**Working Paper**

# A Micro-econometric Examination of the Monetary Transmission Mechanism in Jamaica

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**Abstract**

This study investigates the pass-through of market interest rates to retail bank rates in Jamaica, using bank level data. The speed and rate of adjustment of this pass-through to retail bank rates are estimated using econometric methods on a non-stationary panel data set for the period 2010:01 to 2013:12. In order to provide a clearer understanding of the determinants of the pass-through process, the analysis was augmented with bank- as well as system-specific characteristics. The results confirm that there is incomplete pass-through of market rates to some loan and deposit rates, with deposit rates having the lowest magnitude and speed of adjustment. However, the pass-through to corporate loans and time deposits with maturities of twelve months and over is complete. In addition, the results indicate the existence of asymmetric pricing in the pass-through process for some loan and deposit rates, primarily personal loans as well as demand and savings deposit and that several bank-specific characteristics play a major role in determining the nature and strength of the pass-through.

*JEL Classification numbers: E42, E43*
*Keywords: Market interest rate, retail bank rate, interest rate pass-through*

[♣]The views and results expressed in this paper represent those of the authors and not necessarily those of the Bank of Jamaica.

## Table of Contents

## 1.0 Introduction

It is generally agreed that monetary policy has a significant impact on the performance of the real economy. However, the significance of its impact depends on the effectiveness of the transmission process of the policy rate to the determination of prices and quantities in the real economy. The conventional view of how monetary policy works asserts that the central bank can influence the economy via interest rates, only if its policy rate is successfully (immediately and completely) transferred to the retail lending and deposit rates (Haughton & Iglesias, 2012). The idea is that changes in the central bank's policy rate should trigger a response from the financial system and particularly commercial banks by transferring costs to retail lending and deposit rates. The process by which these changes are propagated throughout the economy is called the monetary transmission mechanism. Despite the extensive literature available on the monetary transmission process, understanding what occurs at the firm level, remains relatively limited.[1] In this regard, this study seeks to add to the literature by examining the interest rate pass-through in Jamaica using bank level data. The aim is not only identify the magnitude and speed of the pass-through process but also any obstacles to the efficient operation of the monetary transmission mechanism.

The primary policy objective of the monetary authority in Jamaica, the Bank of Jamaica (BOJ), is price stability. This objective has been pursued mainly through the use of open market instruments since 1985 to target the stock of liquidity in the economy.[2] Since then, the policy framework has evolved over time to a structure referred to in (Stone, 2003) as "Inflation Targeting Lite". In this framework, although the central bank does not have a legal mandate to target inflation, it announces an inflation target and then effects changes to interest rates to achieve this inflation outcome. However, given that Jamaica is a small open economy which operates a managed floating exchange rate regime, the exchange rate has often been viewed as the central bank's intermediate target to anchor inflation expectations. In that regard, evidence from a few studies suggests that the transmission mechanism in Jamaica runs from the central bank's operating target (base money) to domestic interest rates which is then transmitted to exchange rates, output and prices (Robinson & Robinson, 1997). These studies also suggest that the transmission process is protracted. In fact, (Robinson & Robinson, 1997) concludes that

[1] Bernanke and Gertler (1995) refer to it as a "black box".
[2] For an extensive discussion on Jamaica's monetary policy tools see (Robinson & Robinson, 1997).

monetary policy effects in Jamaica have a lag impact of at least two months and are generally long-lived. It is therefore worthwhile to examine the channels, especially at the micro-level, which affect the transmission process. One of the main concerns about the monetary transmission process in Jamaica is the apparent rigidity in the response of commercial bank's retail rates to the sharp reductions in the central bank's policy rate over the period of the study.

Current studies on the monetary policy transmission mechanism in Jamaica like (Robinson & Robinson, 1997) and (Lattie, 1999) provide broad macroeconomic understandings of the process but were unable to provide a clear understanding of the pass-through of market interest rates to retail rates. Therefore, the purpose of this study is to utilize micro-econometric data to provide a better understanding of the interest rate pass-through. This understanding is critical as the BOJ gradually moves towards full-fledged inflation targeting.

This study contributes to the existing monetary transmission literature in a number of ways. Firstly, given that most studies focused on developed countries, this paper, by concentrating on a small Caribbean economy, adds to the sparse body of literature on banking sector behaviour in developing countries. Indeed, this study is the first in the Caribbean region to estimate a micro-level model of the monetary transmission in the region, using panel data. Secondly, the paper utilizes econometric methods for non-stationary panel data while taking into account the issue of cross-sectional dependence and bank heterogeneity.

The remainder of the paper is organized as follows: Section 2 reviews the existing literature on the pass-through of market interest rates to retail rates; Section 3 describes the data and presents some stylized facts of the banking sector in Jamaica. Sections 4 presents the econometric methodology; Section 5 the results; and Section 6 concludes the study highlighting the policy implications and provides recommendations for further studies.

## 2.0 Literature Review

The monetary transmission process begins with the central bank changing its policy interest rate, which may be propagated through different channels such as the interest rate channel, the credit channel, and other asset-prices channel (Fadiran, 2011). The effectiveness of monetary policy transmission mechanism is assessed by the speed and magnitude with which retail rates respond to changes in the policy rate. Therefore, a quicker and fuller pass-through of the policy rate or market rate to retail bank interest rates implies a more effective monetary policy environment and thus has positive implications for the real economy. The literature assessing this phenomenon of interest rate pass-through is vast, ranging from cross-country differences to individual country studies. These studies have largely focused on uncovering the magnitude of pass-through, the existence of asymmetric pricing and speed of adjustment of bank rates to changes in policy or money market interest rates. Of note, there exists significant variation in the numerical estimates of pass-through coefficients across countries, markets, and time periods; suggesting that retail pricing by banks in different countries and markets have diverse responses to monetary policy shocks (Gigineishvili, 2011). The following sections review the relevant literature in three categories: theoretical, empirical and empirical studies on interest rate pass-through in the Caribbean.

### *2.1 Theoretical literature*

Theoretical studies on monetary transmission and interest rate pass-through are extensive. However, at the centre of theoretical works on monetary policy transmission is the intellectual divide between the classical/monetarist and the Keynesian schools of thought. The central thesis of the Monetarist school (see (Friedman, 1956), (Cagan, 1972), (Meltzer, 1995), and (McCallum, 1999)) is that in the long run money is neutral. They posit that if expectations are rational, then only unanticipated monetary shocks will affect output in the short run while in the long run real variables will return to their long run level but nominal variables will be higher. In essence, monetary policy should be conducted based on rules rather than discretionary actions. The Keynesian view (see (Grossman & Lawerence, 1983), (Romer & Romer, 1990), and (Mankiw, 1994)) on the other hand, emphasized that because wages and prices are rigid, the economy will not always be at the full employment level, thereby creating a role for monetary policy. This view highlights the important feature of the interest rate transmission mechanism. In this context,

the interest-rate transmission channel explains how the central bank makes changes to the short-term nominal interest rate which results in a corresponding change in the real interest rate. Consequently, these changes imply that an expansionary monetary policy lowers the short-term nominal interest rate, which in turn lowers short-term real interest rate (Mishkin, 2004).

The essence of elaborating the traditional views on monetary policy transmission is to highlight the role of interest rate pass-through in affecting the real economy. Interest rate pass-through refers to the size and speed of adjustment of the bank retail rates, including lending and deposit rates, in response to changes in the policy rate which are determined by the central bank in the long and short run. The literature documents that there are complete, incomplete and 'over' pass-through (Wang & Lee, 2009). Complete pass-through describes a movement in the money market or policy rate with a one-for-one change in retail rates, indicative of an effective interest rate channel. Incomplete pass-through occurs when changes in the policy rate to money market rates and eventually to retail rates is less than one. This may occur in situations market imperfections like bank sizes, the level of competition and market asymmetry have a greater influence on the financial system, making commercial banks transmit only a part of, instead of the full cost. Therefore, an incomplete pass-through may signal an uncompetitive and inefficient financial system. Over pass-through would describe an interest rate pass-through ratio that exceeds one (Wang & Lee, 2009). This is usually evident in highly competitive and efficient financial systems. Ideally, policy makers would desire complete or over pass-through of changes in the policy rate to retail rates. However, much of the literature has found that typically pass-through is not immediate and is incomplete or rigid, particularly in the short run.[3] For instance, sluggishness in interest rate pass-through have been documented in (Saborowski & Weber, 2013), (Gigineishvili, 2011), and (Cottarelli & Kourelis, 1994) for cross country comparisons; (Sorensen & Werner, 2006), (de Bondt, 2002) and (Mojon, 2000) for the Euro area and (Neuman & Sharpe, 1992) and (Hannan & Berger, 1991) for the United States.

The prevalence of interest rate stickiness across countries has brought to the forefront the need to examine other factors that could impede or enhance the pass-through process of policy rate

[3] This inefficiency in interest rate transmission has undermined the conduct of monetary policy in most countries (Ogundipe & Alege, 2013).

changes. In an attempt to explain the sluggish adjustment of interest rates, (Stiglitz & Weiss, 1981) noted the role of asymmetric information in credit rationing while (Cottarelli & Kourelis, 1994) provided evidence that the degree of competition and the structure of the financial market have significant impacts on the pass-through process.[4] Other studies have shown that bank concentration (Sorensen & Werner, 2006), menu costs (Hannan & Berger, 1991) and monetary policy regimes (Egert & MacDonald, 2009) have affected the heterogeneity in interest rates pass-through. Bank size, measured by assets or loans, has also been documented in the literature, however, the results have been ambiguous. Of note, (Berstein & Fuentes, 2003) found a slower speed of adjustment for lending rates in bigger banks while (Horvath & Podpiera, 2012) and (Weth, 2002) results indicated a faster adjustment. Alternatively, (Gambacorta, 2008) noted no significant impact of bank size on interest rate pass-through. For the purposes of this study, bank size and concentration were included as bank-specific control variables in order to determine how the pass-through maybe affected by these factors.

Given that monetary policy changes are first transmitted to the financial market, it is important to note the influence of the credit channel on interest rate pass-through.[5] The credit channel focuses on the asset side of commercial bank's balance sheet. Commercial bank's assets, which are defined as loans for the purpose of this paper, are not necessarily a perfect substitute for other sources of credit. Nonetheless, the effectiveness of the credit channel depends on the inter-temporal elasticity of substitution. In other words, the credit channel could increase the strength of monetary policy if there is an over pass-through of changes in the market interest rate to bank lending rates (Dale & Haldane, 1993). Therefore, in developing countries like Jamaica, where commercial banks are generally the main source of capital financing, the credit channel has a greater influence if commercial banks are able to adequately overcome information asymmetries in the credit market. One may therefore argue that the actual channel through which monetary policy affects the economy depends on the level of intermediation in the financial market and its openness, among others factors (Robinson & Robinson, 1997). Evidence of this is illustrated in a cross country study, which included Jamaica, by (Cottarelli & Kourelis, 1994). The authors

[4] (Kashyap & Stein, 2000) and (van Leuvensteijn, Sorensen, Bikker, & van Rixtel, 2008) have also noted that the degree of competition affects interest rate pass-through.

[5] This occurs because changes in the central bank's indicative short term repurchase rate will affect a wide spectrum of interest rates thus altering the whole term structure of interest rates in the financial market (Robinson & Robinson, 1997).

found that there was a strong relationship between the response of the financial variables and monetary policy impulses as well as the structure of the financial system.[6,7] They suggested that the transmission mechanism can be enhanced by reducing the constraints on bank competition among other things.

### *2.2 Empirical literature*

Most empirical studies on interest rate pass-through utilize time series, microeconomic (bank-specific) data within an error correction modelling framework. Typically these studies begin with the modelling framework proposed by (Cottarelli & Kourelis, 1994) or (de Bondt, 2002). (Cottarelli & Kourelis, 1994) employed an autoregressive distributed lag specification estimated with aggregate time series while (de Bondt, 2002) utilized a similar framework but re-parameterized the specification as an error correction model based on marginal cost pricing. More specifically, (Cottarelli & Kourelis, 1994) were the first to provide a systematic measure of the degree of lending rate stickiness across 31 developed and developing countries. Their approach first included measuring the speed of adjustment of bank lending rates to money market rates at different time-horizons, which was then regressed against several variables related to the structure of the financial system. The authors also accounted for other country characteristics such as the effects of interest rate volatility. Their results showed that the degree of stickiness was high, with full adjustment occurring in the long run. In the short run, adjustment was only one third of the long run pass-through.[8] Another major contribution of this study was their analysis of interest rate pass-through in developing countries, which provided useful insights on interest-rate stickiness in developing countries and documented why it occurred. In particular, the authors indicated that the degree of interest-rate stickiness may be moderated by weak barriers to entry, restricted fluctuations of money market rates and the existence of a market for negotiable short-term instruments. (de Bondt, 2002) analysed the entire Euro area and finds incomplete pass-through for lending and deposit rates in the short-run but complete in the long run for most lending rates.

[6] See also (Brunner & Meltzer, 1963).
[7] Similar findings were reported in (Ramlogan, 2004) for Jamaica.
[8] Of note, for Jamaica, the authors utilized monthly data over the period 1991 to 1993 and found that there was short run interest rate stickiness with relative completeness in the long run.

More recent studies have used other estimation techniques to model interest rate pass-through. (Tai, Sek, & Wai, 2012) employed Seemingly Unrelated Regression (SUR) model to investigate the effectiveness of interest rate transmission in six Asian economies over the period 1988-2010. The authors found evidence of interest rate stickiness across countries and posited that the failure of government to control the market rate may be the cause for the slow and small pass-through to deposit and lending rates. (Yildirim, 2012) used threshold co-integration analysis to estimate the interest rate pass-through to lending rates in Turkey and found incomplete pass-through as a result of the downward rigidity in lending rates. Another study worth mentioning is (de Graeve, de Jonghe, & Vennet, 2007). The authors modelled bank heterogeneity by allowing heterogeneity in the slopes and the constant in their regression.[9] The idea is that different slope coefficients allow banks to react differently to changes in money market rates, which the authors' results supported. Based on this result, the authors suggested that estimators that impose a common slope (an identical reaction by the banks) may be inconsistent. Overall, (de Graeve, de Jonghe, & Vennet, 2007) found that there is symmetric adjustment of bank interest rates to changes in the money market rates but that interest rate pass-through in the Belgian market is usually incomplete. (Bernhofer & van Treeck, 2011) employed a similar approach to analyse interest rate pass-through in the Euro area. However, they applied two different estimation techniques. At first, the authors estimated single equation error correction models for seven interest rate categories across ten euro area countries and find that there is substantial heterogeneity in interest rate pass-through, particularly in the short-run. The authors then utilized the pooled mean group estimator, advanced by (Pesaran, Shin, & Smith, 1999), which allows for country-specific interest pass-through in the short-run (while simultaneously restricting the long-run pass-through to be homogeneous across countries) and find evidence of significant heterogeneity in the short-run.

With respect to the use of micro-economic data with panel methods, a few of the studies exist. (Horvath & Podpiera, 2012) estimated the interest rate pass-through from money market to bank interest rate using three different heterogeneous panel co-integration techniques to address bank heterogeneity. Their results indicate that the nature of interest rate pass-through differs across

[9] The authors estimated the average long-run pass-through using the (Phillips & Moon, 1999) estimator and applied a random coefficient estimation method proposed by (Swaby, 1970) to estimate the average short-run pass-through, including speed of adjustment.

banks in the short term and becomes homogenous across banks only in the long term, which supports the findings of (de Graeve, de Jonghe, & Vennet, 2007), who posited that estimators that constrain coefficients to be identical across groups are inconsistent. The authors also find that mortgage and corporate rates are typically complete in the short-run but incomplete in the long-run and that banks with a stable pool of deposits smooth interest rates and thus require a higher spread as compensation. (Aydin, 2007) examined the speed and rate of adjustment of lending rates to monetary policy rate for corporate, housing, cash and automobile loans using bank-level data in Turkey. Similar to (Cottarelli & Kourelis, 1994), the author used an Auto-regressive Distributed Lag (ARDL) framework to investigate the central bank's control over credit market via short-term interest rates, which was more apparent in their post-credit boom period. The results revealed that while corporate loans were not sensitive to changes in the policy rate, cash and automobile loan rates were. Of note, the rates on housing loans were found to display excessive sensitivity to the policy rate.

### *2.3 Empirical literature on the Caribbean*

With regard to the economic analysis of interest rate pass-through in the Caribbean, (Boamah, Jackman, & Ma, 2011) was the first to examine this phenomenon. The authors used an error correction model, derived from a partial adjustment model, to investigate the effectiveness of central bank interest rate policy in influencing commercial banks' lending rate behaviour in Barbados and the Bahamas using quarterly data for the period January 1995 to April 2007. The results for Barbados showed that there was short run stickiness in reaction of commercial bank lending rates to changes in the central bank minimum rate.[10] For Bahamas, the reaction of commercial banks' lending rates to changes in the central bank policy rate was almost instantaneous both the short and long run. It was noted that the full interest rate pass-through in the Bahamas may have resulted from the use of interest rate controls coupled with moral suasion. Overall, this comparative study demonstrated the effectiveness of interest rate pass-through depending on the type of monetary policy used.

[10] On average, it takes about four to six quarters for the full effect of changes in the central bank policy rate to be transmitted to the economy via adjustments.

## 3.0 Data

The data used in this study includes loan and deposit interest rates for each of the seven commercial banks operating in Jamaica as at end June 2014.[11] It consists of monthly data on interest rates on corporate loans, personal loans and mortgages as well as rates on savings, demand and time deposits over the period January 2010 to December 2013. Time deposits include short-term instruments with maturity ranging from less than one month to one year as well as instruments with maturity of over one year. The lending and deposit rates are average interest rates weighted by the volume of the loans and average interest rate charged by the reporting financial institution. In addition, these interest rates reflect both variable and fixed rate term structures. Given the nature of the data source, the scope and classification of loan contracts, for which the lending rates are applicable to, are somewhat ambiguous. Specifically, the lending rates used in this study reflects rates applicable to the stock of outstanding loans at the end of a given period, which could include refinanced loans as well as new loan contracts. Therefore, the volume of newly disbursed loans at any given period is not explicitly known. Overall, this peculiarity of the interest rate data is not viewed as a limitation since our aim is to determine the pass-through of monetary policy changes to retail rates. The effect of monetary policy changes on bank lending is a topic for future research.

It should be noted that these seven commercial banks operating in Jamaica are not homogenous and some banks specialize in certain loan categories. For example mortgages are not offered by all institutions and one bank specializes in corporate lending. Against this background the panel is unbalanced for some loan and deposit types. Additionally, over the sample period, there were instances of mergers and changes in ownership. In that regard, the data was "cleaned" to ensure that, as best as possible, the captured behaviour of each institution remained consistent over the sample period.

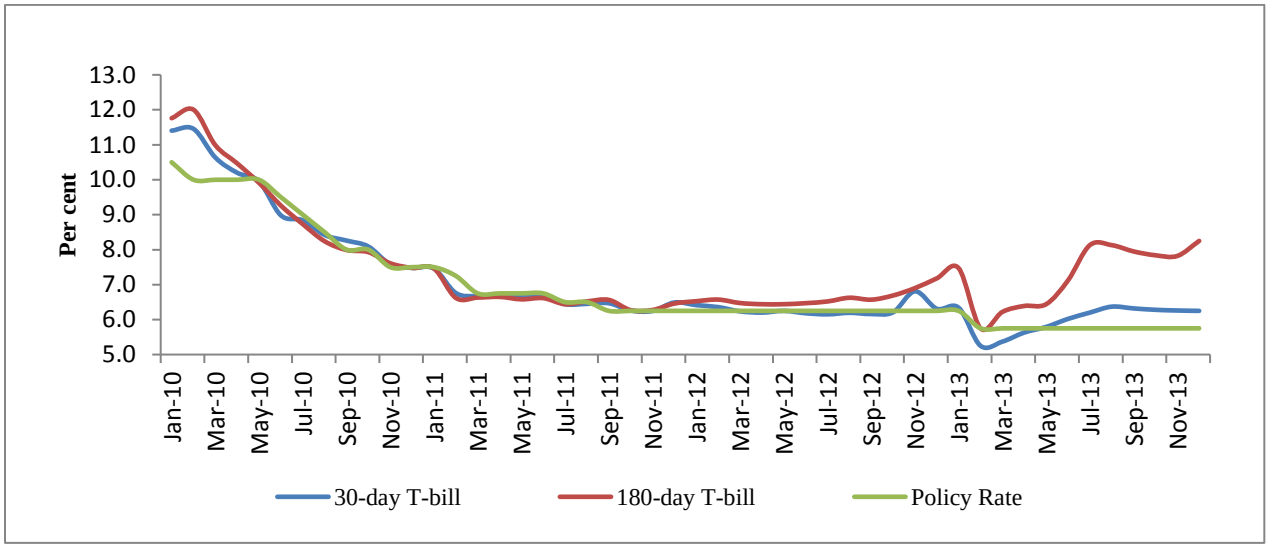
With regard to interest rates, the Government of Jamaica (GOJ) holds three monthly Treasury Bill (T-Bill) auctions. These auctions have tenors of 180-, 90- and 30-day and the yields on

[11] Deposit taking institutions in Jamaica include commercial banks, building societies and other financial institutions licensed under the Financial Institutions Act. For the purpose of the study, only commercial banks will be examined as commercial banks' asset base represents more than 70.0 per cent of industry.

these instruments are highly correlated with the BOJ's policy rate (see **Figure 1**). Following the literature, the T-Bill rates could be used as the market rate that transmits the central bank's policy action. However, in order to ascertain a direct impact, the policy rate was used instead of the T-Bill rates, which slightly improved the pass through in all three models.

In addition to interest rates, the data set included a number of firm specific and system specific variables to provide insight into possible obstacles or enhancements to the pass-through process. These include relative asset size, measures of concentration, exchange rate volatility and the capital adequacy ratio (CAR).[12] Finally, in order to capture possible asymetric policy responses two dummy variables were included to capture a change in the policy rate and when there was a fall in the T-Bill rate. These dummy variables are used in the baseline model in (2) to ascertain if there are asymetries in the price setting behaviour for the different retail rates.

**Figure 1: 180-day Treasury Bill Rate, 30-day Treasury Bill Rate and the BOJ's 30-day CD Rate**




In essence, the data set consists of an unbalanced panel of bank-level data for the aforementioned bank interest rates, which was subsequently tested for non-stationarity. A number of panel unit root tests have been developed since the seminal paper of (Levin & Lin, 1992). This study utilizes the Levin, Lin and Chu (LLC) and the Im, Pesaran and Shin (IPS) unit root tests. The

[12]The measures of concentration investigated include the relative share of deposits, relative share of excess liquid assets and Herfindahl-Hirschman index on asset size.

null hypothesis for these tests is that the series has a unit root or it is non-stationary. Consequently, high p-values implied that the series was non-stationary. Notably, these unit root tests differ on the assumption of cross-sectional dependence and homogeneity. In the alternative hypothesis the LLC test assumes homogeneity of the coefficient of the lagged dependent variable and cross-sectional dependence. On the other hand, the IPS test assumes cross-sectional dependence but allows for heterogeneity in the coefficients of the lagged dependent variables in the alternative hypothesis (Asteriou & Hall, 2007). Unlike the LLC test, the IPS test assesses each cross-section separately for non-stationarity; consequently, the results of IPS unit root test were believed to be most appropriate for the analyses (see results in **Table 2**). Another commonly used unit root test for heterogeneous panel data is (Hadri, 2000), which has the null hypothesis of stationarity in any of the series in the panel. Although this test may be more robust to the LLC and IPS tests, it assumes cross sectional independence and was therefore not suitable for this study.

## 4.0 Methodology

Banks operate with the sole purpose to maximize expected profits from financial transactions, in which it channels collected funds or deposits to households and firms. With symmetric information and under perfect competition, equilibrium conditions suggest that the marginal cost of acquiring loans is equal to the price or the retail bank rate and the derivative of prices with respect to marginal cost equals one (Aydin, 2007) and (De Bondt, 2002). In that context the price setting of banks results in the following marginal cost pricing model.

$$r = \beta_0 + \beta_1 x \qquad (1)$$

where $r$ is the lending rate charged by banks according to the market rate, $x$ and a constant mark-up, $\beta_0$. The market rate is assumed to be the most appropriate marginal cost of lending or saving because of their accurate reflection of the marginal cost faced by the bank.[13] The coefficient $\beta_1$ depends on the demand elasticity of deposits and loans and determines the adjustment of the retail bank rate to changes in the market rate. This parameter is the variable of interest in this

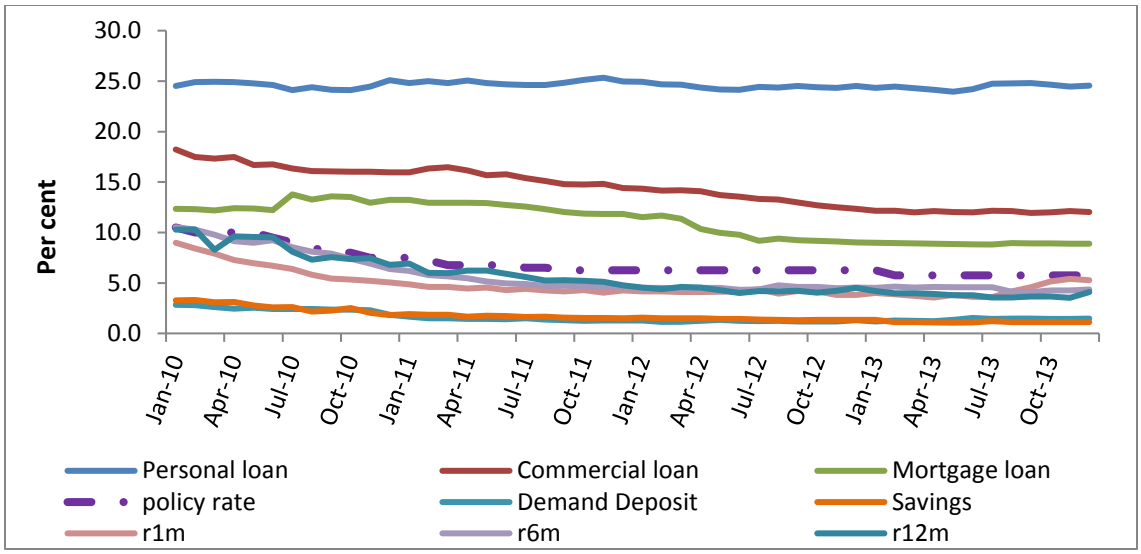
[13] As a baseline model the analysis assumes that the most appropriate marginal cost of lending or saving is the 30-day T-bill rate; the reason for this selection is explained in what follows.

study and will also be less than one if banks have some degree of market power. According to (de Bondt, 2002) retail bank interest rates in less competitive or oligopolistic markets adjust incompletely and with a delay, while bank interest rates set in a fully competitive environment respond quickly and completely. A similar conclusion was made by (Aydin, 2007) who postulated that if the market rate is a good proxy for the opportunity cost of lending or saving then banks will reflect all changes in the lending and deposit rates. Against this background, changes in market and retail interest rates will be one to one or the pass-through would be complete. However, several studies have found incomplete pass-through and have reported that this incomplete transmission reflects the effect of markets that may not be perfectly competitive. Given the oligopolistic structure of the commercial banking system in Jamaica, $\beta_1$ is expected to assume a value less than one.

### *4.1 Model Specification*

It is well-documented in the literature that the analysis of interest rate pass-through is typically estimated within an error correction framework. This sort of framework identifies the short and long term relationship between bank retail interest rates and market rates as well as the timing of the transmission process. By identifying short and long run relationship, the assessment seeks to establish how changes in the lending and deposit interest rates can be attributed to changes in the money market rates. As seen in **Figure 2,** the evolution of retail bank rates and the 30-day T-bill rate suggest that all interest rates display varying degrees of pass-through of the market rate. Of note, personal loans is the only interest rate that does not follow the general declining trend in the market interest rate and should therefore reflect the lowest pass-through.

**Figure 2: Trend Analysis of the variables of interest**




In order to assess interest pass-through in a comprehensive manner, two different estimation techniques were employed: (i) the pooled mean group estimator (PMG) (Pesaran, Shin, & Smith, 1999) and (ii) panel fixed effects (PFE). The PMG estimator was designed for panels with '*T*', the number of time series, and '*N*', the number of cross section or groups, being quite large and of the same order of magnitude. In this study, although '*N'* is relatively small in comparison to '*T*', that is *N=7* and T=*48*, the PMG is still appropriate as is demonstrated in (Pesaran, Shin, & Smith, 1999), where the authors applied the PMG estimator to energy demand functions for Asian developing countries with *N=10* and *T=17*.[14] With respect to the panel fixed effect estimation, the model specification took into account that whenever cross-sectional units are deemed heterogeneous, imposing the restriction that each entity behaves identically would result in inconsistent estimates. In the study on the pass-through by (De Graeve, De Jonghe, & Vennet, 2004), they posited that there may be considerable heterogeneity in this type of data. This heterogeneity may be fixed (that is, bank specific) or random (that is, uncorrelated with banks characteristics). Given the oligopolistic structure of the commercial bank system in Jamaica, the analyses assumed that the pass-through may differ across banks because of bank specific characteristics. As a result, models estimated with fixed effects were preferred and confirmed with results from the Hausman test. In addition, the usefulness of the ARDL was tested using

[14] The empirical literature devoted to 'small N and large T' estimation typically uses the Seemingly Unrelated Regression Equations (SURE) procedure (Zellner, 1962). However, the assumptions underlying this technique were not appropriate for this study.

bound tests for each model in order to identify the presence of the long run relationship between the variables of interest.[15] Each model was estimated as an autoregressive distributed lag (ARDL) as follows:

Panel fixed effects estimator:

$$\Delta r_{it} = \theta_0 + \phi_i + \Sigma_{q=1}^{p} \gamma_{iq} \Delta r_{it-q} + \Sigma_{q=0}^{P} \delta_{iq} \Delta x_{it-q} + \alpha r_{it-1} + \beta_i x_{it-1} + \epsilon_{it} \quad (2)$$

Pooled mean group estimator:

$$\Delta r_{it} = \Sigma_{q=1}^{p} \gamma_{iq} \Delta r_{it-q} + \Sigma_{q=0}^{P} \delta_{iq} \Delta x_{it-q} + \alpha r_{it-1} + \beta_i x_{it-1} + \epsilon_{it} \quad (3)$$

where $r$ represents the retail interest rate across commercial bank $(i)$ and time period $(t)$. $x$ represents the market interest rate. $\phi$ represents the fixed effects and $\epsilon$ represents the error term. The parameters of interest are $\delta_{i0}$ which measures the immediate or short term reaction of retail banks rates to changes in the market rate (since we use monthly data, this reflects interest rate pass-through within a month); $\alpha$ the speed of adjustment term to the long run equilibrium after a short run shock and $\theta_i = -\left(\frac{\beta_i}{\alpha}\right)$, the long-term coefficient of interest rate pass-through. This speed of adjustment term illustrates how fast banks respond to changes in the market rates. According to (Aydin, 2007) the average adjustment period can be calculated as $(1 - \delta_{i0})/\alpha_i$ in terms of months.

It is worth highlighting that the PMG estimator allows the intercepts, short-run coefficients and error variances to differ across groups but constrains the long-run parameters to be the same. Specifically, the test assumes that bank pricing policies are heterogeneous in the short-run. Therefore, $\delta_{i0}$ and $\gamma_{iq}$ may differ across banks, while $\beta_i$ and $\alpha$ are similar for all banks. While this estimator can be restrictive, the Mean Group (MG) estimation technique (Pesaran & Smith, 1995) is less restrictive and assumes that all parameters can differ across banks, even in the long-

[15] Based on the assumptions of the ARDL model variables should be integrated of order I(0) or I(1) with at least one variable I(1). None of the variables should be integrated of the second order, I(2), as they would invalidate the methodology.

run. However, it is less efficient (see (Horvath & Podpiera, 2012) and (Pesaran, Shin, & Smith, 1999)).[16] Consequently, the PMG estimation was preferred to the MG estimation.

### *4.2 Bank-specific Characteristics and Monetary Transmission*

Estimating the pass-through using the specification in (2) was the first part of the analysis. In the second part, the PFE model was augmented with both system and bank specific data such as exchange rate volatility, asset size, CAR and bank concentration in order to ascertain how the heterogeneity in interest rate pass-through maybe affected by these factors (see **Table 3**).[17] This is one of two basic approaches to determine the role of bank-specific characteristics in interest rate pass-through. The second approach would include the bank-specific characteristics directly in the interest rate pass-through regression in (2), which will determine whether bank characteristics affect changes in commercial banks' retail rates. Analysing interest rate pass-through using the second approach may prove useful if a comprehensive set of bank-specific characteristics are used and could therefore be examined in further research.

As a starting point, two bank-specific variables were used, which was informed by the credit channel literature. A usual assumption in the credit channel literature is that bank responsiveness to monetary policy is explained by its size, the degree of liquidity and capitalization. Specifically, small, less liquid and less capitalized banks are expected to cut lending more than their bigger, more liquid and better-capitalized competitors due to problems arising from asymmetric information (Wróbel & Pawlowska, 2002). In fact, (Kashyap & Stein, 1995) noted that after monetary policy tightening, small banks often reduce lending more than large banks. This assumption is assessed through the inclusion of the relative asset size of each bank. Relative size is defined as the ratio of the asset of each commercial bank to total assets for all commercial banks.

Since a weak financial structure impedes the transmission process, a concentration index was included in the analysis to ascertain its effects on the transmission process. The idea behind the

[16] As a check on this, equation (3) was modified and estimated using the MG technique. The results were relatively close to the PMG and PFE estimates. However the standard errors were much larger. Full estimation of these results are available upon request.

[17] A similar two-step approach was done in (Kashyap & Stein, 2000).

inclusion of this variable emanates from the fact that banks in concentrated markets may be slower and more sluggish to adjust to monetary policy. For example, (Corvoisier & Gropp, 2001) posited that for demand deposits and loans increasing bank concentration in individual euro area countries may have resulted in less competitive pricing by banks, whereas for savings and time deposits the opposite seemed to be the case. Additionally, after examining the impact of bank concentration (measure with the Herfindahl-Hirschman index) on the interest rate pass-through in Poland, (Wróbel & Pawlowska, 2002) conclude that the degree of concentration matters for both deposit and lending rates adjustment, however the estimated relationship was different. Specifically, an increase in concentration reduced the adjustment of loan rates and increased the adjustment of deposit rates.[18]

In addition, the CAR was included as another system-specific control variable based on the impact suggected by the bank lending literature. This strand of literature posit that the effects of monetary policy on bank lending will be smaller when banks have low levels of capital relative to the regulatory minimum requirement (see (Peek & Rosengren, 1995) and (Van den Heuvel, 2002)). In other words, the monetary transmission mechanism may be weakened if banks are poorly capitalized or if the capital adequacy requirement is stringent.

## 5.0 Estimation Results

The results of the two unit root tests are presented in **Table 2**. These results differ slightly as the assumption regarding heterogeneity varied across tests. Nonetheless, the preferred unit root test (the IPS test) indicated that the series for personal loan rate and commercial loan rates were non-stationary. These variables were, however, integrated of order one I(1) or stationary after the first difference, which satisfied the requirement of the ARDL estimation technique.

### *5.1 Asymmetric retail rate setting behaviour*

As noted previously, in order to control for potential asymmetries in the retail pricing behaviour in the long run, two binary dummy variables, $dum1$ and $prchg$ were included. Dum1 has a value of one when the market rate increased and zero otherwise while $prchg$ takes a value of one when the policy rate increased and zero otherwise. These dummy variables were included as

[18] A positive coefficient was obtained for concentration when the analysis assessed the pass-through to deposits interest rates, while the estimated coefficients were negative when the analysis focused on interest rates for loans.

interactions with changes in the short term retail or market rates. The results indicated that asymmetric price setting was found to be insignificant in all baseline models with the exception of the model capturing the long run pass-through to personal loans. When bank-specific factors are controlled for, evidence of asymmetric price setting was found in the savings and demand deposits models. More specifically, for personal loans, the pass-through is 120 bps for an increase of 100 bps in the policy rate and 161 bps for a 100 bps decline in the policy rate. For savings deposits, the pass through is 80 bps for an increase of 100 bps in the policy rate and 45 bps for a 100 bps fall in the policy rate.

### *5.2 Baseline results*

The analysis of the interest rates illustrate a downward trend over the sample period; as a result the model outlined in (2) was estimated with and without a trend ($\eta$) (see **Figure 2**). The estimation results are presented in two parts for the PFE estimation where Panel I displays the results for the model with a trend component and Panel II shows the same model specification but without the trend component (see **Table 4)**. At each date, the pass-through measures the contribution of a 1.0 percentage point increase in the market rate to the retail bank interest rate.[19] Each column contains the estimates for each retail and the most appropriate model for each panel is highlighted. The results for PMG are presented in **Table 5** and largely confirms the findings of the PFE model, except that the standard errors are smaller and the speed of adjustment is generally shorter.[20] For that reason, the findings were explained using estimates from the PFE model.

Notably the speed of adjustment term, $\alpha$, was significant in all regression models and had a negative sign, hence confirming the presence of an equilibrium restoring relationship. Similar estimated speed of adjustment was reported by (Kovanen, 2011) (see **Table 6**). The results indicated that the long-run pass through to both deposits and loan rates are generally quick as the

[19] In some cases the residuals were not statistically well behaved. This may have occurred as some irregularities might have arisen because of omitted variable problems. Factors other than the market interest rate may play a role in the determination of the retail interest rate and measurement errors in the interest rate series might have contributed to the problems identified. A similar report was made by (de Bondt, 2002).

[20] (Pesaran, Shin, & Smith, 1999) noted that pooling sharpens the estimates and leads to a much smaller estimated speed of adjustment. However, the diagnostic test results from the PMG estimation were more problematic than the PFE diagnostic tests.

average speed of adjustment for both deposit and loan interest rates was approximately one month. Overall, the average adjustment period was between 1 month and 3 months, an observation that also made by (de Bondt, 2002) in an assessment of the Euro area.

Regarding loans, the results indicated that the immediate pass-through of changes in market interest rates was only significant in the case of personal and mortgage loans rates. Specifically, the portion of the market interest rate change that is passed through within 3 months was found to be approximately 13.0 per cent and 5.8 per cent for personal and mortgage loans, respectively.

Commercial loan rates displayed the second greatest degree of long run transmission ($\theta$) at 0.97, following the over pass-through observed for twelve month time deposit rates (see Panel II, **Table 4**) while the other loans rates exhibit long run pass-through coefficients of 0.83 or less. These estimates were similar to those identified by (Aydin, Interest Rate Pass-Through in Turkey, 2007) for Turkey and (Barbier de la Serre, Frappa, Montornes, & Murez, 2008) for France.

According to (Barbier de la Serre, Frappa, Montornes, & Murez, 2008) interest rates pass-through to commercial loans is traditionally higher than mortgage loans as companies have access to alternative funding sources for mortgages.[21] This argument may be put forward for Jamaica as a significant portion of the mortgage loans issued are not offered by commercial banks but by the National Housing Trust and building societies.[22] Since mortgages issued by commercial banks does not reflect a significant share of the market, their mortgages rates may not respond to changes in the market interest rate but instead to changes in interest rates offered by market leaders, therefore contributing to the incomplete pass-through identified.

The personal loans market may also reflect limited competition, as in the case for mortgage loans, consumers of personal loans have access to alternative funding (from credit unions and micro financial institutions). Consequently, estimates of the long run pass-through from the

[21] In an earlier study, (De Graeve, De Jonghe, & Vennet, 2004) found that the market interest rate pass-through was higher for commercial loans than the pass-through to mortgage or personal loans.
[22] The long run pass-through to mortgages, based on estimates from most suitable model; Panel II, was 83.1 per cent relative to the 97 per cent pass-through to commercial loans.

market interest rate were inconclusive; they had the wrong sign and were insignificant (see Panel I and II in **Table 4**). These low and insignificant estimates seem to suggest that for Jamaica, the opportunity cost of personal loans from commercial banks is not exactly the money market interest rate as consumers may find external source of funding if changes in market interest have an unfavourable impact on commercial bank interest rates.

The close to complete pass-through to commercial loans in the long run was not surprising as the corporate loans market is largely competitive and controlled by commercial banks. Given the level of competition and the market share, the analysis suggests that of the three loan categories offered by commercial banks, the central bank may have a greater impact on corporate loans through changes in monetary policy. Furthermore this finding indicates that the central bank may be able to influence investment decisions more than consumption decisions. Against this background, the relatively weak pass-through of consumer loans may provide some insight into why the central bank's policy actions seem to have a limited impact on influencing private consumption.

Concerning bank liabilities, savings and demand deposit rates also exhibit incomplete long run pass-through, with the response of demand deposits being even more sluggish to changes in market rates, despite a rapid adjustment to the long run level. Similarly, it is noted that time deposits with short maturities (between less than one month and three months) also display smaller long run pass-through. The long run pass-through for these rates ranges between 0.17 for time deposits less than one month and 0.72 for three month time deposits. Comparable results were found in (de Bondt, 2002) and (Kwapil & Scharler, 2010) for the Euro area. (de Bondt, 2002) highlighted that the incomplete pass through for interest rates on time deposits may be due to the fact that these segments of the retail bank market are not fully competitive or that switching costs of demand and savings deposits may be relatively high. However, for Jamaica, the latter may not hold true as a result of the adverse customer reaction hypothesis. The adverse customer reaction hypothesis occurs when banks practice downward rigidity in deposit rates so as to maintain customers (see (John & Pokhariyal, 2013), (Wang & Lee, 2009) and (De Graeve, De Jonghe, & Vennet, 2004)). In fact, (De Graeve, De Jonghe, & Vennet, 2004) posited that the practice of Belgian banks is to offer a very low and stable interest rate on demand deposits,

partly as a compensation for a series of payments services that were offered at low prices (cash cards, money transfer). A similar argument may be offered for the case of Jamaica where commercial banks may exhibit this approach so as entice customers to increase their pool of loanable funds. With regard to saving deposits, a possible argument may be that these interest rates on are not subject to normal market forces as the banks implement policies to make these investment suites attractive.

However, interest rates on time deposits exhibit some of the highest degree of long run transmission among all deposit and loan rates (see panel I **Table 4**). In particular, the long run coefficient of 1.6 for the twelve month time deposit indicates a complete pass through or even over pass-through of market rates to retail rate, which suggests that the market for longer tenured certificate of deposits (CDs) in Jamaica is highly competitive and efficient. The other deposit rates have long run coefficients of 0.72 or less. Similar estimates have also been identified by (Kwapil and Schlarler, 2010) for the United States. According to the literature, competition increases pass-through, mainly in deposit markets (Sander and Kleimeier, 2004). On the surface, these are not necessarily surprising for Jamaica as it is a common practise for banks to offer these instruments as short term investment as opposed to demand and savings deposits that are often targeted at the general public, which uses them for convenience reasons (inelastic demand). This finding further corroborates the view that the central bank may be more successful at influencing investment decisions than consumer decisions.

### *5.3 Bank-specific characteristics and monetary transmission*

The existing literature posits that under perfect competition, prices equal marginal cost, implying that retail interest rates should adjust quickly and completely to changes in the market interest rate. Relaxing this assumption would result in incomplete transmission. The popular assumption is that the interest rate pass-through for the case of Jamaica is obstructed by the oligopolistic structure of the commercial banking sector and the concentration of liquidity within the system. Market-wide variations such as exchange rate volatility may also have a potential impact on the transmission process. Against this background control variables to capture these characteristics were included in the study to ascertain if this would result in faster or more complete pass-through of changes in market to retail interest rates (see **Table 3**). This

investigation was carried out by adding the proposed variables to the previously estimated pass-through equations. Although **Table 3** outlines the different proxies for bank-specific variable, the analyses only included the most appropriate proxy for each control, determined by the significance of the estimates. **Table 7** displays the results of this assessment.

Like the baseline models, the results in **Table 7** showed that the speed of adjustment terms ($\alpha$) remained negative and significant for all models. Of note, the inclusion of size, CAR, concentration and exchange rate volatility improved the pass-through of market interest rates to retail rates for most models. This conclusion was made in a context where the long run pass-through coefficient ($\theta$) for all models, with the exception of those for corporate loan and savings, was stronger. Notably, the pass-through coefficient for corporate loans and savings declined marginally to 0.95 and 0.32, respectively from 0.97 and 0.37, but the relationships remained statistically significant.

The inclusion of market concentration (measured using the share of deposits) not only improved the long run transmission to personal loans but also made the association statistically significant. Though not having a substantial impact on the long run pass-through, exchange rate volatility was also included in the model. Surprisingly, the long run pass-through coefficient was now greater than one and may be an indication of asymmetric information in the market (a similar relationship was identified by (Aydin, 2007) for the case of Turkey.

With respect to the CAR, this was only significant in the corporate loans model, which further substantiates the efficiency of this market structure.

With the inclusion of proxies for size, concentration and exchange rate volatility the long run pass-through to mortgage interest rates became complete ($\theta = 1$). However, the average speed of adjustment was unchanged.

The pass-through coefficient on demand increased slightly to 0.45 from 0.41 and remained statistically significant at the 10.0 per cent level. This confirms the argument put forward by earlier studies (such as (De Graeve, De Jonghe, & Vennet, 2004) and (Wang & Lee, 2009)) that

the interest rate pass-through to deposit rates are relatively small when compared with the transmission to loans rates.

## 6.0 Conclusion

This paper examined the pass-through from market interest rates to retail bank interest rates on a panel of seven commercial banks from Jamaica for the period 2010:1 to 2013:12. The long run pass-through was assessed using PFE and PMG estimation techniques within an ARDL framework.

The long run pass-through from market rates to retail rates were found to be largely incomplete except for twelve month time deposit, which had complete long run pass through. These results indicate that the interest rate pass through process differs across instruments. The interest rates on demand and savings deposits are sticky compared to time deposits. For loan rates, long run pass through ranged from 0.97 for corporate loans to 0.23 for personal loans when bank-specific and market-specific variables were not controlled for. However, similar to earlier studies by (De Graeve, De Jonghe, & Vennet, 2004) and (Wróbel & Pawlowska, 2002) it was found that accounting for market idiosyncrasies, inherent in the Jamaican financial system improved the long-run pass-through from market interest rate to retail rates. Additionally, the results showed that the pass-through to loan interest rates was consistently greater than the estimated transmission to demand and savings deposit interest rates.

Overall, the findings indicate that policy signals will transmit quickly and more efficiently onto market rates if the financial system is well diversified in institutions and instruments. In particular, the results indicate the need to pursue policies to reduce market power and the concentration of deposits in order to improve the pass-through. These policies could include mechanisms that link access to liquidity from the central bank in a way that is inversely related to bank size and deposit. Furthermore, given the results with regard to exchange rate volatility, which was used to proxy uncertainty, the central bank could continue to implement policies to improve liquidity assurance and improve the efficiency of the operations of the foreign exchange market in order to improve the pass-through.

## References


Asteriou, D., & Hall, S. (2007). *Applied Econometrics: A Modern Approach Using Eviews and Microfit Revised Edition.* New York: Palgrave Macmillan.

Aydin, H. (2007). *Interest Rate Pass-Through in Turkey.* The Central Bank of the Republic of Turkey, Working Paper.

Aydin, H. (2007). Interest Rate Pass-Through in Turkey. *Central Bank of Turkey Working Paper*.

Bank of Jamaica Annual Report. (2009, 2010,2011, March ).

Barbier de la Serre, A., Frappa, S., Montornes, J., & Murez, M. (2008). Bank Interest Rates Pass-Through: New Evidence from French Panel Data. *Banque de France, Working Paper*.

Berger, A. N. (1995). The Profit-Structure Relationship in Banking: Tests of Market-Power and Efficient-Structure Hypotheses. *Journal of Money, Credit and Banking, 27* , 404-431.

Bernanke, B. S., & Gertler, M. (June 1995). Inside the Black Box: Credit Channel of Monetary Policy Transmission. *NBER Working Paper Series; 5146*.

Bernhofer, D., & van Treeck, T. (2011). *New evidence of heterogeneous bank interest rate pass-through in the euro area.* Germany: Macroeconomic Policy Institute.

Berstein, S., & Fuentes, J. (2003). Is there lending rate stickiness in the Chilean banking industry? *Banking Market Structure and Monetary Policy.* Central Bank of Chile.

Biggs, M., Mayer, T., & Pick, A. (July 2009). Credit and Economic Recovery. *DNB Working Paper, No.218.*

Boamah, D., Jackman, M. N., & Ma, N. (2011). Bahamas and Barbados: Empirical Evidence of Interest Rate Pass-Through. *Cepal Review; 103*.

Brunner, K., & Meltzer, A. (1963). The Place of Financial Intermediaries in the Transmission of Monetary Policy. *The American Economic Review; 53(2)*, 372-382.

Cagan, P. (1972). *The Channels of Monetary Effects on Interest Rates.* New York: Columbia University Press.

Corvoisier, S., & Gropp, R. (2001). Bank Concentration and Retail Interest Rates. *ECB Working Paper; 72*.

Cottarelli, C., & Kourelis, A. (1994). Financial Structure, Bank Lending Rates, and the Transmission Mechanism of Monetary Policy. *International Monetary Fund, Working Paper; 94(39).*

Dale, S., & Haldane, A. G. (1993). A Simple Model of Money, Credit and Aggregate Demand. *Bank of England Discussion Paper; 7*.

de Bondt, G. (2002). Retail Bank Interest Rate Pass-Through: New Evidence at the Euro Area Level. *European Central Bank, Working Paper; 136*.

De Bondt, G. (2002). Retail Bank Interest Rate Pass-Through: New Evidence at the Euro Area Level. *European Central Bank, Working Paper; 136*.

de Graeve, F., de Jonghe, O., & Vennet, R. (2007). Competition, transmission and bank pricing policies: Evidence from Belgian loan and deposits markets. *Journal of Banking anf Finance, 31*, 259-278.

De Graeve, F., De Jonghe, O., & Vennet, R. V. (2004). The Determinants of Pass-Through of Market Conditions to Bank Retail Interest Rates in Belgium. *National Bank of Belgium, Working Paper; 47*.

De Graeve, F., De Jonghe, O., & Vennet, R. V. (May 2004). The Determinants of Pass-Through of Market Conditions to Bank Retail Interest Rates in Belgium. *National Bank of Belgium, Working Paper; 47*.

Egert, B., & MacDonald, R. (2009). Monetary transmission mechanism in central and eastern Europe: Surveying the surveyable. *Journal of Economic Surveys, 23*(2), 277-327.

Espinosa-Vega, M., & Rebucci, A. (2003). Retail Bank Interest Rate Pass-Through: Is Chile Atypical. *International Monetary Fund; 03(112)*.

Fadiran, G. O. (2011). South African Money Market Volatility, Asymmetry and Retail Interest Rates Pass-Through. *Department of Economics, Rhodes University, Grahamstown*.

Fama, E. F. (1986). Term Premiums and Default Premiums in Money Markets. *Journal of Financial Economics, 17*, 175-96.

Frappa, S., Montornes, J., Barbier de la Serre, A., & Murez, M. (2008). *Bank interest rates pass-through: New Evidence from French panel data.* Banque de France.

Friedman, M. (1956). The Quantity Theory of Money: A Restatement. In M. Friedman, *Studies in the Quantity Theory of Money*. Chicago.

Gambacorta, L. (2008). How do banks set interest rates? *European Economic Review, 52*, 792–819.

Gigineishvili, N. (2011). *Determinants of interest rate pass-through: Do macroeconomic conditions and financial market structure matter?* Washington DC: International Monetary Fund.

Grossman, S., & Lawerence, W. (1983). A Transaction-Based Model of the Monetary Transmission Mechanism. *American Economic Review, 73*(5), 871-880.

Hadri, K. (2000). Testing for Stationarity in Heterogeneous Panel Data. *Econometrics Journal, 3*(2), 148–161.

Hannan, T., & Berger, A. (1991). Rigidity of Prices: Evidence from the Banking Industry. *The American Economic Review; 938*.

Haughton, A. Y., & Iglesias, E. M. (2012). Interest rate volatility, asymmetric interest rate pass through and the monetary transmission mechanism in the Caribbean compared to US and Asia. *Economic Modelling, 29(6)*, 2071-2089.

Hendry, D. (1995). *Dynamic Econometrics.* Oxford University Press.

Horvath, R., & Podpiera, A. (2012). Heterogeneity in bank pricing policies: The Czech evidence. *Economic Systems, 36*, 87-108.

John, M., & Pokhariyal, G. (2013). Two Stage Interest Rate Pass through in Kenya. *Journal of Emerging Trends in Economics and MAnagement Sciences, 4*(1), 54-61.

Kanagasabapathy, K., & Goyal, R. (2002). Yield Spread as a Leading Indicator of Real Economic Activity: An Empirical Exercise on the Indian Economy. *IMF Working Paper*.

Kashyap, A. K., & Stein, J. (1995). The Impact of Monetary Policy on Banks Balance Sheets. *Carnegie-Rochester Conference Series on Public Policy; 42*, 151-195.

Kashyap, A., & Stein, J. (2000). What Do One Million Observations on Banks Have to Say About the Transmission of Monetary Policy. *American Economic Review, 80*, 1183-200.

Kovanen, A. (2011). Monetary Policy Transmission in Ghana:Does the Interest Rate Channel Work? *International Monetary Fund Working Paper, 11(275)*.

Kwapil, C., & Scharler, J. (2010). Interest rate pass-thorugh, monetary policy rules and macroeconomic stability. *Journal of International Money and Finance, 29*(2), 236-51.

Lattie, C. (1999). Estimating a Monetary Conditions Index for Jamaica. *Bank of Jamaica Working Paper*.

Levin, A., & Lin, C. (1992). Unit Root Tests in Panel Data: Asymptotic and Finite-sample Properties. *UC San Diego, Working Paper; 92(23)*.

Mankiw, G. (1994). *Monetary Policy.* The University of Chicago .

McCallum, B. T. (1999). Analysis of the Monetary Transmission Mechanism: Methodological Issues . *NBER Working Paper, No. 7395*.

Meltzer, A. (1995). Monetary Credit and Transmission Processes: A Monetarist Perspective. *Journal of Economic Perspectives, 9*(4), 49-72.

Mishkin, F. (2004). Can Inflation Targeting work in emerging market countries? *International Monetary Fund*.

Modiglian, F. (1971). Consumer Spending and Monetary Policy: The Linkages. *Federal Reserve Bank of Boston Conference Series 5*.

Mojon, B. (2000). Financial Structure and the Ineterest Rate Channel of ECB Monetray Policy. *European Central Bank, Working Paper Series*.

Neuman, D., & Sharpe, S. (1992). Market structure and the nature of price rigidity: Evidence from the market for consumer deposits . *Quarterly Journal of Economics* , 657-680.

Ogundipe, A., & Alege, P. (2013). Interest rate pass-through to macroeconomic variables: The Nigerian experience. *International Journal of Economics and Finance, 5*(10), 18-35.

Patinkin, D. (1989). Money, Interest Rates and Prices. *MIT Press Cambridge*.

Peek, J., & Rosengren, E. (1995). Bank Regulation and the Credit Crunch. *Journal of Banking and Finance, 19*, 679-692.

Pesaran, H., & Smith, R. (1995). Estimating Long-Run Relationships from Dynamic. *Journal of Econometrics, 68*, 79-113.

Pesaran, M., Shin, Y., & Smith, R. (1999). Pooled Mean Group Estimation of Dynamic Heterogenous Panels . *Journal of the American Statistical Association*, 621-634.

Phillips, P., & Moon, H. (1999). Estimating long-run relationships from dynamic heterogenous panels. *Econometrica, 67*, 1057-1111.

Ramlogan, C. (2004). The transmission mechanism of monetary policy. *Journal of Economic Studies, 31*(5), 435 - 447.

Robinson, W., & Robinson, J. (1997). The Transmission Mechanism of Monetary Policy in the Jamaican Economy. *Annual Conference of the Caribbean Centre of Monetary Studies.*

Romer, C., & Romer, D. (1990). New Evidence on the Monetary Transmission Mechanism. *Brookings Papers on Economic Activity, 1*, 149-213.

Saborowski, C., & Weber, S. (2013). *Assessing the determinants of interest rate transmission through conditional impulse response functions.* IMF Working Paper No. 13/23.

Sorensen, K., & Werner, T. (2006). *Bank interest rate pass-through in the Euro area: A cross country comparison.* European Central Bank Working Paper Series No. 580.

Stiglitz, J. E., & Weiss, A. (1981). Credit Rationing in Markets with Imperfect Information. *American Economic Association, 71(3)*, 393-410.

Stone, M. (2003). Inflation Targeting Lite. *IMF Working Paper WP/03/12*.

Swaby, P. (1970). Efficient inference in a random coefficient regression model. *Econometrica, 38*, 311-323.

Tai, P., Sek, S., & Wai, H. (2012). Interest rate pass-through and monetary transmission in Asia. *International Journal of Economics and Finance, 4*(2), 163-174.

Takats, E., & Upper, C. (2013). Credit and Growth After Financial Crises. *BIS Working Papers, No 416*.

Van den Heuvel, S. (2002). *The Bank Capital Channel of Monetary Policy.* mimeo University of Pennsylvania (Wharton School).

van Leuvensteijn, M., Sorensen, C., Bikker, J., & van Rixtel, A. (2008). *Impact of bank competition on the interest rate pass-through in the Euro area.* European Central Bank Working Paper Series No. 885.

Wang, K., & Lee, M. (2009). Market Volatility and Retail Interest Rate Pass Through. *Economic Modelling; 26*, 1270-1282.

Weth, M. (2002). *The pass-through from market interest rates to bank lending rates in Germany.* Economic Research Centre of the Deutsche Bundesbank.

Wróbel, E., & Pawlowska, M. (2002). Monetary Transmission in Poland: Some evidence on Interest Rate and Credit Channels. *National Bank of Poland, Working Papaer, 11(21)*.

Yildirim, D. (2012). *Interest rate pass-through to Turkish lending rates: A threshold cointegration analysis.* Economic Research Center Working papers in Economics 12/07.

Zellner, A. (1962). An efficient method of estimating seemingly unrelated regressions and test for aggregation bias. *Journal of the MAerican Statistical Association, 57*, 348-368.

# Appendices

**Table 1: Correlation Analysis of Retail and Market Interest Rates**

| | $r_{Pl}$ | $r_{cl}$ | $r_M$ | $r_S$ | $r_{DD}$ | $r_{l1m}$ | $r_{1m}$ | $r_{3m}$ | $r_{6m}$ | $r_{12m}$ | $x_{30}$ | $x_{90}$ | $x_{180}$ | $x_{on}$ | $x_{CD}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $r_{PL}$ | 1.000 | | | | | | | | | | | | | | |
| $r_{cl}$ | -0.111 | 1.000 | | | | | | | | | | | | | |
| $r_M$ | -0.062 | 0.718 | 1.000 | | | | | | | | | | | | |
| $r_S$ | 0.034 | 0.391 | 0.314 | 1.000 | | | | | | | | | | | |
| $r_{DD}$ | 0.116 | 0.136 | 0.273 | 0.423 | 1.000 | | | | | | | | | | |
| $r_{l1m}$ | 0.039 | 0.255 | 0.066 | 0.433 | 0.378 | 1.000 | | | | | | | | | |
| $r_{1m}$ | -0.186 | 0.122 | -0.190 | 0.425 | 0.389 | 0.748 | 1.000 | | | | | | | | |
| $r_{3m}$ | -0.112 | 0.235 | 0.059 | 0.383 | 0.444 | 0.729 | 0.842 | 1.000 | | | | | | | |
| $r_{6m}$ | -0.97 | 0.355 | 0.062 | 0.323 | 0.479 | 0.614 | 0.755 | 0.817 | 1.000 | | | | | | |
| $r_{12m}$ | 0.031 | 0.540 | 0.076 | 0.179 | 0.205 | 0.678 | 0.679 | 0.671 | 0.729 | 1.000 | | | | | |
| $x_{30}$ | 0.009 | 0.533 | 0.138 | 0.630 | 0.489 | 0.679 | 0.685 | 0.661 | 0.749 | 0.582 | 1.000 | | | | |
| $x_{90}$ | 0.006 | 0.386 | 0.024 | 0.545 | 0.460 | 0.689 | 0.668 | 0.634 | 0.678 | 0.495 | 0.935 | 1.000 | | | |
| $x_{180}$ | 0.006 | 0.356 | 0.016 | 0.526 | 0.453 | 0.679 | 0.665 | 0.628 | 0.661 | 0.473 | 0.919 | 0.986 | 1.000 | | |
| $x_{on}$ | 0.001 | 0.239 | -0.064 | 0.141 | 0.377 | 0.622 | 0.568 | 0.529 | 0.538 | 0.352 | 0.745 | 0.835 | 0.855 | 1.000 | |
| $x_{CD}$ | 0.007 | 0.359 | 0.000 | 0.508 | 0.454 | 0.677 | 0.674 | 0.622 | 0.647 | 0.468 | 0.881 | 0.938 | 0.956 | 0.809 | 1.000 |

Note: $r_{pl}$ represents the interest rate on personal loans, $r_{cl}$ the rate on corporate loans, $r_m$ the rate on mortgages, $r_s$ the rate on savings $r_{DD}$ the rate on demand deposits, $r_{l1m}$ the rate on call and time deposits up to one month, $r_{1m}$ the rate on one month to three months, time deposits, $r_{3m}$ the rate on time deposits between three and six months, $r_{6m}$ the rate on time deposits between six and twelve months and $r_{12m}$ the rate on time deposits over twelve months. $x_{30}$ represents the interest on the 30-day T-bill, $x_{90}$ the on the 90-day T-bill, $x_{180}$ the on the 180-day T-bill, $x_{on}$ the on the overnight repo and $x_{CD}$ the on the 30-day CD.

**Table 2:**

| 2010:1 - 2013:12 | Im, Pesaran and Shin Unit Root Test | | Levin, Lin and Chu Unit Root Test | | |
|---|---|---|---|---|---|
| | **Levels** | **Difference** | **Levels** | **Difference** | |
| Null Hypothesis | There is a unit root | | | | |
| Personal loan rate | -0.2599 | -7.11464*** | -0.2477 | -6.22130*** | I(1) |
| Corporate loan rate | -0.71272 | -7.87239*** | -3.47158*** | | I(1) |
| Mortgage rate | -3.17155*** | | -0.48229 | -5.12870*** | I(1) |
| Savings rate | -17.2383*** | | -25.9966*** | | I(0) |
| Capital adequacy ratio | 1.5336** | 1.4253**** | 2.4103** | 2.1025*** | I(1) |
| Demand deposit rate | -1.9237** | | -3.46415*** | | I(0) |
| Time deposit rate less than one month | -5.8372*** | | -4.8310*** | | I(0) |
| One month time deposit rate | -4.9235*** | | -5.5155*** | | I(0) |
| Three month time deposit rate | -7.4172*** | | -8.3004*** | | I(0) |
| Six month time deposit rate | -4.5804*** | | -5.9232*** | | I(0) |
| Twelve month time deposit rate | -3.6686*** | | -3.0750*** | | I(0) |
| Overnight repo rate | -8.23471*** | | -7.64316*** | | I(0) |
| 30-day CD rate | -1.86972** | | -1.77738** | | I(0) |
| 30-day T-bill rate | -8.09053*** | | -10.6969*** | | I(0) |
| 90-day T-bill rate | -8.25235*** | | -9.51136*** | | I(0) |
| 180-day T-bill rate | -5.82618*** | | -7.08355*** | | I(0) |
| Concentration index(using deposits) | -3.30461*** | | -3.62138*** | | I(0) |
| Concentration index(using excess liquid assets) | -16.2358*** | | -19.9452*** | | I(0) |
| Percentage change in asset | -21.9039*** | | -23.0580** | | I(0) |
| Excess liquid asset | -5.97212*** | | -4.36636*** | | I(0) |
| Exchange rate volatility | -1.64003** | | -4.17257*** | | I(0) |
| Relative asset | -2.26772*** | | -2.39573*** | | I(0) |

Note: Asterisk, *** represents 1 per cent level of significance and ** represents 5 per cent level of significance. PR represents the policy rate. I (0) indicate that the variable is stationary in levels while I (1) indicate that the variable is stationary after first difference.

**Table 3: Expected Results**

| Bank-specific Characteristic | Proxies | A Priori Expectations |
|---|---|---|
| Size[1] | ➢ Relative asset size | Ambiguous - (Berstein & Fuentes, 2003) found a slower speed of adjustment for lending rates in bigger banks while (Horvath & Podpiera, 2012) and (Weth, 2002) found faster adjustment. Alternatively, (De Graeve, De Jonghe, & Vennet, 2004) noted that a bank with a high market share exploits its market power by following market movements. |
| Concentration | ➢ concentration index (using deposits)<br>➢ concentration index (using excess liquid assets)<br>➢ Herfindahl-Hirschman index | Ambiguous - earlier studies identified a positive coefficient for concentration when the analysis assessed the pass-through to deposits interest rates, while the estimated coefficients were negative when the analysis focused on interest rates for loans. However, the literature generally suggests that an increase in bank concentration negatively impacts interest rate pass through. The opposite may hold true. |
| Uncertainty | Exchange rate volatility | Ambiguous - uncertainty may result in an asymmetric association. As a result banks may not always adjust their deposit and lending interest rates to the changes in the market interest rate. Nonetheless, the literature supports an inverse relationship with interest pass through. |
| Capital Adequacy Ratio | | Negative |

[1] Another measure of size, percentage change in asset size, was also calculated and incorporated in the models. However, it had the lowest correlation and was insignificant in most of the models.

**Table 4 : Interest rate pass-through, PFE estimation**

Panel I

| | $r_{pl}$ | $r_{cl}$ | $r_m$ | $r_{DD}$ | $r_s$ | $r_{l1m}$ | $r_{1m}$ | $r_{3m}$ | $r_{6m}$ | $r_{12m}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| $\theta$ | -0.24 | 0.34 | 0.83 | 0.41 | 0.30 | 0.44 | 0.65 | 0.72 | 0.87 | 1.55 |
| $\beta$ | -0.01<br>(0.03) | 0.04<br>(0.04) | 0.02**<br>(0.01) | 0.04*<br>(0.02) | 0.07***<br>(0.02) | 0.20**<br>(0.09) | 0.16***<br>(0.06) | 0.20***<br>(0.07) | 0.24**<br>(0.11) | 0.25***<br>(0.07) |
| $\alpha$ | -0.04*<br>(0.02) | -0.11***<br>(0.03) | -0.03*<br>(0.02) | -0.10***<br>(0.03) | -0.24**<br>(0.10) | -0.45***<br>(0.11) | -0.24***<br>(0.07) | -0.28***<br>(0.06) | -0.28***<br>(0.09) | -0.16***<br>(0.04) |
| $\delta$ | 0.17 | -0.05 | -0.06 | 0.12 | -0.10 | -0.49 | 0.16 | -0.01 | -0.24 | -0.18 |
| $\gamma$ | 0.12 | 0.10 | 0.21 | 0.18 | -0.11 | -0.23 | -0.21 | -0.15 | -0.08 | -0.19 |
| $\eta$ | 0.00<br>(0.00) | 0.00*<br>(0.00) | 0.00<br>(0.00) | 0.00**<br>(0.00) | 0.00<br>(0.00) | 0.00**<br>(0.00) | 0.00***<br>(0.00) | 0.00**<br>(0.00) | 0.00*<br>(0.00) | 0.00<br>(0.00) |
| prchg*dtbill | -0.42*** | | | | | | | | | |
| Avg. adj. period | 2.89 | 1.14 | 1.10 | 0.90 | 1.35 | 2.11 | 0.76 | 1.02 | 1.28 | 1.01 |

Note: Avg. adj. period represents the average adjustment in months. Panel I was estimated with a trend and a constant. In Panel II the regression model in Panel I was re-estimated without the trend component. Asterisk, *** represents 1 per cent level of significance, ** represents 5 per cent level of significance and * represents 10 per cent level of significance. The interest rates on personal loans, corporate loans mortgages, savings deposits and demand deposits are represented by $r_{pl}$, $r_{cl}$, $r_m$,, $r_s$ and $r_{DD}$, respectively. *prchg*dtbill* is the interaction of two dummy variables to capture a change in the policy rate and when there was a fall in the Tbill rate. Standard errors are represented in parentheses and the preferred models are highlighted.

Panel II

| | $r_{pl}$ | $r_{cl}$ | $r_m$ | $r_{DD}$ | $r_s$ | $r_{l1m}$ | $r_{1m}$ | $r_{3m}$ | $r_{6m}$ | $r_{12m}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| $\theta$ | 0.75 | 0.97 | 0.56 | 0.19 | 0.37 | 0.17 | 0.28 | 0.48 | 0.76 | 1.50 |
| $\beta$ | 0.03<br>(0.03) | 0.08**<br>(0.04) | 0.02*<br>(0.01) | 0.02<br>(0.02) | 0.09***<br>(0.03) | 0.07<br>(0.08) | 0.06<br>(0.06) | 0.13**<br>(0.06) | 0.21*<br>(0.11) | 0.24***<br>(0.06) |
| $\alpha$ | -0.04*<br>(0.02) | -0.08***<br>(0.02) | -0.04***<br>(0.01) | -0.10***<br>(0.03) | -0.23**<br>(0.09) | -0.43***<br>(0.11) | -0.22**<br>(0.08) | -0.27***<br>(0.06) | -0.28***<br>(0.09) | -0.16***<br>(0.03) |
| $\delta$ | 0.13* | -0.21 | -0.06** | 0.14 | -0.09* | -0.37 | 0.24 | 0.12 | -0.21 | -0.01 |
| $\gamma$ | 0.12 | 0.10 | 0.22 | 0.19 | -0.11 | -0.24 | -0.20 | -0.15 | -0.08 | -0.19 |
| $\eta$ | | | | | | | | | | |
| *prchg*dtbill* | -0.40** | | | | | | | | | |
| Avg. adj. period | 0.82 | 1.22 | 1.10 | -0.64 | 1.24 | 3.19 | 0.16 | 0.75 | 1.28 | 1.00 |

Note: Avg. adj. period represents the average adjustment in months. Panel I was estimated with a trend and a constant. In Panel II the regression model in Panel I was re-estimated without the trend component. Asterisk, *** represents 1 per cent level of significance, ** represents 5 per cent level of significance and * represents 10 per cent level of significance. The interest rates on personal loans, corporate loans mortgages, savings deposits and demand deposits are represented by $r_{pl}$, $r_{cl}$, $r_m$,, $r_s$ and $r_{DD}$, respectively. *prchg*dtbill* is the interaction of two dummy variables to capture a change in the policy rate and when there was a fall in the Tbill rate. Standard errors are represented in parentheses and the preferred models are highlighted.

**Table 5: Interest rate pass-through, PMG Estimation**

| | $r_{pl}$ | $r_{cl}$ | $r_m$ | $r_{DD}$ | $r_s$ | $r_{l1m}$ | $r_{1m}$ | $r_{3m}$ | $r_{6m}$ | $r_{12m}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| $\theta$ | 0.86 | 1.14 | 1.05 | 0.50 | 0.56 | 0.59 | 0.50 | 0.48 | 0.83 | 1.11 |
| $\beta$ | 0.06<br>(0.01) | 0.08**<br>(0.02) | 0.21*<br>(0.01) | 0.05<br>(0.01) | 0.10**<br>(0.02) | 0.27<br>(0.05) | 0.15<br>(0.05) | 0.19*<br>(0.04) | 0.25*<br>(0.09) | 0.21**<br>(0.03) |
| $\alpha$ | -0.07*<br>(0.02) | -0.07***<br>(0.02) | -0.02***<br>(0.01) | -0.01**<br>(0.03) | -0.18**<br>(0.09) | -0.46**<br>(0.10) | -0.30**<br>(0.03) | -0.40***<br>(0.05) | -0.30***<br>(0.07) | -0.19***<br>(0.02) |
| $\delta$ | 0.01* | -0.19 | -0.01** | 0.07 | -0.05* | -0.04 | 0.02 | 0.10 | -0.20 | -0.01 |
| $\gamma$ | 0.14 | 0.12 | 0.22 | 0.21 | -0.17 | -0.37 | -0.25 | -0.13 | -0.06 | -0.17 |
| *prchg*dtbill* | -0.25** | | | | | | | | | |
| Avg. adj. period | 1.00 | 0.43 | 1.00 | 1.20 | 0.28 | 0.50 | 0.93 | 0.73 | 0.17 | 1.05 |

Note: Avg. adj. period represents the mean adjustment lag, in months, at which the market rate is fully passed through to the retail rates. Following (Hendry, 1995) and (Horvath & Podpiera, 2012), the mean adjustment lag is calculated as $(\theta - \delta)/\alpha$. Asterisk, *** represents 1 per cent level of significance, ** represents 5 per cent level of significance and * represents 10 per cent level of significance. The interest rates on personal loans, corporate loans mortgages, savings deposits and demand deposits are represented by $r_{pl}$, $r_{cl}$, $r_m$,, $r_s$ and $r_{DD}$, respectively. *prchg*dtbill* is the interaction of two dummy variables to capture a change in the policy rate and when there was a fall in the Tbill rate. Standard errors are represented in parentheses.

**Table 6: Summary Results from Other Studies on Interest Rate Pass-Through**

| Author(s) | Country/region | Dependent variable | Independent variable | Short-term pass-through | | | Adjustment speed | Long-term pass-through complete |
|---|---|---|---|---|---|---|---|---|
| | | | | T | T-1 | T-2 | | |
| Kwapil and Scharler-2010 (Monthly data) | US | Deposits | Money market rate | | | | | |
| | | 1 month | | 0.76 | | | | Yes |
| | | 3 months | | 1.02 | | | | Yes |
| | | 6 months | | 1.03 | | | | Yes |
| | | 1 year | | 1.08 | | | | No |
| | | Lending | Money market rate | | | | | |
| | | Short-term business | | 0.44 | | | | Yes |
| | | Long-term mortgages | | 0.71 | | | | No |
| | | Short-term consumer | | 0.3 | | | | No |
| | | Weighted average | | 0.79 | | | | No |
| | Euro area | Deposits | Money market rate | | | | | |
| | | Up to 3 months | | 0.09 | | | | No |
| | | Over 3 months | | 0.32 | | | | No |
| | | Up to 2 years | | 0.36 | | | | No |
| | | Over 2 years | | 0.4 | | | | No |
| | | Weighted average | | 0.16 | | | | No |
| | | Lending | Money market rate | | | | | |

| Author(s) | Country/region | Dependent variable | Independent variable | Short-term pass-through | Adjustment speed | Long-term pass-through complete |
|---|---|---|---|---|---|---|
| | | Business, up to 1 year | | 0.27 | | No |
| | | Business, over 1 year | | 0.47 | | No |
| | | Mortgage | | 0.35 | | No |
| | | Households, short-term | | 0.09 | | No |
| | | Weighted average | | 0.34 | | No |
| Sander and Kleimeier (2006) | SACU | | | | | |
| | | Retail rates | | | | |
| | | Deposits | National discount | 0.42 | | No |
| | | | South Africa discount | 0.3 | | No |
| | | | National treasury bill | 0.36 | | No |
| | | | South Africa treasury bill | 0.47 | | No |
| | | Lending | National discount | 0.54 | | Yes |
| | | | South Africa discount | 0.39 | | Yes |
| | | | National treasury bill | 0.66 | | Yes |
| | | | South Africa treasury bill | 0.69 | | Yes |
| Ghartey-2005 (Monthly data) | Ghana | Treasury bill rate | Policy rate | | | |
| | | 91 days | | 0.4 | | |

| Author(s) | Country/region | Dependent variable | Independent variable | Short-term pass-through | | | Adjustment speed | Long-term pass-through complete |
|---|---|---|---|---|---|---|---|---|
| | | 182 days | | 0.44 | | | | |
| | | 1 year | | 0.62 | | | | |
| Tieman-2004 | Central Europe | Deposits | | | | | | |
| | | Short term rate | Policy rate | | 0.16 | | -0.28 | No |
| | | Long term rate | | | 0.05 | | -0.21 | No |
| | | Lending | Policy rate | | | | | |
| | | Short term rate | | | -0.03 | | -0.16 | No |
| | | Long term rate | | | 0.01 | | -0.13 | No |
| Bondt-2002 (Monthly data) | Euro area | Deposits | Overnight interest rate | -0.04 | | | -0.06 | No |
| | | | Up to 3 month notice | 0.11 | | | -0.11 | No |
| | | | Over 3 month notice | 0 | | | -0.03 | Yes |
| | | | Up to 2 year maturity | -0.08 | | | -0.14 | Yes |
| | | | Over 2 year maturity | 0.21 | | | -0.21 | No |
| | | Lending | Up to 1 year to firms | 0.04 | | | -0.09 | No |
| | | | Over 1 year to firms | 0.25 | | | -0.12 | Yes |
| | | | Consumer lending | 0.52 | | | -0.09 | Yes |
| | | | House purchase | 0.43 | | | -0.26 | Yes |
| Hofmann and Mizen-2001 (Monthly data) | UK | Deposit interest rate | Base rate | 0.2 | 0.29 | | -0.08 | No |
| | | Mortgage interest rate | Base rate | 0.2 | 0.06 | 0.2 | -0.18 | Yes |

Note: Table taken from (Kovanen, 2011).

**Table 7: Factors Affecting the Pass-through**

Panel I

| | $r_{PL}$ | $r_{cl}$ | $r_m$ | $r_{DD}$ | $r_s$ | $r_{l1m}$ | $r_{1m}$ | $r_{3m}$ | $r_{6m}$ | $r_{12m}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| $\theta$ | 1.44 | 0.80 | 1.06 | 0.48 | 0.001 | 0.78 | 1.13 | 0.75 | 1.37 | 1.43 |
| $\beta$ | 0.07 | 0.09** | 0.05** | 0.06* | 0.00** | 0.30*** | 0.14*** | 0.22** | 0.41** | 0.22** |
| | (0.06) | (0.04) | (0.01) | (0.03) | (0.02) | (0.10) | (0.05) | (0.09) | (0.14) | (0.07) |
| $\alpha$ | -0.05** | -0.11*** | -0.05* | -0.12*** | -0.21** | -0.39*** | -0.20*** | -0.29*** | -0.30** | -0.16*** |
| | (0.02) | (0.03) | (0.02) | (0.03) | (0.10) | (0.10) | (0.07) | (0.07) | (0.11) | (0.03) |
| $\delta$ | 0.44** | -0.02** | -0.18** | 0.12 | -0.03** | -0.14** | -0.03 | -0.14 | -0.03 | -0.24 |
| $\gamma$ | 0.19 | 0.11*** | -0.07** | 0.16* | -0.47** | -0.25** | -0.23** | -0.14** | -0.07 | -0.04 |
| $\eta$ | 0.00 | 0.00 | 0.00 | 0.00** | 0.00 | 0.00** | 0.00*** | 0.00** | 0.00 | 0.00 |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| *prchg*dtbill* | -0.62*** | | | -0.22* | 0.35*** | | | | | |
| *avg adj period* | 0.69 | 1.03 | 1.17 | 0.75 | 4.06 | 1.18 | 1.03 | 1.19 | 1.02 | 1.17 |
| *Size* | -0.01* | -0.01*** | 0.01** | -0.05** | -0.083*** | 0.02 | 0.04 | 0.006 | 0.04 | 0.05 |
| *Concentration* | -0.18*** | -0.273*** | -0.08** | -0.05** | | -0.09** | -0.01 | -0.073 | -0.02 | 0.02 |
| *exchange rate volatility* | 0.002** | -0.001*** | 0.00* | 0.000 | 0.00* | 0.00 | -0.00 | 0.000 | 0.00 | -0.00* |
| *CAR* | | 0.003** | | | | | | | | |

Note: Avg. adj. period represents the average adjustment in months. Panel I was estimated with a trend and a constant. In Panel II the regression model in Panel I was re-estimated without the trend component. Asterisk, *** represents 1 per cent level of significance, ** represents 5 per cent level of significance and * represents 10 per cent level of significance. The interest rates on personal loans, corporate loans mortgages, savings deposits and demand deposits are represented by $r_{pl}$, $r_{cl}$, $r_m$,, $r_s$ and $r_{DD}$, respectively. Standard errors are represented in parentheses and the preferred models are highlighted.

**Table 8: Factors Affecting the Pass-through**

Panel II

| | $r_{PL}$ | $r_{cl}$ | $r_m$ | $r_{DD}$ | $r_s$ | $r_{l1m}$ | $r_{1m}$ | $r_{3m}$ | $r_{6m}$ | $r_{12m}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| $\theta$ | 1.61 | 0.95 | 0.32 | 0.21 | 0.32 | 0.53 | 0.43 | 0.55 | 0.99 | 1.10 |
| $\beta$ | 0.08* | 0.10** | 0.07** | 0.02* | 0.06** | 0.29*** | 0.14*** | 0.18** | 0.30** | 0.17** |
| | (0.05) | (0.04) | (0.03) | (0.02) | (0.03) | (0.09) | (0.05) | (0.07) | (0.14) | (0.07) |
| $\alpha$ | -0.05** | -0.10*** | -0.20** | -0.11*** | -0.20** | -0.54*** | -0.24*** | -0.33*** | -0.30*** | -0.16*** |
| | (0.02) | (0.02) | (0.09) | (0.03) | (0.09) | (0.08) | (0.07) | (0.07) | (0.10) | (0.03) |
| $\delta$ | 0.33** | -0.51** | -0.02 | 0.13* | 0.06 | 0.13 | -0.11 | 0.15 | -0.07 | -0.10 |
| $\gamma$ | 0.18 | 0.11*** | 0.02 | 0.17* | -0.54* | -0.40* | -0.21** | 0.25** | 0.12 | 0.32 |
| $\eta$ | | | | | | | | | | |
| *prchg*dtbill* | -0.57*** | | | -0.23** | 0.37*** | | | | | |
| *avg adj period* | 0.80 | 1.54 | 1.07 | 0.36 | 0.83 | 0.76 | 0.93 | 0.73 | 1.78 | 1.09 |
| $Size$ | | -0.01*** | -0.08*** | -0.05** | -0.083*** | 0.02 | 0.04 | 0.006 | 0.04 | 0.05 |
| $Concentration$ | -0.33*** | -0.273*** | | -0.05* | | -0.09** | -0.01 | -0.073 | -0.02 | 0.02 |
| *exchange rate volatility* | 0.00** | -0.001*** | 0.00* | 0.00** | 0.00* | 0.00 | -0.00 | 0.000 | 0.00 | -0.00* |
| $CAR$ | | 0.003** | | | | | | | | |

Note: Avg. adj. period represents the average adjustment in months. Panel I was estimated with a trend and a constant. In Panel II the regression model in Panel I was re-estimated without the trend component. Asterisk, *** represents 1 per cent level of significance, ** represents 5 per cent level of significance and * represents 10 per cent level of significance. The interest rates on personal loans, corporate loans mortgages, savings deposits and demand deposits are represented by $r_{pl}$, $r_{cl}$, $r_m$,, $r_s$ and $r_{DD}$, respectively. Standard errors are represented in parentheses and the preferred models are highlighted.