589 for lag one, two, and three, and statistically significant at 5%, 1%, and 5% level, respectively. More interestingly, the change of 6-Month SIBOR at lag-two has a positively significant effect on the change of the borrowing rate at 5% level. In contrast, the change of the borrowing rate is being weakly negative affect by the change of 1-Year SIBOR at lag-two since the probability value is 0.0952, which is less than 10% significant level.

Table V. Error Correction Model, BR

Dependent Variable: DBR

Method: Least Squares

Sample (adjusted): 2007M01 2018M10

Included observations: 142 after adjustments

HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 5.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002962	0.005462	0.542284	0.5885
BR(1)-1.170383*MR (1)+6.577768 *SIBOR6M(1)-6.834493*SIBOR1Y(1)	-0.004442	0.012694	-0.349954	0.7269
DMR(1)	0.205750	0.087687	2.346411	0.0205
DSIBOR6M(1)	0.035464	0.283141	0.125252	0.9005
DSIBOR1Y(1)	-0.196380	0.311918	-0.629588	0.5301
DMR(2)	0.244805	0.087633	2.793513	0.0060
DSIBOR6M(2)	0.510093	0.241875	2.108912	0.0369
DSIBOR1Y(2)	-0.377059	0.224323	-1.680878	0.0952
DMR(3)	0.272589	0.132894	2.051182	0.0422
DSIBOR6M(3)	-0.063085	0.304000	-0.207517	0.8359
DSIBOR1Y(3)	-0.048999	0.281445	-0.174097	0.8621
R-squared	0.329563	Mean dependent var		-0.002725
Adjusted R-squared	0.278384	S.D. dependent var		0.091142
S.E. of regression	0.077424	Akaike info criterion		-2.204750
Sum squared resid	0.785269	Schwarz criterion		-1.975777
Log likelihood	167.5372	Hannan-Quinn criter.		-2.111704
F-statistic	6.439485	Durbin-Watson stat		2.293842
Prob(F-statistic)	0.000000	Wald F-statistic		6.303205
Prob(Wald F-statistic)	0.000000			

In order to check whether there is an interest rate pass through from bank's borrowing interest rate to lending interest rate and to control for other factors that might have influence on the borrowing rate, BR Forecast which denoted as BRF is derived from the co-integration equation of BR which showed in Table III. In the next step, the long-run equation or the co-integration equation of LR which is a function of MR and BRF, is developed and the estimated method is FMOLS.

Table VI. Co-integration Equation, LR

Dependent Variable: LR

Method: Fully Modified Least Squares (FMOLS)

Sample (adjusted): 2007M02 2019M01

Included observations: 144 after adjustments

No cointegrating equation deterministics

Long-run covariance estimate (Bartlett kernel, Newey-West fixed bandwidth = 5.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
MR	0.393084	0.729747	0.538657	0.5910
BRF	2.631384	0.455992	5.770674	0.0000
R-squared	0.553733	Mean dependent var		13.51944
Adjusted R-squared	0.550590	S.D. dependent var	2.248588	
S.E. of regression	1.507410	Sum squared resid	322.6643	
Long-run variance	9.885668			

The estimated result of the LR model has indicated in the long-run bank's borrowing rate has a highly positive impact on lending rate since the sample parameter is 2.6313 which is positive and the probability of the calculated t-Statistic is close to zero which is less than 1% significant level. The rejection of the null hypothesis indicated that the interest rate pass through really does exist in Cambodia.

Table VII. Unit Root Test, Residual Terms of LR

Null Hypothesis: RESID02 has a unit root

Exogenous: None

Bandwidth: 5 (Newey-West automatic) using Bartlett kernel

			Adj. t-Stat	Prob.*
Phillips-Perron test statistic			-2.019032	0.0420
Test critical values:	1% level		-2.581233	
	5% level		-1.943074	
	10% level		-1.615231	

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

The Phillips-Perrons unit root test of the residual term predicted from long-run equation of LR has revealed that at 5% significant level the null hypothesis stated that the residual term has a unit root is rejected which is claimed that the three variables are co-integrated or have long-run relationship.

Table VIII. Error Correction Model, LR

Dependent Variable: DLR

Method: Least Squares

Sample (adjusted): 2007M01 2018M12

Included observations: 144 after adjustments

HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 5.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.037262	0.025608	-1.455084	0.1479
LR(1)-0.393084* MR(1)-2.631384* BRF(1)	-0.004815	0.019367	-0.248636	0.8040
DLR(1)	-0.165308	0.073944	-2.235574	0.0270
DMR(1)	0.181353	0.472102	0.384139	0.7015
DBRF(1)	0.134050	0.534990	0.250566	0.8025
R-squared	0.032496	Mean dependent var		-0.033865
Adjusted R-squared	0.004654	S.D. dependent var		0.346043
S.E. of regression	0.345237	Akaike info criterion		0.744933
Sum squared resid	16.56719	Schwarz criterion		0.848051
Log likelihood	-48.63516	Hannan-Quinn criter.		0.786834
F-statistic	1.167150	Durbin-Watson stat		1.979355
Prob(F-statistic)	0.328012	Wald F-statistic		2.485802
Prob(Wald F-statistic)	0.046328			

The results of the error correction model or short-run dynamic model of LR is presented in Table VIII. Despite the estimated speed of adjustment parameter has a correct sign, but it is statistically insignificant. Surprisingly, the change of LR is not determined by the change of MR and the change of BRF in the short-run, yet it is explained by the change its own lag term which is one-lag at 5% significant level.

CONCLUSION

The empirical result of this research has revealed that a long-run relationship between bank's borrowing interest rate and market interest rate, 6-Month SIBOR, and 1-Year SIBOR is found. Giving the question stated earlier, the borrowing rate is determined by both domestic and foreign interest rates. Furthermore, any shocks that might have happened in the future especially in the short-run, which would cause the interaction between BR and its explanatory variables deviate from equilibrium; certainly, it will adjust back toward a long-run equilibrium. The residual term

of the long-run model is stationary, but the speed of adjustment coefficient is statistically insignificant despite it has a correct sign. In the short-run, the borrowing interest rate is statistically explain by market interest rate, 6-Month SIBOR, and 1-Year SIBOR. In order to control for a particular shocks from other variables on the borrowing interest rate, the rate has been predicted from the co-integration model, which defined as BRF. The interest rate pass through from borrowing rate to lending rate is found since the forecasted borrowing interest rate has a statistically significant effect the lending interest rate. The pass through has transferred from domestic market interest rate and foreign interest rate, 6-Month and 1-Year SIBOR, to borrowing interest rate. Thereafter, the borrowing rate pass through the lending rate. The empirical finding of this research has concluded that the Cambodia's banking lending interest rate has influenced by the foreign interest rates proxied by 6-Month and 1-Year SIBOR.

Of course, in a dollarized economy as such Cambodia, the monetary policy has a weakly influence on domestic market interest rate since the majority of the borrowing and lending activities in the market are conducted in foreign currency obviously US Dollar. In addition, there has no interbank market yet in Cambodia. Traditionally, there are three different types of monetary policy instruments, which are carried out by the policymakers at the central bank in order to manage money supply in an economy, reserved requirement, open market operation, and discount rate. In Cambodia, the open market operation known as OMO, which is a process of buying or selling government securities from public, does not exist yet. The discount rate is so-called the refinancing rate is a Khmer Riel interest rate that the National Bank of Cambodia charges from private banks as a lender of last resort; therefore, the change of this policy rate has a less influence on domestic market rate. In order to reduce the level of interest rate pass through caused by the fluctuation of foreign interest rate, the policymakers should create policies that could lead the country relying more on domestic funds. Thus, financial resource mobilization in the country is considered to be one of the most effective strategy ensuring the availability of funds for domestic development especially to cope with the unstoppable economic growths of Cambodia which have been accomplished for more than a decade.

The analysis of the interaction between all variables, BR, MR, 6-Month SIBOR, and 1-Year SIBOR in this research paper is depending on a single equation model, the first equation is a long-run and the second equation is a short-run or ECM model which do not reflect the interrelationship between all indicators in the system. To expand this research in depth, a system of equations such as Vector Autoregressive (VAR) or Vector Error Correction Model (VECM) should be applied for further studies.

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